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"LET KNOWLEDGE GROW FROM MORE TO MORE
AND THUS BE HUMAN LIFE ENRICHED."

A New Survey of Universal Knowledge

ENCYCLOPÆDIA BRITANNICA

Volume 11

GUIZOT TO HYDROXYLAMINE

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Volume 11

GUIZOT TO HYDROXYLAMINE

GUIZOT, FRANÇOIS PIERRE GUILLAUME (1787–1874), French historian and statesman, was born at Nîmes, Oct. **4,** 1787, of Protestant parents His father perished on the scaffold (April **8,** 1794) and the boy was brought up by his mother in Geneva. In 1805 Guizot began the study of law in Paris, living in the house of M. Stapfer, formerly Swiss minister in France, as tutor. He contributed to the *Publiciste,* and marned (1812) Pauline de Meulan, who was also a contributor to Suard's journal. After her death, in **1827,** Guizot married her niece, Elisa Dillon (d. **1833).** Their son, Maurice Guillaume (1833–1892), became a ell-known scholar and writer. Under the Empire, Guizot devoted himself exclusively to literary works, including, a critical edition of Gibbon's *Decline and Fall.* This work led to his appointment (1812) to the chair of modern history at the Sorbonne. But, though he took no public part in politics, he was closely associated with leading Liberals, notably with Royer-Collard, who secured for him the position of secretary-general of the Ministry of the Interior at the first Restoration.

During the Hundred Days Guizot returned to his literary pursuits. He then went to see Louis XVIII at Ghent, and, in the name of the Liberal Party, told him frankly that the open adoption of a liberal policy was the essential condition of a permanent monarchy. The advice was ill-received by the king's advisers, and the visit itself brought him into disgrace with the Bonapartists.

After the second Restoration Guizot had two short spells of official work, as secretary-general of the Ministry of Justice (1815–16) and as a director at the Ministry of the Interior (1819–20). He was one of the leaders of the *Doctrinaires,* monarchists who desired a *juste milieu* between absolutism and democracy. Their motives were honourable. Their views were philosophical. But they were opposed alike to the democratic spirit of the age, to the military traditions of the empire, and to the bigotry and absolutism of the court. They lived by a policy of resistance; they perished by another revolution **(1830).** They are remembered more for their constant opposition to popular demands than by their undoubted services.

In **1820,** when the reaction was at its height after the murder of the duc de Berri and the fall of the ministry of the duc Decazes, Guizot was deprived of his offices. and from **1822** to **1828** even his course of lectures were interdicted. He was now one of the leaders of the Liberal opposition to the Government of Charles X. His numerous works at this period include: *Histoire des origines du gouvernement représentatif* (**1821–22,** 2 vol.; Eng. trans. 1852); *Histoire de la révolution d'Angleterre depuis Charles Ier à Clzarles II.* (2 vols., 1826–27; Eng. trans., 1838), revised by him in his later years; *Histoire de la civilisation en Europe* **(1828;** Eng. trans by W. Hazlitt, **3** vols., **1846);** and *Histoire de la civilisation en France* (4 vols., **1830).** In addition he published during this period two great collections of sources for English and French history, a revised translation of Shakespeare, essays and pamphlets.

Hitherto Guizot's fame rested on his merits as a writer on public affairs and as a lecturer on modern history. In Jan. **1830** he was elected by Lisieux to the Chamber of Deputies, and he retained that seat during the whole of his political life. His first speech in the chamber was in defence of the celebrated address of the **221,** in answer to the menacing speech from the throne, which was followed by the dissolution of the chamber, and was the precursor of another revolution. On July **27** Guizot was called upon by his friends Casimir-Périer, Laffitte, Villemain and Dupin to draw up the protest of the Liberal deputies against the royal ordinances of July, whilst he applied himself with them to control the revolutionary character of the late contest. Personally, Guizot deprecated a change in the hereditary line of succession. But once convinced that it was inevitable, he became one of the most ardent supporters of Louis-Philippe. From August to November Guizot was minister of the interior. He had now passed into the ranks of the Conservatives, and for the next **18** years was the most determined foe of democracy, the unyielding champion of "a monarchy limited by a limited number of bourgeois." In Marshal Soult's Government formed on Oct. 11, **1832,** Guizot was minister of public instruction. Guizot applied himself in the first instance to carry the law of June **28, 1833,** establishing and organizing primary education. The branch of the Institute of France known as the Académie des Sciences Morales et Politiques, suppressed by Napoleon, was revived by Guizot. Some of the old members of this learned body — Talleyrand, Siéyès, Roederer and Lakanal — again took their seats there, and new members were

elected. The "Société de l'Histoire de France" was founded for the publication of historical works; and a vast publication of mediaeval chronicles and diplomatic papers was undertaken at the expense of the state.

The object of the cabinet of Oct. 1832 was to organize a Conservative Party, and to resist the Republican faction, which threatened the existence of the monarchy. The real strength of the ministry lay not in its nominal heads, but in the fact that in this Government and this alone, Guizot and Thiers acted in cordial co-operation. But in 1840 parliamentary difficulties arose and Guizot was not sorry to accept the post of ambassador in London, which withdrew him for a time from parliamentary contests. This was in the spring of 1840, and Thiers succeeded shortly afterwards to the Ministry of Foreign Affairs.

Thiers' policy regarding the Syrian question led France to the brink of war, until the king put an end to the crisis by refusing his assent to the military preparations of Thiers, and by summoning Guizot from London to form a ministry and to aid his majesty in what he termed "ma lutte tenace contre l'anarchie." Thus began, under dark and adverse circumstances, on Oct. 29, 1840, the administration in which Guizot remained the master-spirit for nearly eight years. He himself took the portfolio of foreign affairs, to which he added some years later, on Soult's retirement, the ostensible rank of prime minister. His first care was the restoration of amicable relations with the other Powers of Europe. His success in calming the troubled elements and healing the wounded pride of France was due mainly to the indomitable courage and splendid eloquence with which he faced a raging opposition, gave unity and strength to the Conservative Party, and appealed to the thrift and prudence of the nation rather than to their vanity and their ambition. In his pacific task he was fortunately seconded by the formation of the Peel administration in England, in the autumn of 1841. Lord Palmerston held (as it appears from his own letters) that war between England and France was, sooner or later, inevitable. Guizot held that such a war would be the greatest of all calamities, and certainly never contemplated it. In Lord Aberdeen, the foreign secretary, Guizot found a friend and an ally. Both of them held the common interest of peace and friendship to be paramount; and when differences arose, as they did arise, in remote parts of the world—in Tahiti, in Morocco, on the Gold Coast—they were reduced by this principle to their proper insignificance.

The history of Guizot's administration is dealt with in the article FRANCE: *History*. It was the longest and the last which existed under the constitutional monarchy of France, and bears the stamp of the great qualities and the great defects of his political character, for he was throughout the master-spirit of that Government. He united and disciplined the Conservative Party, which had been broken up by previous dissensions and ministerial changes. No one ever doubted the purity and disinterestedness of Guizot's own conduct. He despised money; he lived and died poor; and though he encouraged the fever of money-getting in the French nation: his own habits retained their primitive simplicity. But some of his instruments were mean; he employed them to deal with meanness after its kind. Gross abuses and breaches of trust came to light, and under an incorruptible minister the administration was denounced as corrupt.

Of his parliamentary eloquence it is impossible to speak too highly. It was terse, austere, demonstrative and commanding—not persuasive, not humorous, seldom adorned, but condensed with the force of a supreme authority in the fewest words. He was essentially a ministerial speaker, far more powerful in defence than in opposition. Like Pitt he was the type of authority and resistance, unmoved by the brilliant charges, the wit, the gaiety, the irony and the discursive power of his great rival. Nor was he less a master of parliamentary tactics and of those sudden changes and movements in debate which, as in a battle, sometimes change the fortune of the day. His confidence in himself, and in the majority of the chamber which he had moulded to his will, was unbounded; and long success and the habit of authority led him to forget that in a country like France there was a people outside the chamber elected by a small constituency, to which the minister and the king himself were held responsible.

After the fall of the monarchy in 1848 Guizot found a temporary refuge in Paris and then escaped via Belgium to London, where he arrived on March 3.

He stayed in England about a year, devoting himself again to history. He published two more volumes on the English revolution, and in 1854 his *Histoire de la république d'Angleterre et de Cromwell* (2 vols., 1854), then his *Histoire du protectorat de Cromwell et du rétablissement des Stuarts* (2 vols., 1856). He also published an essay on Peel, and the extensive *Mémoires pour servir à l'histoire de mon temps* (9 vols., 1858–68). His speeches were included in his *Histoire parlementaire* de *la France* (5 vols., 1863).

Guizot survived the fall of the monarchy and the Government he had served 26 years. He was of no party, a member of no political body; no murmur of disappointed ambition, no language of asperity, ever passed his lips; it seemed as if the fever of oratorical debate and ministerial power had passed from him and left him a greater man than he had been before, in the pursuit of letters, in the conversation of his friends, and as head of the patriarchal circle of those he loved. The greater part of the year he spent at his residence at Val Richer, an Augustine monastery near Lisieux in Normandy, which had been sold at the time of the first Revolution. His two daughters, who married two descendants of the illustrious Dutch family of De Witt, kept his house. One of his sons-in-law farmed the estate. And here Guizot devoted his later years with undiminished energy to literary labour, which was in fact his chief means of subsistence. Proud, independent, simple and contented he remained to the last: and these years of retirement were perhaps the happiest and most serene portion of his life. He was a member of three of the five academies of the Institute of France. In these learned bodies Guizot continued for nearly 40 years to take a lively interest and to exercise a powerful influence. He continued to be the jealous champion of their independence. His voice had the greatest weight in the choice of the new candidates; the younger generation of French writers never looked in vain to him for encouragement; and his constant aim was to maintain the dignity and purity of the profession of letters. In the consistory of the Protestant church in Paris Guizot exercised a similar influence. He remained through life a firm believer in the truths of revelation, and a volume of *Meditations on the Christian Religion* was one of his latest works.

His last and not his least work, the *Histoire de France racontée à mes petits enfants*, which came down to 1789, was continued to 1870 by his daughter Madame Guizot de Witt from her father's notes (7 vol., 1870–80). Guizot died Sept. 12, 1874.

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GUJARAT (also GUJRAT or GUJERAT), a state of the Republic of India which came into existence under the Bombay Reorganization act on May 1, 1960. Before that, the term Gujarat was loosely applied to a region lying north of Bombay city where Gujarati is spoken. When India became independent in 1947 the British-Indian province long known as the Bombay Presidency became Bombay state (*q.v.*). In the years which followed there was a successive reorganization of former princely states, notably the rich state of Baroda and the numerous small units which made up the peninsulas of Kathiawar and Cutch (Kutch). From 1948 to 1956 the greater part of the Kathiawar peninsula formed the separate Rajpramukh's state of Saurashtra with capital at Rajkot. When the states of peninsular India were reorganized on a linguistic basis in 1956 there was difficulty in separating the Gujarati-speaking and the Marathi-speaking parts of Bombay state and the

separation was deferred till 1960. In broad terms Gujarat is that part of India nhere Gujarati is the dominant language. comprising Cutch, Kathiawar and the parts of the former Bombay state north of Damão (Daman). Although the boundary usually drann along the northern shore of the seasonal marsh known as the Rann of Cutch is now commonly accepted as the frontier with West Pakistan, the line is not finally agreed. Accepting this, the area is 72.-154 sq mi., bounded by West Pakistan and Rajasthan on the north. Madhya Pradesh. Maharashtra and Damão on the east and south.

Physical Geography. — The state of Gujarat is one of great contrasts; it stretches from the wet fertile rice-growing plains of the west coast north of Bombay city to the almost rainless salt deserts of Cutch. The state is best considered on a basis of its natural divisions. In the northwest. Cutch (*q.v.*) comprises a single district so arid as to be almost desert; it is bounded on the south by the Gulf of Cutch and on the north and east is separated from Pakistan and the mainland of India by the Great Rann of Cutch best described as a vast salt marsh covering about 8 000 sq mi. The Rann floods during the rainy season slight though the rains may be, and Cutch is converted into an island; in the dry season it is a sandy salty plain plagued by duststorms. To the south of Cutch is the large peninsula of Kathiawar lying betneen the Gulf of Cutch and the Gulf of Cambay. It also is arid and rises from the coasts to a low rolling area of hill land in the centre. covered with scrub or sparse woodland. The chief towns are found in the more fertile spots and mere formerly the capitals of small states; non six of them are headquarters of districts Soils are mostly poor being derived from a variety of the old crystalline rocks but among the products of value are the fine building stones of Porbunder. Rivers. except for seasonal streams, are absent. On the southern shores of the peninsula is the former Portuguese territory of Diu (q v.). Northern Gujarat, using the old regional name, occupies the northeastern part of the new state and is mainly a country of small plains and low hills through nhich runs the main line of the Western railway (formerly the Bombay, Baroda and Central Indian) from Bombay to Delhi Rainfall is low; January temperatures may drop almost to freezing point whilst 118° F has been recorded in the hot season. Dry zone crops of millet with some cotton are grown; Ahmedabad is an important cotton town.

Southward in central Gujarat the rainfall increases, temperature ranges are less, soils are more fertile being derived partly from the Deccan basalts. The focus of this area is the city of Baroda, formerly the capital of a rich and powerful state. South of what is now the Baroda district, the important river, the Narmada (formerly Narbada), empties into the Gulf of Cambay and it is the silt borne by this river and the Tapti which is responsible for the shallowing of the Gulf of Cambay and the decline of its former ports.

Southern Gujarat, the districts of Broach and Surat, are famed for their rich soils and fine crops of cotton. The great river Tapti, flowing in a deep trench from the east, cuts through Surat and in the eastern parts of south Gujarat the country is mountainous. This is indeed the northern extension of the Sahyadri mountains or Western Ghats, so important in Maharashtra state and which attract a heavy rainfall from the summer monsoon. Farther south, the mountains are forested and the small district of the Dangs (*q.v.*) lies here. Along the coastal plains conditions begin to approach the equable climate, with rainfall nearing 80 in., characteristic of Bombay city. Almost the only unifying factor in the varied state of Gujarat is the Gujarati language.

(L. D. S.)

History. — Rich in Paleolithic and microlithic finds, the area included in Gujarat state has been inhabited from prehistoric times. It is believed that there was contact with the Indus Valley civilization, for a cult of the Mother Goddess has been traced along with more characteristic Hindu faiths. Between the 4th and the 8th centuries A.D., Gujarat was ruled successively by the Mauryas, the Sakas. the Guptas and the Valabhis. It mas during the 8th century that the Parsees entered the country from Iran. The Chalukya (*q.v.*) dynasty reigned from the 10th to the 13th century. Their power was then usurped by the Vaghelas who ruled until the Muslim conquest in 1298. The imperial rule of the sultans of Delhi ended with the usurpation of the first sultan of Gujarat, whose capital was at Anhilvada (Patan) Sultan Ahmed I founded Ahmedabad in 1411. From 1515 to 1572–73, when Akbar conquered Gujarat, the sultans were constantly embroiled with their Hindu. Rajput neighbours. About that time Affonso de Albuquerque and other Portuguese leaders made strenuous efforts to establish trading posts and forts in the coastal areas. Diu was obtained in 1535 and Damão in 1558, but relations with the Muslim rulers were seldom easy. Bassein (Vasai) was founded in 1534–35, and became an important centre of Portuguese and missionary activity, but it was taken by the Marathas in 1739 Between 1719 and 1758 the Marathas infiltrated through Gujarat. After the collapse of Maratha pouer. the former princely states entered into treaty relations with the British. They included Cambay, Chota Udaipur, Bariya, Balasinor and numerous petty states The Gaekwar of Baroda was left as the principal representative of Maratha dominance, and his state was famed for enlightened administration. In 1937 the political agencies Rewa Kantha. Surat, Kaira, Nasik and Thana combined with Baroda to form the Gujarat States Agency with headquarters at Baroda city. In July 1947, on the eve of Indian independence, all the component states joined the union of India and were subsequently incorporated into the state of Bombay. The latter was reorganized in 1960 to form the states of Gujarat and Maharashtra.

Apart from the areas that were formerly under direct British control, much of the modern Gujarat state still auaits development and socially and (except for the textile industry) economically also it retains archaic features. Its architecture is exceptionally rich, particularly in elaborate tracery and highly ornate temples and sculpture. Jainism there reached a high pitch of intellectual development. being patronized lavishly by the wealthy, numerous and abstemious Hindu mercantile classes. (See also INDIA *History*.)

(J. D. M. D)

Population, Administration and Social Conditions. — At the 1961 census the population figure for Gujarat was 20.621 283, giving a density of 286 persons per square mile. Ahmedabad is the provisional capital; the projected new capital. 15 mi. N of Ahmedabad, is to be called Gandhinagar. There are about 250 towns and more than 18.700 villages in the state; the chief towns are Ahmedabad (pop., 1961, 1,149,852), Baroda (295,304), Surat (288,167), Rajkot (194,510), Bhavnagar (177,488), Jamnagar (147,420); all the others have fewer than 100.000 persons.

Gujarat comprises 17 districts. They are Cutch; six which make up most of the Kathiawar peninsula, Jamnagar (formerly Halar), Junagadh (Sorath), Rajkot (Madhya Saurashtra), Amreli. Bhavnagar (Gohilnad) and Surendranagar (Zalawad); and ten in the old Gujarat region. Surat, Dangs, Kaira, Mehsana, Sabarkantha, Banaskantha, Broach, Baroda, Panch Mahals and Ahmedabad.

By the early 1960s Gujarat. with more than 30% of the population literate, ranked fourth among the Indian states in literacy. There are more than 24.500 schools and educational institutions, including three universities (Gujarat in Ahmedabad, Sayajirao in Baroda and Sardar Vallabhbhai Vidyapeeth in Anand). Free and compulsory primary education for children aged 7 to 11 is provided in all districts of Baroda division. The Gujarati language (*q.v.*) is spoken by most people.

By the early 1960s about 900 hospitals and dispensaries were providing generally free medical treatment. There are a number of labour welfare centres which provide free recreational facilities and cultural activities for industrial workers. The state government spends about Rs. 56,000,000 annually on educational, housing, medical and cultural facilities for backward classes and tribal people.

(S. CH.; S. B. L. N.)

Economy. — The main products of the state are cotton, rice, wheat, jowar, bajri and pulses. Forests produce teak, bamboos and sandalwood The Gir forests contain the only lions' sanctuary in India Minerals include calcite and limestone in Jamnagar and manganese in Baroda Kaira has bauxite and limestone and Saurashtra has gypsum. When completed the Ukai project will irrigate 555 000 ac. of land and help the industrial development of southern Gujarat. There are cement works at Porbunder, Dwarka

and Sikka, and factories for drugs and medicines near Bulsar and in Raroda. Silk goods are produced and there is a smaller output of gold and silver thread, carved sandalwood, and leather goods.

The industrialization characteristic of the city of Bombay (*q.v.*) and especially the textile industry. extends northward into Gujarat with such centres as Surat. Broach. Baroda and Ahmedabad well served by rail and road. To relieve the pressure on this main railway and the port of Bombay, it has been the policy of the central government of India to develop railways and modern deep water ports in Cutch and Kathiawar since the Gulf of Cambay is too shallow. Okha at the western tip of the Kathiawar peninsula has proved too distant and involves a long rail haul; Port Kandla on the Gulf of Cutch has accordingly been developed. Gujarat is credited with 3.529 mi. of railway. and road construction in the drier parts is relatively easy. But Gujarat has less than half of the number of factories and of factory workers found in Maharashtra. (L. D. S.)

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GUJARATI LANGUAGE, spoken by about 16,000,000 people in the present states of Gujarat and Maharashtra and adjoining districts, is one of the Indo-Aryan languages (*q.v.*). Its neighbour east and northeast is the Rajasthani language (*q.v.*) into which it merges so gradually that it is difficult to assign border dialects to either language. Gujarati, one of the 14 regional languages specified in the Indian constitution, has a number of dialects and class variations; *e.g.,* Parsis make distinctions between cerebrals and dentals that are disregarded by Moslems. Both communities have borrowed Persian and Arabic words more freely than standard Gujarati, which, because of its maritime connections, has borrowed occasional words from other parts of Asia and from Europe, especially in the dialect of the Kathiawar sailors. There are differences in pronunciation among the Hindus, too, *e.g.,* variation between *ē* and i, k and c, kh and ch, *s* and *ch,* as well as loss of It, confusion of cerebrals and dentals and alternation of d, *r,* l and *l.* (For standard Gujarati grammar, *see* G. P. Taylor, *The* Student's *Gujarati Grammar,* 3rd ed., 1944.)

Gujarati has a long literary tradition with an almost unbroken evolution from Gaurjara Apabhramsa to Old Gujarati (or Old Western Rajasthani). the latter generally considered to begin with the Bhakta or devotional poems of Narasimha Mehta (15th century) and, in the same period, the writings of the great poetess Mira Bai. Premanand, the 17th-century master of narrative poetry, adapted themes from the Sanskrit epics "Mahābhārata" and "Rāmāyaṇa." The last great poet of Old Gujarati was Dayaram (1767–1852). Jain *bhaṇḍārs* or libraries are veritable storehouses of Old Gujarati manuscripts.

On the impact of European civilization Narmadashankar (1833–1886), in his prose and verse innovations, gave direction to a literary revival; he is justly termed the founder of modern Gujarati literature. Govardhanram Tripathi's (1855–1907) novel *Saraswaticandra* depicts Gujarati life; it marks a renaissance and gives a literary inspiration to the period. K. M. Munshi (1887–) captured a wide public with his historical novels. The Gujarati writings and speeches of Mohandas K. Gandhi (1869–1948) had a strong literary influence. Panalal Patel wrote novels about village life.

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GUJRANWALA, a municipal town. a district and a *tehsil* in Lahore division, West Pakistan. The town, headquarters of the district, lies 42 mi. N. of Lahore. Pop. (1961), including refugee camp, 196,154. Originally a village founded, as the name shows, by Gujars, it was renamed Khanpur by some Sansi Jats of Amritsar who settled there, but its old name survived. Little is known about its early history till it rose to importance during the Sikh period. It owes its growth to the father (Mahan Singh) and grandfather (Charat Singh) of Maharaja Ranjit Singh (*q.v.*). whose capital it was during the early 19th century. the early period of Sikh power. The principal places of interest include the grave of Mahan Singh. Mahan Singh's garden and a lofty cupola covering part of the ashes of the great maharaja. There are two degree colleges, for men and women, both affiliated to the Punjab university, and an intermediate college and secondary schools.

Gujranmala lies on the railway line to Peshawar, and on the Grand Trunk road, and is the chief market of the district and an important industrial centre. Manufacturing of iron safes and aluminum, brass and copper utensils are the old industries for which it occupies an important position in Pakistan. New industries have grown since independence, including manufactures of textiles. hosiery, sanitary fittings and electric fans, and tanneries.

GUJRANWALA TEHSIL, area 936 sq.mi., had a population in 1961 of 745,393.

GUJRANWALA DISTRICT comprises an area of 2.312 sq.mi. Pop. (1961) 1,291,886. In 1847 the district came under British influence in connection with the regency at Lahore. In 1849 it was included in the territory annexed after the second Sikh War. and became a part of Pakistan in 1947. Located in the Rechna doab it consists of a featureless plain that naturally falls into two divisions: the low-lying lands fringing the Chenab and the Degh. and the upland between them. Wheat. rice and cotton are the chief crops. As a result of canal irrigation large areas have been affected by waterlogging and salinity. A number of factories have grown up along the Grand Trunk road. (K. S. AD.)

GUJRAT, a town, *tehsil* and district in Rawalpindi division. West Pakistan. The town stands about 5 mi. from the right bank of the Chenab river, 70 mi. N. of Lahore by rail. Pop. (1961) 59,608. It is built upon an ancient site formerly occupied, according to tradition,, by two successive cities, the second supposedly destroyed in 1303, the year of a Mongol invasion. More than 200 years later either Sher Shah or Akbar founded the existing town. Though standing in the midst of a Jat neighbourhood the fort was first garrisoned by Gujars, and took the name of Gujrat. The town has manufactures of furniture, brassware, boots, cotton goods and shawls. It is the site of the Zamindar college and the government college for women affiliated to Panjab university at Lahore. Gujrat *tehsil* covers an area of 565 sq.mi. Pop. (1961) 433,340.

GUJRAT DISTRICT comprises a narrow ridge of sub-Himalayan plain country, possessing few natural advantages. A range of low hills. known as the Pabbi, traverses the northern angle. They are destitute of vegetation and present a barren chaos of naked rock, deeply scored with ravines.

Numerous relics of antiquity stud the surface of the district. A mound occupied by the village of Moga (Mong) has been identified by some as the site of Nicaea, the city built by Alexander the Great on the field of his victory over Porus. In 1846 Gujrat first came under the supervision of British officials. Two years later the district became the theatre for the important engagements of the second Sikh war. After several battles in which the British were unsuccessful. the Sikh power was irretrievably broken at the battle of Gujrat in Feb. 1849. The Punjab then passed by annexation under British rule. At Chillianwalla, a village in the district situated on the left bank of the Jhelum river, an obelisk erected by the British government preserves the names of those who fell in the battle of that name on Jan. 13, 1849.

The district comprises an area of 2.264 sq.mi. In 1961 the population was 1,326,012. The district has a large export trade in wheat and other grains, oil, wool, cotton and hides. It is traversed by the Northern railway. The southern part of the district receives irrigation from the Upper Jhelam canal. and contains the headworks of the Lower Jhelam canal.

GULA, a Sumerian goddess, patroness of Medicine, the consort of Nin-urta. She is identical with another goddess, known as Bau, though it would seem that the two were originally independent. The name Bau is more common in the oldest period and gives way in the post-Khammurabic age to Gula. Other names borne by this goddess are Nin-Karrak. Ga-tum-dug and Nin-din-dug, the latter signifying "the lady who restores to life." The designation well emphasizes Bau-Gula's chief trait, which is that of healer. She is often spoken of as "the great physician," and accordingly plays a specially prominent role in incantations and incantation rituals intended to relieve those suffering from disease. She is, however, also invoked to curse those who trample upon the rights of rulers or those who do wrong with poisonous potions. As in the case of Nin-urta, the cult of Bau-Gula is prominent in Lagash and in Nippur, but her principal cult was at Isin. While generally in close association with her consort, she is also invoked by herself, and thus retains a larger measure of independence than most of the goddesses of Babylonia and Assyria. She appears in a prominent position on the designs accompanying the Kudurrus boundary-stone monuments of Babylonia, being represented by a statue attended by a dog when other gods and goddesses are merely pictured by their shrines, by sacred animals or by weapons. In neo-Babylonian days her cult continued to occupy a prominent position, and Nebuchadrezzar II speaks of no less than three chapels or shrines within the sacred precincts of E-Zida in the city of Borsippa, besides a temple in her honour at Babylon. Another deity (namely, the heaven god Anu) is often called Gula, for the word means "the great one"

GULBARGA, a city and district in Mysore, India. The city, headquarters of the district. lies about 100 mi. E. of Hyderabad. Pop. (1951) 77.189. Originally included in the territory of the Kakatiyas of Warangal. it was annexed to the kingdom of Delhi in the early 14th century by Ulugh Khan, afterward Mohammed Tughluq; after his death it fell to the Bahmani kingdom and, upon the breakup of that power, to Bijapur. With the conquest of the Deccan by Aurangzeb it was again included in the empire of Delhi, but was separated from it by the establishment of Hyderabad state in the early 18th century.

There are many ancient monuments. In the eastern quarter of the city are the tombs of the Bahmani kings; the most notable building is a mosque said to be modeled upon that of Córdoba in Spain. Gulbarga is also a centre of the cotton trade with ginning and pressing factories and spinning and weaving mills, and also flour and oil mills and paint factories. It is situated on the main line from Bombay to Madras.

GULBARGA DISTRICT (pop., 1961, 1,391,815; area 6.348 sq.mi.) lies on the north bank of the river Krishna and mainly in the valley of its tributary, the Bhima. The rainfall is low, seldom exceeding 30 in. The chief crops are millets, pulses, cotton and linseed. Limestone is quarried in places, but the majority of the population is engaged in agriculture. Formerly in Hyderabad state, the district became part of Mysore in 1956. (S. AH.)

GULBENKIAN, CALOUSTE SARKIS (1869–1955), Armenian oil financier, connoisseur and philanthropist, was born in Scutari, Turk., March 24, 1869. Educated in France and England, he became a naturalized British citizen in 1902, but assumed Iranian citizenship in 1926

He was a founder and constituent member of the Iraq Petroleum company in 1911. The following year, he admitted Royal Dutch Shell with a 25% interest to the combine; the British Petroleum company got 25% in 1914; the Compagnie Française des Pétroles received 22½% in 1920; and the U S.-owned Near East Development corporation obtained 23¾% in 1925. During this time, Gulbenkian reduced his personal holdings in Iraq Petroleum to 40% in 1911, to 15% in 1912 and to 5% in 1920. From 1925 until Gulbenkian's death, each group held 23¾% of the stock with Gulbenkian's holdings remaining at 5%. In 192; the government of Iraq entered into an equal ownership agreement with the company.

Gulbenkian died in Lisbon, Port., July 20, 195j, leaving the bulk of his vast fortune, including an art collection valued at approximately $15,000,000, to a charitable foundation he had established

See Ralph Hewins, *Mr Five Per Cent* (1958) (R A Hs)

GULDBERG, OVE HÖEGH- (1731–1808), Danish statesman, one of the principal ministers of Christian VII's reign, was born at Horsens on Sept. 1, 1731, the son of a shopkeeper. He grew up in straitened circumstances and norked for a time as a tutor before taking a degree in theology in 1753. He then occupied himself with historical studies. but became professor of rhetoric at Soro academy in 1761. In 1764, however, he was appointed tutor to Prince Frederick. half brother of the future King Christian VII (*q.v.*). He became Frederick's private secretary in 1771 and shared his indignation at the usurpation of power by J. F. Struensee (*q.v.*). After contributing to Struensee's fall in 1772. he began, in collaboration with Prince Frederick and the dowager queen Juliana Maria, to exert considerable influence over internal affairs; and in 1774 he was appointed confidential cabinet secretary. Mild in manner but ambitious, Guldberg gradually increased his power. From his office issued increasing numbers of cabinet orders which bypassed his colleagues and the council but were signed by the unbalanced christian VII. By this means the important law concerning citizenship, which reserved the holding of public office to Danish citizens, was passed. Guldberg concerned himself with educational and religious affairs, but was conservative in the matter of land reform and wished to preserve the landowners' authority over the peasants. When the foreign minister Andreas Peter Bernstorff (*q.v.*) opposed the influence of the cabinet and conducted a foreign policy of his own, Guldberg had him dismissed (1780) and tried to pursue a policy based exclusively on cooperation with Russia. A director of several companies, he also controlled Denmark's financial policy from 1782 and so could secure government support for his companies during the economic difficulties after the close of the American Revolution in 1783. In April 1784, just as he was about to be admitted to the privy council, Guldberg was overthrown by the crown prince Frederick's coup *d'état*. For the next 18 years Guldberg was a loyal and active provincial civil servant He also resumed the writing of works of scholarship. At his death on Feb. 7, 1808, in Hald, he was a landowner.

See Aage **Friis,** *Andreas Peter Bernstorff og Ove Hoegh Guldberg* (1899); *E.* Holm, *Danmark-Norges Historie* 1720–1814, vol. v–vi (1906–09). (F. SK.)

GULDEN, a term used synonymously with guilder and florin to denote the monetary unit of the Netherlands. The original Netherlands florin, a silver coin of about ten grams. became the unit of account with the adoption of the silver standard in 1847. When, as a result of the severe fall in the world price of silver, the silver standard was abandoned in 1873, the Netherlands had for a time no metallic standard of value. Then, in 1875, the florin was linked to gold, and the largest, the ten-florin piece, contained slightly more than six grams of fine gold. At the time, 12.107 florins were equal to £1 sterling and 1 florin equaled 40.196 U.S. cents.

As the florin was perhaps the most important of the neutral currencies during World War I, the exchange quotations in Amsterdam provided one of the few guides to the relative financial position of the belligerent countries. Nevertheless, nar pressures and postnar inflation undermined the florin and brought about the temporary suspension of its link with gold. In 1925 the Netherlands re-established the florin on the basis of prewar parity. Attempts to maintain this level long after the devaluation of sterling in 1931 failed; the gold standard was suspended and the foreign-exchange value of the currency was reduced in 1936.

The florin virtually ceased to operate as an international currency after the German occupation of the Netherlands in World War II, but 'transactions based on a stabilized florin or gulden (valued at 10.69 gulden to the pound sterling) were resumed in Sept. 1945. The devaluation of sterling as against the dollar in 1949 was followed by a similar adjustment in the guilder; its parity was established at .233861 grams of fine gold per unit, or 3.80 florins per U.S. dollar. From March 7, 1961, its par value was changed to 3.62 florins per U.S. dollar. (Jo. M. L.; C. G. T.)

GULF INTRACOASTAL WATERWAY, an improved navigable waterway along the Gulf of Mexico coast of the United States, extends from Apalachee bay, Fla., westward to the Mexi-

can border at Brownsville, Tex.. a distance of more than 1,100 mi. In part artificial, the waterway consists of a channel paralleling the coast behind barrier beaches, linked by a series of canals and maintained at a minimum depth of 12 ft. by the U.S. army corps of engineers.

The Gulf Intracoastal waterway is an important route for barges, and several sections of it furnish access to major gulf ports for ocean-going vessels. Among the major ports along the waterway are Panama City and Pensacola, Fla.; Mobile, Ala.; Gulfport, Miss.; New Orleans and Lake Charles, La.; and Port Arthur, Freeport, Beaumont, Galveston, Corpus Christi and Brownsville, Tex.

Although much of the traffic is short-haul, averaging about 170 mi., the waterway is connected with the Mississippi valley system of inland waterways; through barge traffic is handled between such ports as Chicago, Pittsburgh, St. Louis and Memphis and points on the Gulf Intracoastal waterway and its branches. Among the principal items moved on the waterway are petroleum and its products, industrial chemicals, pipe and other supplies for the oil fields, sulfur and seashells.

At its eastern end, the waterway is not directly connected with the Atlantic Intracoastal waterway, except via the open waters of the Gulf of Mexico; numerous studies and plans were made for a connection across Florida, to provide a continuous protected waterway from the northeastern United States to the Mexican border. Traffic is concentrated in that section of the waterway connecting the Warrior-Tombigbee system on the east at Mobile bay, Ala., with the Mississippi river system at New Orleans, La., and between the Mississippi river and the major Texas ports. A cut-off route. the Plaquemine waterway, provides direct connection west of New Orleans between the Gulf Intracoastal waterway and the Mississippi river. The waterway is at sea level. The Harvey lock at New Orleans provides entrance from the Mississippi river. Part of the route of the waterway at New Orleans consists of the Inner Harbor Navigation canal, an artificial waterway which is the axis of a major industrial district.

See also WATERWAYS, INLAND. (H. M. M.)

GULFPORT, a city and seat of Harrison county in southeastern Mississippi. U.S., on the Gulf of Mexico, is midway between Mobile, Ala., and New Orleans, La.. on the Old Spanish. trail. Gulfport was founded in 1887 by Capt. William H. Hardy, Confederate soldier and engineer. who selected the site for the southern terminus of his Gulf and Ship Island railroad. Its development. however, was made possible by Capt. Joseph T. Jones of the Bradford (Pennsylvania) Construction company, who completed the railroad, secured controlling interest and moved to the city in 1902. Jones and his family mere leaders in the building of the city, including its excellent harbour, transferred to the U.S. government in 1907.

Gulfport is in the centre of what has been called the world's longest man-made sand beach (28 mi. long and 300 ft. wide) which helped make the city a year-around resort.

Gulfport was incorporated as a city in 1904. (For comparative population figures see table in MISSISSIPPI: *Population.*)

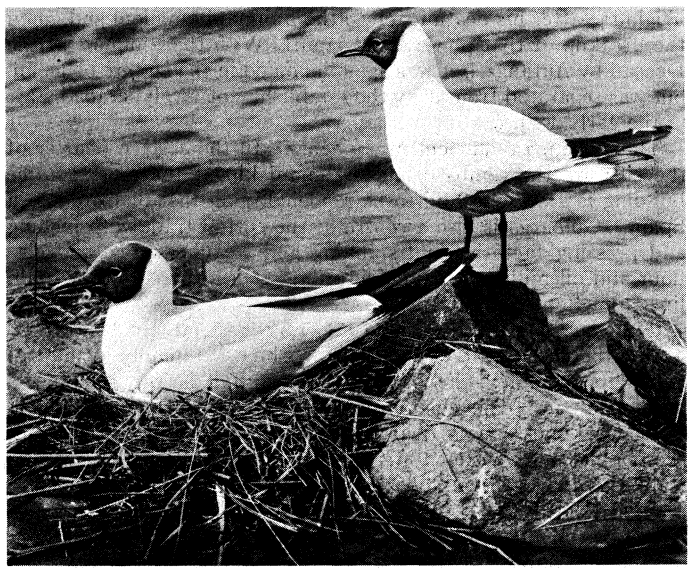
There is a frontage of 6 mi. on the Gulf which includes a modern deepwater port: consisting of two moles, separated by a harbour one-half mile long. The commerce of the port is chiefly in wood products, creosoted piling, cottonseed products. salt of potash, phosphate rock and fish. A number of industries produce a variety of goods, including textile products, concrete and building materials, fertilizers. small craft and drugs. There is also a U.S. Veterans hospital there. (J. T. D.)

GULF STREAM, the western and northern quadrants, extending from Florida to the Grand Banks of Newfoundland, of the current system which sets clockwise around the North Atlantic in mid-latitudes. Fed by water from the Gulf of Mexico and reinforced off Florida by some water from the trade-wind current. the initial Gulf stream is relatively narrow and deep. Maximum velocities exceed four knots, with a rate of flow about 1,000 times that of the Mississippi river. Beyond Cape Hatteras it broadens, slackens and breaks down into a meandering streaky pattern with countercurrents and eddies. Its deep blue colour and higher salinity and temperature distinguish it from the inshore countercurrent (Cold Wall) along the eastern coast of the United States, and from the Labrador current with which it mixes along the periphery of the Grand Banks. East of the Banks the continuing current is normally referred to as the North Atlantic current. The offshore boundary of the stream is generally difiuse and poorly defined: the result in part of the similarity of the stream and central Atlantic waters. See ATLANTIC OCEAN: Surface *Currents;* OCEAN AND OCEANOGRAPHY: *Movement* of Sen Water. (C. A. Bs.)

GULFWEED, a popular name given to a species of the brown seaweeds (Phaeophyta) belonging to the genus *Sargassum,* more particularly the species (*Sargassum natans*) that grows in free-floating masses in the Gulf stream and the Sargasso sea. It is remarkable among seaweeds for its form, which resembles branches bearing leaves and berries; the latter are hollow floats answering the same purpose as the bladders in another brown seaweed, *Fucus vesiculosus,* common around the British Isles between high and low water.

GULL, the common name for sea birds of the family Laridae, subfamily Larinae. Perhaps the most beautiful of all gulls is the ivory gull (Pagophila eburnea), which breeds in the high arctic. The plumage is pure white, the legs black. The well-known kittiwake (*q.v.*) (Rissa tridactyla) inhabits the seas of the northern hemisphere, breeding as far south as the coasts of Britain; in this species the hind toe is lacking. Of the 25 or more species of the genus Larus, the largest are the glaucous and greater black-backed gulls (L. hyperboreus and L. *marinus*), of which the former is circumpolar, the latter nearly so, not occurring, however, between Labrador and Japan. These species are more or less raptorial in their habits, eating the eggs, young and even adults of many other birds.

L. *minutus* of Europe is the smallest species. The black-headed gull. L. *ridibundus,* breeds in large colonies in marshes, but



ERIC HOSKING FROM NATIONAL AUDUBON SOCIETY

BLACK-HEADED GULL (LARUS RIDIBUNDUS)

most species prefer cliffs. The silvery gull (L. novae-hollandiae) has a southern habitat. The rare and beautiful roseate gull (*Rhodostethia rosea*), an arctic form, is recognized by the pink tinge in its plumage. Sabine's gull, Xema sabini, breeds in arctic America and Siberia; it has a forked tail. Franklin's gull (L. *pipixcan*) inhabits the interior of North America, breeding in marshes. It is the only bird with a monument to it—in Salt Lake City to commemorate its services in the destruction of grasshoppers. The herring gull (L. argentatus) is the commonest Atlantic species; a dozen races breed over northern parts of the northern hemisphere, two in North America. The laughing gull (L. atricilla) breeds on coasts from Maine to Texas and Venezuela, and southern California, robbing pelicans (*q.v.*). The ring-billed gull (L. *dominicanus*) is common in the interior United States and Canada, the California gull (L. *californicus*) also about inland lakes farther

west, the western gull (L. *occidentalis)* along the U.S. Pacific shores. The only gull with a strikingly forked tail is the swallow-tailed gull *(Creagrus furcatus)* of the Galapagos archipelago. The large Pacific gull (*Gabianus pacificus*) breeds about Tasmania and southern Australia, the medium-sized dolphin gull (*Gabianus scoresbii)* from Tierra del Fuego southnard. (G. F. Ss.)

GULLAH is the dialect of former slaves and their descendants (also called Gullahs and Geechees, West African tribal names) on the sea islands of South Carolina and Georgia and on the mainland nearby. It reveals characteristics of the speech of British settlers in that region during the 17th and 18th centuries and of several West African languages—including Vai, Mende, Twi, Ewe, Hausa, Yoruba, Ibo, Kikongo and others—spoken by slaves imported to the region during the 18th and 19th centuries. The influence of these languages upon Gullah is evident in its vocabulary, sounds, syntax, morphology, intonation and word formations.

Nearly 6,000 African words have been identified in Gullah, most of which are now used as personal names, such as *Abiona,* "born by the wayside" (Yoruba); *Adanse,* a place name in Ghana; *Anyika,* "she is beautiful" (Vai); *Pitipa,* a Mende name given children born during a rain; etc. Many African words in Gullah are fairly common in American English, such as *cooter,* "tortoise"; *goober,* "peanut"; *gumbo,* "okra"; *juke* as in "jukebox"; *voodoo,* "witchcraft"; etc. Gullah speakers simplify English words and constructions! speak rapidly with no southern drawl, and use an intonation unlike that of English. The following sentences reveal features of Gullah: *Dey fa* go *shum,* "They went to see her," literally, "They take go see her"; *Shishuh tall pass una,* "Sister is taller than you"; 'E *yedi wulisankpankpan, but cyan' shum,* "He hears the woodpecker, but can't see it"; *'Twix' me na una 'e duh badnzout 'em fuh trut, enti?,* "Between me and you he surely put a curse on them, didn't he?"; *Uma-chil' nyamnyam fufu an' t'ree roll-roun', but 'e ain' been satify,* "The girl ate mush and three biscuits, but she wasn't satisfied."

For an analysis of Gullah with illustrative texts, *see* Lorenzo D. Turner, "Notes on the Sounds and Vocabulary of Gullah," *Am. Dialect Soc.* (May 1941), "Problems Confronting the Investigator of Gullah," *Am. Dialect Soc.* (April 1948) and *Africanisms in the Gullah Dialect* (1949). For Gullah stories, *see* Ambrose E. Gonzales, *The Black Border* (1922); S. G. Stoney and G. Shelby, *Black Genesis* (1930). (L. D. T.)

GULLANE, a village in the parish of Dirleton, East Lothian, Scot., on the southern shore of the Firth of Forth, lies 17 mi. E. of Edinburgh. Pop. (1951) 1,182. The 12th-century kirk of St. Andrew (now disused) has a Norman chancel arch and a 15th-century north transept. Gullane's associations with Knights Templar are indicated in such names as Templar lane. The 16th century Saltcoats castle. ½ mi. S.W., belonged to the Livingston family, whose ancestor obtained a grant of land for killing a wild boar, the last in Scotland, which terrorized the neighbourhood. Gullane possesses three excellent golf courses. (W. Be.)

GULLSTRAND, ALLVAR (1862–1930), Swedish physician, was born on June 5, 1862, at Landskrona. In 1894 he became professor of diseases of the eye at Uppsala, and in 1913 was appointed professor of physiological and physical optics there. His investigations concerned the general laws of dioptrics, a new conception of the theory of optical images; the extrication of the optical images in the eye; and the eye's relation to the diffusion of light. In 1911 he was awarded the Nobel prize for medicine. Among Gullstrand's works are *Allgemeine Theorie der monochromatischen Aberrationen* (1900), *Die optische Abbildung in heterogenen Medien und die Dioptrik der Kristallinse des Menschen* (1908) and *Einführung in die Methoden der Dioptrik des Auges des Menschen* (1911). He received the honorary degree of doctor of science at Dublin in 1912.

GULLY, JOHN (1783–1863), British prize fighter, racing man and politician, a light of the 19th-century English sporting world, was born Aug. 21, 1783, at Wick near Bristol, the son of an innkeeper. In 1805, having failed as a butcher, he was in the king's bench prison when he was visited by his Bristol pugilist friend Henry Pearce, the "Game Chicken." As the result of an informal bout between them Gully's debts were paid and he was matched against Pearce. They met at Hailsham, before the duke of Clarence (afterward William IV), when Gully lost after 59 rounds. In 1807 he twice beat the huge Bob Gregson. He then retired from the ring. was landlord of "The Plough" in Carey street in London and took to horse racing. He executed betting commissions for important patrons including the prince regent. In 1827 he lost £40,000 in backing Mameluke (which he had bought for 4,000 guineas) in the St Leger. With Robert Ridsdale as his confederate in 1832 he won the Derby and St. Leger with St. Giles and Margrave respectively. In alliance with John Day he won the Two Thousand Guineas with The Ugly Buck in 1844 and two years later the Derby with Pyrrhus the First and the Oaks with Mendicant. In 1854 he non the Two Thousand Guineas with The Hermit and, in partnership with Henry Padwick, the Derby with Andover. For many years his horses were trained at Danebury in Hampshire, where he and his betting associates were called the Danebury confederacy. He bought Ackworth park, Yorkshire, and was member of parliament for the pocket borough of Pontefract from Dec. 1832 to July 1837. In 1862 he bought the Wingate estate and collieries in Durham. Gully married twice and had 24 children, 12 by each wife. He died on March 9, 1863, in Durham He was a fine figure, six feet tall and immensely strong He was a man of resolute character who lived in an age of dubious sporting ethics and scandal has not wholly spared him; he probably kept to his own reasonably high standard of honesty and was always ready to fly to arms if defamed. (B. Dn.)

GUMAL (Gomal) **PASS,** the route that leads along the valley of the Gumal river, through South Waziristan agency. connecting Ghazni in eastern Afghanistan with Tank and Dera Ismail Khan in West Pakistan, via Domandi. Gulkach (Gul Katch) post, Nilikach and Kot Murtaza near the entrance of the pass. The name is sometimes applied to the whole course of the Gumal river. The actual Gumal pass is a four-mile defile, and the most important pass between the Khyber and Bolan passes (*qq.v.*), providing the oldest of the trade routes in that area. It has been traditionally used by traders called Powindahs, nho carry all their goods on the hacks of camels or donkeys. They spend the summer in Afghanistan and on the approach of winter cross over to Pakistan in caravans The Powindahs are mostly of the Ghilzai clan (mainly Nasir and Sulaiman Khel tribes) who live on the Afghan side of the frontier. They trail their camels along the borders of the territory of the Mahsud Waziris, bringing fruits, skins and cloth for disposal in the frontier markets or in the plains of Dera Ismail Khan. The entry of Powindahs into Pakistan is no longer free.

Gumal River rises near Sarwandi on the Koh Nak range in Afghanistan. Between Waziristan and the highland plateau of Afghanistan there is a belt of hills, in more or less parallel lines, which forms the barrier through which the Gumal breaks before it enters West Pakistan near Domandi. where it is joined by the Kundar. It is joined by the Wana Toi (from the north) at Toi Khula and by the Zhob (from the south) at Khajuri Kach, and falls into the Indus a few miles south of Dera Ismail Khan cantonment. Almost all its water is used for irrigation.

In the early 1960s plans were in hand to construct a multipurpose dam at Khajuri Kach, below the junction of the Zhob and the Gumal, to form a reservoir with a storage capacity of 2,500,000 ac.ft. It was designed to provide irrigation to about 115,000 ac., to produce 73,000 kw, of hydroelectric power and also to control floods in the area. (K. S. Ad.)

GUM ARABIC, an exudation from various varieties of acacia, much used in the arts *(see* Gums. Plant).

GUMBINNEN (Gusev), a town in the Kaliningrad *oblast,* Russian Soviet Federated Socialist Republic, U.S.S.R., formerly in East Prussia, Ger., on the Pissa, 70 mi. E. of Konigsberg (Kaliningrad). Frederick William I in 1724 raised Gumbinnen to the rank of a town, and in 1732 brought to it a number of persons who had been driven from Salzburg by religious persecution. The manufacture of agricultural machinery, cotton and linen weaving, tanning, brewing and distilling are the chief industries. There are horse and cattle markets

GUMBO or Okra. a herbaceous hairy annual plant *(Hibiscus esculentus)* of the mallow family (Malvaceae), of the old world tropics and widely cultivated or naturalized in tropical and sub-

tropical countries. The leaves are heart shaped, three to five lobed, and the flowers yellow with a crimson centre. The fruit or pod. the *bendi-kai* of the Europeans of southern India, is a tapering, ten-angled capsule, 4 to 10 in. in length (except in the dwarf varieties) and contains numerous oval. dark-coloured seeds. hairy at the base. The unripe fruit is eaten either pickled or prepared like asparagus. It is also an ingredient in various dishes (*e.g.*, the gumbo of the southern Cnited States), and because of the large amount of mucilage it contains it is extensively used for thickening broths and soups. The fruit is grown on a large scale in the vicinity of Istanbul. The seeds of the gumbo are used as a substitute for coffee. From their demulcent and emollient properties. the leaves and immature fruit have long been in repute in the east for use in poultices and fomentations.

The musk mallow or abelmosk (*Hibiscus abelmoschus*), a related plant indigenous to India and cultivated in most warm regions of the globe, is a low, slightly woody plant. bearing a conical five-ridged pod about 3 in. in length. within which are numerous brown reniform seeds. smaller than those of H. *esculentus*. The seeds possess a musky odour caused by an oleoresin and are known to perfumers under the name of "ambrette," now mostly of synthetic origin.

The seeds are used in Africa as beads. The plant yields an excellent fibre and, being rich in mucilage, is employed in upper India for clarifying sugar. The best-perfumed seeds are reported to come from Martinique.

GUMMA, Japanese prefecture located in the western Kantō plain. Pop. (1935) 1,613,549; area 2,445 sq.mi. Gumma is mostly mountainous. with two-thirds of its territory over 1.640 ft. elevation with volcanic peaks towering over 6,560 ft. The capital Maebashi (*q.v.*) and most of the population are on a small segment of the Kantō plain in the southeastern corner. Sericulture and wheat growing are the most important activities in its predominantly agricultural economy. Mountain forests and mineral deposits (sulfur. manganese, limestone) are exploited. The silk-reeling industry. conducted on a small workshop scale. is centred in Maebashi. Tomioka, Kiryū (*q.v.*) and Isezaki.

(J. D. Ee.)

GUMS, PLANT, are adhesive substances of plant origin that are carbohydrate in nature and are usually produced as exudates from the bark of trees or shrubs. The term plant gums does not normally include the so-called varnish gums which, although they are of natural origin. are in fact resins and quite different chemically (*see* Abietic Acid). Some plant gums. such as gum arabic. are soluble in water, dissolving to give clear solutions. Others including gum tragacanth give mucilages by the absorption of large amounts of water. When the water evaporates after the application of gum solutions, a film with considerable adhesive properties is formed.

Plant gums are produced by trees either after mechanical damage to the hark or atter a bacterial insect or fungal attach upon it It may thereiore be possible that the formation oi gums (a proc ess otten reierred to as gummosis) is associated with some protective mechanism However all reasons tor gummosis are not completely understood. Concerning this. it may be mentioned that the yield of gum acacia from the Acacia *senegal* tree is greatest when the trees are in an unhealthy condition, but methods of good culture reduce the yield of plant gum.

The production of plant gums for commercial use involves making an incision in the bark of the tree and after a month or so collecting the exudate. The collection is repeated throughout the season and the gums so obtained consist of small lumps, each about the size of a walnut, which are usually transparent and light-yellow in colour.

A number of plant gums are used on a considerable scale commercially. They come from many parts of the world: some originate in Africa and include Sudan gum and Kordofan gum from Sudan and Senegal gum from Senegal. These are varieties of gum arabic which is also collected in northern Nigeria, 'Tripoli. Tunisia and Tanganyika. Gum ghatti is collected in India. gum tragacanth comes from Asia Minor and Iran and wattle gum from Australia.

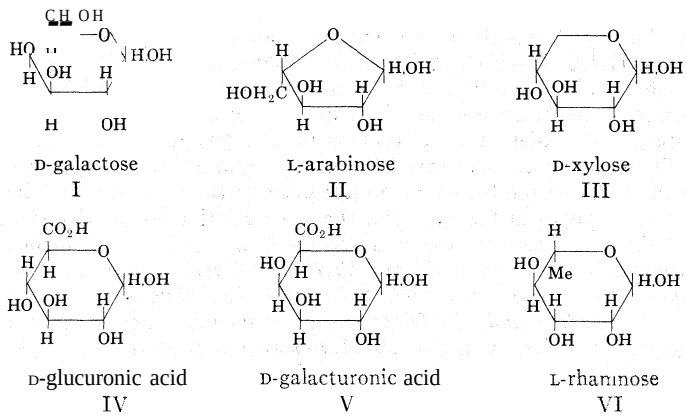
Gum arabic is the most widely used of the truly water-soluble gums. True gum arabic (gum acacia) is produced by species of Acacia only. but the term is sometimes used to include gum arabic suhstitutes obtained from other sources. Gum sudan and gum kordofan are names which refer to their geographical origin. but they are also a type of gum arabic in that they are produced from various Acacia trees.

Gum tragacanth is the second most important commercial gum and is produced by several shrubs which belong to the *Astragalus* genus. *Astragalus gummifer* is the source of most of the gum tragacanth and is endemic in the arid regions of Iran. Asia Minor and Greece. The exudate is produced spontaneously on the bark of the shrub. but the yield is often increased by making an incision and driving wooden wedges into it. Gum tragacanth is not totally soluble in water. but forms a mucilage on treatment with water. It is one of the oldest drugs known and its use has dated from pre-Christian times. It is still used pharmaceutically as a demulcent and as an adhesive agent in pill manufacture. It is also used in food manufacture as an emulsifying agent and as a thickener in sauces.

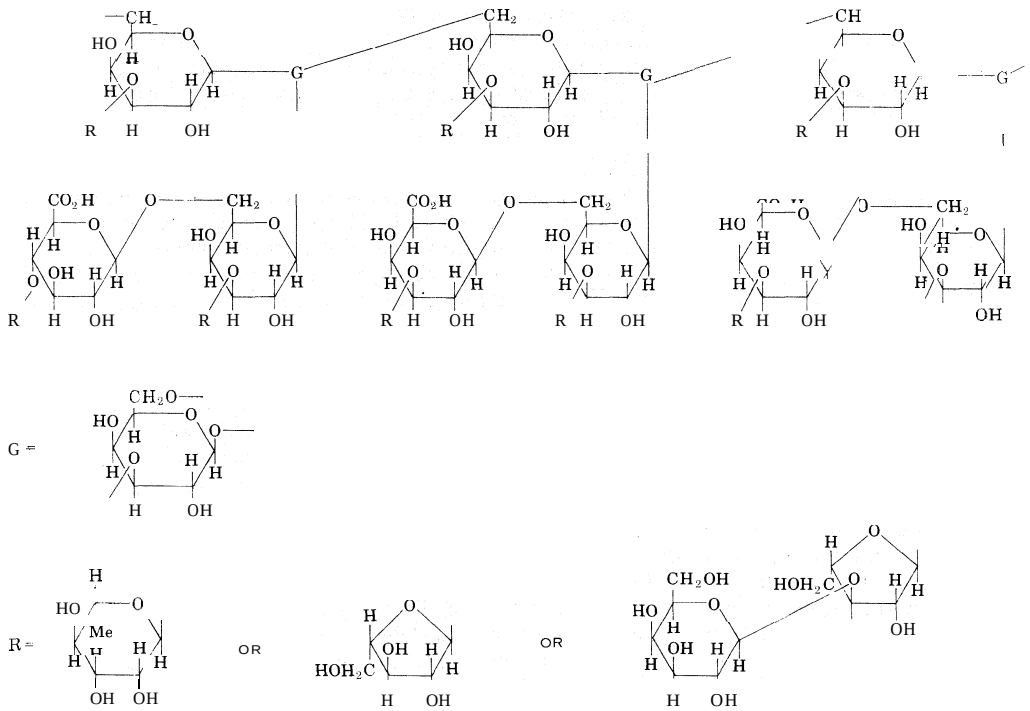
Other plant gums include gum ghatti which has been used as a gum arabic substitute. Gum karaya and carob gum have been used as substitutes for gum tragacanth, but their use is limited. Many cultivated trees yield plant gums including cherry (*Prunus cerasus*) and plum (P. *domestica*), while other miscellaneous sources yield cholla gum (*Cylindropuntia fulgida*) and mesquite gum (Prosopis species). Some of these gums are used in cosmetics. pharmaceuticals and food; an examination of their chemical nature (see below) has shown that they have a close relationship to other plant gums.

Chemical Investigations and Structure of Plant Gums.— The plant gums are complex carbohydrate derivatives which are polysaccharide in nature (see Carbohydrates). Their chemical study is complementary to the detailed study of the other polysaccharides that has been made. The polysaccharides are an important group of natural products and the chemistry of the plant gums has contributed to knowledge regarding their structure and function.

Plant gums are the neutral potassium. magnesium or calcium salts of acidic polysaccharides. whose acidity is due to the presence of uronic acid functions in their structure. Hydrolysis of plant gums gives a mixture of monosaccharides, including D-galactose (I) and L-arabinose (II) in all cases and D-xylose (III) fairly frequently. With the exception of gum tragacanth. which yields D-galacturonic acid (V), all plant gums yield D-glucuronic acid (IV) on acid hydrolysis. Thus the acidity of gum tragacanth is due to D-galacturonic acid residues. whereas the acidity of the other plant gums is due to D-glucuronic acid residues. Sugars such as L-rhamnose (VI) and L-fucose occur rather rarely as plant gum hydrolysis products.



The problem of determining the complete structure of a plant gum is really the determination of the order of the various monosaccharide residues in the parent polysaccharide molecule. The researches of E. L. Hirst. J. K. N. Jones and F. Smith have enabled substantial progress to he made with this problem and the determination of the structure of gum arabic is illustrative of the methods which have been used.



A possible repeating unit in the gum arabic molecule

The sugar units of which the gum arabic .molecule is composed are indicated by the acid hydrolysis products which are D-galactose (I), L-arabinose (11), L-rhamnose (VI), and D-glucuronic acid (IV) and the problem of structure determination is really (a) the identification of the repeating unit in the macromolecular polysaccharide structure and (b) the determination of the arrangement of the monosaccharide components within this repeating unit. Several formulae are possible for the gum arabic molecules and one of them is indicated. Comparison of this structure with the structures of the monosaccharide units (I, II, IV and VI) show the way in which they are linked together.

It can be seen therefore that gum arabic has a highly branched structure which is no doubt responsible for its special physical properties. Similar studies have been made of several different plant gums and an over-all similarity between their structures is detectable.

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GUMTI, a river of northern India. It rises in Pilibhit district, Uttar Pradesh, and after a sinuous southeasterly course of 500 mi. past Lucknow and Jaunpur joins the Ganges in Ghazipur district. At Jaunpur it is spanned by a fine 16th-century bridge and is navigable. There is also a river of the same name rising in Tripura state, India, and falling into the Meghna in Tippera district, East Pakistan, after a 150-mi. course.

GUMULJINA or KOMOTINE, capital of the department of Rhodope in western Thrace, Greece. Pop. (1951 census) 29,734. Gumuljina is situated on the river Karaja-Su, south of the eastern extremity of the Rhodope range of mountains and 13 mi. inland from the Aegean sea. The district produces wheat, maize, barley and tobacco; sericulture and viticulture are both practised on a limited scale. A cattle fair is held annually on Greek Palm Sunday. Copper and antimony are found in the neighbourhood. The town went to Greece in 1918 and was occupied by Bulgaria in 1941.

GUMUSH-KHANEH or GUMUSANE, the chief town of a vilayet of the same name in Asiatic Turkey, situated on high ground (4,400 ft.) in the valley of the Kharshut Su, about ½ mi. S. of the Trebizond-Erzerum *chaussée*. The silver mines from which the place takes its name were noted in ancient times and are mentioned by Marco Polo. Pop. (1955) 4,197.

GUN: *see* SMALL ARMS, MILITARY.

GUN, MACHINE: see MACHINE GUN.

GUNCOTTON, a high-grade type of nitrocellulose (cellulose nitrate) resembling cotton in appearance. It contains more than 13% nitrogen and is prepared by the nitration of cotton fibres with a strong mixture of nitric and sulfuric acids. Commonly a batch process of nitration in iron or earthenware pots is used. After nitration care must be taken to hydrolyze unstable chemicals by boiling the final product in slightly acidified water (stabilization) and washing it free of all acid. Unless this is done the inherent instability associated with nitric esters of this type is enhanced even at ordinary temperatures.

Guncotton, like other forms of nitrocellulose, will decompose with time forming nitrogen dioxide in air which promotes further decomposition.

Guncotton is insoluble in water, alcohol and ether and will dissolve in acetone, nitrobenzene and ethyl acetate. The essential constituent of cotton is cellulose which is a long chain polymer of anhydroglucose units having the empirical formula of $C_6H_{10}O_5$. Cotton linters may have as many as 1,000 to 1,500 of these units in a single molecular chain. In the nitration process the three hydroxyl (OH) groups of each unit can be replaced by a nitrate (ONO_2) ion. If this replacement is complete the resulting guncotton would contain 14.14% nitrogen.

Actually complete nitration is not accomplished and the attached nitrate groups are believed to be distributed randomly along the chain among the three possible positions for each unit. For military purposes in the United States a minimum nitrogen content of 13.35% is used. This represents a somewhat more complete nitration of the cellulose than the *coton-poudre* no. 1 (CP_1) used in World War I.

A characteristic property of this highly nitrated cellulose is its low solubility in an ether-ethanol solution. This property distinguishes guncotton from the less nitrated celluloses which are referred to as collodion cotton or soluble nitrocellulose because of the fact that they dissolve in the ether-alcohol solvent. Guncotton has superior explosive properties to those of collodion and has been extensively employed in conjunction with nitroglycerin for the production of cordite, the British service propellant. The blending of the two ingredients is brought about by acetone, but by the use of collodion with a large proportion of nitroglycerin a cordite is obtainable without the employment of acetone.

During the mid-19th century numerous attempts were made, particularly in Austria, to employ guncotton alone and unmodified as a military propellant, the necessity for tempering its explosive violence by colloiding processes being as yet unrecognized. All ended in failure.

Moist guncotton has been used as a high explosive, but is quite unsatisfactory because of the hazards in handling. Dry guncotton is even more hazardous, being sensitive to all forms of initiation—friction, impact, heat, sparks, etc. Its sensitivity is comparable with other primary explosives such as mercury fulminate or lead azide. It propagates detonation and has a brisance (shattering effect) comparable with TNT. See NITROCELLULOSE.

See T. E. Thorpe, *Dictionary of Applied Chemistry*, vol. iii (1922); Tenney L. Davis, *The Chemistry of Powder and Explosives* (1943). (P. M. FE.)

GUN METAL, a variety of bronze (*q.v.*), formerly used for ordnance. Gun or "G" metals are copper-base casting alloys of the general type: 88% copper, 10% tin and 2% zinc or 86% copper, 10% tin and 4% zinc. Usually up to 1% nickel is present in the modern alloys to add strength, promote grain refinement and reduce segregation. The addition of 0.5% lead improves machinability without harming the cold mechanical properties. A small quantity (0.05% max.) of phosphorus may be used as a deoxidizer to promote metal fluidity and soundness of the casting.

The 88–10–2 alloys are used frequently for gears and bearings subjected to heavy loads and low speeds. They also withstand atmospheric, steam and sea-water corrosion, and thus are suitable for valves, pump parts and steam fittings. The mechanical properties of the "as cast" alloy are: tensile strength, 36,000–46,000 lb. per square inch (p.s.i.), yield point 18,000–26,000 (p.s.i.); elongation 15%–25% (in 2 in.), reduction of area 12%–26% and Brinell hardness 65–80. (D. S. E.)

GUNNERY, NAVAL. Naval gunnery is the art and science of using naval guns and rocket and missile launchers. It is distinguished from land-based military gunnery in that the naval gun fires from an unsteady and moving platform. The task of the military gunner is to fire at one fixed point from another fixed point. The naval gunner has a task comparable to firing at a fast automobile moving along a bumpy and twisting road from another fast automobile also moving along a bumpy and twisting road. In this respect it has points of similarity with aerial gunnery. (See also ARTILLERY: Technique.)

The principal developments in naval gunnery of modern times have been in fire control, automatic fire, antiaircraft guns and missiles. Fire control improvements included use of radar, greatly improved directors and more accurate ballistic computing devices. Automatic fire was improved by the introduction of more reliable ammunition as well as new and improved loading mechanisms. Antiaircraft gunnery was improved by the introduction of more accurate guns of larger calibre. Missile development greatly increased range and the probability of hits on high-speed air targets.

Types of Guns.—It is convenient to classify naval guns by the type of breech-operating mechanisms employed.

Automatic.—An automatic gun is one that uses part of the energy of explosion to eject the empty cartridge case and to energize a device which automatically loads another cartridge and continues to fire the gun as long as the firing circuit is closed and the ammunition supply is maintained. An example is the 40-mm. antiaircraft gun.

Semiautomatic.—A semiautomatic gun is one in which part of the energy of explosion is first stored and later used to open the breech, eject the empty cartridge case and close the breech after another round is loaded, either by hand or by auxiliary power. Most naval guns are of this type.

,?ionautomatic.—A nonautomatic gun is one in which none of the energy of the explosion is used to operate any part of the operating mechanism other than the salvo latch. The salvo latch is a device which prevents the unintentional opening of the breech of a loaded gun. The main battery guns of battleships and most heavy cruisers are of this type.

Gun Mounts.—The naval gun mount is the entire system of gun-supporting parts, elevating and training mechanisms, recoil and counterrecoil equipment. The two classes of mounts are deck mounts and turret mounts. Deck mounts may be worked either manually or by power; turret mounts are invariably worked by power, either electric, hydraulic or a combination of both.

The principal parts of the deck mount are the slide, carriage and stand. The slide is a hollow cylindrical support in which the slide cylinder of the gun is housed. During recoil and counterrecoil, the gun rides back and forth in this support. Two horizontal projections on the slide, called trunnions, provide the axis about which the gun is free to move in the vertical plane. The carriage supports the slide and rests on roller bearings. It is free to rotate in a horizontal plane and provides means for training the gun. The stand is the stationary part of the mount, bolted to the deck of the ship and containing the lower roller path on which the roller bearings rest. It supports the combined gun, slide and carriage. Movement of the gun in the horizontal and vertical planes is by a system of handwheels, shafting and gearing. Movement may also be accomplished by a power source through suitable shafting and gearing. Deck mounts may be partially or completely shielded by armour.

The turret mount consists of the barbette, the turret revolving structure, the gunhouse and the turret foundation. The barbette is a heavy fixed cylinder of armour extending from the gunhouse to the lowest armoured deck. Its sole function is to protect the turret revolving structure and the turret foundation. The gunhouse is a heavily armoured rotatable structure containing the guns. The turret revolving structure, which corresponds to the carriage of the deck mount, extends from the gunhouse down to the magazine handling rooms (located outside the barbette) and is composed of steel girders and bulkheads that form the various compartments for the turret machinery and personnel. The turret foundation is composed of steel girders built into the hull of the ship to support the turret revolving structure and the gunhouse. Training of the turret is accomplished by a system of power-driven gears and a toothed rack fitted inside, but not attached to, the barbette. Elevation is accomplished by means of a long, power-driven shaft and pinion.

Recoil and Counterrecoil.—In naval gun mounts the recoil mechanism is generally a hydraulic brake consisting of one or more cylinders secured to the slide of the mount; in the slide, pistons operate so that they move to the rear during recoil and forward during counterrecoil. The cylinders are filled with hydraulic fluid that must pass through orifices in the pistons which are so designed that the resistance to flow is approximately constant throughout the length of the piston's travel. The work done by the recoil in forcing the piston through the liquid absorbs the momentum of the gun in recoil.

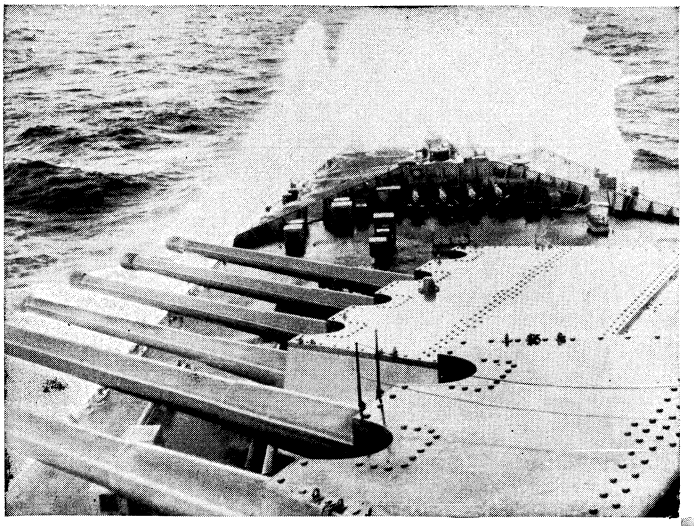
The counterrecoil mechanism may be either mechanical, pneumatic, hydraulic or a combination of all three. The counterrecoil system must not only return the gun to firing position (battery), but must be able to hold it there at all angles of elevation.

Fire Control.—The practical application of exterior ballistics and the methods and devices used to control guns and other weapons are known as fire control. In the early days of naval gunnery and until well past Horatio Nelson's time, fire control was a simple matter. Each gunner peered along the barrel of his muzzle-loader and trained his gun by means of a lever; he also estimated the range and elevated his gun by means of a wedge under the breech or by a threaded shaft.

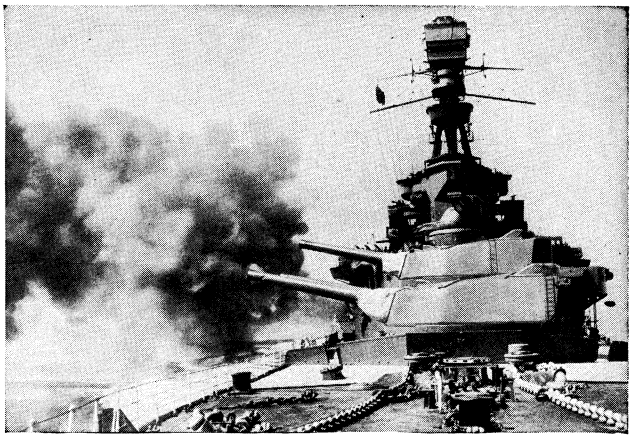
As guns became more powerful and ranges increased from a few hundred to several thousand yards, this hit-or-miss system was no longer effective. Range finders were introduced to determine the exact distance to the target, and guns were elevated according to the number of degrees required to shoot a given distance.

By World War I, battle ranges exceeded 10,000 yd. and additional problems arose: (1) It was no longer possible to fire at the target directly; allowance had to be made for movement of the target while the projectile was in flight. (2) Allowances were necessary for the wear of gun barrels (called bore erosion), temperature of the powder, effects of air density and upper air wind velocity. (3) Allowance had to be made for the ship's roll and pitch. Failure to allow for any one of these might change the range of the projectile by several thousand yards. To meet these problems, director firing was instituted. Director firing is essentially the firing of all guns in one battery by use of a director, a range-determining device and a computer.

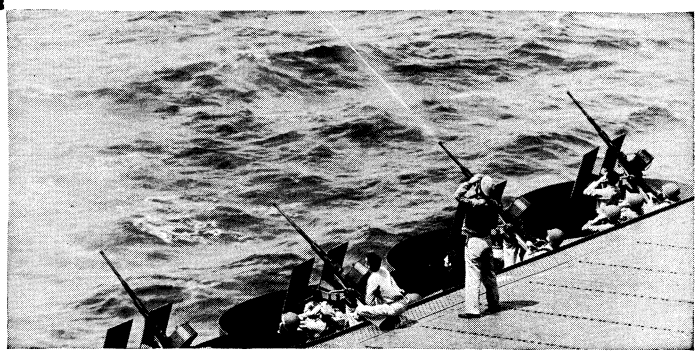
The director itself is a master gun sight for all the guns in its battery. The director is trained continuously on the target, giving the line-of-sight bearing and elevation. These, and the distance to the target as given by the range-determining equipment, are fed directly to the computer. Other information sent to the computer includes: firing ship's motion with respect to the horizontal plane, from a stable element; firing ship's course and speed; surface wind velocity, projectile muzzle velocity loss through gun erosion and powder temperature; time; and certain other nonstandard variables such as air density and unavoidable errors in calculations. These data are combined by the computer and result



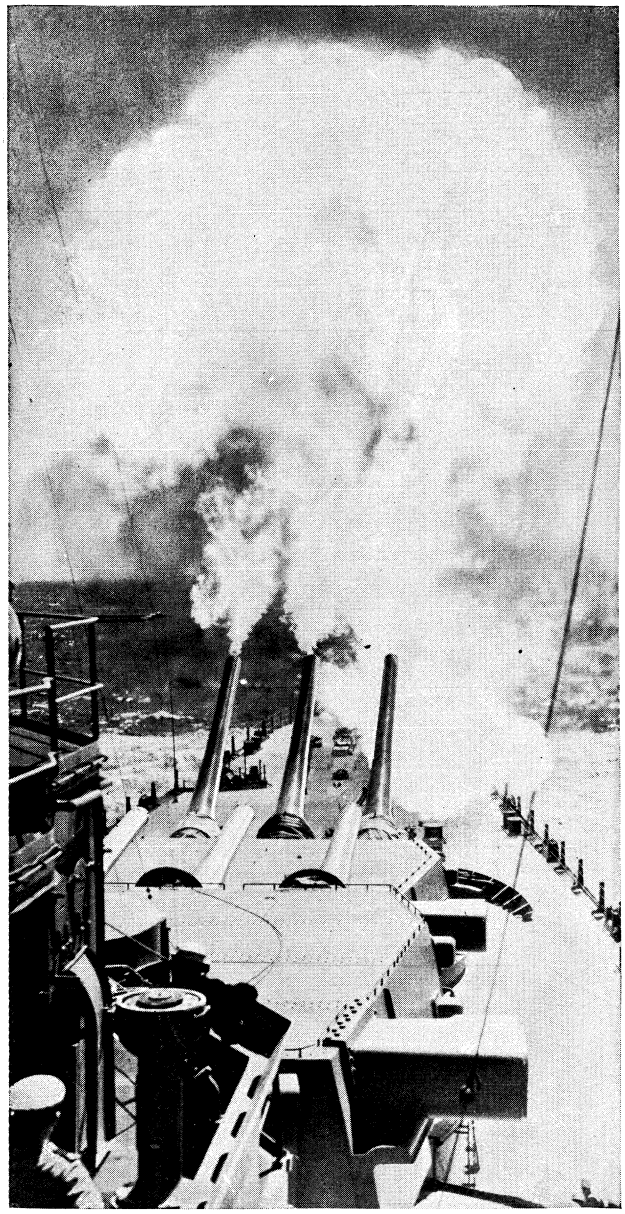
Forward turrets of H.M.S. "Duke of York," with 14-in. guns



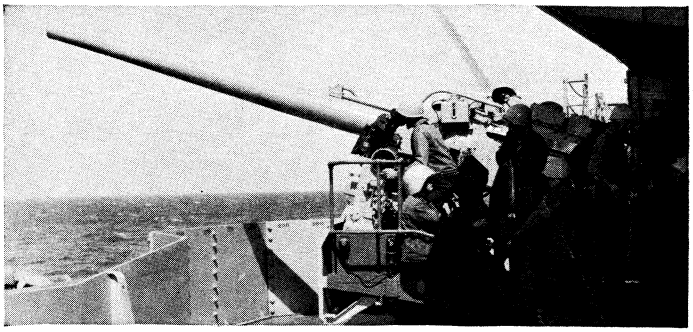
A salvo from the 15-in. guns of the British battle cruiser "Repulse," sunk Dec. 10, 1941, off Malaya



Firing incendiary tracer shells from 20-mm. antiaircraft guns on the flight deck of a U.S. aircraft carrier



Firing 16-in. guns of the number one turret of the U.S.S. "North Carolina"



Manning 5-in. gun mount on the U.S.S. "Tarawa"

A 40-mm. gun of the U.S.S. "Rochester"

NAVAL ORDNANCE

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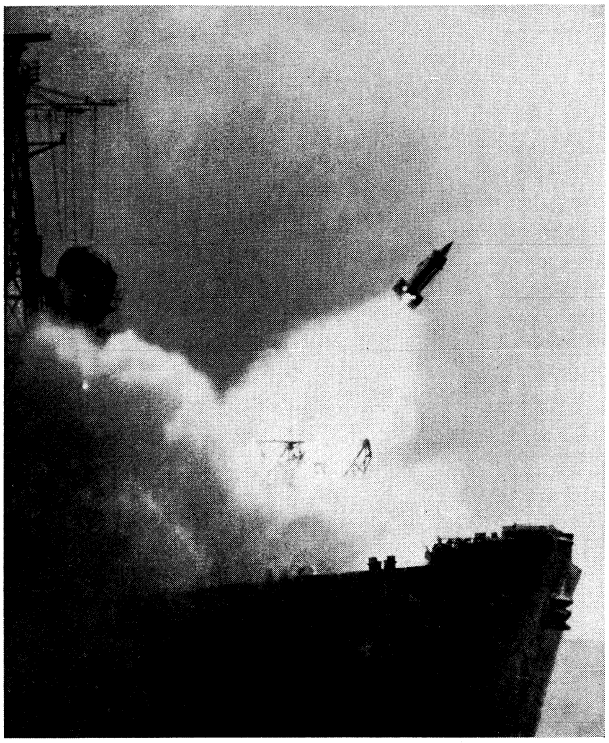
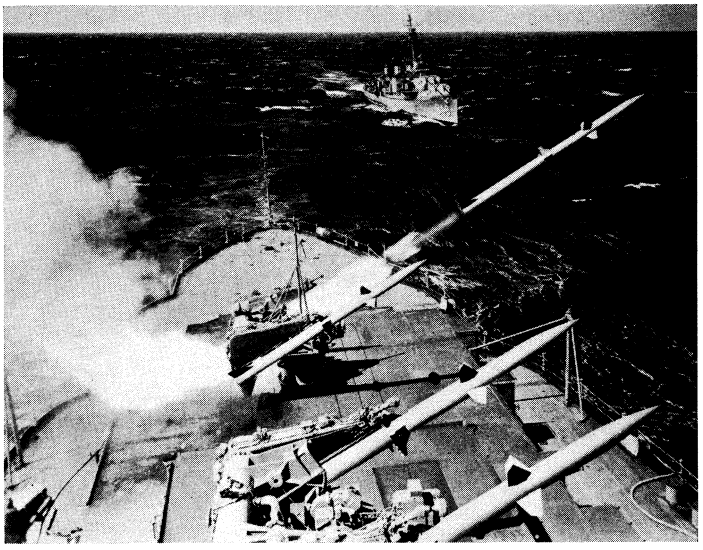
GUNNERY, NAVAL

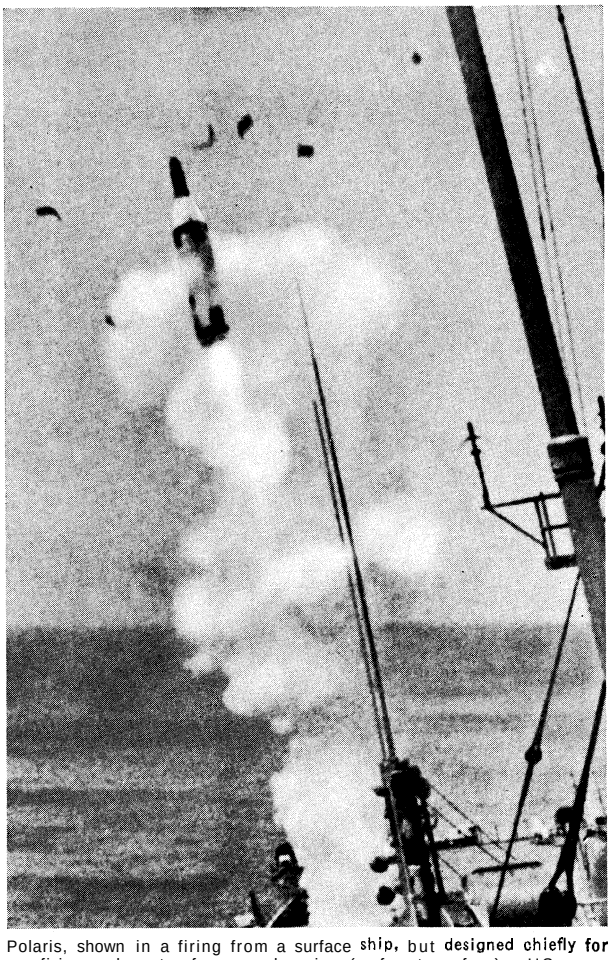


Sea Slug, surface-to-air missile of the British Royal navy

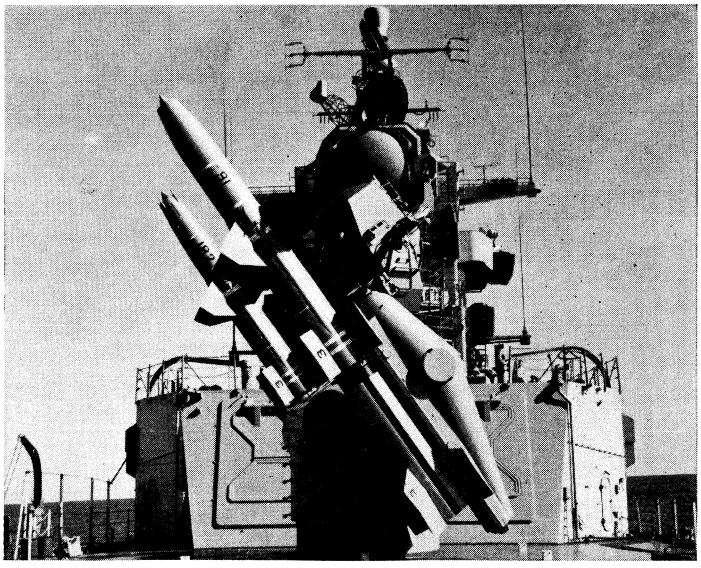
Regulus I, the first operational attack missile of the U.S. navy; surface-to-air type



Terrier, surface-to-air missile. U.S. navy



Polaris, shown in a firing from a surface ship, but designed chiefly for use firing underwater from a submarine (surface-to-surface) ; U.S. navy



Talos installation aboard a guided missile cruiser; surface-to-air, U.S. navy

NAVAL MISSILES

BY COURTESY OF (TOP RIGHT, CENTRE RIGHT. BOTTOM LEFT, BOTTOM RIGHT) U.S. NAVY: OFFICIAL PHOTOS; PHOTOGRAPH, (TOP LEFT) UNITED PRESS INTERNATIONAL

in a continuous output of the following: present target range and bearing; advance range, used in setting gun sights; gun and elevation orders to position the guns; and fuze orders or time of flight. (*See* SIGHTS, GUN.)

In earlier director systems, train and elevation orders were sent by electrical connections to indicators on the guns. The gun layers kept the gun trained and elevated by keeping pointers on the guns in coincidence with the director indications. Firing took place at a predetermined point of the ship's roll. In later director systems, the guns were trained and elevated automatically, and stabilizing devices discounted the roll and pitch of the firing ship. Antiaircraft fire presents a quite different problem. The antiaircraft battery must cope with high-speed targets that may attack from several directions simultaneously. To achieve the necessary flexibility, the battery is divided into four groups, each capable of independent operation in its own sector, or of combining with an adjacent group to defend a sector common to both. Each group has its own director system, and in cases where two groups fire together, one director handles the fire control problem for both groups.

The introduction of radar changed naval gunnery drastically. It permitted the automatic tracking of targets and accurate firing under adverse conditions. The effective range of large guns formerly had been limited to the visible range; haze, fog, smoke or darkness sometimes reduced this range to a few hundred yards. Radar not only permitted the ranging of targets under conditions of poor or limited visibility, but allowed effective firing at them. Battle ranges often exceeded 25,000 yd.

The introduction of high-speed aircraft and bombs with a large destructive radius also introduced new problems. It became necessary to destroy the most dangerous, not necessarily the nearest, target first. This destruction had to be accomplished quickly before the target could arrive at a position, such as the bomb release point, where it could damage the ship. This involved early detection of the target, rapid determination of the firing data and fast. accurate firing.

Before the end of World War II, it had become apparent that self-propelled, guided missiles were necessary to cope with the increased speed of aircraft. By the early 1950s, all major naval powers had operational antiaircraft missiles available for use in their fleets. These missiles were capable of rapid launching, of receiving post-launching guidance during the intermediate part of their flight and of automatically seeking the target at long range. Some of these antiaircraft or antimissile missiles were capable of destruction of the target at ranges up to 65 mi. from the launching ship. The use of such missiles combined with nuclear warheads seemed to be the answer to the problem of improving the range, accuracy and destructive effect of naval weapons. *See* MISSILES; ROCKETS.

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(R. L. NE.; H. J. SL.)

GUNPOWDER (BLACK POWDER), generic names applied originally to a mechanical mixture of saltpetre (potassium nitrate), charcoal (carbon) and sulfur. Gunpowder is the older and more commonly used term but black powder is preferred in military circles in the United States. Prepared in approximately the correct proportions (74.6% saltpetre, 13.5% charcoal, 11.9% sulfur) it will, when ignited, burn rapidly and evolve a large volume of whitish gas. In a confined space this pent-up gas can be used for blasting or for propelling missiles. Black powder is a low explosive rather than a high explosive like TNT. It is easily ignited and is nidely used for primers, fuzes and blank fire charges in military ammunition. See AMMUNITION, ARTILLERY.

History. — Discovery of black powder and its adaptation to firearms marks one of the most important events in the history of civilization. The blasting power of black powder enabled men to do work that had formerly required brute force, and its use to propel missiles gave civilized men ascendancy over barbarians. On the other hand the introduction of siege artillery toward the end of the middle ages diminished the defensive value of feudal castles and other fortifications. Black powder was the sole explosive material available for about 600 years, from the time of its discovery to mid-19th century when nitroglycerin and nitrocellulose were discovered.

There is no certainty as to the actual date of the invention of black powder, but early experiments with such materials as oil, pitch, sulfur and other ingredients were all steps on the road to its discovery. These predecessors were of a sticky nature; they not only adhered to objects they hit, but their fire was difficult to extinguish, especially with water. Best known of these mixtures was Greek fire (*q.v.*), long a terror to the enemies of the ancient Byzantine empire.

There is some evidence that the Chinese possessed black powder in ancient times, but the evidence is not conclusive. It may be significant that saltpetre (or nitre), an essential ingredient of black powder. was mentioned for the first time in the writings of the Arabian Abd Allah, about A.D. 1200. Nevertheless, it may have been used in rockets or in "Roman candles" in the 10th century or even earlier.

Among the many claimants of the honour of discovering black powder are Chinese, Hindus, Greeks, Arabs, English (Roger Bacon) and Germans (Berthold Schwarz). The subject attained greater prominence when the first guns were invented to utilize black powder as a propellanf, early in the 14th century. The actual loading of the powder into cannon required considerable artistry to get uniform and maximum results, and therefore good gunners were in great demand. There had to be just the right density of loading for optimum propagation of the flame, since burning occurs mostly on exposed powder surfaces. (*See* ARTILLERY.) Other applications followed slowly. For example, no record is found of the use of black powder for blasting for nearly 300 years.

The original powdered form of black powder burned too rapidly and generated high pressures that often caused guns to burst. Successive steps to develop slower burning material that would create less extreme and longer lasting pressures include "corning" (pressing into grains of specific sizes and shapes) and the use of undercharred carbonaceous material. These developments are described more fully below.

Early Manufacture. — The preparation of black powder from solid ingredients requires fine particle sizes for uniform mixing and blending of the saltpetre, carbon and sulfur. In the earliest processes these were combined by simple mortar-and-pestle methods, often with improvised equipment — even to the point of using hollowed-out logs as mortars.

A little later methods were devised to raise the pestle mechanically. using horse or water power, and to drop it by the automatic tripping of a trigger. These rather violent blows increased the danger of spontaneous fires and explosions, so these "stamp mills" were banned in some quarters (notably England, in 1772).

One of the main problems at first was to secure sufficiently pure ingredients, especially important being the purity of the saltpetre. This material is found in many parts of India and in Spain and southern Andalusia. Various means of developing it from other sources, such as the decomposition of organic matter, were devised by governments of most European countries. Near the end of the 19th century the discovery in Chile of huge deposits of sodium nitrate (Chilean saltpetre), which could readily be converted to potassium nitrate by treatment with potassium chloride, improved the world supply situation.

As the powdered form of black powder burned too rapidly, 15th-century powder makers introduced a process for corning or graining the powder. The mixture of ingredients was moistened while being pounded in the pestle, using various fluids such as alcohol and urine. The paste so formed was beaten into a more or less coherent cake under the action of the pestle, then removed and broken into chunks. These chunks were broken down into smaller particles by agitation with metal balls in the mass; the resulting particles were "classified" by passing through various meshes of sieve. The final "grains" were irregular in shape and left ample space for the passage of flame throughout the charge. Particles of different sizes were readily adapted to varying sizes of cannon

to furnish burning rates that were effective ballistically but did not create excessive pressures.

As elongated projectiles replaced round balls and rifling of gun tubes was adopted to rotate and stabilize the projectile, ordnance specialists searched for slower burning propellants. Capt. (later Brig Gen.) Thomas J. Rodman, of the U.S. army, conducted many experiments in the 1850s and finally came up with grains of controlled shape and size. The shape was hexagonal with a number of perforations parallel to the edges. These perforations provided expanding burning surfaces, thus promoting progressive burning rates as the projectile traveled down the bore of the gun. These grains could be made in various sizes, by pressing the ordinary black ponder particles into specially designed dies.

For even slower burning in heavy ordnance, brown or "cocoa" ponder nas introduced in the late 19th century. Here the carbonaceous material was prepared from rye straw and was undercharred. For dependable burning the saltpetre content was increased from 75% to 80% and the sulfur reduced to 3%. This powder, made in the prism form devised by Rodman, proved to be the best evolved. With it the U.S. navy fought the Spanish-American War (1898) but that was the last great conflict in which black powder played an important role as a propellant.

Modern Manufacture. — Black powder is manufactured by pulverizing charcoal and sulfur together in a ball mill, whereby some of the sulfur is incorporated or worked into the cellular openings of the charcoal. The dampened material is mixed with finely ground nitrate and the moisture content is adjusted to approximately 4%. About 300 lb of the mixture is placed in a wheel mill having tno wheels, each 18 in. wide and weighing 8 or 10 tons. The milling operation, which is continued for 3 to 6 hours. increases the degree of incorporation.

The milled material is then pressed into cakes. using a pressure of approximately 6,000 p.s.i. The cake is broken up by means of adjustable rolls nith corrugated surfaces. The several rolls in the corning mill reduce the material to the desired grain size. Passage of the material over shaker screens removes dust and fines, which are returned to the wheel mill. The coarse material is passed through the rolls a second time and is rescreened.

In the blending house, the screened material is tumbled for about 8 hours in a rotating drum of hardwood. Because of friction the powder is heated to as much as 6j° C. and any moisture present is removed by evaporation. If the powder is to be glazed. graphite is added to the contents of the drum after the moisture has been reduced to a certain point but before the powder is too dry. The dried powder is separated into standard granulations by sieving and then packed in metal drums holding 20 to 2j lb. Manufacture of black powder is hazardous because of the sensitivity of the material to ignition by spark: the separate operations are conducted by remote control in widely spaced buildings. The corning mill operation is considered the most hazardous.

Properties and Variations. — The early composition of black powder saw little change in the proportions of ingredients for 400 years or more. Since then, however. the properties, and especially the burning rate. have been altered for various uses by changing the percentage of saltpetre, using different types of wood to make the charcoal, substituting powdered coal for the charcoal and substituting sodium nitrate for the saltpetre. The original material is no longer used as a propellant but still finds valuable application as an igniting medium. In an artillery shell. for example, it apparently projects almost an optimum mixture of hot gases and incandescent solid particles onto the surface of the propellant grains. In the absence of moisture, black ponder is quite stable chemically, its ingredients being essentially nonreactive with each other even at 120° C. Presence of moisture causes black powder to react with some metals such as steel, brass and copper. The high degree of accidental explosion hazard is attributable to its great sensitivity to ignition by flame, incandescent particles or electric spark.

In addition to use as an igniting material, black powder (with variations in compositions as described above) finds useful application in time fuzes, saluting charges. squibs, smoke-puff charges, "spotting" charges for practice bombs and, of course, many commercial applications such as fireworks and signals. For blasting purposes it is still employed in large quantities and is especially effective where a relatively slow "push" is required to avoid excessive break-up of the material being excavated. This property would be ideal for coal mining except for the fact that the resultant flames cannot be tolerated because of flammable gases present in many mines.

One may wonder at the sudden demise of black powder as a propellant, for centuries its most dramatic use. The question is partly answered by the terminology of its replacement, "smokeless" powder. Nitrocellulose propellants burn more completely and thus produce less smoke. because both the fuel (carbon and hydrogen) and the oxygen exist together in the same molecule. Furthermore, modern propellants deliver much more mechanical work per unit of weight, and from many weapons the undesirable muzzle flash can be prevented by addition of certain alkali metal salts (as K_2SO_4) or cooling agents (as dibutylphthalate) in the colloid. Curiously, the term "ponder" still is applied in some quarters to modern propellants, even though a single grain for rockets may have a diametre of many inches and a length measured in feet. Fortunately, the single word propellant is rapidly replacing the inaccurate terms gunpowder and smokeless powder.

Folloaing World War II the production rate of most types of black powder dropped off considerably as military requirements were reduced and substitute materials were utilized for special purpose application. For example, such metals as magnesium and aluminum. uith an oxidizer, give higher burning rates. much more heat energy and cleaner burning. Nevertheless, black powder has served mankind well for many centuries. It has acted as a most important tool and steppingstone in the rapid march toward the modern concept of civilization.

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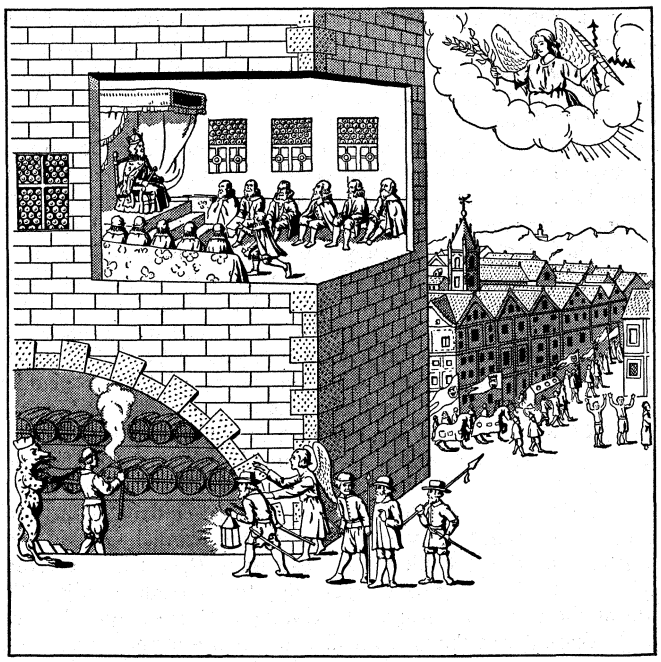
(B. E. AN.)

GUNPOWDER PLOT, the name given to a conspiracy for blowing up King James I and the parliament on Nov. 5, 1605. Organized as a reply to the anti-Roman Catholic laws, which: after a temporary relaxation, were being applied by James with renewed vigour, it originated at a meeting, probably in Jan. 1604. at a house in Lambeth. among Robert Catesby and his cousin Robert Winter and John Wright. Later: several other persons mere included in the plot, Winter's brother Thomas. Thomas Percy. John Grant. Ambrose Rokewood. Robert Keyes, Sir Everard Digby, Francis Treshani (a cousin of Catesby) and Catesby's servant Thomas Bates, all, with the exception of the last, being men of good family and all Roman Catholics. Father Greenway and Father Garnet, the Jesuits, mere both cognizant of the plot. Guy Fawkes was brought over from Flanders in 1604. In March 1605 a vault immediately under the house of lords was hired by Percy and 36 bbl. of gunpowder (amounting to about 1 ton 12 cwt.), concealed there under coal and faggots. The preparations were completed in May and the conspirators separated.

On Oct. 26 Lord Monteagle (a brother-in-law of Tresham), who had engaged in Romanist plots against the government, but who had given his support to the new king, was seated at supper at Haxton when the following letter was brought to him: "My lord, out of the love I bear to some of your friends, I have a care for your preservation. Therefore I would advise you, as you tender your life to devise some excuse to shift of your attendance of this Parliament, for God and man hath concurred to punish the wickedness of this time. And think not slightly of this advertisement, but retire yourself into your country. where you may expect the event in safety, for though there be no appearance of any stir, yet I say they shall receive a terrible blow, the Parliament. and yet they shall not see who hurts them. This counsel is not to be contemned, because it may do you good and can do you no harm, for the danger is past as soon as you have burnt the letter: and I



THE GUNPOWDER PLOT. 1605, AS REPRESENTED IN AN OLD PRINT

James I is seen opening parliament. Guy Fawkes stands below, at the entrance to the cellar, with lighted taper ready to fire the barrels of gunpowder. The Devil is at his side with bellows. An angel accompanies the discoverer of the plot, who is shown with lighted lantern. The scene is purely imaginative, since the plot was discovered two days before parliament opened

hope God will give you the grace to make good use of it, to whose holy protection I commend you."

The authorship of the letter has never been disclosed or proved, but all evidence seems to point to Tresham and to the probability that he had warned Monteagle and agreed with him as to the best means of making known the plot and preventing its execution; at the same time of giving the conspirators time to escape.

Monteagle at once showed the letter to Salisbury and other ministers, but the cellar under the house of lords was not searched until Nov. 4. The whole plot was then discovered; Fankes was arrested and tortured; Catesby and others fled into the country, rejoining each other in Warwickshire, as had been agreed in case the plot had been successful. Catesby with some others covered the distance of 80 mi. between London and his mother's house at Ashby St. Legers in eight hours. He informed his friends in Warwickshire of the failure of the plot, but succeeded in persuading Sir Everard Digby, by an unscrupulous falsehood, further to implicate himself in his hopeless cause by assuring him that both James and Salisbury were dead. They failed to rally any of the support that they had expected from the countryside. and their small party was run to earth by the sheriff at Hewell Grange on Nov. 8. Catesby, Percy and the two Wrights were killed, Winter and Rokewood wounded and taken prisoners with the men who still adhered to them. In all, eight of the conspirators including the two Winters, Digby, Fawkes. Rokewood, Keyes and Bates, were executed; Tresham died in the Tower. Of the priests involved. Garnet was tried and executed, Greenway and Gerard succeeded in escaping. The allegation that the whole affair was an *agent-provocateur's* plot for which Salisbury was responsible is regarded as baseless.

In England, the anniversary of the discovery of the Gunpowder plot is still celebrated on Guy Fawkes' day (Nov. 5) by bonfires, fireworks, and the carrying of "guys" through the streets.

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GUNTER, EDMUND (1581–1626), English mathematician, invented several useful measuring devices. Of Welsh extraction. he was born in Hertfordshire in 1581. He was educated at Westminster school, and in 1599 was elected a student of Christ Church, Oxford. He was professor of astronomy at Gresham college from 1619 until his death on Dec. 10, 1626. Descriptions of some of his inventions were given in his treatises on the sector, cross-staff, bow, quadrant and other instruments. In 1620 he published his Canon *triangulorum*. There is reason to believe that Gunter was the first to discover (in 1622 or 1625) that the magnetic declination at one place varies (see GEOMAGNETISM). He introduced the words cosine and cotangent (see TRIGONOMETRY). and he suggested to Henry Briggs. his friend and colleague, the use of the arithmetical complement (see Briggs. *Arithmetica logarithmica,* ch. xv, and LOGARITHMS).

His practical inventions included Gunter's chain, the chain in common use for surveying. 22 yd. long and divided into 100 links; Gunter's line, a logarithmic line! the forerunner of the slide rule; Gunter's quadrant. used to find the hour of the day, the sun's azimuth, etc., and also to take the altitude of an object in degrees; and Gunter's scale, generally called by seamen the gunter, a large plane scale engraved with various lines of numbers and used to solve problems in navigation, trigonometry, etc., with the aid of a pair of compasses. (O. OE.)

GÜNTHER, (FRANZ) IGNAZ (1725–1775). German sculptor who specialized in the carving of great altarpieces in wood, full of rococo fantasy, vivacity and imagination, was born Nov. 22, 1725, in Altmannstein in the Gpper Palatinate. At first a pupil of his father, he went to Munich in 1743 and studied for seven years under J. B. Straub. As an independent master he worked in the tradition of wooden altar art of south Germany. In his later period signs of neoclassicism, beginning in the altar at Starnberg (1766–68), are to be seen. An extraordinary number of his works survive in south Germany, notably at Freising. Munich, Nenningen in Württemberg (late style) and Ingolstadt. Günther died in Munich on June 26. 1775. (A. K. McC.)

GÜNTHER, JOHANN CHRISTIAN (1695–1723). German poet, was born at Striegau, Lower Silesia, on April 8, 1695. In 1717 he went to Leipzig and was befriended by J. B. Mencke (1674–1732). A recommendation from Mencke to Frederick Augustus II of Saxony, king of Poland, proved worse than useless, as Giinther appeared at the audience drunk. He died at Jena, March 15, 1723. Goethe pronounces Gunther a poet in the fullest sense of the term. His lyric poems reveal fine imagination, clever wit and a true ear for melody and rhythm; but duil or vulgar witticisms are frequently found side by side with the purest inspirations of his genius.

Gunther's collected poems were published in 4 vol. (1723–35). They are also included in vol. vi. of Tittmann's *Deutsche Dichter des 17ten Jahrh.* (1874) and vol. xxxviii. of Kürschner's *Deutsche Nationalliteratur* (1883). *A* life by Siehrand appeared in 1738.

GÜNTHER OF SCHWARZBURG (1304–1349), German king, was a descendant of the counts of Schwarzburg and the younger son of Henry VII, count of Blankenburg. He was elected German king at Frankfort (Jan. 30, 1349) by four of the electors, partisans of the house of Wittelsbach and opponents of Charles of Luxemburg, afterward Charles IV. Charles defeated him at Eltville, and Giinther renounced his claims for 20,000 marks of silver. He died three weeks later at Frankfort.

GUNTRAM or GONTRAN (561–592), king of Burgundy, was a son of Clotaire I. On the death of his father (561) he and three brothers divided the Frankish realm. Guntram received as his share the valleys of the Saône and Rhône, together with Berry and the town of Orléans, which he made his capital. On the death of Charibert (567). he obtained the cioitates of Saintes. Angoulême and Périgueux. During the civil war between the kings of Neustria and Austrasia, he sought to maintain equilibrium. After the assassination of Sigebert (575), he took the youthful Childebert II under his protection. After the death of Chilperic (584) he protected the young Clotaire II, and prevented Childebert from seizing his dominions. The danger to the Frankish realm caused by the expedition of Gundobald (585), and the anxiety which was caused him by the revolts of the great lords in Xustrasia finally decided him in favour of Childebert. He adopted him as his son and recognized him as his heir at the treaty of Andelot (587). Guntram died in 592, and Childebert received his inheritance.

GUNTUR, city and district in Andhra Pradesh, India. The city (pop. [1961] 187,068) is 20 mi. S.W. of Bezwada, east of the Kondavid hills. Guntur appears to have been founded in the 18th century by the French. At the time of the cession of the Circars to the English in 1765, it was exempted during the life of Basalat Jang. whose personal *jagir* it was. In 1788 it came into British possession. the cession being confirmed in 1823. It has cotton factories, tobacco factories and oil and rice mills.

GUNTUR DISTRICT, constituted in 1904 from territory till then divided between Kistna and Nellore, has an area of 5.795 sq.mi.; pop. (1961) 3,009,997. It is bounded east and north by the Kistna river; in the west, part of the boundary is formed by the Gundlakamma river. Most of it is a fertile plain irrigated by canals from the Kistna, producing cotton, rice and other crops.

GURDASPUR, a municipality and district in the Jullundur division of Punjab, India. The town is 9 mi. S.E. of the West Pakistan frontier; pop. (1951) 22.677. It has a fort (now a Brahman monastery) which was famous for the siege it sustained in 1712 from the Moguls.

GURDASPUR DISTRICT (pop [1961] 984,152), has an area of 1.363 sq.mi., 480 sq.mi. having been allotted to Pakistan at the 1947 partition. Pathankot (pop.. 1951. 23,108), the neighbouring villages in the plain and all the hill country of Gurdaspur district, formed part of the area ceded by the Sikhs to the British after the first Sikh war in 1846. The largest town and chief commercial centre is Batala (55,850). There are woolen mills at Dhariwal, and the district exports cotton! sugar: grain and oilseeds.

GURGAN (GORGAN), formerly Xsterabad, a town of Mazandaran ostan (province), Iran, lies on a small tributary of the Kara Su, 23 mi. from the Caspian sea, at the foot of a steep wooded spur of the Elburz mountains. The population (1956) 28.525, has nearly trebled since 1900. Most of the houses are built of baked bricks, with tilted and tiled roofs, because of the frequent rains. Occupying a commercially and strategically important position, the town dates back to remote antiquity. Its surroundings are dotted with mounds or *tappeh,* the remains of Neolithic and Bronze Age settlements. During the disorders in Persia in the 18th century, Xsterabad was frequently ravaged but was reinforced by the Kajar dynasty. It was renamed Gurgan in the 1930s. The chief articles of trade are cotton; rice, wheat, salt, sesame oil, soap and carpets; trade was favourably affected by the trans-Iranian railway which ends at the nearby port of Bandar Shah.

The former province of Gurgan-Xsterabad had long suffered from the inroads of the Turkoman tribes who occupied the plain north of the Kara Su. In modern times this plain was settled by the tribesmen and turned into a flourishing granary. (H. Bo.)

GURGAON, a municipality and district in the Ambala division of Punjab, India. The town (pop., 1951, 18,613) is 17 mi. S.W. of Delhi.

GURGAON DISTRICT has an area of 2,368 sq.mi. It comprises the southernmost corner of Punjab state. Salt is processed and mineral products are iron ore, copper ore, plumbago and ochre. In 1803 Gurgaon district passed to the British. On the outbreak of the mutiny in 1857, the nawab of Farukhnagar rose in rebellion. After the fall of the rebel capital, the territory of the nawab was confiscated. Pop. (1961) 1,238,128. The chief trade centre is Rewari (pop., 1951, 34,082); trade is in cereals, and hardware.

The former principality of Pataudi (53 sq.mi.) was incorporated into the district in 1948.

GURKHA, the ruling Hindu caste in Nepal (*q.v.*). Courageous, faithful and self-reliant, they make excellent riflemen, at their best in hill warfare.

GURKB, VASILI (1864–1937), Russian general, was born in 1864. He was educated in the corps of pages, and in 1885 was given a commission in the Grodno Hussar regiment. In 1911 he was chief of the 1st cavalry division, which in Xug. 1914 advanced into eastern Prussia. In 1915 he was commander of the VI corps. At the end of 1917, during Gen. Mikhail Alexeyev's illness, he fulfilled the duties of chief of staff. Later, after the revolution, he was dismissed by Alexander Kerensky, because of his objections to risking an offensive with the army in a ferment, and of his outspoken opinions as to the causes of this condition. Gurko was imprisoned, released, imprisoned again and finally exiled.

GURNARD (Trigla), a genus of fishes forming a group of the family Triglidae, recognized by the three first fin rays of the pectoral fin being detached to form movable fingerlike appendages, serving as organs of touch and of locomotion along the bottom, and by their large, angular, bony head. Gurnards are coast fishes, generally distributed over the tropical and temperate areas. Although never found far from the coast, gurnards descend to several hundred fathoms; they are caught chiefly by the trawl. In young fishes, the pectorals are comparatively longer than in the adult, extending to the end of the body. These fins are beautifully coloured, especially in the young. When taken out of the water, gurnards emit a grunting noise produced by the vibrations of a perforated diaphragm across the cavity of the air bladder. Their flesh is white, firm and wholesome.

GURNEY, the name of an English family of bankers and merchants. In 1770 the brothers JOHN and HENRY GURNEY founded a banking house at Norwich, the business passing in direct line to SAMUEL GURNEY (1786–1856), who assumed control of the bank in 1809. At approximately the same time Samuel Gurney took over the control of the bill broker business of Richardson. Overend and Co., a London firm devoted entirely to the trade in bills. The title of the firm was changed to Overend, Gurney and Co., and for 40 years it was the greatest discount house in the world. The firm was known as "the banker's banker" and competed effectively with the Bank of England. In 1866, Overend, Gurney and Co., by then a joint stock company, suspended payment with liabilities amounting to £11,000,000. (J. R. LT.)

GUSTAVO A. MADERO, a town in Mexico's federal district whose name was changed from Guadalupe Hidalgo on Dec. 22, 1931. to honour the brother of Francisco Indalecio Madero (*q.v.*), revolutionary hero and former president of Mexico. Named the Villa de Guadalupe by royal decree in the 18th century for the Virgin of Guadalupe, the town became Guadalupe Hidalgo on Feb. 12, 1828, to honour Miguel Hidalgo y Costilla, hero of Mexican independence. (H. R. HY.)

GUSTAVUS I ERIKSSON (1496–1560), king of Sweden, was born at Lindholm on Ascension Day, 1496. His family was conspicuous in 15th century politics. Gustavus' youthful experiences gave him a lifelong distrust of everything Danish — strengthened by the fact that in 1516 King Christian, to whom he had been sent as a hostage, treacherously carried him prisoner to Denmark. Detained for 12 months in the island fortress of Kalö, he contrived to escape to Lubeck in Sept. 1519. On May 20, 1520, he chartered a ship to Kalmar, one of the few Swedish fortresses which held out against Christian II. While hunting near Lake Mälar, news of the Stockholm massacre was brought to him. Gustavus appealed to the sturdy yeomen of the dales, and finally drove the Danes out of Sweden (1521–23). After his coronation on June 6, 1523, order had to be evolved from the chaos in which Sweden had been plunged by the disruption of the union. The shortest way was to restore the royal authority, which had been in abeyance during 90 years. But an effective reforming monarchy must stand upon a sound financial basis; and the usual revenues of the crown were so diminished that they did not cover half the daily expenses of government. New taxes could only be imposed with extreme caution. The lack of capable, trustworthy administrators threw the burden of government on the shoulders of the young king. His time was taken up in traveling about the kingdom and doing purely clerical work for want of competent assistance. This lack of native talent compelled Gustavus to employ the services of foreign adventurers like Berent von Mehlen, John von Hoja, Konrad von Pyhy and others. Gustavus had constantly to watch the Swedish peasantry; he put down four rebellions between 1525 and 1542, but the strain upon his resources was damaging, and more than once he was on the point of abdicating.

He was compelled (1534–36) to take part in *Grevens* fejde (Counts' War) (see DENMARK: *History*), as the ally of Christian III, but his exaggerated distrust of the Danes was invincible. A fresh cause of dispute was generated in 1548, when Christian III's daughter was wedded to Duke Augustus of Saxony. On that occa-

sion, apparently by way of protest against the decree of the diet of Vesterås (Jan. 15, 1544), declaring the Swedish crown hereditary in Gustavus's family, the Danish king caused to be quartered on his daughter's shield not only the three Danish lions and the Norwegian lion with the axe of St. Olaf, but also "the three crowns" of Sweden. Gustavus, naturally suspicious, was perturbed by the innovation, and warned all his border officials to be watchful. In 1557 he even wrote a letter of protest to the Danish king, but Christian III. replied that "the three crowns" signified not Sweden in especial, but the three Scandinavian kingdoms, and that their insertion in the Danish shield was only reminiscent of the union of Kalmar. But Gustavus was not satisfied, and this was the beginning of "the three crowns" dispute which did so much damage to both kingdoms.

The rupture of Gustavus with the Holy See was a purely political act, as Gustavus, personally, had no strong dogmatic convictions. He not unnaturally expressed his amazement when Olavus Petri informed him that the pope was antichrist. He consulted the older and graver Laurentius Andreae, who told him how "Doctor Martinus had clipped the wings of the pope, the cardinals and the big bishops," which could not fail to be pleasing intelligence to a monarch who was never an admirer of episcopacy, while the rich revenues of the church were tempting to the impecunious ruler of an impoverished people. When the Protestant hierarchy was forcibly established in Sweden, matters were much complicated by the absolutist tendencies of Gustavus. The incessant labour, the constant anxiety, which were the daily portion of Gustavus Vasa during the 37 years of his reign, told at last even upon his magnificent constitution. In the spring of 1560, conscious of a decline of his powers, Gustavus summoned his last diet, to give an account of his stewardship. On June 16, 1560 the assembly met at Stockholm. Ten days later, supported by his sons, Gustavus greeted the estates in the great hall of the palace, when he took a retrospect of his reign. Four days later the diet passed a resolution confirming the hereditary right of Gustavus's son, Prince Eric, to the throne. The old king's last anxieties were now over and he could die in peace. He expired on Sept. 29, 1560.

Gustavus was thrice married. His first wife, Catherine, daughter of Magnus I, duke of Saxe-Lauenburg, bore him in 1533 his eldest son Eric. This union was neither long nor happy, but the blame for its infelicity is generally attributed to the lady, whose abnormal character was reflected and accentuated in her son. Much more fortunate was Gustavus's second marriage with his own countrywoman, Margaret Lejonhufvud, who bore him five sons and five daughters, of whom three sons, John, Magnus and Charles, and one daughter, Cecilia, survived their childhood. Queen Margaret died in 1551; and a twelvemonth later Gustavus wedded her niece, Catharine Stenbock, a handsome girl of 16, who survived him more than 60 years.

Gustavus's outward appearance in the prime of life is thus described by a contemporary: "He was of the middle height, with a round head, light yellow hair, a fine long beard, sharp eyes, a ruddy countenance . . . and a body as fitly and well proportioned as any painter could have painted it." Learned he was not, but he had naturally bright and clear understanding, an unusually good memory, and a marvellous capacity for taking pains. He was also very devout, and his morals were irreproachable. On the other hand, Gustavus had his full share of the family failings of irritability and suspiciousness, the latter quality becoming almost morbid under the pressure of adverse circumstances. His energy too not infrequently degenerated into violence, and when crossed he was apt to be tyrannical.

See A. Alberg, *Gustavus Vasa and his Times* (London, 1882); R. N. Bain, *Scandinavia*, chaps. iii. and v. (Cambridge, 1905); P. B. Watson, *The Swedish Revolution under Gustavus Vasa* (London, 1889); O. Sjögren, *Gustaf Vasa* (Stockholm, 1896); C. M. Butler, *The Reformation in Sweden* (New York, 1883); *Sveriges Historia* (Stockholm, 1877–81); J. Weidling, *Schwedische Geschichte im Zeitalter der Reformation* (Gotha, 1882); M. Edén, *Om Centralregieringens Organisation 1823–94* (1899); A. Falk, *G. Wasas utrikes politik och dess company påhandeln* (1907).

(R. N. B.; X.)

GUSTAVUS II. ADOLPHUS (1594–1632), king of Sweden, the eldest son of Charles IX. and of Christina, daughter of Adolphus, duke of Holstein-Gottorp, was born at Stockholm castle on Dec. 9, 1594. From the first he was carefully nurtured to be the future prop of Protestantism by his austere parents. Gustavus was well grounded in the classics, and his linguistic accomplishments were extraordinary. He may be said to have grown up with two mother-tongues, Swedish and German; at twelve he had mastered Latin, Italian and Dutch; and he learnt subsequently to express himself in Spanish, Russian and Polish. But his practical father took care that he should grow up a prince, not a pedant. So early as his ninth year he was introduced to public life; at 13 he received petitions and conversed officially with the foreign ministers; at 15 he administered his duchy of Vestmanland and opened the Örebro diet with a speech from the throne; indeed from 1610 he may be regarded as his father's co-regent. In all martial and chivalrous accomplishments he was already an adept; and when, a year later, he succeeded to supreme power, his superior ability was as uncontested as it was incontestable.

The first act of the young king was to terminate the fratricidal struggle with Denmark by the peace of Knäred (Jan. 28, 1613). Simultaneously, another war, also an heritage from Charles IX., had been proceeding in the far distant regions round lakes Ilmen, Peipus and Ladoga, with Great Novgorod as its centre. It was not, however. like the Danish War, a national danger, but a political speculation meant to be remunerative and compensatory, and was concluded very advantageously for Sweden by the peace of Stolbova on Feb. 27, 1617 (see SWEDEN: *History*). By this peace Gustavus succeeded in excluding Muscovy from the Baltic. "I hope to God," he declared to the Stockholm diet in 1617. when he announced the conclusion of peace, "that the Russians will feel it a bit difficult to skip over *that* little brook." The war with Poland which Gustavus resumed in 1621 was a much more difficult affair. It began with an attack upon Riga as the first step towards conquering Livonia Riga was invested on Aug. 13 and surrendered on Sept. 15; on Oct. 3 Mitau was occupied; but so great were the ravages of sickness during the campaign that the Swedish army had to be reinforced by no fewer than 10,000 men A truce was thereupon roncluded and hostilities were suspended till the summer of 1625, in the course of which Gustavus took Kokenhusen and invaded Lithuania. In Jan. 1626 he attacked the Poles at Walhof and scattered the whole of their army after slaying a fifth part of it. This victory, remarkable besides as Gustavus's first pitched battle, completed the conquest of Livonia. As, however, it became every year more difficult to support an army in the Dvina district, Gustavus now resolved to transfer the war to the Prussian provinces of Poland with a view to securing the control of the Vistula, as he had already secured the control of the Dvina. At the end of 1626, the Swedish fleet, with 14,000 men on board, anchored in front of the chain of sand-dunes which separates the Frische-Haff from the Baltic. Pillau, the only Baltic port then accessible to ships of war, was at once occupied, and Konigsberg shortly afterwards was scared into an unconditional neutrality. July was passed in conquering the bishopric of Ermeland The surrender of Elbing and Marienburg placed Gustavus in possession of the fertile and easily defensible delta of the Vistula, which he treated as a permanent conquest, making Axel Oxenstjerna its first governor-general. Communications between Danzig and the sea were cut off by the erection of the first of Gustavus's famous entrenched camps at Dirschau. From the end of August 1626 the city was blockaded, and in the meantime Polish irregulars, under the capable Stanislaus Koniecpolski, began to harass the Swedes. But the object of the campaign. a convenient basis of operations, was won; and in October the king departed to Sweden to get reinforcements He returned in May 1627 with 7,000 men. which raised his forces to 14,000 against which Koniecpolski could only oppose 9,000. But his superior strategy frustrated all the efforts of the Swedish king, who in the course of the year was twice dangerously wounded and so disabled that he could never wear armour again. Gustavus had made extensive preparations for the ensuing campaign and took the field with 32,000 men But once again, though far outnumbered, and unsupported by his own government, the Polish grand-hetman proved more than a match for Gustavus, who, on Sept. 10, broke up his camp and returned to

Prussia; the whole autumn campaign had proved a failure and cost him 5,000 men. During the ensuing campaign of 1629 Gustavus had to contend against the combined forces of Koniecpolski and 10,000 of Wallenstein's mercenaries. The Polish commander now showed the Swedes what he could do with adequate forces. At Stuhm, on June 29, he defeated Gustavus, who lost most of his artillery and narrowly escaped capture. The result of the campaign was the conclusion of the six years' truce of Altmark, which was very advantageous to Sweden.

And now Gustavus turned his attention to Germany. The motives which induced the Swedish king to intervene directly in the Thirty Tears' War are told us by himself in his correspondence with Oxenstjerna. Here he says plainly that it was the fear lest the emperor should acquire the Baltic ports and proceed to build up a sea-power dangerous to Scandinavia. For the same reason, the king rejected the chancellor's alternative of waging a simply defensive war against the emperor by means of the fleet, with Stralsund as his base. He was convinced by the experience of Christian IV. of Denmark that the enemies' harbours could be wrested from them only by a successful offensive war on land; and, while quite alive to the risks of such an enterprise in the face of two large armies, Tilly's and Wallenstein's, each of them larger than his own, he argued that the vast extent of territory and the numerous garrisons which the enemy was obliged to maintain, more than neutralized his numerical superiority. Merely to blockade all the German ports with the Swedish fleet was equally impossible. The Swedish fleet was too weak for that; it would be safer to take and fortify the pick of them. In Germany itself, if he once got the upper hand, he would not find himself without resources. It is no enthusiastic crusader, but an anxious and far-seeing if somewhat speculative statesman who thus opens his mind to us. No doubt religious considerations largely influenced Gustavus. He had the deepest sympathy for his fellow-Protestants in Germany; he regarded them as God's peculiar people, himself as their divinely appointed deliverer. But his first duty was to Sweden; and, naturally and rightly, he viewed the whole business from a predominantly Swedish point of view. Lutherans and Calvinists were to be delivered from a "soul-crushing tyranny"; but they were to be delivered by a foreign if friendly power; and that power claimed as her reward the hegemony of Protestant Europe and all the political privileges belonging to that exalted position.

On May 19, 1630 Gustavus solemnly took leave of the estates of the realm assembled at Stockholm. He appeared before them holding in his arms his only child and heiress, the little princess Christina, then in her fourth year, and tenderly committed her to the care of his loyal and devoted people. Then he solemnly took the estates to witness, as he stood there "in the sight of the Almighty," that he had begun hostilities "out of no lust for war, as many will certainly devise and imagine," but in self-defence and to deliver his fellow-Christians from oppression. On June 7, 1630 the Swedish fleet set sail, and two days after midsummer day, the whole army, 16,000 strong, was disembarked at Peenemiinde. Gustavus's plan was to take possession of the mouths of the Oder Haff, and, resting upon Stralsund in the west and Prussia in the east, penetrate into Germany. In those days rivers were what railways now are, the great military routes; and Gustavus's German war was a war waged along river lines. The opening campaign was to be fought along the line of the Oder. Stettin, the capital of Pomerania, and the key of the Oder line, was occupied and converted into a first-class fortress. He then proceeded to clear Pomerania of the piebald imperial host composed of every nationality under heaven, and officered by Italians, Irishmen, Czechs, Croats, Danes, Spaniards and Walloons. Gustavus's army has often been described by German historians as an army of foreign invaders; in reality it was far more truly Teutonic than the official defenders of Germany at that period. Gustavus's political difficulties (see SWEDEN: History) chained him to his camp for the remainder of the year. But the dismissal of Wallenstein and the declaration in Gustavus's favour of Magdeburg, the greatest city in the Lower Saxon Circle, and strategically the strongest fortress of north Germany, encouraged him to advance boldly. But first, honour as well as expediency moved him to attempt to relieve Magdeburg, now closely invested by the imperialists, especially as his hands had now been considerably strengthened by a definite alliance with France (treaty of Bärwalde, Jan. 13, 1631). Magdeburg, therefore. became the focus of the whole campaign of 1631; but the obstructive timidity of the electors of Brandenburg and Saxony threw insuperable obstacles in his way, and, on the very day uhen John George I. of Saxony closed his gates against Gustavus the most populous and prosperous city in north Germany became a heap of smoking ruins (May 20). Gustavus. still too weak to meet the foe, entrenched himself at Werben, at the confluence of the Havel and Elbe. Only on Sept. 12 did the elector of Saxony, alarmed for the safety of his own states, now invaded by the emperor, place himself absolutely at the disposal of Gustavus; and, five days later, at the head of the combined Swedish-Saxon army, though the Swedes did all the fighting, Gustavus routed Tilly at the famous battle of Breitenfeld, north of Leipzig.

The question now was. In what way should Gustavus utilize his advantage? Should he invade the Austrian crown lands, and dictate peace to Ferdinand II. at the gates of Vienna? Or should he pursue Tilly westwards and crush the league at its own hearth and home? Oxenstjerna was for the first alternative; Gustavus decided in favour of the second. His decision has been greatly blamed. More than one modern historian has argued that if Gustavus had done in 1631 what Napoleon did in 1805 and 1809, there would have been a fifteen instead of a thirty years' war. But it should be borne in mind that, in the days of Gustavus. Vienna was by no means so essential to the existence of the Habsburg monarchy as it was in the days of Napoleon; and even Gustavus could not allow so dangerous an opponent as Tilly time to recover himself. Accordingly, he set out for the Rhine, taking Marienberg and Frankfort on his way, and on Dec. 20 entered Mainz, where he remained throughout the winter of 1631–32. At the beginning of 1632, in order to bring about the general peace ne so earnestly desired, he proposed to take the field with an overwhelming numerical majority. The signal for Gustavus to break up from the Rhine was the sudden advance of Tilly from behind the Danube. Gustavus pursued Tilly into Bavaria, forced the passage of the Danube at Donauuorth and the passage of the Lech, in the face of Tilly's strongly entrenched camp at Rain, and pursued the flying foe to the fortress of Ingolstadt where Tilly died of his wounds a fortnight later. Gustavus then liberated and garrisoned the long-oppressed Protestant cities of Augsburg and Ulm, and in May occupied Munich. The same week Wallenstein chased John George from Prague and manoeuvred the Saxons out of Bohemia. Then, armed as he was with plenipotentiary power, he offered the elector of Saxony peace on his own terms. Gustavus suddenly saw himself exposed to extreme peril. If Tilly had made John George such an offer as Wallenstein was now empowered to make. the elector would never have become Gustavus's ally; would he remain Gustavus's ally now? Hastily quitting his quarters in upper Swabia, Gustavus hastened towards Kuremberg on his way to Saxony. but finding that Wallenstein and Maximilian of Bavaria had united their forces, he abandoned the attempt to reach Saxony. and both armies confronted each other at Yuremberg which furnished Gustavus with a point of support of the first order He quickly converted the town into an entrenched and fortified camp. Wallenstein followed the king's example, and entrenched himself on the western bank of the Regnitz in a camp twelve English miles in circumference. His object was to pin Gustavus fast to Nuremberg and cut off his retreat northwards. Throughout July and August the two armies faced each other immovably. On Aug. 24 after an unsuccessful attempt to storm Alte Veste, the key of Wallenstein's position, the Swedish host retired southwards

Towards the end of October, Wallenstein, after devastating Saxony, was preparing to go into winter quarters at Lutzen, when the king surprised him as he was crossing the Rippach (Nov. 1) and a rearguard action favourable to the Swedes ensued. Indeed, but for nightfall, Wallenstein's scattered forces might have been routed. During the night, however, Wallenstein re-collected his host for a decisive action, and at daybreak on Nov. 6, while an autumn mist still lay over the field, the battle began. It was obviously Gustavus's plan to drive Wallenstein away from the Leip-

zig road, north of which he had posted himself, and thus, in case of success, to isolate, and subsequently, with the aid of the Saxons in the Elbe fortresses, annihilate him. The king, on the Swedish right wing, succeeded in driving the enemy from the trenches and capturing his cannon. What happened after that is mere conjecture, for a thick mist now obscured the autumn sun, and the battle became a colossal mêlée the details of which are indistinguishable. It was in the midst of that awful obscurity that Gustavus met his death—how or where is not absolutely certain; but it would seem that he lost his way in the darkness while leading the Småland horse to the assistance of his infantry, and was despatched by a hostile horseman as he lay severely wounded on the ground.

By his wife, Marie Eleonora, a sister of the elector of Brandenburg, whom he married in 1620, Gustavus Adolphus had one daughter, Christina, who succeeded him on the throne of Sweden.

(R. N. B.)

See *Sveriges Historia* (Stockholm, 1877, 81), vol. iv.; A. Oxenstjerna, *Skrifter och Brefvexling* (Stockholm, 1900, etc.); G. Bjorlen, *Gustaf Adolf* (Stockholm, 1890); R. N. Bain, *Scandinavia* (1905); C. R. L. Fletcher, *Gustavus Adolphus* (1892); J. L. Stevens, *History of Gustavus Adolphus* (1885); J. Mankell, Om *Gustaf* II. *Adolfs politik* (Stockholm, 1881); E. Bluemel, *Gustav Adolf, König von Schweden* (Eisleben, 1894); A. Rydfors, *De diplomatiska förbindelserna mellan Sverige och England 1624–1630* (Upsala, 1890); Varenius, *Gustav Adolfs Sverige* (1900); H. Hjärne, *Gustav Adolf, protestantismens forkampe* (1901; Ger. trans. 1901); G. Egelhaaf, *Gustav Adolf in Deutschland 1630–32* (1901); J. Kretzschmar. *Gustav Adolfs Pläne und Ziele in Deutschland* (1904); Fr. Bothe, *Gwtav Adolfs und seines Kanzlers wirtschaftpolitische Absichten auf Deutschland* (1910); Adolf och Ebba Brahe, *Brefväxlingen mellan Gustaf II.* (1915).

GUSTAVUS **III.** (1746–1792), king of Sweden, the eldest son of Adolphus Frederick, king of Sweden, and Louisa Ulrica of Prussia, sister of Frederick the Great, was born on Jan. 24, 1746. Gustavus was educated under the care of two eminent Swedish statesmen, Carl Gustaf Tessin and Carl Scheffer; but he owed most, perhaps, to the poet and historian Olof von Dalin. His teachers were amazed by the brilliance of his natural gifts, and, while still a boy, he possessed that charm of manner which was to make him so fascinating and so dangerous in later life, coupled with the strong dramatic instinct which won for him his honourable place in Swedish literature. There was scarce a French author of his day with whose works he was not intimately acquainted; while his enthusiasm for the new French ideas of enlightenment was as sincere as his mother's. On Nov. 4, 1766, Gustavus married Sophia Magdalena, daughter of Frederick V. of Denmark. The match was an unhappy one.

Gustavus first intervened in politics in 1768, at the time of his father's interregnum, when he compelled the dominant Cap faction to summon an extraordinary diet from which he hoped for the reform of the Constitution in a monarchical direction. But the Hats refused to redeem the pledges which they had given before the elections. "That we should have lost the constitutional battle does not distress us so much," wrote Gustavus, "but what does dismay me is to see my poor nation so sunk in corruption as to place its own felicity in absolute anarchy." From Feb. 4 to March 2j, 1771, Gustavus was in Paris, where the poets and the philosophers paid him enthusiastic homage. But his visit to the French capital was a political mission. The duc de Choiseul, weary of Swedish anarchy, had resolved to discuss with him the best method of bringing about a revolution in Sweden. Before he departed, the French Government undertook to pay the outstanding subsidies to Sweden unconditionally, at the rate of one and a half million livres annually; and the comte de Vergennes was transferred from Constantinople to Stockholm. On his way home Gustavus visited his uncle, Frederick the Great, at Potsdam. Frederick bluntly informed his nephew that, in concert with Russia and Denmark, he had guaranteed the integrity of the existing Swedish constitution, and advised the young monarch to play the part of mediator and abstain from violence.

On his return to Sweden Gustavus made a sincere attempt to mediate between the Hats and Caps who were ruining the country between them *(see* **SWEDEN**: ***History)***. On June 21, 1771, he opened his first parliament in a moving speech. Addressing the diet in the Swedish tongue, he laid stress on the necessity of sacrifice for the common weal and offered to mediate between contending factions. A composition committee was actually formed, but it proved illusory from the first. The subsequent attempts of the dominant Caps still further to limit the prerogative, induced Gustavus at last to consider the possibility of a revolution. Of its necessity there could be no doubt. Under the sway of the Cap faction, Sweden, already the vassal, could not fail to become the prey of Russia. Only by a swift coup *d'état* could the independence of a country isolated from the rest of Europe by a hostile league, be saved from absorption into that northern system, the invention of Count Nikita Panin. At this juncture Gustavus was approached by Jakob Magnus Sprengtporten, a Finnish nobleman of determined character, with the project of a revolution. He undertook to seize the fortress of Sveaborg, and, Finland once secured, to embark for Sweden, meet the king and his friends near Stockholm, and surprise the capital by a night attack, when the estates were to be forced to accept a new constitution from the king.

The plotters were reinforced by an ex-ranger from Scania (Skåne), Johan Kristoffer Toll, also a victim of Cap oppression. Toll proposed that a second revolt should break out in the province of Scania, to confuse the Government still more, and undertook to secure the southern fortress of Kristianstad. It was finally arranged that, a few days after the Finnish revolt had begun, Kristianstad should declare against the Government. Prince Charles was thereupon to mobilize the garrisons of all the southern fortresses, ostensibly to crush the revolt at Kristianstad; but on arriving before the fortress he was to make common cause with the rebels, and march upon the capital from the south, while Sprengtporten attacked it simultaneously from the east. On Aug. 6, 1772, Toll succeeded in winning the fortress of Kristianstad, and on the 16th Sprengtporten successfully surprised Sveaborg. But contrary winds prevented him from crossing to Stockholm, and in the meanwhile events had occurred which made his presence there unnecessary.

On Aug. 16, the Cap leader, Ture Rudbeck, arrived at Stockholm with the news of the insurrection in the south, and Gustavus, finding himself isolated in the midst of enemies, resolved to strike the decisive blow without waiting for the arrival of Sprengtporten. On the evening of the 18th all the officers whom he thought he could trust received instructions to assemble in the square facing the arsenal on the following morning. At ten o'clock on the 19th Gustavus rode to the arsenal, joined on the way by his adherents, so that by the time he reached his destination he had about 200 officers in his suite. After parade he reconducted them to the guard-room of the palace and unfolded his plans. He then dictated a new oath of allegiance, absolving them from their allegiance to the estates, and binding them to obey their lawful king, Gustavus III. Meanwhile the senate and the governor-general, Rudbeck, had been arrested and the fleet secured. On the evening of the 20th heralds proclaimed that the estates were to meet in the Rikssaal on the following day; every deputy absenting himself would be regarded as the enemy of his country and his king. On the 21st, a few moments after the estates had assembled, the king in full regalia appeared, and taking his seat on the throne, delivered that famous philippic in which he reproached the estates for their unpatriotic venality in the past. A new constitution was recited by the estates and accepted by them unanimously. The diet was then dissolved.

Gustavus was inspired by enthusiasm for the greatness and welfare of Sweden, and worked in the same reformatory direction as the other contemporary sovereigns of the "age of enlightenment." He took an active part in every department of business, but relied far more on extra-official counsellors of his own choosing than upon the senate. The effort to remedy the corruption which had been fostered by the Hats and Caps engaged a considerable share of his time and he even found it necessary to put the whole of a supreme court of justice (Gota Hofratt) on its trial. Measures were taken to reform the administration and the judicial procedure, and torture as an instrument of legal

investigation was abolished. In 1774 an ordinance providing for the liberty of the press was issued, the national defences were developed on a "Great Power" scale, and the navy was so enlarged as to become one of the most formidable in Europe. The finances were set in good order by the "currency realization ordinance" of 1777, and in 1775 free trade in corn was promoted and a number of oppressive export-tolls abolished.

The poor law was amended, absolute religious liberty was proclaimed, and he even succeeded in inventing and popularizing a national costume which was in general use from 1778 till his death. His one economic blunder was the attempt to make the sale of spirits a government monopoly, which was an obvious infringement upon the privileges of the estates. His foreign policy, on the other hand, was at first both wise and wary. Thus, when the king summoned the estates to assemble at Stockholm on Sept. 3, 1778, he could give a brilliant account of his six years' stewardship. Never was a parliament more obsequious or a king more gracious. Yet, short as the session was, it was long enough to open the eyes of the deputies to the fact that their political supremacy had departed. They had changed places with the king, who for all his gentleness, guarded his prerogative jealously. Even the few who were patriotic enough to acquiesce in the change by no means liked it. The diet of 1778 had been obsequious; the diet of 1786 was mutinous. The consequence was that nearly all the royal propositions were either rejected outright or so modified that Gustavus himself withdrew them.

The diet of 1786 marks a turning-point in Gustavus's history. Henceforth we observe a determination on his part to rule without a parliament; a passage, cautious and gradual, yet unflinching, from semi-constitutionalism to semi-absolutism. His opportunity came in 1788, when the political complications arising out of his war with Catherine II. of Russia enabled him by the Act of Unity and Security (on Feb. 17, 1789) to override the opposition of the rebellious gentry, and, with the approbation of the three lower estates, establish a new constitution, in which, though the estates still held the power of the purse, the royal authority largely predominated. Throughout 1789 and 1790 Gustavus gallantly conducted the unequal struggle with Russia, finally winning in the Svensksund (July 9–10) the most glorious naval victory ever gained by the Swedish arms, the Russians losing one-third of their fleet and 7,000 men. A month later, on Aug. 14, 1790, peace was signed between Russia and Sweden at Varala. The peace of Varala saved Sweden from humiliating concessions, and in Oct. 1791 Gustavus took the bold step of concluding an eight years' defensive alliance with the empress, who thereby bound herself to pay her new ally annual subsidies amounting to 300,000 roubles.

Gustavus now aimed at forming a league of princes against the Jacobins, and every other consideration was subordinated thereto. His profound knowledge of popular assemblies enabled him accurately to gauge from the first the scope and bearing of the French Revolution. But he was hampered by poverty and the jealousy of the other European Powers, and, after showing once more his unrivalled mastery over masses of men at the brief Gefle diet (Jan. 22–Feb. 24, 1792), he fell a victim to a widespread aristocratic conspiracy. Shot in the back by Anckarstrom at a midnight masquerade at the Stockholm opera-house, on March 16, 1792, he died on the 29th.

Although he may be charged with many foibles and extravagances, Gustavus III. was indisputably one of the greatest sovereigns of the 18th century. Unfortunately his genius never had full scope, and his opportunity came too late. Gustavus was, moreover, a most distinguished author. He may be said to have created the Swedish theatre, and some of the best acting dramas in the literature are by his hand. His historical essays, notably the famous anonymous eulogy on Torstenson crowned by the Academy, are full of feeling and exquisite in style,—his letters to his friends are delightful. Every branch of literature and art interested him, every poet and artist of his day found in him a most liberal and sympathetic protector. (R. N. B.; X.)

See E. G. Geijer, *Konung Gustaf III.'s efterlemnade papper* (Upsala, 1843–45); B. von Beskow, Om Gustaf III. sasom Konung och människa (1860–61); Geffroy, *Gustav III. et la cour de France* (1867–2 vols.), Ehrensvärd, *Dagboksanteckningar förda vid G. III.'s hof* (1878); *Gustaf III.'s bref till G. M. Armfelt* (Fr.) (1883); Y. K. Grot, *Catharine II. and Gustavus III.* (Russ.) (St. Petersburg, 1884); C. T. Odhner, *Sveriges politiska historia under Konung Gustaf III.'s regering* (1885–96); Mellin, *Verschworung und Mordal tentat gegen G. III.* (1890); E. Tegnér, *Från Tredje Gustavs dagar* (1892–94); O. Levertin, *Gustaf III. som dramatisk forfattare* (1894); and *Från Gustav III.* (1909); H. Schiick, *Gustav III., en karaktarsstudie* (1904); R. N. Bain, *Gustavus III. and his Contemporaries* (1904); Stavenow, *Konung G. III.* (2nd ed. 1910); A. Söderhjelm, *Sverige och den franska revolutionen* (1920).

GUSTAVUS IV. (1778–1837), king of Sweden, the son of Gustavus III. and Queen Sophia Magdalena, was born at Stockholm, on Nov. 1, 1778. Carefully educated under the direction of Nils von Rosenstein, he grew up serious and conscientious. In 1797 he married Frederica Dorothea, daughter of Charles Frederick, grand-duke of Baden, a marriage which might have led to a war with Russia but for the hatred of the French republic shared by the emperor Paul and Gustavus IV., which served as a bond of union between them. Indeed the king's morbid horror of Jacobinism drove him to adopt all sorts of reactionary measures and to postpone his coronation for some years, so as to avoid calling together a diet; but the disorder of the finances, caused partly by the continental war and partly by the almost total failure of the crops in 1798 and 1799, compelled him to summon the estates to Norrkoping in March 1800, and on April 3, Gustavus was crowned.

The change which now took place in Sweden's foreign policy and its consequences are elsewhere set forth (see SWEDEN: History). By the end of 1808 it was obvious that the king was insane. His violence had alienated his most faithful supporters, while his obstinate incompetence paralysed the national efforts. To remove a madman by force was the one remaining expedient; and this was successfully accomplished by a conspiracy of officers of the western army, headed by Adlersparre, the Anckarsvards, and Adlercreutz. On March 13, 1809 seven of the conspirators broke into the royal apartments unannounced, seized the king, and conducted him to the château of Gripsholm; Duke Charles was persuaded to accept the leadership of a provisional Government, which was proclaimed the same day; and a diet, hastily summoned, approved the revolution.

On March 29, Gustavus, in order to save the crown for his son, voluntarily abdicated; but on May 10, the estates, dominated by the army, declared that his whole family had forfeited the throne. On June 5, the duke regent was proclaimed king under the title of Charles XIII., after accepting the new liberal constitution, which was ratified by the diet the same day. In December Gustavus and his family were transported to Germany. Gustavus now assumed the title of count of Gottorp, but subsequently called himself Colonel Gustafsson, under which pseudonym he wrote most of his works. Separated from his family, he led an erratic life for some years; was divorced from his consort in 1812; and finally settled at St. Gall in Switzerland in great loneliness and indigence. He died on Feb. 7, 1837, and, at the suggestion of King Oscar II. his body was brought to Sweden and interred in the Riddarholmskyrka.

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GUSTAVUS V. (1858–1950), king of Sweden, son of Oscar II, king of Sweden and Norway, and Queen Sophia of Eassau, was born at Drottningholm on June 16, 1858. He entered the army and was a great traveller. As crown prince he held the title of duke of Wärmland. He married in 1881 Victoria (1862–1930), daughter of Frederick William Louis, grand duke of Eaden, and of Louise, princess of Prussia. The duchess of Baden was the granddaughter of Sophia, princess of Sweden, and the marriage of the crown prince thus effected a union between the Bernadotte dynasty and the ancient Swedish royal house of Vasa. Gustavus,

who had repeatedly acted as regent, became king Dec. 8, 1907. He died at Stockholm, Swed., on Oct. 29, 1950.

See Erik Lindorm, Gustav V och hans tid, 4 vol. (1947).

GUSTAVUS VI (1882–), king of Sweden, eldest son of Gustavus V (*q.v.*), was born in Stockholm on Nov. 11, 1882. He married in 1905 Princess Margaret of Connaught (1882–1920), and in 1923 Lady Louise Mountbatten (1889–). To the first marriage were born Gustavus Adolphus (1906–47; m. in 1932 Sibylle, princess of Saxe-Coburg-Gotha, to whom were born four daughters and a son, crown prince Carl Gustav, 1946–); Sigvard (1907–); Ingrid (1910– ; m. in 1935 Frederick, who in 1947 became king of Denmark); Bertil (1912–); and Carl Johan (1916–). Gustavus VI succeeded his father in 1950.

GUSTAVUS ADOLPHUS UNION, a society formed of members of the Evangelical Protestant churches of Germany, which has for its object the aid of feeble sister churches, especially in Roman Catholic countries. The project of forming such a society was first broached in connection with the bicentennial celebration of the battle of Lützen on the 6th of November 1832; a proposal to collect funds for a monument to Gustavus Adolphus having been adopted, it was agreed that the best memorial to the great champion of Protestantism would be the formation of a union for propagating his ideas. The society received a new impulse in 1841 through the energy and eloquence of Karl Zimmermann (1803–1877), under whose direction it became more definitely "evangelical" in its tone. The society has distributed about two and a half million pounds for church aid and development among various Protestant evangelical communities.

See K. Zimmermann, Geschichte des Gustav-Adolf-Vereins (Darmstadt, 1877).

GÜSTROW, a town of Germany, situated in the district of Schwerin, on the Nebel and the railway from Lübeck to Stettin, 20 mi. S. of Rostock. Pop. (1950) 35,237.

Güstrow was a place of some importance as early as the 12th century, and in 1219 it received Schwerin privileges. From 1316 to 1436 the town was the residence of the princes of the Wends, and from 1556 to 1695 of the dukes of Mecklenburg-Güstrow. The principal buildings are the castle, erected in the middle of the 16th century, the cathedral, dating from the 13th century, restored in 1868, and the town hall (Rathaus), uhich dates from the 16th century. The town has machine works, foundries, sawmills, breweries, distilleries, and manufactories of chemicals, sugar and soap. There is also a considerable trade in wool, corn, wood, butter and cattle

GUTENBERG, JOHANN (*c.* 1398–*c.* 1468), "the strongest claimant to the honour of the invention of printing" (see PRINTING), is supposed to have been born at Mainz of well-to-do parents, his father being Friele zum Gensfleisch and his mother Elsgen Wyrich (or, from her birthplace, zu Gutenberg, the name he adopted). The family appears to have been expelled from Mainz and to have settled in Strasbourg. Gutenberg is said to have been living there in 1434, and to have seized and imprisoned the town clerk of Mainz for a debt due to him by the corporation of that city, releasing him, however, at the representations of the mayor and councillors of Strasbourg, and relinquishing at the same time all claims to the money.

In 1438 a partnership arrangement was made between Gutenberg, Andreas Dritzehn, and Andreas and Anton Heilmann, and that this had in view the art of printing has been inferred from the word "drucken" used by one of the witnesses in the law proceedings which soon after followed. An action was brought, after the death of Dritzehn, by his two brothers to force Gutenberg to accept them as partners in their brother's place, but the decision was in favour of the latter. Documents of 1441 and 1442 show him to have been still in Strasbourg, but there is no trace of him between March 1441 and Oct. 1448. About 1448 Johann Fust (*q.v.*) advanced him 800 guilders to promote his work, on no security except that of "tools" still to be made. Fust seems also to have undertaken to advance him 300 guilders a year for expenses, but he does not appear to have ever done so. If at any time they disagreed, Gutenberg was to return the 800 guilders, and the "tools" were to cease to be security. In the minutes of the law-suit of 1455 Gutenberg says that he had to make his "tools" with the money advanced. But he is presumed to have begun a large folio Latin Bible, and to have printed during its progress some smaller books[1] and likewise the Letter of Indulgence (of April 12, 1451, by Pope Nicholas V. in aid of John II., king of Cyprus, against the Turks), of 31 lines, having the earliest printed date 1454, of which several copies are preserved in various European libraries

It is not known whether any books were printed while this partnership between Gutenberg and Fust lasted. Trithemius (Ann. Hirsaug. ii. 421) says they first printed, from wooden blocks, a vocabulary called Catkolicon, which cannot have been the Catholicon of Johannes de Janua, a folio of 748 pages in two columns of 66 lines each, printed in 1460, but was perhaps a small glossary now lost[2].

The Latin Bible of 42 lines, a folio of 1282 printed pages, in two columns with spaces left for illuminated initials (so called because each column contains 42 lines, and also known as the Mazarin Bible, because the first copy described was found in the library of Cardinal Mazarin), was finished before Aug. 15, 1456[3]; German bibliographers now claim this Bible for Gutenberg, but, according to bibliographical rules, it must be ascribed to Peter Schoffer, perhaps in partnership with Fust. It is in smaller type than the Bible of *36* lines, which latter is called either (a) the Bamberg Bible, because nearly all the known copies were found in the neighbourhood of Bamberg, or (b) *Schelhorn's* Bible, because J. G. Schelhorn was the first who described it in 1760, or (c) *Pfister's* Bible, because its printing is ascribed to Albrecht Pfister of Bamberg, who used the same type for several small German books, the chief of which is Boner's Edelstein (1461, quarto), 88 leaves, with 85 woodcuts, a book of fables in German rhyme. Some bibliographers believe this 36-line Bible to have been begun, if not entirely printed, by Gutenberg during his partnership with Fust, as its type occurs in the 31-line Letters of Indulgence of 1454, was used for the 27-line Donatus (of 1451?), and, finally, when found in Pfister's possession in 1461, apparently was old and worn, except the additional letters k, w, *z* required for German, which are clear and sharp like the types used in the Bible. Again, others profess to prove (Dziatsko, *Gutenberg's früheste Druckerpraxis*) that B^{36} was a reprint of B^{42}.

Gutenberg's work, whatever it may have been, was not a commercial success, and in 1452 Fust had to come forward with another 800 guilders to prevent a collapse. But some time before November 1455 the latter demanded repayment of his advances (*see* the Helmasperger Notarial Document of Nov. 6, 1455, in Dziatzko's *Beiträge zur* Gutenbergfrage, Berlin, 1889), and took legal proceedings against Gutenberg. We do not know the end

[1] Among these were perhaps (1) one or two editions of the work of Donatus, De octo *partibus* orationis, 27 lines to a page, of one of which two leaves, now in the Paris National Library, were discovered at Mainz in the original binding of an account book, one of them having, but in a later hand, the year 1451 (?); (2) the *Turk-Kalendar* for 1455 (preserved in the Hof-Bibliothek at Munich); (3) the *Cisianus* (preserved in the Cambridge Univ. Libr.), and perhaps others now lost.

[2] Ulric Zell states, in the Cologne Chronicle of 1499, that Gutenberg and Fust printed a Bible in large type like that used in missals. It has been said that this description applies to the 42-line Bible, as its type is as large as that of most missals printed before 1500, and that the size now called missal type (double pica) was not used in missals until late in the 16th century. This is no doubt true of the smaller missals printed before 1500, some of which are in even smaller type than the 42-line Bible. But many of the large folio missals, as that printed at Mainz by Peter Schöffer in 1483, the Carthusian missal printed at Spires by Peter Drach about 1490, and the Dominican missal printed by Andrea de Torresanis at Venice in 1496, are in as large type as the 36-line Bible. Peter Schöffer (1425–1502) of Gernsheim, between Mainz and Mannheim, who was a copyist in Paris in 1449, and whom Fust called his servant (*famulus*), is said by Trithemius to have discovered an easier way of founding characters, whence Lambinet and others concluded that Schoffer invented the punch. Schoffer himself, in the colophon of the Psalter of 1457, a work which some suppose to have been planned and partly printed by Gutenberg, claims only the mode of printing rubrics and coloured capitals

[3] The Leipzig copy of this Bible (which formerly belonged to Herr Klemm of Dresden) has at the end the ms year 1453 in old Arabic numerals But certain circumstances connected with this date make it look very suspicious.

of these proceedings, but if Gutenberg had prepared any printing materials it would seem that he was compelled to yield up the whole of them to Fust; that the latter removed them to his own house at Mainz, and there, with the assistance of Peter Schoffer, issued various books until the sack of the city in 1462 by Adolphus II caused a suspension of printing for three years, to be resumed again in 1465.

We have no information as to Gutenberg's activity and little of his whereabouts, after his separation from Fust. A document dated June 21, 1457, shows that he was then still at Mainz. Entries in the registers of the St. Thomas Church at Strasbourg make it clear that the annual interest on the money which Gutenberg on Nov. 17, 1442, had borrowed from the chapter of that church was regularly paid till Nov. 11, 1457, either by himself or by his surety, Martin Brechter. But the payment due on the latter date appears to have been delayed, as an entry in the register of that year shows that the chapter had incurred expenses in taking steps to have both Gutenberg and Brechter arrested. This time the difficulties seem to have been removed, but on and after Nov. 11, 1458, Gutenberg and Brechter remained in default. The chapter made various efforts, all recorded in their registers, to get their money, but in vain. Every year they recorded the arrears with the expenses to which they were put in their efforts to arrest the defaulters, till at last in 1474 (six years after Gutenberg's death) their names are no longer mentioned.

Meantime Gutenberg appears to have been printing, as we learn from a document dated Feb. 26, 1468, that a syndic of Mainz, Dr. Conrad Humery (who had formerly been in the service of the elector Count Diether of Ysenburg), had at one time supplied him, not with money, but with some forms, types, tools, implements and other things belonging to printing, which Gutenberg had left after his death, and which had, and still, belonged to him (Humery); this material had come into the hands of Adolf the archbishop of Mainz, who handed or sent it back to Humery, the latter undertaking to use it in no other town but Mainz, nor to sell it to any person except a citizen of Mainz, even if a stranger should offer him a higher price for the things. This material has never yet been identified so that we do not know what types Gutenberg may have had at his disposal; they could hardly have included the types of the *Catlzolicon* of 1460, as is suggested, this work being probably executed by Heinrich Bechtermunze (d 1467), who afterward moved to Eltville, or perhaps by Peter Schoffer, who, about 1470, advertised the book as his property. *(See* K. Burger, *Buchhändler-Anzeigen.*)

It is uncertain whether Gutenberg remained in Mainz or moved to the neighbouring town of Eltville, where he may have been engaged for a while with the brothers Bechtermunze, who printed there for some time with the types of the 1460 *Catholicon.* On Jan. 14, 1465, he accepted the post of salaried courtier from the archbishop Adolf and in this capacity received annually a suit of livery together with a fixed allowance of corn and wine. Gutenberg seems to have died at Mainz at the beginning of 1468 and was, according to tradition, buried in the Franciscan church in that city. No books bearing the name of Gutenberg as printer are known, nor is any genuine portrait of him known, those appearing upon medals, statues or engraved plates being all fictitious.

In 1898 the firm of L. Rosenthal, at Munich, acquired a *Missale speciale* on paper, which Otto Hupp, in two treatises published in 1898 and 1902, asserts to have been printed by Gutenberg about 1450, seven years before the 1457 Psalter. Various German bibliographers, however, think that it could not have been printed before 1480; and, judging from the facsimiles published by Hupp, this date seems to be approximately correct..

In 1902 a vellum fragment of an *Astronomical Kalendar* was discovered by the librarian of Wiesbaden, Dr. G. Zedler (*Die alteste Gutenbergtype,* Mainz, 1902), apparently printed in the 36-line Bible type, and as the position of the sun, moon and other planets described in this document suits the years 1429, 1448 and 1467, he ascribes the printing of this *Kalendar* to the year 1447. A paper fragment of a poem in German, entitled *Weltgericht,* said to be printed in the 36-line Bible type, appears to have come into the possession of Eduard Beck at Mainz in 1892, and was presented by him in 1903 to the Gutenberg museum in that city. Zedler published a facsimile of it in 1904 (for the *Gutenberg Gesellschaft*), with a description, in which he places it before the 1447 *Kalendar,* c. 1444–1447. Moreover, fragments of two editions of Donatus different from that of 1451 (?) have been found; *see* Schwenke in *Centralbl. für Bibliothekwesen* (1908).

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GÜTERSLOH, a town in the *Land* of North Rhine-Westphalia, Ger., 11 mi. S.W. of Bielefeld, on the railway Cologne-Bielefeld-Berlin. Pop. (1910) 43,111. It manufactures machines. metal and wooden goods. furniture, silk and cotton. Distilling and printing are carried on. Gütersloh trades in Westphalian hams and sausages and is famous for its rye bread (*Pumpernickel*).

GUTHRIE, SIR JAMES (1859–1930), Scottish painter, and one of the leaders of the Glasgow school, was born at Greenock. In his early works, such as "The Gipsy Fires Are Burning, for Daylight Is Past and Gone" (1882), and the "Funeral Service in the Highlands," he favoured a thick impasto, but with growing experience he used his colour with greater economy and reticence. Subsequently he devoted himself almost exclusively to portraiture. He was elected A.R.S.A. in 1888, R.S.A. in 1892, P.R.S.A. in 1902 and was knighted in 1903. He was trustee of the National Galleries of Scotland from 1906 to 1920. His painting "Schoolmates" is at the Ghent gallery. Among his most successful portraits are those of his mother, Major Hotchkiss, Professor Jack and Mrs. Watson. He died on Sept. 6, 1930.

GUTHRIE, THOMAS ANSTEY (1856–1934), known by the pseudonym of F. Anstey, English novelist and playwright, was born in Kensington, London. He was educated at King's college, London, and at Trinity Hall, Cambridge, and was called to the bar in 1880. The popular success of his story *Vice-Versa* (1882), with its topsy-turvy substitution of a father for his schoolboy son, made his reputation, which was further confirmed by *The Black Poodle* (1884), *The Tinted Venus* (1885), *The Fallen Idol* (1886) and other works. On the stage his best piece was *The Man from Blankley's* (1901).

GUTHRIE, a city of central Oklahoma, U.S., near the Cimarron river, is 30 mi. N. of Oklahoma City and the seat of Logan county. Guthrie is the trade centre for a large and productive agricultural region, specializing chiefly in fruit, poultry raising and dairying. It has sundry manufacturing industries.

There are several deep mineral springs in the city and numerous oil wells in the county. Guthrie was founded in 1889, when Oklahoma was opened to settlement. It was the capital of the territory and the state from 1890 to 1910. In 1929 it adopted a council-manager form of government.

For comparative population figures *see* table in OKLAHOMA: *Population.*

GUTHRUM (GODRUM) (d. 890), king of East Anglia, first appears in the *English Annuls* in the year 875, when he is mentioned as one of three Danish kings who went with the host to Cambridge. He was probably engaged in the campaigns of the next three years; and after Alfred's victory at Edington in 878, Guthrum met the king at Aller in Somersetshire and was baptized there under the name of Aethelstan. He stayed there for 12 days and was greatly honoured by his godfather Alfred. In 890 Guthrum-Aethelstan died: he is then spoken of as "se norderna cpning" (probably) "the Norwegian king." referring to the ulti-

mate origin of his family, and we are told that he was the first (Scandinavian) to settle East Anglia. Guthrum is perhaps to be identified with Gormr (= Guthrum) hinn heimski or hinn riki of the Scandinavian sagas, the foster father of Hörðaknutr, the father of Gorm the old. There is a treaty known as the peace of Alfred and Guthrum. For details of the struggle with the English *see* ALFRED.

GUTIÉRREZ NÁJERA, MANUEL (1859–189j), Mexican poet, who in 1894 founded the *Revista azul,* Mexico s first modernist journal. Born in Mexico City on Dec. 22, 1859, he received his early education from his mother, and later studied French and Latin. His first article appeared in the newspaper La *Iberia* when he was 13, and until his death he published several a week. He used many pseudonyms, "El Duque Job" being his favourite.

His prose and verse show the influence of Alfred de Musset, Theophile Gautier, Paul Verlaine and other French writers, and represent the transition between romanticism and modernism. His poems are musical, elegant, melancholy and often witty. The best known are "La Duquesa Job," "La Serenata de Schubert," and "De blanco." Modernist writers were influenced by his graceful and light prose style, in which he wrote *crdnicas* or sketches (a genre he created) and excellent short stories, as *Rip-Kip*—reminiscent of Washington Irving—and the *Historia de un peso falso.* He died in Mexico City on Feb. 3, 1895.

BIBLIOGRAPHY.—*Obras completas,* 4 vol (1898–1910); Nell Walker, *The Life and Works of Manuel Gutiérrez Najera* (1927); Boyd G. Carter, *Manuel Gutiérrez Nájera* (1956). (L. LL.)

GUTIÉRREZ SOLANA, JOSÉ (1886–194j), Spanish painter of the Castilian school. was born on Feb. 28, 1886, in Madrid and died there on June 24, 1945. He lived in Madrid throughout his life, except for a few trips in Spain and abroad.

He is remarkable for his devotion to his chosen subject matter and for his treatment of it in a tragic and restrained style in uhich the influence of academic training is modified by the romantic-expressionist tradition of Goya and James Ensor. His technique is austere and tortured; his colours are dull and earthy, with yellouish ochres, blacks and grays. He depicts the most desolate aspects of human existence. with solitary figures dominated by a lifeless environment. The usual characters of Spanish painting, gloomy landscapes and taverns full of masked faces, skulls and old carvings are essential themes of his work.

But Gutierrez Solana's whole view of life in all its sourness, with its brothel scenes, dreary suburban bars and corteges, is transfigured by the powerful internal consistency of his design and by the subtlety of his colour scheme. His vigorous nudes are particularly notable. being quite unlike those of most other painters; so also are his conversation pieces showing family reunions, assemblies of professional men or parties of friends, such as "La Botica" in the Barcelona museum.

BIBLIOGRAPHY.—M. Sánchez Camargo, *Solana* (1945); Emilio M. Aguilera, *Solana* (1947); also special number devoted to Gutiérrez Solana of *Papeles de Son Armadans,* year iii, vol. xi, no. 33 (1958). (J. GL.)

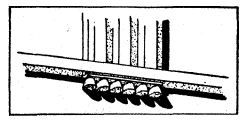
GUTSCHMID, ALFRED, BARON VON (1835–1887), German historian and orientalist, was born on July 1. 1835, at Loschwitz (Dresden). After holding chairs at Kiel (1866), Konigsberg (1873), and Jena (1876), he was finally appointed professor of history at Tubingen, where he died on March 2. 1887. He devoted himself to the study of eastern language and history in its pre-Greek and Hellenistic periods and contributed largely to the literature of the subject. Of his numerous works the best known is his *Geschichte Irans* (Alexander the Great to the fall of the Xrsacidae) (Tubingen, 188;).

He wrote on Persia and Phoenicia in the 9th edition of the *Encyclopædia Britannica.*

A collection of minor works entitled *Kleine Schriften* was published in 5 vol. by F. Rühl at Leipzig (1889–94), with complete list of his writings.

GUTS-MUTHS, JOHANN CHRISTOPH FRIEDRICH (1759–1839), German teacher and the principal founder of the German school system of gymnastics, was born at Quedlinburg on Aug. 9, 1759, and died on May 31, 1839. It was chiefly through his books on the subject that gymnastics came to occupy such an important position in the school system of Germany.

His principal works are *Gymnastik fur die Jugend* (1793); *Spiele zur Übung und Erholung des Korpers und Geistes fur die Jugend* (1796); *Turnbuch* (1817); *Handbuch der Geographie* (1810); *and* a number of books constituting a *Bibliothek für Padagogik, Schulwesen, und die gesammte padagogische Literatur Deutschlands.*



GUTTA, in architecture, one of the small, conical or cylindrical forms carved on the under side of the mutules, or flat projections on the under side of the Doric cornice; they also hang from the regula under the taenia. the crowning member of the architrave, directly below each triglyph.

GUTTA-PERCHA, the name applied to the evaporated milky fluid or latex furnished by several trees chiefly found in the islands of the Malay archipelago, also in Brazil. The hard, non-brittle characteristics of gutta-percha find use in such varied articles as golf ball covers, electrical insulation, cable coverings and chewing gum. Because of its high cost, gutta-percha is gradually being replaced by newer synthetic materials such as polyethylene, vinyl resins and nylon.

Botanical Origin and Distribution.— The best gutta-percha of Malaya was chiefly derived from two trees belonging to the family Sapotaceae—Palaquium *gutta* (no longer cultivated) and P. *oblongijolia.* Allied trees of the same genus and of the same family yield similar but usually inferior products. Among them may be mentioned species of *Payena.*

Gutta-percha trees often attain a height of 70 to 100 ft. and the trunk has a diameter of from 2 to 3 ft. They are mature when about 30 years old. The leaves of *Palaquium,* which are obovate-lanceolate with a distinct pointed apex, occur in clusters at the end of the branches and are bright green and smooth on the upper surface but on the lower surface are yellowish-brown and covered with silky hairs. The leaves are usually about 6 in. long and about 2 in. wide at the centre. The flowers are white; and the seeds are contained in an ovoid berry about 1 in. long.

The gutta-percha tree is almost entirely confined to the Malay peninsula and its immediate neighbourhood. It includes a region within 6° north and south of the equator and 93°–119° longitude, where the temperature ranges from 66° to go° F. and the atmosphere is exceedingly moist. The trees may be grown from seeds or from cuttings.

Preparation of **Gutta-Percha.**—The gutta is furnished by the grayish milky fluid, the latex, chiefly secreted in cylindrical vessels or cells in the cortex. Latex also occurs in the leaves of the tree and may be removed from the powdered leaves by the use of appropriate solvents, but the process is not practicable commercially. The latex flows slowly where an incision is made through the bark. but not nearly so freely as the India rubber latex. On this account the Malays usually fell the tree to collect the latex, which is done by chopping off the branches and removing circles of the bark, forming cylindrical channels about an inch wide at various points about a foot apart down the trunk. The latex exudes and fills these channels, from which it is removed and converted into gutta by boiling in open vessels over wood fires.

The work is usually carried on in the wet season when the latex is more fluid and more abundant. Sometimes when the latex is thick, water is added before boiling. The best results are obtained from mature trees which furnish about two to three pounds of gutta.

The Chinese and Malays were acquainted with the characteristic property of gutta-percha of softening in warm water and of regaining its hardness when cold, but this plastic property seems to have been utilized only for ornamental purposes, the construction of walking sticks, knife handles, whips, etc. John Tradescant brought samples of the curious material to Europe about the middle of the 17th century. (X.)

Character and Properties.— Gutta-percha appears in commerce as gray blocks, often with a reddish tinge. It is a hard, inelastic solid. just soft enough to be indented by the nail and is

tough at ordinary temperature. Gutta-percha from the tree is in a crystalline form *(a)*, which melts at about 65° C. Above this temperature. it becomes soft and plastic, but is still inelastic. On slow cooling again, gutta-percha returns to the (α) crystalline form but u-ith rapid cooling, a different crystalline form (β) is obtained which melts at 56° C. These two forms differ in the pattern in which the molecules are arranged and can be distinguished by X-ray methods. The β form is unstable and can be converted to the α form by slight warming. About 60% of gutta-percha is normally crystalline at ordinary temperature, the remainder being amorphous.

Composition and Structure. — The principal constituent of gutta-percha is a hydrocarbon *gutta* of the empirical formula C_5H_8, having a molecular weight of about 30.000. Each molecule is composed of isoprene units, joined in regular fashion into a long chain. There are two possible geometric configurations of isoprene units within a molecule: the *trans* form, exemplified by gutta-percha, and the *cis* form, typical of India rubber or caoutchouc. The *trans* and *cis* forms are identical chemically. The difference in physical character lies in the geometry of the molecules.

The hydrocarbon of gutta-percha is unsaturated, having one double bond for each *gutta* unit. It will react n-ith chlorine. The reaction with sulfur is utilized to vulcanize gutta-percha, rendering it nonplastic and insoluble. Gutta-percha is dissolved by carbon disulfide, chloroform and benzene. Alkaline solutions or dilute acids do not affect it. Strong sulfuric acid chars it when warm and nitric acid effects complete oxidation. When exposed to air and light. gutta-percha rapidly deteriorates, absorbing oxygen and producing a brittle resin. Ozone attacks gutta-percha extremely rapidly with similar results. The attack by air or ozone is slowed greatly by adding antioxidants, generally aromatic amines or phenols. When heated in the absence of air at a high temperature, gutta-percha decomposes into a mixture of isoprene and higher hydrocarbons. Crude gutta-percha contains resinous materials: which are usually deleterious. These resinous components can be removed by solvents.

Gutta-percha is identical in nature to balata. which is obtained from *Bumelia retusa.* Chicle gutta is a similar material, having about half the molecular weight of gutta-percha. Chicle gutta is obtained from *Sapota achras* latex, where it occurs together with a smaller amount of caoutchouc. (A. W. MR.; J. A. DN.)

GUTTER, in architecture, a horizontal channel or trough contrived to carry away the water from a flat or sloping roof to its discharge down a vertical pipe or through a spout or gargoyle; more specifically. but loosely, the similar channel at the side of a street. In Greek and Roman temples the cymatium of the cornice was the gutter, and the water was discharged through the mouths of carved lions' heads. In medieval work the gutter rested on the top of the wall or on a corbel table. and the water was discharged through gargoyles. Sometimes, however, a parapet or pierced balustrade was carried outside the gutter. In many buildings the parapet is only a continuation of the wall below. and the gutter is set back and carried in a trough resting on the lower end of the roof timbers. The most practical form is an eaves gutter which projects more or less in front of the wall and is secured to and carried by the rafters of the roof.

In French Renaissance work the gutter is frequently concealed behind a rich cresting in stone, lead or copper at the edge of the main cornice.

GUTTIFERAE, the St.-John's-wort family, a family of dicotyledonous plants with 46 genera and more than 1,000 species, belonging to the order Guttiferales. Most of the genera consist of shrubs or trees, with a characteristic yellowish or whitish latex. *Hypericum,* with over 300 species, is largely developed in the temperate and subtropical regions of both hemispheres and includes many herbs; it is placed by some in a separate family, the Hypericaceae. The name applied to many of these in England and in North America is St.-John's-wort (*q.v.*). Other large genera include *Vismia,* with 20 or more species in tropical Xmerica; *Psorospermum* in tropical Africa with about 30 species; *Ochrocarpus,* with 20 species in the old world tropics; *Calophyllum* with 70 species, chiefly paleotropical and including important timber trees; *Clusia* in tropical America with 100 species; *Tovomita,* also in tropical America, with 40 species; *Rheedia,* 30 species. mostly in tropical America: *Garcinia,* with more than 200 species, paleotropic. with several important fruit trees, including the mangosteen (*q.v.*), *Garcinia mangostana.* Gamboge (*q.v.*) is the resin derived from various species of this genus, including *Garcinia cambogia. Mammea americana* is an important fruit tree in tropical America.

(E. D. ML.)

GUTZKOW, KARL FERDINAND (1811–1878), German novelist and dramatist, who opened a way to the German social novel of the 20th century, was born. March 17. 1811, at Berlin. In 1832 he published anonymously his *Briefe eines Sarren an eine Närrin,* and in 1833 appeared *Maha-Guru, Geschichte eines Gottes,* a fantastic and satirical romance. In 183j he published *Wally, die Zweiflerin,* an attack on marriage which marks the beginning of the revolt of "Young Germany" against romanticism. He was violently attacked by Wolfgang Menzel, and the federal diet condemned Gutzkow to three months' imprisonment and ordered the suppression of all he had written or might yet write. During his imprisonment at Mannheim, Gutzkow wrote his treatise *Zur Philosophie der Geschichte* (1836). On his release he produced *Richard Savage* (1839), a play which immediately made the round of all the German theatres. Of his numerous other plays a few keep a place in the German repertory. In 1847. Gutzkow went to Dresden. where he succeeded J. L. Tieck as literary adviser to the court theatre. Meanwhile he had written the novels *Seraphine* (1838) and *Blasedow und seine Söhne* (3 vol.; 1838), a satire on the educational theories of the time. In 18jo appeared the first of the nine volumes of *Die Ritter vom Geiste,* which may be regarded as the starting point for the modern German social novel. *Der Zauberer von Rom* (9 vol.; 1858–61) is a powerful study of Roman Catholic life in southern Germany.

Gutzkow died at Sachsenhausen on Dec. 16, 1878.

BIBLIOGRAPHY.—Gutzkow's dramatic works were published in 20 vol. (1873–75) and his collected works in 12 vol. (1872–76). For Gutzkom's life *see* his various autobiographical writings: *Aus der Knabenzeit* (1852), *Rückblicke auf mein Leben* (1875) and the biography in the selected works (1908). *See* also H. *H.* Houben, *Studien über die Dramen Gutzkows* (1898), *Gutzkou-Funde* (1901); J. E. Dresch, *Gutzkow et la jeune Allemagne* (1904); *E.* Metis, *Karl Gutzkou als Dramatiker (1915);* *P.* Westra, *Gutzkows religiose Ansichten* (1948).

GÜTZLAFF, KARL FRIEDRICH AUGUST (1803–1851), German missionary to China. was born at Pyritz in Pomerania on July 8, 1803 After serving as a missionary in Java and Siam, he went to China, and there translated the Bible into Chinese, published a Chinese monthly magazine. and wrote in Chinese various books on subjects of useful knowledge. In 1834 he published a *Journal of Three Voyages along the Coast of China in 1831, 1832 and 1833.* He was appointed in 1835 joint Chinese secretary to the English commission, and during the opium war of 1840–42 and the negotiations connected with the peace his knowledge of the country and people made him extremely useful. Giitzlaff in 1844 founded an institute for training native missionaries. He died at Hong Kong on Xug. 9, 1851.

Giitzlaff also wrote *A Sketch of Chinese History, Ancient and Modern* (1834). and a similar work published in German at Stuttgart in 1847; *China Opened* (1838); and the *Life of Taow-Kwang* (1851; German edition published at Leipzig in 1852). There is a complete collection of his Chinese writings in the Munich library.

GUY, THOMAS (1644–1724), founder of Guy's hospital. London, was the son of a lighterman and coal dealer at Southwark. After an apprenticeship of eight years with a bookseller, he, in 1668, began business on his own account. He dealt largely in Bibles, which were poorly and incorrectly printed in England. These he at first imported from Holland, but subsequently obtained from the Cniversity of Oxford the privilege of printing. He died on Dec. 17, 1724. In 1707 he built three wards of St. Thomas's hospital. He erected Guy's hospital, leaving for its endowment £219,449, and endowed other charities. He was M.P. for Tamworth from 1695 to 1707.

See *A True* Copy *of the Last Will and Testament of Thomas Guy, Esq.* (1725); *C.* Knight, *Shadows* of *the Old Booksellers,* pp. 3–23

(1865); S. Wilkes and G. T. Bettany, *A Biographical History of Guy's Hospital* (1892).

GUYAU, JEAN MARIE (1854–1888), French philosopher, was born on Oct. 28, 1854, at Laval and died on March 31. 1888, at Mentone. Ill-health required him to resign his professorship at the Lycée Condorcet and to live in the French Sudan where he devoted himself to questions of aesthetics, ethics and religious philosophy. His chief works are: *Mémoire sur la Morale utilitaire, depnis Epicure jusqu'à l'école anglaise* (1878, 7th ed. 1913); *Esquisse d'une morale sans obligation ni sanction* (1885, 2nd. ed. 1890) and *L'irréligion de l'avenir* (1887, 7th ed. 1904).

See H. Hoffding. *Modern Philosophers* (1905); *G.* Aslan, *La morale selon Guyau* (1906); and E. Bergmann, *Die Philosophie Guyaus* (1912).

GUYNEMER, GEORGES (1894–1917), French aviator, born in Paris on Dec. 24, 1894 was the most famous of all the aviators on the French side in the World War. His courage, his gaiety, his 53 victories over enemy aviators, and his death in a battle in the air above Poelcapelle on Sept 11, 1917, made him a popular hero For the story of his brief life *see* H. Bordeaux, *Le chevalier de l'air, Guynemer* (1919).

GUY OF WARWICK, English hero of romance. Guy. son of Siward or Seguard of Wallingford, by his prowess in foreign wars wins in marriage Félice (the Phyllis of the well-known ballad), daughter and heiress of Roalt. earl of Warwick. Soon after his marriage, seized with remorse for the violence of his past life, he leaves his wife and fortune to make a pilgrimage to the Holy Land. After years of absence he returns in time to deliver Winchester for King Aethelstan from the invading northern kings, Anelaph (Anlaf or Olaf) and Gonelaph, by slaying in single fight their champion, the giant Colbrand Local tradition fixes the duel at Hyde Mead near Winchester. Making his way to Warwick he becomes one of his wife's bedesmen, and retires to a hermitage in Arden, only revealing his identity at the approach of death. The versions of the Middle English romance of Guy which we possess are adaptations from the French. and open with a long recital of Guy's wars in Lombardy, Germany and Constantinople. The kernei of the tradition evidently lies in the fight with Colbrand, which may represent an historical fact If so, the Anlaf of the story is probably Olaf Tryggvason, who, with Sweyn of Denmark, harried the southern counties of England in 993 and pitched his winter quarters in Southampton Winchester was saved, however. not by the valour of an English champion, but by the payment of money. This Olaf was not unnaturally confused with Xnlaf Cuaran or Havelok (*q v*). Guy's Cliffe, near Warwick, where in the 14th century Richard de Beauchamp, earl of Warwick ,erected a chantry, with a statue of the hero, does not correspond with the site of the hermitage as described in the romance The bulk of the legend is obviously fiction.

The French romance (Harl ms 3,775) is described by Émile Littre in *Hist. litt. de la France* (xxii, 841–851, 1852) A French prose version was printed in Paris, 1525, and subsequently (*see* G Brunet. *Manuel du libraire, s v* "Guy de Warvich"); the English metrical romance exists in four versions. dating from the early 14th century; the text was edited by J. Zupitza (1875–76) for the E E T S. (extra series. Nos 42, 49, 59) The popularity of the legend is shown by the numerous versions in English, such as Guy *of Warwick,* translated from the Latin of Girardus Cornubiensis (*fl.* 1350) into English verse by John Lydgate between 1442 and 1468. See also an article by S. L. Lee in the *Dictzonary* of *National Biography.*

GUYON, JEANNE MARIE BOUVIER DE LA MOTHE (1648–1717), French quietist writer, was born of good family at Montargis on April 13, 1648. She attended various convent schools, and in 1664 married a rich invalid of the name of Guyon, many years her senior. Twelve years later he died, leaving his widow with three small children and a considerable fortune.

Her attraction towards the mystical life was developed by her spiritual director. Father Lacombe, a Barnabite monk of weak character and unstable intellect, and from 1681 the two rambled about together in Savoy and the south-east of France, spreading their mystical ideas. At last they excited the suspicion of the authorities; in 1686 Lacombe was recalled to Paris, put under surveillance, and was finally sent to the Bastille in 1687. He was presently transferred to the castle of Lourdes, where he died in 1717.

Meanwhile Madame Guyon had been arrested in 1688, but was delivered in the following year by her old friend, the duchesse de Béthune, who had become a power in the devout court-circle presided over by Madame de Maintenon. Before long Madame Guyon herself was introduced into this pious assemblage where she displayed her charm and eloquence. She became friendly with Fénelon, now a rising young spiritual director. Between 1689 and 1693 they corresponded regularly.

hleanwhile similar reports had strained her relationship with Madame de Maintenon, and to clear her orthodoxy, Madame Guyon appealed to Bossuet, who decided that her books contained "much that was intolerable, alike in form and matter." Madame Guyon promised to "dogmatize no more!" and disappeared into the country (1693). In the next year she again petitioned for an inquiry, and was eventually sent to Bossuet's cathedral town of Meaux. She soon left without his leave, bearing with her a certificate of orthodoxy signed by him. Bossuet regarded this flight as an act of disobedience; in the winter Madame Guyon was arrested and shut up in the Bastille. There she remained till 1703. In that year she was liberated, on condition she would live on her son's estate near Blois, under the eye of a stern bishop. Here the rest of her life was spent in charitable and pious exercises; she died on June g, 1717. In France she has often been reckoned an hysterical degenerate; in England and Germany she has as often roused enthusiastic admiration.

BIBLIOGRAPHY.—Mme. Guyon's complete works appeared in 40 vols. (1767–91). There are English translations of her autobiography by T. T. Allen (2 vols.,. 1897), of her *Spiritual Torrents* by *A.* W. Marston (1908), of her *Mystical Sense of Sacred Scriptures by T. W.* Duncan (1872), of her *Method of Prayer by D.* Macfadyen (1902) and of ner select poems by W. Cowper (1801). *See* T. C. Upham, *Life of Mme. Guyon* (new ed., 1905); M. Masson, *Fénelon et Mme. Guyon, Documents nouveaux et inédits* (1907) and *E.* Seillière, *Mme. Guyon et Fénelon* (1918). *See* also QUIETISM; and H. Delacroix, *Etudes d'histoire et de psychologie sur le mysticisme* (Paris, 1908).

GUYON, RICHARD DEBAUFRE (1803–1856), British soldier, general in the Hungarian revolutionary army and Turkish pasha, was born at Walcot, near Bath, in 1803. After receiving a military education in England and in Austria he entered the Hungarian hussars in 1823. At the outbreak of the Hungarian War in 1848, he re-entered active service as an officer of the Hungarian Honvéds, and he won great distinction in the action of Sukoro (Sept. 29, 1848) and the battle of Schwechat (Oct. 30). He served in important and sometimes independent commands to the end of the war, after which he escaped to Turkey. In 1852 he entered the service of the sultan. He was made a pasha and lieutenant-general without being required to change his faith, and fought in the campaign against the Russians in Asia Minor (1854–55). General Guyon died of cholera at Scutari on Oct. 12, 1856.

See A. W. Kinglake, *The Patriot and the Hero General Guyon* (1856).

GUYOT, ARNOLD HENRY (1807–1884), Swiss-U.S. geologist and geographer who pioneered modern methods of teaching geography in the schools of the United States, was born at Boudevilliers. near Neuchâtel, Switz., on Sept. 28. 1807. He studied at Neuchâtel and in Germany. and in 1838 began the study of glaciers under the influence of Louis Agassiz, making some important observations on glacial motion and structure. After a period in Paris, he left Europe in 1848 for the United States. From about 1850 to 1856 he was employed by the Massachusetts board of education to lecture on geography and teaching methods. His ideas were incorporated in his series of school textbooks which served as models for future works. Guyot taught his young pupils to begin by studying their surroundings and consulting the topographical map.

In 1854 he had become professor of geology and physical geography at Princeton university and held this post until his death. He ranked high as a geologist and also as a meteorologist. his ex-

tensive meteorological observations leading to the establishment of the U.S. weather bureau. His *Tables, Meteorological and Physical* (4th ed. by W. Libbey, 1887) were long standard. He also wrote *The Earth and Man* (Eng. trans. by C. C. Felton, 1850). A devout Protestant. Guyot attempted to interpret the biblical cosmogony in the light of current theories in his *Creation* (1884). He died on Feb. 8, 1884.

In 1946 the word "guyot" was coined to describe submerged flat-topped peaks that rise from the floor of the ocean.

GUYOT, YVES (1843-1928), French politician and economist. was born at Dinan on Sept. 6, 1843. Educated at Rennes, he took up the profession of journalism. coming to Paris in 1867. He was for some time editor in chief of *L'Indépendant du midi* of Nîmes, joined the staff of *La Rappel* on its foundation, and worked on other journals. He waged a keen campaign against the prefecture of police. for which he suffered six months' imprisonment. He entered the chamber of deputies in 1885 as representative of the first *arrondissement* of Paris and was *rapporteur général* of the budget of 1888. He was minister of public works from 1889 to 1892. He lost his seat in the election of 1893 owing to his militant attitude against Socialism. An uncompromising free-trader. he published *La Comédie protectionniste* (1905; Eng. trans. *The Comedy of Protection*); *La Science économique* (1st ed. 1881; 3rd ed. 1907); *La Prostitution* (1882); *La Tyrannie socialiste* (1893), all three translated into English; *Les Conflits du travail et leur solution* (1903); *La Démocratie individualiste* (1907). Other important works are *Etudes de physiologie sociale* (6 vol., 1882–1905), and *La Gestion par l'état et les municipalités* (1912). Guyot died on Feb. 21, 1928.

GUYTON DE MORVEAU, LOUIS BERNARD, BARON (1737–1816). French chemist and co-author of proposals for a revised chemical nomenclature which helped establish the distinction between elements and compounds. was born on Jan. 4, 1737, at Dijon. He studied law at Dijon, and became advocate-general in the *parlement*, until 1782. He devoted his leisure to the study and teaching of chemistry, and in 1772 published *Digressions académiques*, containing his views on phlogiston and crystallization. An essay on chemical nomenclature in the *Journal de physique* (May 1782) was developed, with the aid of Antoine L. Lavoisier. Claude L. Berthollet and Antoine F. Fourcroy, into the *Méthode d'une nomenclature chimique* (1787), the principles of which were adopted by chemists throughout Europe. He adopted Lavoisier's views on combustion and published his reasons in the first volume of the section "Chymie. Pharmacie et Metallurgie" of the *Encyclopédie méthodique* (1786), the chemical articles in which were written by him. In 1791 he was elected as member of the legislative assembly, and in 1792 of the convention. becoming a member of the committee of public safety. From 1795 to 1805 he taught at the École Polytechnique, Paris, of which he was the director. He was master of the mint from 1800 to 1814. In 1811 he was made baron of the French empire. He died in Paris on Jan. 2, 1816.

In addition to many scientific papers, Guyton wrote *Mémoire sur l'éducation publique* (1762); a satirical poem entitled "Le Rat iconoclaste, ou le Jésuite croqué" (1763); *Discours publics et éloges* (1775–82); *Plaidoyers sur plusieurs questions de droit* (1788); and *Traité des moyens de désinfecter l'air* (1801), describing the disinfecting powers of chlorine and of hydrochloric acid gas which he had successfully used at Dijon in 1773. With Hugues Maret (1726–85) and Jean François Durande (d. 1794) he also published *Élémens de chymie théorique et pratique* (1776–1777).

GUZMÁN BLANCO, ANTONIO (1829–1899), Venezuelan soldier and statesman, was born in Feb. 1829 in Caracas, Venez., where his father. Antonio Leocardio Guzmán. had held important offices in the governments of Bolivar and Paez. Guzmán Blanco received the degree of licenciate of jurisprudence in the university. and afterward travelled in the United States. where he represented his country in several capacities. notably as secretary to the Venezuelan legation in Washington. In 1859 he returned to Venezuela to take part in a revolution under General Falcon which was finally successful in 1863. Under the new government he was vice-president, minister of the treasury and minister for foreign affairs. During the period from 1863 to 1868 he acted several times as president *ad interim*, as commander of the army and as special finance commissioner to Europe. and displayed in each capacity extraordinary energy and ability. In 1868, while he was in Europe. the Falcon government was overthrown. In Feb. 1870 he headed a counter-revolt, set up a dictatorship (April 1870) and after more than two years of civil war was elected constitutional president on Feb. 20. 1873. Re-elected in 1880, 1882 and 1886, though frequently away, he retained absolute control of the government until 1888.

Guzmán Blanco's rule was arbitrary, his policy was corrupt and his methods were harsh. but under his regime Venezuela experienced a renaissance. He reorganized the government. asserted the national prestige, enforced security of life and property, placed the finances on a sound footing, broke the power of the church, established primary education, sponsored immigration, constructed railways and roads and spent immense sums on public works.

A revolt broke out, however. against him in the capital in 1889, during the presidency of Rojas-Paul. Guzmán Blanco was in Europe, the government repudiated his authority and the army deserted him. He never returned to Venezuela, and on July 30, 1899, died in Paris.

No authoritative life of Guzmán Blanco has appeared. but interesting chapters on the man and his career will be found in W. E. Curtis. *Venezuela* (New York, 1896), and in Alfred Deberle. *The History of South America* (New York, 1899). (W. B. P.)

GUZMICS, IZIDOR (1786–1839). Hungarian theologian, was born on April 7, 1786. at Vamos-Csalad. He became a Benedictine, and after studying at Pesth, in 1816 settled at the monastery at Pannonhegy, where he devoted himself to dogmatic theology and literature. and contributed largely to Hungarian periodicals. In 1832 he was appointed abbot at Bakonybel. He died on Sept. 1, 1839. Guzmics' chief work is *Theologia Christiana fundamentalis et theologia dogmatica* (4 vol., Gyor, 1828–29).

GWADUR (GWADAR; ancient BARNA), a seaport of West Pakistan, on the Makran (Baluchistan) coast of the Arabian sea, 287 mi. W. of Karachi. The port and dependent hinterland (area 36 sq.mi.) was purchased in 1958 by Pakistan from the sultanate of Muscat and Oman. The town, with small fortress, is on the east side of Gwadur bay on the narrow neck of the Ras Nuh peninsula and below a rocky cliff. Pop. approximately 15,000, including Arabs, Baluchi, Indians, Malays and Sephardic Jews. The Ras Nuh shelters the roadstead of the port, from which fresh and salt fish, dates and wool are exported. Gwadur is on the telegraph routes from India and Pakistan to the Persian gulf and Europe. Sultan Ibn Ahmad of Muscat added Gwadur and other Makran coastal townships to his dominions in 1797. During the subsequent rise of the khanate of Kalat and the consolidation of Persian control to the west of it Muscadine possessions on the north coast of the Gulf of Oman were reduced to Gwadur.

GWALIOR, the winter capital of the state of Madhya Pradesh, India. and capital of the former princely state of Gwalior. Pop. (1951) 241,577. It is a centre of industry, the chief products being textiles, pottery, footwear, silks, carpets, biscuits, confectionery, glass and matches. There are six colleges (including a medical school and an agricultural college) connected with Agra university.

The city centres round a fortress built on a rocky escarpment and guarding the main road from the fertile plains of the north to central India. The fort is first mentioned in a temple inscription of about A.D. 525. It was in the hands of Hindu rulers till 1232 when it was taken by the Moslem ruler Altamsh after the traditional holocaust of women. In 1398 it was taken by the Rajputs. and Raja Man Singh (1486–1516) built two of the palaces within the fort. Recovered by Akbar in 1559, the fort was used by the Moguls as a prison till 1751, when it was conquered by the Marathas. In 1761 it became the headquarters of the Sindhia family. It was taken by the British in 1780, recaptured by the Marathas in 1783, retaken in 1804 and restored to Sindhia in 1805. In 1844 the fort was garrisoned by British troops. In 1853 it was handed over to Sindhia. who held it till the mutiny (1857) when it was seized by the rebel sepoys. In 1858 the mutineers sur-

rendered to the British. In 1886 the fort was restored to Sindhia in exchange for Jhansi.

The fort now contains eight tanks. six palaces, six temples. a mosque and other buildings. The Telika Mandir (11th century'), the Man Mandir, the Gujari Mahal and the surviving atrium of the Great Sas Bahu temple (dedicated 1093) are distinguished examples of early Hindu architecture. The rock face of the fort is covered with numerous Brahmanical and Jain scriptures.

(S. GL.)

History of **Gwalior** State. — Prominent among those Maratha military leaders who were gaining their independence of the peshwa in the second quarter of the 18th century was Ranoji Sindhia (d. 1745), who laid the foundations of the state of Gwalior. The defeat of the peshwa by Ahmad Shah Durrani at Panipat in 1761 accentuated the tendency to independence among the generals. Power now passed from the Brahman peshwas of Poona to the non-Brahman generals, the most important of whom was Rlahadaji Sindhia of Gwalior. a natural son of Ranoji. Toward the end of the first Anglo-Maratha war in the time of Warren Hastings, Mahadaji realized that his true policy lay in throwing in his lot with the British. and his influence at Poona led to the treaty of Salbai (1782). From this date until his death in 1794 Mahadaji strove to consolidate his position in Hindustan and to control the peshwa, primarily in his own interests. This necessitated undermining the Brahman ascendancy at Poona, since the aim of Nana Phadnavis mas to preserve the peshwa's supremacy over the confederacy. In 1785 Mahadaji re-established Shah Alam on the imperial throne at Delhi. In 1788 he took advantage of the cruelties practised by Ghulam Kadir on Shah Alam to occupy Delhi, where he established himself as the protector of the aged emperor. Though nominally a deputy of the peshwa he was the ruler of a vast territory. including parts of central India and Hindustan proper, while his officers exacted tribute from the chiefs of Rajputana.

Mahadaji was succeeded in 1794 by his adopted nephew. Daulat Rao. The death of Kana Phadnavis in 1800 and dissensions in the confederacy were followed by the flight of the peshwa to Bassein, where in 1802 he entered into a subsidiary alliance with the British. This was resented by the other members of the confederacy and brought on the Anglo-Maratha war of 1803 in which Daulat Rao's forces were defeated. By the treaty of Surji Arjangaon (Dec. 30, 1803) his territories were considerably reduced. In 1816 he was called upon to assist in the suppression of the Pindaris, but his conduct was so equivocal that in 1818 he mas forced to sign a fresh treaty by which his territories were further reduced. During the governor-generalship of Lord Ellenborough the growth of turbulence and misrule necessitated British intervention in Gwalior, and the Marathas were defeated at Maharajpur and at Punniar in Dec. 1843. In the 1857 mutiny the maharaja of Gwalior remained loyal to the British even after his troops had joined the mutineers. From that time on Gwalior remained faithful to the British connection. This was maintained through a British resident stationed at Morar. 4 mi. E. of Gmalior city. (This officer in 1936 also became responsible for imperial relations with the United Provinces states of Benares *[see* VARANASI] and Rampur [*q.v.*].) The former Gwalior state (26,367 sq.mi.; pop., 1941, 4,006.159) was divided as follows: (1) large northern tract southeast of the Chambal river and extending southward to the Bhopal border; (2) a large tract about the headwaters of the Kali Sind river, north of the Vindhya hills; (3) three smaller areas west of this, the southernmost containing Ujjain, the original Sindhia capital; (4) a further division to the southeast, north of the Narbada river. The state administrative headquarters were at Lashkar, founded *c.* 1800, 4 mi. S. of old Gwalior. (C. C. D.)

GWATKIN, HENRY MELVILL (1844–1916), English theological scholar, was born at Barrow-on-Soar, Leicestershire, on July 30. 1844, and was educated at Shrewsbury and St. John's college, Cambridge. In 1868 he became a fellow of St. John's and in 1874 theological lecturer. He succeeded Creighton as Dixie professor of ecclesiastical history at Cambridge (1891). He died at Cambridge on Nov. 14. 1916.

His chief works were *Studies of Arianism* (1882); *The Knowledge of God,* the published version of his Gifford lectures (1906); and *Early Church History* (1909).

GWEDUC: see CLAM.

GWILT, JOSEPH (1784–1863), English architect and writer, was born in Southwark, London. Jan. 11. 1784, and died at Henley-on-Thames. Oxfordshire. Sept. 14, 1863. He designed St. Thomas's. Charlton. Greenwich (1846), in the revived Italian Romanesque style then fashionable; also the mansion of Markree castle. County Sligo. But he was best known as a translator of Vitruvius (1826) and author of an *Encyclopaedia of Architecture* (1842). His brother GEORGE GWILT (1775–1856) restored the tower. choir and lady chapel of St. Mary Overy, Southwark (now cathedral,. in 1822–25, using cast iron extensively.

GWINNETT, BUTTON (*c.* 1735–1777), American merchant, patriot and signer of the Declaration of Independence, was born in Gloucester. Eng., probably in 1735, and moved to the colony of Georgia in America some time before 176j. On Feb. 2, 1776, he was elected a delegate from that colony to the .continental congress, and as such signed the Declaration of Independence. His name is known today chiefly because his autographs are of extreme rarity, and collectors of the signers have forced their value to a high figure. Returning to Georgia he was a member of the convention to frame a new constitution for the state and speaker of the assembly. He was mortally wounded in a duel with Gen. Lachlan McIntosh, and died at his home on St. Catherine's Island on May 19, 1777.

See C. F. Jenkins, *Button Gwinnett* (1926).

GWYN, NELL (ELEANOR GWYN, GWYNNE OR GWYNN) (1650–1687), English actress and mistress of Charles II, whose frank recklessness, generosity, invariable good temper, ready wit, infectious high spirits and amazing indiscretions appealed irresistibly to a generation that welcomed in her the living antithesis of Puritanism, was born on Feb. 2, 1650, probably in an alley near Covent Garden, London. Her father's name is unknown; according to tradition he died in a debtors' prison in Oxford during Nell's infancy. Her mother, Helena Gwyn, kept a bawdyhouse in the Covent Garden district, where Nell was brought up "to fill strong waters [brandy] to the guests" (Pepys, *Diary,* Oct. 26. 1667). In 1664. through the influence of her older sister, Rose, Nell became an orange-girl in the King's theatre. Quickly attracting the attention of the leading actor, Charles Hart (whose mistress she became), Nell mounted to the stage, making her first appearance as Paulina, a courtesan, in Thomas Killigrew's *Thomaso,* probably in Dec. 1664. From 1666 to 1669 Nell was the leading comedienne of the King's company, playing continuously save for a brief absence in the summer of 1667 when she lived at Epsom as the mistress of Lord Buckhurst, afterward 6th earl of Dorset (*q.v.*). She created such popular roles as Florimel in Dryden's *Secret Love,* Mirida in James Howard's *All Mistaken* and Jacinta in Dryden's *An Evening's Love.* An excellent singer and dancer, and much in demand as a speaker of impudent prologues and epilogues, "pretty, witty Nell" was ill-suited to serious parts, yet she was often cast for roles in romantic dramas.

Her last appearance was as Almahide to the Almanzor of Hart in Dryden's two-part heroic play The *Conquest of Granada* (Dec. 1670–Jan. 1671), the production of which had been postponed several months for her return to the stage after the birth of her first son by the king (May 14. 1670).

Established in a fine house in Pall Mall and admitted to the inner circles of the court, Nell spent the rest of her life entertaining the king and his friends, living extravagantly and intriguing against her rivals. She persuaded the king to create her son Charles Beauclerk, Baron Hedington and earl of Burford and, subsequently, duke of St. Albans. Her second son, James, Lord Beauclerk (b. Dec. 25, 1671), died in 1680. Nell settled her mother in a house in Chelsea, where, in July 1679, overcome by brandy, Madam Gwyn fell into a nearby brook and was drowned.

Of all the mistresses of Charles II, Nell was the only one beloved by the public. Her popularity was due partly, no doubt. to the disgust inspired by her rival. Louise de Kéroualle, duchess of Portsmouth, and to the fact that, while the Frenchwoman was a Catholic, Nell was a Protestant. But very largely it was the

result of exactly those personal qualities that appealed to the monarch himself. She was small, slender and shapely, with a heart-shaped face. hazel eyes and chestnut-brown hair. She was illiterate, and with difficulty scrawled an awkward "E. G." at the bottom of her letters, written for her by others. "A true child of the London streets," she never pretended to be superior to what she was, nor to interfere in matters outside the special sphere assigned to her; she made no ministers, she appointed to no bishoprics, and for the high issues of international politics she had no concern. She never forgot her old friends and, as far as is known, remained faithful to her royal lover from the beginning of their intimacy until his death and, after his death, to his memory.

When Charles II died in Feb. 1685, Nell was so deeply in debt that she was outlawed by her creditors. However, the king's deathbed request to his brother, "Let not poor Nelly starve," was faithfully carried out by James II, who paid off enough of her debts to re-establish her credit, gave her sizable amounts in cash and settled on her a pension of £1,500 a year. In March 1687 Nell was stricken by apoplexy and partial paralysis. She died Nov. 14, 1687, and on Nov. 17 was buried, according to her request, in the church of St. Martin's-in-the-Fields. Her funeral sermon was preached by the vicar, Thomas Tennison (afterward archbishop of Canterbury), who took as his text, "Joy shall be in Heaven over one sinner that repenteth, more than over ninety and nine just persons who need no repentance."

BIBLIOGRAPHY.—Peter Cunningham, *The Story of Nell Gwyn* (1852); A. I. Dasent, *Nell Gwynne* (1924); J. H. Wilson, *Nell Gwyn: Royal Mistress* (1952). *(J. H. W.)*

GWYNIAD, a species of the salmonid genus *Coregonus,* inhabiting Bala lake in Wales, nearly identical with the powan of Loch Lomond and the schelly of Ullswater and Haweswater. The snout is truncated and the lower jaw included. as in related species from Scandinavia and central Europe. *(See* SALMON AND SALMONIDAE; WHITEFISH.)

GWYNN, STEPHEN LUCIUS (1864–1950), Irish public official and man of letters. was born in County Dublin on Feb. 13, 1864. After studying at St. Columba's college. Dublin. and Brasenose college. Oxford, he taught classics at various places from 1887 to 1596. In the latter year he went to London, where he became a journalist.

In 1904 he returned to Ireland. He was Nationalist member for Galway city in the Westminster parliament, 1906–18, and a member of the Irish convention. 1917–18.

Gwynn published a considerable number of histories, essays, guides and biographies, including lives of Jonathan Swift, Oliver Goldsmith, Sir Walter Scott and Robert Louis Stevenson.

Other books include *Decay of Sensibility* (1900), *The Queen's Chronicler* (verses) (1901j, *Collected Poems* (1923), *The History of Ireland* (1923), *In Praise of France* (1937), *Irish Literature and Drama* (1936), *Memories of Enjoyment* (essays) (1946) and *Aftermath* (verses) (1946). Gwynn died in Dublin on June 11, 1950. His son Denis Rolleston Gwynn (1893–) also became a journalist, and a professor in modern Irish history at Cniversity college. Cork, and wrote biographies and a number of books on Catholic and Irish history. His books include *A Hundred Years of Catholic Emancipation* (1929), *The Inner History of Ireland's Partition* (1950) and *Father Luigi Gentili and His Mission* (1951).

GWYNNE, HOWELL ARTHUR (1865–1950), English journalist arid editor. was born at Kilvey, Swansea. He began his career as correspondent for the *Times* in the Balkans and served that newspaper and the Reuters agency in many areas, including the Sudan, the far east and South Africa, and was foreign director of Reuters in 1904. He was editor of the *Standard* (1904–11) and of the *Morning Post* until it ceased publication (1911–37). A lifelong opponent of sensational journalism. he resisted it to the end, even after the *Morning Post* became a penny paper. Politically he was an uncompromising Conservative. and as such had a part in the deposing of Lord Balfour as party leader and in the overthrow of David Lloyd George's coalition. He was created C.H. in 1938, and died at Little Easton. Essex, on June 26, 1950.

GYANTSE, one of the large towns of Tibet. It lies southeast of Shigatse, 130 mi. from the Indian frontier and 145 mi. from Lhasa. Its central position at the junction of the roads from India and Bhutan with those from Ladakh and central Asia leading to Lhasa made it a considerable distributing trade centre. Its market became one of the largest in Tibet, after Lhasa and Shigatse, especially celebrated for its woollen cloth and carpet manufactures. Caravans arrived there from Ladakh, Nepal and upper Tibet, bringing gold, borax, salt, wool, musk and furs to exchange for tea, tobacco, sugar, cotton goods, broadcloth and hardware. In the British expedition of 1904 Gyantse was one of the first towns occupied. Pop. (1953 est.) 10,000.

GYGES, king of Lydia (*q.v.*) and founder of the Mermnad dynasty, began the transformation of his country into an empire. The dates of his reign are uncertain, H. Gelzer giving 687–652 B.C. and H. Winckler 690–657 B.C. The historical facts of Gyges' accession to power are hidden in a cloud of legends. All agree that in gaining the throne Gyges killed the last of the Heraclid dynasty, variously called Sadyattes, Candaules and Myrsilus, and that he then married the widowed queen to consolidate his power. According to Herodotus in his *History* (7-13), Sadyattes set in motion the events that led to his murder because he was inordinately proud of his wife's beauty. He invited Gyges, a member of his bodyguard. to hide in the royal bedchamber to see the queen naked. Despite Gyges' stealth in leaving after he had seen her; the queen was aware of his presence and the next day summoned him, pleaded that she had been dishonoured and gave Gyges the choice of killing the king and taking his place on the throne or of himself dying. Gyges chose to murder the king.

In Plato's *Republic* (359) the story of Gyges is told as an allegory of how public knowledge of men's acts impel them to act justly. There Gyges was a shepherd who found a ring on a corpse in a hole in the earth made by an earthquake. While talking with other shepherds, Gyges discovered that by turning the ring he could make himself invisible. He then contrived to have himself appointed by the shepherds as a messenger to the king, and when he came to court used his power of invisibility to enter the royal bedchamber, seduce the queen and enlist her aid in killing the king and seizing the throne. Yet another story made Gyges the son of Dascylus, an exiled Lydian. who sent him to the court of Sadyattes where he became a favourite. The king sent him to fetch the daughter of Arnossus of Mylasa, whom he was to marry, and on the way back Gyges fell in love with her. She complained of his conduct to the king. Forewarned of the king's intention to punish him with death, Gyges enlisted the help of the Carian captain of the bodyguard. Arselis of Mylasa, killed the king, seized the throne and married the queen. The civil war which followed was ended only by Gyges' successful appeal to the oracle at Delphi (Herodotus says he was the first barbarian to do so) for confirmation of his right to the throne. Sir James Frazier in *The Golden Bough* theorized that the constant allusion to Gyges' ensuring his power by marrying the widowed queen was evidence that the Delian crown may have descended matrilineally.

The knowledge of Gyges' reign after his confirmation in power is somewhat more factual historically than the stories of how he gained power. He devoted himself to establishing Lydia as a maritime and military power. He is variously credited with successful attacks on the Troad, Miletus, Colophon. Magnesia ad Sipylum and possibly Smyrna. The attacks were probably raids rather than conquests. Whether Gyges was successful in securing the aid of Assur-bani-pal of Assyria when Lydia was invaded by the Cimmerii is uncertain, but the fact that he sent two captured chieftains of the Cimmerii to the court of Assur-bani-pal after successfully repelling the invasion would seem to make Assyrian aid probable. At any rate. Gyges later allied himself with Psammetichus of Egypt. sending him his faithful Carian troops and Ionian mercenaries when Egypt overthrew Assyrian rule. Gyges died in battle during another invasion of the Cimmerii and was succeeded by his son Ardys.

Gyges is said to be the first ruler to be called tyrant (*q.v.*). It was also during his reign that the minting and use of coins is said to have begun.

GYLIPPUS, a Spartan general of the 5th century B.C.; he was the son of Cleandridas, who had been expelled from Sparta for accepting Athenian bribes (446 B.C.) and had settled at Thurii. When Alcibiades urged the Spartans to send a general to take charge of the defense of Syracuse, Gylippus was appointed, and his arrival was undoubtedly the turning point of the struggle (414–413).

When he arrived the Syracusans were on the point of negotiating for a surrender, but Gylippus at once took vigorous measures. His first move was to block the completion of the Athenians' encircling wall. Later he organized assistance among the other Sicilian cities, and was responsible for the decisive step of attacking the Athenian fleet in the harbour. Persisting in this policy in spite of an early reverse, he turned defense into attack. According to Thucydides. who is probably right, he wished to spare the Athenian commanders when they were captured, in order to take them to Sparta. Later, entrusted with a large sum by Lysander to deliver to the ephors, he embezzled it, and went into exile when discovered.

See also SYRACUSE (for the siege operations), commentaries on Thucydides and the Greek histories.

GYLLEMBOURG-EHRENSVARD, THOMASINE CHRISTINE, BARONESS (1773–1856), Danish author, was born on Nov. 9, 1773, at Copenhagen. Her maiden name was Buntzen. Before she was 17 she married the famous writer P. A. Heiberg. Their son was afterward illustrious as the poet and critic J. L. Heiberg. In 1800 her husband was exiled, and she obtained a divorce, marrying in Dec. 1801 the Swedish Baron K. W. Ehrensvard, himself a political fugitive. Her second husband, who presently adopted the name of Gyllembourg, died in 1815. In 1822 she followed her son to Kiel, where he was professor, returning with him to Copenhagen in 1825. Her most famous work is *En* Hverdegs *historie* ("An Everyday Story"). On July 2, 1856, she died in her son's house at Copenhagen. For English readers no closer analogy can be found than between her and Mrs. Gaskell, and *Cranford* might well have been written by the witty Danish authoress.

See J. L. Heiberg, *Peter Andreas Heiberg og Thomasine Gyllembourg (1882)*; L. Kornelius-Hybel, *Nogle Bemaerkninger om P. A. Heiberg og Fru Gyllembourg* (1883).

GYLLENBORG, GUSTAF FREDRIK, COUNT (1731–1808), Swedish poet, a friend of G. Ph. Creutz and Hedvig Charlotta Nordenflycht (*qq.v.*), known for his satirical and reflective poetry, was born on Nov. 25, 1731, in Svinstad (Bankekind), Östergötland. Although his family were prominent in political life, he refused to engage in party battles, and attacked the weaknesses of modern society in the spirit of Rousseau in such poems as "Verldsforaktaren" ("The Misanthrope," 1762). A pessimism typical of the late 18th century is expressed in his most famous poem, "Menniskjans Elände" ("Misery of Man," 1762). After parting with Creutz and Mrs. Nordenflycht in 1763, Gyllenborg wrote little of importance, but devoted himself to a career in the civil service. He died in Stockholm, March 30, 1808.

Gyllenborg's poems were published in *Vitterhetsarbeten af Creutz och Gyllenborg* (1795); his memoirs, *Mitt lefverne 1731–1775,* appeared in 1885.

See M. Lamm, *Upplysningstidens romantik,* vol. 1, pp. 263–308 (1918); G. Sahlberg, *G. F. Gyllenborg* (1943). (L. G. Bz.)

GYLLENSTJERNA, JOHAN, COUNT (1635–1680), Swedish statesman, began his political career at the diet which assembled on the death of Charles X (1660). An aristocrat by birth and inclination, he was nevertheless a true patriot and demanded the greatest sacrifices from his own order in the national interests. He laboured zealously for the recovery of the crown lands, and in the upper house he was the spokesman of the gentry against the magnates. whose inordinate privileges he would have curtailed or abolished.

Gyllenstjerna's adversaries vainly endeavoured to gain him by favour, for as court marshal and senator he was still more hostile to the patricians who followed the policy of Magnus de la Gardie. Thus he opposed the French alliance which De la Gardie carried through in 1672, and consistently advocated economy in domestic and neutrality in foreign affairs.

On the outbreak of the war in 1675 he loyally supported the young Charles XI, whose indispensable counselor he became. Indeed. it may be said that the political principles which he instilled into the youthful monarch were faithfully followed by Charles during the whole of his reign.

In 1679 Gyllenstjerna was appointed the Swedish plenipotentiary at the peace congress of Lund. The alliance which he then concluded with Denmark bound the tno northern realms together in a common foreign policy. and he sought besides to facilitate their harmonious co-operation by every means in his power. In 1680, after bringing home Charles XI's Danish bride from Copenhagen, he was appointed governor general of Scania (Skane), but died a few weeks later.

See M. Hojer, *Ofversigt af Sveriges yttre politik under aren 1676–1680* (1875). (R. N. B.; X.)

GYMKHANA is a display of athletics and equestrian events originated at the military stations of India. The word apparently is derived from the Hindustani *gend-khana,* "ball house" or "racquet court," and the Persian *khana,* "house." The first syllable of "gymnastics" is substituted for gend, implying athletic competition.

Outside India amusing races were added. Thus gymkhanas now include varied competitions, some serious and some funny, on foot, on horseback and on bicycles.

"Gymkana," introduced at the University of Illinois in 1933 and continued at Florida State university after 1949, is a group-recreational activity combining gymnastics with showmanship. (H. D'O. P.)

GYMNASIUM. The history of the gymnasium dates back to ancient Greece where the literal meaning of the word was "school for naked exercise." The gymnasiums were of great significance to the ancient Greeks and every important city had at least one. These were usually built by the state and from a humble beginning of merely a gathering place where exercises were performed grew to imposing structures with dressing rooms: baths, training quarters and special areas for contests.

Originally these gymnasiums were public institutions where only male athletes over the age of 18 received training for competition in the public games of that time as opposed to the palestrae which were private schools where boys were trained in physical exercises. The supervision of the gymnasiums was entrusted to "gymnasiarchs." who were public officials responsible for the conduct of sports and games at public festivals and who directed the schools and supervised the competitors. The "gymnastae" were the teachers, coaches and trainers of the athletes.

Gradually, the gymnasiums developed into institutions of learning and schools of intellectual culture (see SCHOOLS, ANCIENT). In the German speaking countries, the term "Gymnasium" is still applied to the higher grades in secondary schools and has no association with athletics or sports; the name *"Turnverein"* is used to designate a site for physical exercise. However, in the English speaking countries the gymnasium's connection with philosophy and mental culture has been dropped and it ordinarily designates a room or building for the practice of physical culture. Although the Greeks attempted to establish their gymnasiums in the Roman empire, the Romans had little regard for the institution as they felt it was too effete and contributed little to the military training which was paramount for their youth.

One of the first gymnasiums of modern times was the Berlin *Turnverein* (*q.v.*) established by Frederich Ludwig Jahn (*q.v.*) in 1811. A military gymnasium was established at the United States Military academy at West Point in 1817, and in 1822 Capt. P. H. Clias, a Swiss army officer, was appointed gymnastics instructor in the English army and instructed at the gymnasium established at Aldershot, Eng.

Round Hill school at Northampton, Mass.. first offered systematic instruction in a gymnasium in 1823 arid the first German *Turnverein* in the United States was built in 1848 in Cincinnati. O. Princeton erected the first college gymnasium building in the U.S. in 1856 and in 1879 Harvard university built the Hemenway gymnasium which was considered the finest of its time.

Gymnastic instruction at a college for women was first offered in 1862 by Mount Holyoke college, South Hadley. Mass. in a storeroom over the wood and coal shed; a gymnasium was erected in 1865.

The famous Czech (Bohemian) gymnastic society, the *Sokol* established its first gymnasium in Prague in 1862, and its first gymnasium in the United States at St. Louis, Mo.. in 1865. The first Y.M.C.X. gymnasium was opened in 1869, in San Francisco, Calif.

The main purpose of these early institutions was to provide a suitable place for physical exercise and the practice of the sport of gymnastics on the various apparatus *(see* GYMNASTICS). Gradually, however, the scope of the activities carried on in gymnasiums broadened so that 20th-century gymnasiums have facilities for a great many other sports and games such as basketball, volleyball, tennis, handball, etc

(For special equipment. dimensions of playing areas, etc., *see* separate articles on the various sports.)

In addition, most gymnasiums are equipped with dressing and locker rooms, shower rooms and swimming pools, special exercise rooms for remedial gymnastics, boxing, arestling, weight-lifting and fencing rooms, running tracks. etc.

A typical list of standard gymnasium equipment includes the following:

1. Apparatus specified by the Federation of International Gymnastics (F.I.G.) for international gymnastic competitions, *i.e.,* pommelled or side horses, long (vaulting) horses; parallel bars, horizontal bars, stationary rings, balance beams (for detailed description *see* GYMNASTICS: *Men's Events and Apparatus; Women's Events and Apparatus.*
2. Climbing ropes, 1) to 2 in. in diameter (competitive climbing for time is for a distance of 20 ft. under U.S. collegiate and Amateur Athletic union rules).
3. Swinging (flying) rings, similar to the stationary rings, except that they are suspended from a height of 23 to 24 it. and the rings may be made of wood, metal or metal covered with seamless rubber or leather, weighing not less than 4 and not more than 6 lb. per ring. Exercises are performed on the swinging rings while they are in motion, maintaining an angle of at least 40° on each side of vertical (making a total swing of 80°).
4. Elementary apparatus such as low horizontal and parallel bars, vaulting bucks, wall bars and horizontal and oblique ladders.
5. High-jump and pole vaulting standards, together with the necessary sticks and poles ior indoor practice of these activities.
6. Mats, provided for safety when exercising on the apparatus and also large sized, single piece mats for wrestling and tumbling.
7. Necessary equipment for games such as volleyball and tennis nets, basketball goals and backstops. Cabinets provide for the neat and protective storing of equipment-such as basketballs, medicine balls, volleyballs and the portable hand apparatus such as Indian clubs, wands. dumbbells, etc.
8. Special exercise rooms contain such equipment as pulleys, chest weights and weightlifting equipment Boxing and iencing rooms are equipped with the accessaries for these sports.
9. Handball and squash courts, requiring specially constructed walls, are often included in a modern gymnasium.

In design, the recommended dimensions of a gymnasium are a minimum nidth of 60 ft., with a ratio of width to length of 3 to j. Height should be a minimum of 23 ft., and running tracks or galleries should be not less than 10 ft. above the floor. The space required for each person exercising is 40 to 50 sq ft. The floor, usually of maple, should have a hard, clear finish and may be permanently marked to designate boundary lines for basketball, volleyball, tennis courts. etc.

Accommodations for spectators at sporting events may be provided by bleachers — a series of tiered benches — which may be permanent in nature or portable, in that they may be folded up against the walls when not in use.

Gymnasiums often provide the facilities for holding social functions such as dances, receptions, bazaars, fairs, etc. Many gymnasiums include meeting rooms, lounges, auditoriums, theatres, cafeterias, workshops and other facilities to provide recreational and leisure time activities for an entire community. *See* also STADIUM. *(J. F. HY)*

GYMNASTICS. A system of physical exercises practised either to promote physical development or as a sport. The history of gymnastics dates back to the public games of ancient Greece, where the general term included activities which have since developed as separate sports, for example, track and field athletics, fencing, wrestling, boxing, etc. A primitive form of modern gymnastics was practised as training for the more strenuous combative sports and later developed into a competitive sport of its own to the extent of forming part of the ancient Olympic games (*q.v.*). With the termination of the ancient Olympic games all sports fell into a decline. In the middle ages jousts and various field sports were popular, but the systematic training of the body which the Greeks had associated with gymnastics fell into neglect.

The modern development of gymnastics started in the 19th century when there was a revival of interest in all sports, and gymnastics early came to be recognized as a systematized form of physical exercise having not only recreational but therapeutic value, and offering a means of developing a high degree of discipline of both mind and body.

Gymnastic societies were founded first in Germany (*Turnvereins*) and in the Bohemia of the Austro-Hungarian empire *(Sokols)*. followed by France and Suitzerland (where a system of gymnastics performed in unison by groups was developed) then gradually spread throughout western Europe. Gymnastics was one of the first sports to recognize that its recreational and therapeutic advantages were as valuable to women as to men and by the middle of the 18th century provided for the participation of women. The European gymnastic societies also provided children's classes starting youngsters as early as the age of five.

While interest in gymnastics in England and Canada has been mainly in its remedial and physical training qualities, particularly in connection with the military, its recreational and competitive aspects have slowly gained recognition.

The original impetus to gymnastics in the United States came in the 1880s with the advent of the great tide of immigrants from the European countries. who brought with them the ideas of their gymnastic societies and founded these wherever they settled. For additional historical details *see* GYMNASIUM.

COMPETITIVE GYMNASTICS

As a competitive sport gymnastics is akin to diving and figure skating in that it is a "demonstration" sport and the effectiveness of the competitor is assessed solely by the judgment of officials who have a knowledge of the technical rules and regulations governing the competition.

In international competition these rules and regulations are promulgated by the Fédération Internationale de Gymnastique (F.I.G.). The F.I.G. prescribes international standards for the apparatus to be used, the types of exercises to be performed and the conduct of the competition. It is charged with the conduct of the gymnastic competition at the Olympic games and holds world championships in gymnastics every four years (two years after each Olympic games).

Governing bodies in the different countries (such as the amateur athletic unions of England, the Cnited States, Canada, etc.) hold membership in the F.I.G. and conduct gymnastic competitions under F I.G rules.

The men's competition in the international program of competitive gymnastics consists of seven events: the horizontal bar, parallel bars, side or pommelled horse, long or vaulting horse, stationary rings, floor exercises or calisthenics and the all-around event consisting of the combined scores in the first six events (international rules require that a gymnast perform in all events, similar to the decathlon event in track and field).

The women's competition consists of the balancing beam, uneven parallel bars, vaulting horse, floor exercises or calisthenics and the all-around event.

On the apparatus and in calisthenics each competitor performs two exercises, one is a prescribed exercise which all competitors must perform. This prescribed exercise is composed by the governing administrative body of the sport (the amateur athletic unions of the different countries, and the F.I.G. for international competitions). The performance of this exercise is judged solely on its execution, that is, the form of the gymnast, the fluency of his performance, the correctness of the execution and the beauty of combining the component parts of the exercise.

In addition, an optional exercise, composed by the gymnast himself, must also be performed. The element of difficulty of the component movements of the exercise enters into the evaluation of the optional exercise. Beside difficulty, other elements of the optional exercise are originality, beauty of combining of the various movements and the fluency and perfection of its execution.

Four judges, supervised by a "superior judge" evaluate and score each exercise on a one-tenth basis, *i.e.* 8.8, 9.3, etc.. with 10.0 for a perfect exercise. For the prescribed exercise the entire 10.0 points are confined to the execution of the exercise inasmuch as all competitors perform the same exercise. In the evaluation of the optional exercise, 3.0 points are allotted for the difficulty of the exercise: 2.0 points for the element of combination of the various movements and 5.0 points for the execution of the exercise as a whole. All four judges evaluate and score each exercise independently. Then, in order to eliminate gross errors of judgment, the scorers delete the highest and the lowest marks of the four judges, and the two middle marks are averaged for the score of the exercise. For example, if the four judges' marks are 9.6, 9.2, 9.1, 8.7, the 9.6 and 8.7 are deleted and the 9.2 and 9.1 are averaged, giving the final score of 9.15. The average score of the prescribed exercise is added to that of the optional exercise to determine the final score of the competitor in the event and his standing as compared with the other competitors. To obtain the all-around score, the final scores of the six events (four in the case of women) are added and the total comprises the score of the gymnast in the all-around competition.

Since the diinensions and specifications of the apparatus used in the Olympic games and other international gymnastic competitions; as well as the type of exercises performed thereon, are standardized by the F.I.G., when gymnasts from all parts of the world gather for an international competition they have all trained on the same type of apparatus and have a common knowledge of the conditions and requirements of the competition. The F.I.G. delegates the task of prescribing these rules and regulations to two technical committees: one for the men's and one for the women's program, composed of experts who have made a study of the technical aspects of the sport and are alert to changes in the trend of gymnastics and change the programs accordingly.

It should be noted that there was a gradual change in the trend of competitive gymnastics from its earlier concept of emphasizing strength and the holding of classical poses to a more liberal interpretation, and the phrase "artistic gymnastics" came to describe perfection of execution and fluency of movement. Ballet movements, particularly in calisthenics, gained approval and on the apparatus fluent movement; and swinging exercises requiring changes of grasps and position were encouraged to the extent of limiting movements requiring strength and pressing.

Any changes in the rules by its technical committees are published by the F.I.G. and are disseminated to the governing bodies of the sport in the various countries holding membership so that they in turn may keep the gymnasts under their jurisdiction currently informed.

The following is a description of the apparatus as specified by the F.I.G. and the types of exercises to be performed thereon. Inasmuch as most of the countries use the metric system of measurement, the dimensions are so stated rather than in English linear measurements.

MEN'S EVENTS AND APPARATUS

Horizontal Bar.—This is a polished steel bar, 28 mm. in diameter, 2.35 to 2.50 m. long and 2.40 to 2.50 m. high from the floor: supported at the ends by steel poles which are held upright by guy wires. Only movements of swinging and vaulting, without pause. are permitted. Such exercises as upstarts, back and front (by which the gymnast swings himself from a hang to a support above the bar); giant circles forward and backward (rotating around the bar from a handstand position with the arms fully extended) and with inverted or dislocate grips and changes from one to another; vaulting over the bar. releasing the grip and regrasping the bar; movements requiring turns and changes of the position of the body and the releasing and regrasping of the bar; and finishes with straddles over the bar or forward and backward somersaults from the bar are performed on this apparatus.

Parallel Bars.—The two bars, made of wood, are oval in form, 42 to 48 cm. apart, 3.50 m. long and 1.60 to 1.70 m. high. The requirements for this apparatus are movements combining swings, vaults, strength and balances, although the elements of swings, and vaults must predominate. There may not be more than three balances (such as handstands) in an exercise (a sequence of at least ten different movements or tricks) and there must be at least one movement of strength (as a handstand which is pressed into by strength from a support, rather than swung up into). Movements below the bars and movements that require the release and regrasping of the bars are also required.

Side or Pommelled Horse.—This apparatus is a leather covered form, 1.60 m. long, 35 to 37 cm. wide and raised 1.08 m. from the floor (measured to its top) by a support in its centre. Curved wooden pommels, 12 cm. high are inserted in the top of the horse 40 to 45 cm. apart in the centre, or "saddle" of the horse. The gymnast supports himself on the pommels over the horse and performs movements of the trunk and legs, without stops, such as single or double leg circles, crosses of the legs (scissors); with turns and changes of the grasp to the forward (neck) part of the horse, the centre (saddle) and the rear (croup). It is necessary to vary the movements and also to perform them both to the left (clockwise) and to the right.

Long or Vaulting Horse.—The same apparatus is used as for the side horse, except that the pommels are withdrawn and the horse is placed lengthwise so that when the gyinnast faces it the part nearest to his stand is the croup, and the neck is farthest away from him, with the saddle in between. The height of the horse is raised to 1.35 m. The Reuther-type elastic board, placed in front of the croup end of the horse, is 1.20 m. long, 60 cm. wide and raised 12 cm. on the end nearest to the horse, tapering back to the floor. The gymnast takes a run, gathers momentum as he nears the horse, rebounds off the elastic board and, supporting his hands on the horse. vaults over it. A variety of vaults is performed such as vaulting over with straddled legs, with the legs together and bent into a squatting position or the legs straight with the hips bent into a "stooping" position; a handspring over the horse, a cartwheel, etc. The hands may be placed on either the croup or the neck end of the horse, but the space for the support of the hands is limited and encroaching beyond this space inflicts a penalty on the scoring of the vault. Each vault is evaluated by a table as to its difficulty.

Stationary Rings.—The rings are made of wood, 28 mm. in thickness and 18 cm. in diameter (inside). They are suspended by straps at a height of j.50 m. from the floor to the point of suspension, with the rings themselves hanging 2.40 to 2.50 m. above the floor. The exercise must be performed with the rings in a stationary position (without a swinging or pendulum movement of the rings) and must combine swinging movements of the body, strength and holding of positions. There must be at least two handstands in an exercise, one of which must be pressed into by strength from a support above the rings, and the other swung up into from a hanging position below the rings, and at least one other part of strength such as a cross (holding the body vertical with the arms fully stretched sideways); or a lever (hanging with straight arms, with the body stretched out horizontally, either in front of the arms or in a dislocated hang (changing in an inverted position: with the head nearest the floor, and then lowering the body backward, stretching it in a horizontal position with the body stretched backward in back of the arms). Combined with such required movements may be movements of upstarts, either forward or backward, forward or backward uprises, straight or inverted hangs, and dislocate circles of the body, either forward or backward.

Floor Exercises or Calisthenics.—KOapparatus is used in the floor exercises or calisthenic event. The exercise is done on the floor, which may be covered by canvas or felt, in an area 12 by 12 m., and must be at least one minute and not more than two minutes in duration. The type of exercise required is a series of combined movements of the elements of flexibility (tumbling movements

such as handsprings, cartwheels, somersaults in the air, etc.), jumps, strength, holding of poses, balances and other tricks. The exercise must be performed with rhythm and harmony and the gymnast must move in different directions and utilize a major portion of the allotted area. The exercise usually starts and finishes with a series of tumbling movements such as a cartwheel with half a turn ("round-off") continuing with handsprings and somersaults backward or forward in the air. In between the start and finish balances are held on one leg (scales), handstands are pressed into by strength, movements resembling ballet are employed and a variety of tumbling movements and jumps are interposed.

WOMEN'S EVENTS AND APPARATUS

Balance Beam. — This is a wooden beam 5 m. long, 10 cm. wide and raised 120 cm. from the floor. The performer begins the exercise by mounting the beam either by a vault or a jump and executes movements which must include steps, running, jumps, turns, sitting and lying positions and some held or posed positions. The duration of the exercise is from one and one-half to two minutes.

Uneven Parallel Bars. — These are of the same dimensions and construction as the men's parallel bars, except that the top bar is 2.30 m. above the floor while the lower bar is only 1.50 m. high. This apparatus is the latest to be developed, being first used in the 1936 Olympic games, and permits of a great variety of movements, although hanging and swinging exercises predominate (such as hanging from the higher bar and swinging forward to grasp the lower bar and transferring to a support on the lower bar), interspersed with support and balance movements. The performer uses either of the bars, or combines movements using both bars.

Vaulting Horse. — This is the same as men's long horse. except that it is only 1.10 m. high and is placed sideways instead of lengthwise. Women also use the Reuther-type elastic board and perform similar vaults to those done by men except that the vault is much shorter, inasmuch as it is performed over the width of the horse, rather than its length.

Floor Exercises or Calisthenics. — This event is similar to the men's except that it is performed to music and the duration is from 1 to 1½ min.

Other Apparatus

Mats. — Mats to protect the gymnasts against injury in the event of a fall off the apparatus or when dismounting are placed around the apparatus at all times for both men and women.

Elementary Apparatus. — In addition to the apparatus used in competitive gymnastics, an elementary form of apparatus is usually employed by children's classes or beginners in gymnastics to learn the rudiments and elementary movements of the sport and for body development. Examples of such elementary apparatus are the low parallel bars (3 ft. 4 in. high), the low horizontal bar (about chest height), the vaulting buck (a modified form of the long horse), climbing ropes and poles, wall bars and horizontal and oblique ladders.

Rebound Tumbling Apparatus. — To the traditional gymnastic apparatus may be added an apparatus developed in the late 1930s — for rebound tumbling — a table-height metal frame to which is attached a canvas or a webbing bed, the elasticity of which permits the performer to continue springing upward by rebound and perform acrobatics in his flight.

FESTIVALS AND DEMONSTRATIONS

Although gymnastics as a sport also has its recreational qualities, this form is popular mainly in the European countries where it is practised by groups ranging from a few gymnasts to mass demonstrations of many thousands. The *Sokols*, gymnastic societies, in Czechoslovakia have promoted gymnastic festivals in which as many as 10,000 gymnasts participated simultaneously in a mass calisthenic drill. The *Turnvereins* of Germany and the gymnastic societies of the Scandinavian countries also participate in mass demonstrations not only in calisthenic drills but also on apparatus.

OTHER TYPES OF GYMNASTICS

Generally speaking, in addition to being recognized as a sport, there are two other types of gymnastics — physical education and remedial exercises.

Physical Education. — The value of physical education had long been recognized in military circles as a means of promoting general health and self-discipline and had become an essential part of the training of the army recruit, particularly in England and the United States during World Wars I and II, when untrained civilians were inducted into the armed forces. In the elementary schools the term physical education appeared in England and the United States in 1880 and took the imagination of the educational authorities at the beginning of the 20th century. The principal object was the introduction of a balanced and graduated system of exercises to children in the early grades, progressing to more advanced exercise in the secondary schools and colleges. *See* also Physical Education.

Remedial Gymnastics. — Much study and research has been made of the value of remedial gymnastics in connection with the rehabilitation of men badly wounded in wartime and persons with injuries caused by industrial accidents and those handicapped by such diseases as cerebral palsy, poliomyelitis, etc. It was found that with specially graduated exercises constructed for individual needs it was possible to enable a crippled or handicapped individual to enjoy greater mobility by flexing and moving atrophied muscles. Incorporating many of the theories and movements used in gymnastics is a regular feature of practice in orthopedic hospitals. Great progress has been made in the development of remedial gymnastics and the application of its therapeutic qualities. *See* Physical Therapy.

Swedish System. — In Sweden a system of free exercises on the ground was developed in mid-19th century with the objective of developing perfect rhythm of movement. This system was introduced in England and the United States in about 1889 and for the next 20 years the relative merits of Swedish (rhythmic) gymnastics and the German gymnastic system (apparatus work of a formal nature. stressing muscular development) were debated intensively by both the educational authorities and adherents of the sport. A solution was found by the International Gymnastic Federation in the 1920s which blends the rhythmic, fluent movements of the Swedish system with the precision and developmental emphasis of the German system.

Although the Swedish system is still popular in the country of its origin, the combined version has been adopted by sport authorities.

SCHOOL AND COLLEGE GYMNASTICS

Although gymnastics had been practised as a competitive sport in the schools and colleges for many years in the United States it wasn't until shortly after World War II that it came into prominence and gained recognition as a major sport with dual meets and sectional and national championships being regularly scheduled. The school and college program does not comply with the F.I.G. rules inasmuch as it does not require the performance of prescribed exercises and lays more stress on the difficulty of the optional exercise rather than on its execution. The schools and colleges also have competition in events not recognized by the F.I.G. such as tumbling on the mats, rebound tumbling, a 20-ft. rope climb for speed and the flying or swinging rings (the same apparatus as the stationary rings except that the rings are suspended from a point 24 ft. from the floor and the gymnast performs on them while they are swinging). While women participate in physical training, competition in gymnastics in the schools and colleges is confined to men only.

AMATEUR ATHLETIC UNION

The Amateur Athletic union (A.A.U.) is responsible for the administration of amateur gymnastics in the United States. It conducts local, district and national championships under F.I.G. rules and sponsors visiting groups of foreign gymnasts and trips of U.S. gymnasts abroad for international competition. It publishes the rules and regulations governing competitions in its *Gymnastic Yearbook*, basing them on F.I.G. rules and amending them whenever the F.I.G. promulgates changes.

To provide for competition in events which, although not on the international program, still hold a wide interest in the United States, the A.A.U. also includes in its program events such as tumbling, rebound tumbling, rope climb and swinging rings for men and tumbling and rebound tumbling for women. No prescribed exercises are required in these events. Also, the A.A.U. does not require a gymnast to compete in every event (although it encourages all-around gymnasts) but permits competition in individual events.

The various gymnastic clubs holding membership in the A.A.U., such as the German and Swiss Turnvereins, *Sokols* and Y.M.C.A.'s, as well as the colleges, participate in the A.A.U. program and are the nucleus of developing gymnasts to represent the United States in the Olympic games and other international competitions.

For gymnastic records see OLYMPIC GAMES. (J. F. **HY.**)

GYMNOSOPHISTS, the English form of the name *gymnosophistai*, by which the ancient Greeks sometimes designated the ascetic philosophers of India (*gymnos* "naked" and sophistes "teacher of wisdom"). Diogenes Laertius quotes Aristotle as mentioning Indian gymnosophists in a catalogue of the names for wise men and wonder-workers current among non-Greek peoples.

Strabo, however, who writes at some length, though rather superficially, about Indian philosophers and wise men (*Geographica,* sections 703 and 711–715), does not speak of "gymnosophists" but cites Megasthenes as having drawn a distinction between Brachmanes (Brahmans) and the ascetic "dwellers in the forests," who fed on leaves and wild fruits and made what covering they wore from bark.

GYMNOSPERMS. Most of the trees commonly referred to as evergreens belong to the group of seed plants called gymnosperms. They are abundant in nature in many parts of the world and are to be seen everywhere in cultivation. In addition to these common representatives of the group, however, the interesting and often bizarre cycads and Gnetales also belong here. As a group the gymnosperms are particularly interesting to the biologist because of their antiquity. their excellent fossil record, and their great diversity of form and life cycle.

All living seed plants customarily are divided into two main groups, the gymnosperms and the angiosperms (*q.v*). By definition the gymnosperms have naked ovules, exposed to the pollen at the time of pollination, and naked seeds. The angiosperms have ovules enclosed within the ovary of a pistil (gynoecium), with the pollen falling on the stigma at its tip. so that the pollen tube must grow through considerable tissue before reaching the ovules. The seeds of the angiosperms throughout their development are enclosed within the ovary, which becomes a fruit that may be single seeded or many seeded.

The ovules of some gymnosperms are buried rather deeply between the scales of the cone in which they are produced. but the pollen is able to sift down through to them. In a few angiosperms the carpels are open so that the ovules are exposed, but the pollen always lands on the stigma. The basic difference between the two groups thus lies in the behaviour of the pollen, nhich produces a long tube growing down the style in the angiosperms, but which usually enters the ovule directly in the gymnosperms.

All the seed plants have an alternation of generations and the prominent plant ahich is seen is the sporophytic or asexual generation. Spores produced by these plants give rise to the alternating generation. the gametophytes. In the lower plants the gametophyte is the dominant generation. and even in the ferns it is relatively conspicuous. On the other hand, in the gymnosperms and angiosperms the gametophytes are usually quite small, the male gametophyte or pollen grain being transported through the air to the ovule from which the female gametophyte never escapes.

Another basic difference between the two groups lies in the gametophytic generations. The male gametophyte of the gymnosperms always produces more sterile cells than the male gametophyte of the angiosperms. The female gametophyte of most gymnosperms is comparatively large and, like that of the ferns, produces large eggs in cellular structures called archegonia. No archegonia are formed in the angiosperms where the gametophyte is small and produces but one egg.

As a consequence of there being several eggs, the gymnosperms are nearly always polyembryonic — that is, they have several embryos beginning their development, depending upon how many eggs are fertilized. Actually only one embryo usually survives the intense competition to maturity. Angiosperms, having usually a single egg and embryo in an ovule, are rarely polyembryonic. In exceptional cases it is common for several of the embryos to survive to the maturity of the seed.

There are anatomical differences between the gymnosperms and the angiosperms, as well. The phloem of gymnosperms lacks companion cells associated with the sieve cells (which are not sufficiently specialized to be called sieve tubes, as in the angiosperms). Vessels and vessel elements are characteristic of the angiosperms and they are lacking in all the gymnosperms except the Gnetales. In the latter group, as will be seen below, it can be shown that the vessels arose independently of those in the angiosperms.

In addition to the living gymnosperms there are several entire groups which have become completely extinct. The fossil seed ferns (Pteridospermae) are related to the cycads and the Cordaitales are related to Ginkgo and the conifers. The false cycads (Cycadeoidales) are of uncertain affinities.

The only other plants which might be considered to have seeds are fossil. These belong to the group of club mosses (Lycopsida; see PALAEOBOTANY: Plants *of the Palaeozoic* Ern) and there are differences of opinion as to whether the structures produced by them can properly be regarded as seeds. They are so similar to seeds, however, as to suggest that even this characteristic probably has arisen more than once in the evolution of the vascular plants and that perhaps the true gymnosperms are not the homogeneous group they are often thought to be.

Present day gymnosperms include only woody perennial plants which are usually evergreen trees. seldom shrubs. or lianas. There are several more or less distinct growth forms: the palm or tree fern type of the cycads; the profusely branched evergreen tree type of nearly all conifers, conical in their youth and often becoming irregular with age; and the shrubby types represented by dwarf conifers and most of the Gnetales. Nearly all of the latter are either shrubs or woody vines. These growth forms are associated with pronounced differences in size. While the cycads may remain small palmlike trees with a trunk about a foot in diameter and less than 10 to 20 ft. high, surmounted by a crown of compound palm- or fernlike leaves, the conifers include the largest trees known. The giant sequoia, *Sequoiadendron giganteum,* is the world's most massive organism, but it has not been proved to be, as was once thought, the oldest. The latter distinction belongs to another conifer. *Pinus* aristata (foxtail pine). The coast redwood. Sequoia *sempervirens,* is probably the tallest tree known. The cycads. though small in comparison. grow relatively slowly and may become very old. Even the small *Welwitschia* mirabilis of the coastal desert region of western South Africa may live for a century.

Gymnosperms are sometimes referred to as "living fossils." In many features they remain essentially unchanged from their fossil ancestors and their history extends back in an uninterrupted series to the Paleozoic era. There are apparently at least eight phyletic branches of gymnosperms, of which three are entirely extinct and one is represented by a single living representative. the maidenhair tree (Ginkgo). Two other divisions of the gymnosperms include relatively rare plants; only one group. the Coniferales (including pines, cedars, firs. spruces, redwoods. cypresses, etc.), constitutes a really large conspicuous and important part of our existing vegetation.

If we accept the view that all gymnosperms had a common origin, it seems likely that the group from which they evolved is the Filicales or true ferns. There are other possible interpretations, however, and there is not even general agreement that the group is a natural one with a single common ancestor. The earliest fossil types date from the Devonian and they are relatively advanced. An important part of the divergence which they show in their fundamental structures nas attained during the close of the Paleozoic era. They were dominant land plants during the greater part of

the Mesozoic era. Angiosperms did not become abundant until the latter part of the Mesozoic era. Gymnosperms were contemporaneous with the dinosaurs but, unlike these reptiles which have become extinct, a fairly representative group of the former, including some of the most massive organisms that ever existed, remain as a part of our living vegetation.

The eight divisions (taxonomic orders) of gymnosperms are as follows:

1. Pteridospermae or Cycadofilicales. The so-called seed ferns which combine a fernlike habit with seed production are wholly extinct (see PALAEOBOTANY: Plants of the Palaeozoic Era).

2. Cycadales. The cycads, comprising about nine living tropical or subtropical genera, were more abundant in the Mesozoic than today.

3. Cycadeoidales or Bennettitaies. A group of wholly extinct cycadlike plants whose relations are uncertain (see PALAEOBOTANY: Plants of the Mesozoic Era).

4. Cordaitales. The cordaites are now completely extinct, but apparently gave rise to the Ginkgoales, Coniferales, Taxales and possibly the Ephedraceae in the Gnetales (see PALAEOBOTANY: Plants *of* the Palaeozoic Era).

5. Ginkgoales. Mostly extinct but with a single surviving species.

6. Coniferales. The largest and most important order of living gymnosperms; 45 genera with many Mesozoic fossil representatives (see CONIFERS).

7. Taxales. A small group of gymnosperms (the yews) formerly included in the Coniferales.

8. Gnetales. An order including three peculiar genera of uncertain affinities. mostly tropical and subtropical, with few, if any fossil representatives.

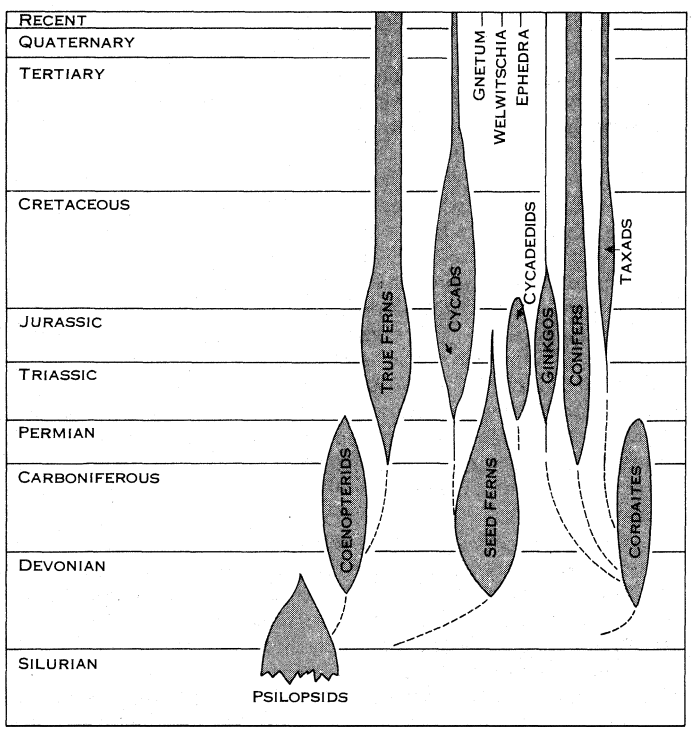


FIG. 1.—DIAGRAM SHOWING EVOLUTION OF GYMNOSPERMS AND RELATIONSHIPS OF THE LIVING GROUPS

The general relationships of the gymnosperms is diagramed in fig. 1 which also shows the major divisions of the geological time scale. Representations of this sort are very general and tentative but may be useful in visualizing one hypothesis of the evolutionary history. Each of the larger divisions represented by living forms has had a continuous history down to the present. Only the Gnetales have no history of which one can be certain. They must have been derived in relatively recent times in areas where fossils rarely if ever were formed.

Gymnosperms are classified primarily on the basis of their reproductive structures. Although these structures are often described as flowers, especially in the original descriptions, it is better to avoid that term and speak of cones or strobili. All of the living gymnosperms have cones of two kinds: the pollen or staminate cones and the seed or ovulate cones. The latter are greatly reduced in some species so that the cone structure is scarcely or not at all obvious and some orders, such as the Ginkgoales and Taxales, probably never had ovulate cones. In those conifers which are monoecious both kinds of cones are borne on the same plant. In other conifers and in all other living gymnosperms, the species are dioecious with pollen cones and seed cones formed on different plants.

The pollen producing plant is often referred to as the male plant and the seed bearing plant as the female. This terminology is not strictly accurate, for the gymnosperms, like the mosses, ferns, and angiosperms, have an alternation of an asexual sporophytic generation with the sexual or gametophytic generation. Although the gametophytic plants in gymnosperms and angiosperms are quite small (sometimes comprising only three cells), they are nonetheless individual plants of a separate generation and are properly called male or female. Since there is not general agreement as to whether the gymnosperms are truly heterosporous, rather than merely heterothallic. it appears preferable to avoid using the terms microspore and megaspore for the spores which will give rise to the male and female gametophytes respectively.

The classification in all groups involves many histological details including the succession of events that go on within the ovules of the cones that bear them. Much of the following discussion necessarily has to do with these internal microscopic details. It is possible to distinguish the gymnosperms on the basis of vegetative characteristics, such as the morphology of the leaves, stems, buds, and on the externally obvious characteristics of the cones. But their classification and phylogenetic position is determined by their reproductive mechanism.

CYCADALES

This division includes about 85 species situated in the tropics and subtropics and includes also a large group of Mesozoic fossil cycads not placed with the Cycadeoidales. The living species belong to nine genera; all are dioecious, bearing only one kind of a cone on a particular plant, either seed cone or pollen cone. Four genera are found in the new world, five in the old world. There are two slightly different growth forms, those with columnar stems and those with stems usually referred to as tuberous. The columnar types consist of erect cylindrical stems, seldom branched, that may become 10 to 30 ft. high, surmounted by a crown of large compound leaves at the top giving the appearance of a palm. The tuberous forms have stems that are subterranean or remain very short and are often branched, but are otherwise similar. The stems of the columnar forms may have an armour of persistent leaf bases covering the younger portion only or occurring throughout their entire length, while in the tuberous forms the leaf bases may scale off. In some of the tuberous forms only the tip of the stem, the cones and the crown of leaves appear above the ground level.

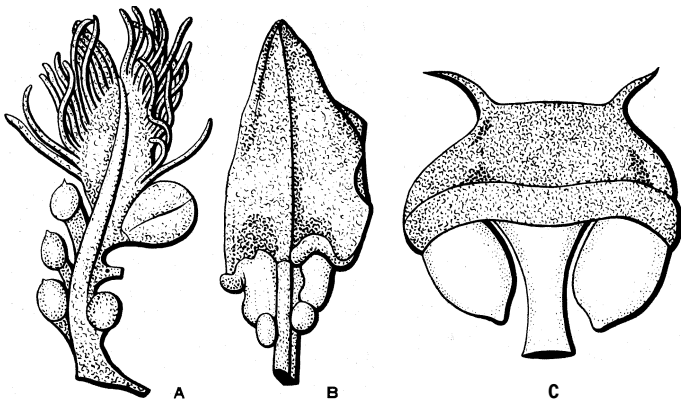
Though cycads are regarded as woody plants, they really have only a scanty zone of wood surrounding a very large pith and enclosed by a very large cortex. Thus the stem is relatively weak in comparison with other gymnosperms. The softer tissues are often permeated with mucilage canals. All cycads grow very slowly. Cycads of the columnar type attain their maximum height only after many centuries of growth. A new crown of leaves is produced annually in some species, biennially in others and the leaves of each successive crown usually persist for several years. Whenever cones are produced, a new crown of leaves is not formed until the following year or the plant may remain dormant for several years before growth is resumed.

The leaves of cycads are pinnately compound and remarkably like those of the palms in appearance. Usually the cuticle is relatively thick and hard and the leaves have a tough texture. In some species the tips of the leaflets are spiny and the entire plant with the spines pointing outward from all of the leaflets makes a formi-

dable barrier.

The following genera of cycads are known:

Cycas with about *16* species extending from southern Japan and Asia, through the Netherlands Indies to Australia, includes only columnar forms which diifer from the remaining genera in having the seed cones produced terminally. Upon resumption of vegetative growth. the crown of new leaves appears at the tip of the seed cone axis and individual cone scales are cast off rather than the entire cone. In all other genera the seed cone is crowded aside and may become detached as a unit if it has not already disintegrated. The meristem forming the new crown of leaves then appears laterally to the base of the old cone. This condition holds



FROM LOTSY, "VORTRAGE UBER BOTANISCHE STAMMESGESCHICHTE" (FISCHER)

FIG. 2.—SEED CONE SCALES OF CYCADS: (A) CYCAS REVOLUTA; (B) DIOON EDULE; (C) CERATOZAMIA MEXICANA

for the pollen cones of all species. *Cycas revoluta* is frequently found in cultivation. in conservatories or as decorative ornamental tub plants or growing in the open in subtropical or warm temperate regions. The leaflets of *Cycas* have a single median vein. The seed-bearing members of the cone have in several species a dissected terminal blade with several ovules or seeds attached laterally to the rachis *(see* fig. 2). The pollenbearing scales are narrower and have a broad pointed tip.

Macrozamia with about *14* species is confined to Australia. This genus includes columnar as well as tuberous species. The leaflets are parallel veined without a midrib and some species have a gland at the base of the leaflet. In many of them both kinds of cone scales are terminated by very long flat spines and in these, as well as in all remaining genera of cycads, only two ovules are produced on the ovulate scales. The seed cones of *Macrozamia denisonii* may become a yard long and weigh up to 85 lb.

Bowenia is the remaining genus found in Australia. It has two species. These are both low tuberous forms with the subterranean stem resembling a gigantic carrot. They differ from all other cycads in having leaves that are twice pinnate. The cones are relatively small and have peltate scales bearing two ovules each.

Encephalartos is a genus with 12 species, all South African cycads. Some are tuberous but most of them are of columnar habit. The margins of the leaves or the tips of the leaflets of many of these species are very jagged or spinous. The bread "palm." *Encephalartos caffer,* produces the largest known cone, sometimes fully a yard in length and weighing up to 100 lb. The other species have much smaller cones, but in several species these are borne in great numbers.

Stangeria, the other South African cycad. a genus with one (or possibly two) species. is a tuberous plant the leaflets of which have dichotomous veins branching off from a central midvein. Its leaves are so similar to those of some ferns that this plant was originally named and classified as a species of the fern *Lomaria* and not until many years later when seed cones were found. was its status as a cycad recognized. The cones are terminal, their scales having a distinct lamina terminating the stalk.

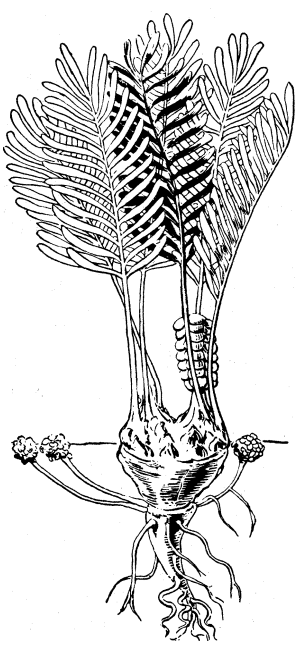
The four remaining genera are all new world plants. *Dioon,* with four species. occurs in central Mexico. The leaflets, without a midrib, are parallel veined and have a broad insertion on the rachis. The Dioons are all columnar in habit and have terminal cones. The ovulate cone scales are especially broad with the two ovules borne laterally on the stalks as shown in fig. 2. The pollen-bearing scales are also very broad at the apex which is broad triangular and turned upward.

Ceratozamia is another Mexican and Central American genus with three to four species. The leaflets are pointed and narrowed below at their insertion on the rachis. They are short. columnar in habit and bear terminal cones. The cone scales are tipped by two firm laterally divergent spines *(see* fig. 2).

Microcycas is a monotypic genus of western Cuba, columnar in habit. with stems that sometimes branch and may become 20 ft. in height. The leaflets are parallel veined and strongly reflexed on the rachis. The cones are large, the scales bearing two ovules each terminated by a rounded pyramidal extension. The single species, *Microcycas calocoma,* has not been successfully grown in cultivation.

Zamia is a genus of about 13 species, ranging from Florida through the Caribbean islands: Mexico. Central and South America to Brazil and Peru. Zamias are all tuberous in habit and frequently branched. The leaflets are parallel veined. *Zamia pygmaea* of western Cuba is probably the smallest cycad. with leaves only a few inches in length and a stem less than a half inch thick. It bears a correspondingly small seed cone with seeds less than 8 mm. long. Most species of *Zamia* are much larger and may produce more than a single cone. especially the pollen cones. The cone scales of *Zamia* are always shield shaped and though actually in a spiral arrangement, they are so regularly spaced that they appear to be attached in vertical rows. *(See* fig. 3.)

Uses of Cycads.—The cycads are valued as decorative, ornamental and conservatory plants. They are not hardy and only a few species may be used as tub plants in temperate regions. In subtropical regions. *Cycas revoluta,* a few species of *Dioon, Encephalartos,* and *Macrozamia* are sometimes grown in the open. Their firm leathery leaves find floricultural use. both while fresh as ceremonial "palm" leaves or as dried leaves which are sometimes dyed green and used in permanent decorations. The stems of *Cycas, Zamia, Encephalartos,* and other genera contain much starch and some yield a sort of sago used by the indigenous peoples. Most species contain an alkaloid which must be washed out and separated from the starch when used as food. The very young leaves of some East Indian species of *Cycas* are cooked as vegetables. The seeds of many species serve as food for animals and man. In South Africa the natives use the seeds of the bread palm. *Encephalartos caffer,* in making bread. On the other hand, in Australia the leaves of *Macrozamia moorei* are poisonous to cattle and this species is therefore being rapidly exterminated.



FROM SMITH ET AL., "A TEXTBOOK OF GENERAL BOTANY" (THE MACMILLAN CO.)

FIG. 3.—MATURE SPOROPHYTE OF ZAMIA BEARING A SEED CONE

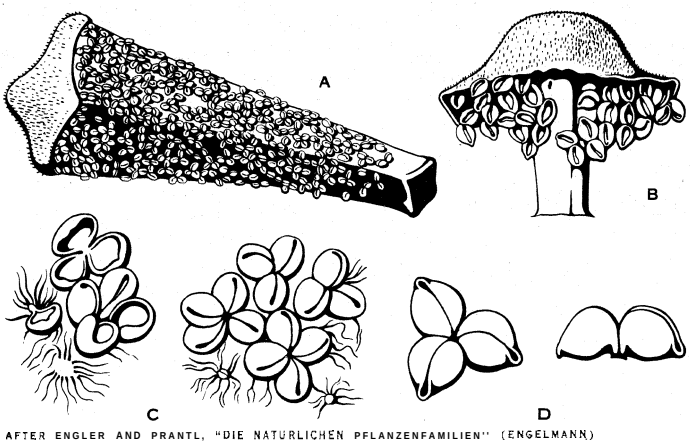
Relationships.— Of the genera enumerated above, when judged by morphology. *Cycas* is regarded as the most primitive. The cone scales of some of these show a closer resemblance to those of certain Mesozoic fossils than to the extremes found among other living species of *Cycas.*

In the old world the Australian *Macrozamia* includes several species that would stand close tb *Cycas,* and some of the species of *Encephalartos* would stand only slightly higher in the scale of evolution.

The Australian *Bowenia* is in some respects the most highly

specialized genus, but has twice compound leaves that may be among the most primitive, and likewise. *Stangeria* is primitive with respect to its fernlike leaves and cone scales, but more specialized in other directions. Among the American genera *Dioon* is the most primitive genus. In some respects it is not far removed from *Cycas. Zamia* is the most advanced, with *Cerutozamia* and *Microcycas* between these extremes and each of them is somewhat specialized.

Reproductive Morphology. — The development of the reproductive structures in the cycads is so little variable that a general description of the phases of the life cycle for any one of them will serve as a general outline for most of the other genera.



AFTER ENGLER AND PRANTL, "DIE NATURLICHEN PFLANZENFAMILIEN" (ENGELMANN)

FIG 4 — SCALESOF THE POLLEN CONES OF CYCADS
(A) Cycas circinalis: (B) Zamia *integrifolia;* (C) parts of A; (D) parts of B, showing sporangia grouped into sori

The spores which developed into the male gametophyte or pollen grain are produced on the scales of the pollen cone in sporangia that are arranged in groups (sori) on the lower surface of the scale and are similar in appearance to those of the Eusporangiate ferns. Fig. 4 shows the sporangia and sori of several species. The sporogenous tissue which will give rise to the spores arises below the epidermis and the sporangium has a jacket several cell layers thick. Within this is the tapetum, a layer of nutritive cells which produce materials needed by the developing spores.

The spore mother cells undergo a specialized type of cell division. called meiosis. which reduces the chromosome number by one-half and produces four cells, each of which is a spore. This reduction of chromosome number from the sporophytic (symbolized by *an)* to the gametophytic number (*n*) is necessary, of course, since fertilization subsequently will double the gametic number. The division of the spore nucleus results in the formation of a pollen grain which is a gametophytic plant — even though very small — equivalent to the prothallus of a fern or to a leafy moss plant. Further divisions will produce the gametes. In the development of pollen in cycads, a single vegetative cell is formed, the prothallial cell. and it persists. The remaining nucleus divides again giving rise to the tube nucleus and a generative cell. By this time the pollen grain has developed a specialized coat consisting of an outer layer, the exine, and an inner layer, the intine. Only the intine is capable of extension as the pollen tube in later stages of development. The pollen grains are in this three-celled condition at the time of shedding and all subsequent development must be observed in the nucellus of the ovules where some of the pollen eventually becomes lodged in the process of pollination. Fig. j shows in A and B the stages before the pollen grain is shed and in C and D stages after it germinates on the nucellus.

Pollination is accomplished by the wind in all of the genera: reports of possible insect pollination in one of the African species may indicate the evolution of another type of pollination. In the cycads that have been observed closely a pollination droplet appears at this time at the micropyle. a small opening through the integument of the ovule. This droplet originates from the tissues at the tip of the nucellus which is the tissue of the ovule in which the spore producing the female gametophyte arises. The formation of the pollination droplet produces the pollen chamber in the nucellus at its tip below the micropyle. The pollen grains falling upon the droplet are held within it by surface tension. As the liquid is resorbed into the nucellus, the entrapped pollen grains are brought into intimate contact with the cells lining the pollen chamber and here they germinate.

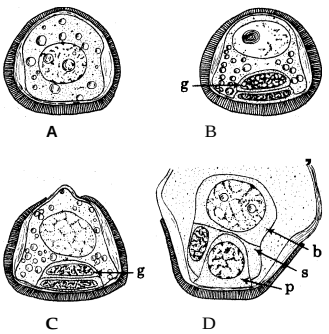
The pollen tubes are formed by an extension of the intine, which emerges at the side where the exine is thinnest. The tubes grow out into the nucellus and penetrate this tissue laterally. Usually there are several radiating outward and downward in all directions. The exine is spread open and adheres to the exposed end where it may be seen throughout the period of pollen tube growth. When the growing end has penetrated deeply into the nucellus, this opposite exposed end, tipped by the exine, elongates and bends downward toward the female gametophyte. Meanwhile the generative cell within the pollen tube has divided to form two cells called the stalk cell and the body cell. The stalk cell clasps or partially surrounds the prothallial cell and maintains contact with the body cell which enlarges greatly as the exposed end of the pollen tube expands and elongates. In fig. 5, C and D show stages in germination of the pollen grains and the formation of the pollen tube of which only the lower end is shown. The body cell divides later to form two cells within each of which a sperm is organized. Fig. 6 shows later stages of several pollen tubes in position above the eggs of the female gametophyte.

As the time of division of the body cell approaches, two conspicuous structures. the blepharoplasts, appear in the cytoplasm of the body cell on opposite sides of the nucleus. Similar blepharoplasts are found in sperm-producing cells of ferns. During division of the nucleus these play a role similar to that of the centrosome of animal cells in marking the poles of the spindle. After mitosis they organize the cilia of the sperm.

The sperms of cycads, nearly .3 mm. in diameter, are large enough to be observed with a hand lens. They are top-shaped cells, the greater part of which is occupied by nucleus. On the pointed end is a spiral row of thousands of cilia that emerge from the cytoplasm in a single spiral band that encircles the sperm many times between the point and the outer margin.

As the female gametophyte enlarges, the nucellar tissue between the exposed ends of the pollen tubes and the female gametophyte breaks down completely. Meanwhile the opening above the pollen chamber at the top of the nucellar tip extending into the lower end of the micropyle is closed. The nucellus becomes a very thin and membranous cap, tipped by a brown point, as shown in fig. 6.

The Ovule and Seed. — As previously stated, the ovulate cones of cycads vary considerably in appearance depending upon the size and shape of the scales of a particular species. Fig. 2 shows how the ovules are attached in three different genera. Ovules are borne at the lateral margins of species with peltate scales, as well as those having spatulate cone scales. They are only partially developed at the time of pollination, but become full grown before fertilization takes place.



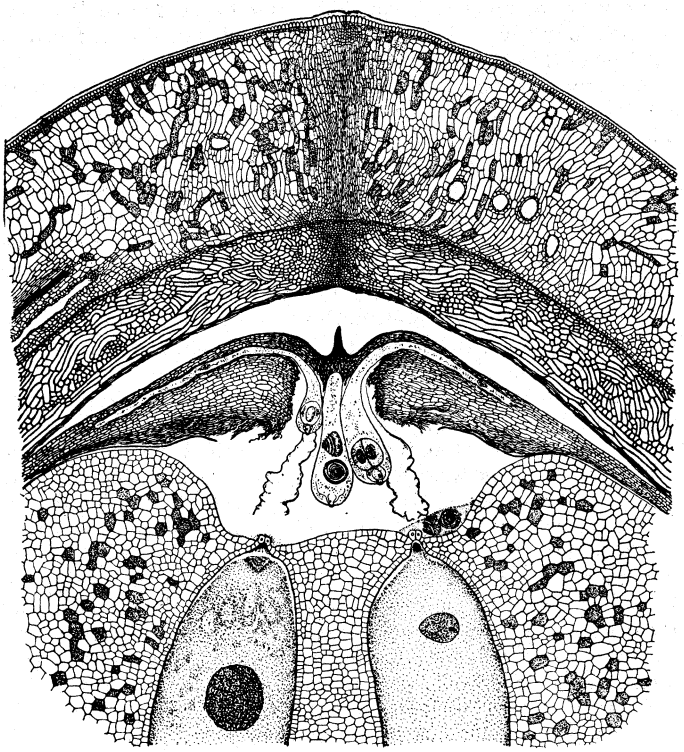
FROM CHAMBERLAIN, "GYMNOSPERMS, STRUCTURE AND EVOLUTION" (UNIVERSITY OF CHICAGO PRESS:

FIG. 5.—DIOON EDULE
(A) micraspore; (B) germinating micraspore showing tube nucleus above (g) the generative cell beside the prothallial cell: (C) exine ruptured by the young pollen tube; (D) later stage, the generative cell has divided, forming a stalk cell (s) and body cell (b). The prothallial cell (p) is protruding into the stalk cell

Young ovules consist of a central ovoidal mass of tissue, the nucellus, surrounded by a thick integument which leaves only a narrow passageway, the micropyle, leading to the tip of the nucellus. The ovules are always attached at the end opposite the micropyle and are thus regarded as atropous or erect.

Deep within the tissue of the nucellus an enlarged cell, the spore mother cell, appears. This cell undergoes meiosis during

which the chromosome number is reduced from *2n* to *n* in forming spores. Only one of the row of four spores persists; the three on the side toward the micropyle are usually aborted. This haploid *(n)* cell gives rise to the female gametophyte. The latter begins to develop by free-nuclear division. that is, no cell walls are formed between the nuclei at first. Soon it becomes an oval cellular structure situated in the centre of the nucellus. At the upper end of the gametophyte several cells enlarge greatly and form the archegonia or egg-containing structures. These may usually be recognized long before they are fully developed.



FROM CHAMBERLAIN, 'GYMNOSPERMS, STRUCTURE AND EVOLUTION' (UNIVERSITY OF CHICAGO PRESS)

FIG. 6.—DIOON EDULE

A reconstruction, from several sections, of an ovule at the time of fertilization. The pollen tube on the left shows the body cell still undivided; the one in the middle shows two sperms and the remains of the prothallial and stalk cells; the one on the right shows the two sperm mother cells and the spiral ciliated band beginning to develop. Two pollen tubes have discharged their sperms. A sperm has entered the egg on the left. Two sperms, in the liquid discharged from the pollen tube, are ready to enter the egg

The early formation of the archegonia checks the growth and enlargement of the gametophyte in this region so that these egg-bearing structures come to lie in a cylindrical depression, the archegonial chamber shown in fig. 6. The wall of the spore becomes thick and remains to envelop the entire gametophyte as a distinct tough spore coat. It is ruptured only in the region above the archegonial chamber a week or more before fertilization.

The archegonia are formed in a manner similar to that of ferns but are deeply embedded and have a distinct jacket of nutritive cells surrounding the eggs.

Fig. 6 shows the disposition of the female gametophyte with the archegonia and its relation to the pollen tubes above in the nucellus and to the surrounding tissues of the ovule. The eggs of cycads are so large that they are easily visible to the naked eye. In *Dioon* edule they are up to 4 mm. long and over 1 mm. in diameter, unquestionably the largest eggs produced anywhere in the plant kingdom.

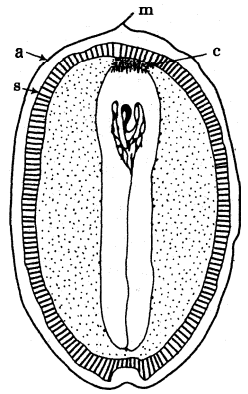
FROM CHAMBERLAIN GYMNOSPERMS STRUCTURE AND EVOLUTION (UNIVERSITY OF CHICAGO PRESS)

FIG. 7.—CERATOZAMIA MEXICANA

Young embryos with suspensors; the rounded bodies at the top are the tough egg membranes; magnification x 1.5

At the time of fertilization a pair of motile sperms may be seen with a hand lens swimming about within the liquid of the pollen tube. These are discharged into the archegonial chamber upon the neck cells of the archegonia causing them to rupture and thus afford direct access to the egg. The motility of the sperms enables them to enter the neck of the archegonia, but soon afterward the cilia are left behind in the upper part of the cytoplasm of the egg. Only the naked nucleus penetrates deeper to unite with the nucleus of the egg cell. This is fertilization, and it restores the chromosome number from *n* to *2n* in forming a zygote.

Sometimes additional sperms enter the upper part of the egg. However, these remain lodged near the neck of the archegonium where they may still be found and recognized by their spiral bands of cilia in the embryos dissected out weeks or months later.



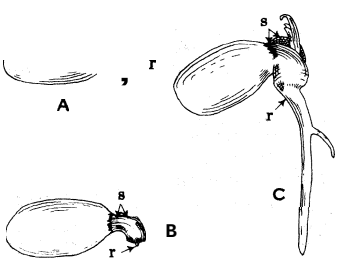
FROM CHAMBERLAIN, "GYMNOSPERMS, STRUCTURE AND EVOLUTION" (UNIVERSITY OF CHICAGO PRESS)

FIG. 8.— DIOON EDULE

Mature seed. The darkly shaded part at the top is the crushed suspensor and root tip (c); the two cotyledons and first leaf are shown; (s) indicates the stony layer of the seed, outside of which is the outer fleshy layer (a); (m) micropyle

Microcycas calocoma of Cuba differs from other cycads in having a large number of smaller archegonia situated over the surface of the gametophyte. Its pollen tubes differ also in giving rise to many sperms each, instead of the usual two.

The embryo of all cycads is formed from the repeated division of the zygotic nucleus. These early free-nuclear divisions and all stages before cell elongation has begun are usually included in what is called the proembryo stage. Nuclear divisions take place until there are from 500 to 1,000 free nuclei. Walls appear between the nuclei situated in the lower part of the archegonium and in some genera the entire egg may be blocked off into cell areas, but the growing meristem of the embryo is always confined to the lowest group of cells. The cells immediately above this meristem elongate to form a suspensor which. by elongating tremendously. thrusts the embryonic tip into the tissue of the gametophyte as the latter becomes the nutritive endosperm of the seed. This process is both mechanical and digestive. The embryonic structures secrete an enzyme which hollows out a cavity within the gametophyte while the suspensor, which becomes long and coiled, keeps the embryo pushed as far forward as possible.



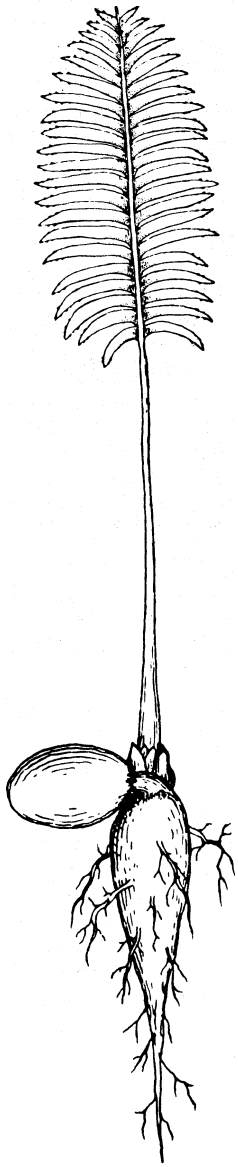
FROM CHAMBERLAIN. "THE LIVING CYCADS" (UNIVERSITY OF CHICAGO PRESS)

FIG. 9.—DIOON EDULE

Seedling; (A) and (B) root tip is emerging and the root end is turning down; about two-thirds of the protruding part is cotyledon, with the root visible at the base. (C) later stage with three leaves between the cotyledons; (r), root; (s), cotyledons; half natural size

Since there are several eggs which may be fertilized. an embryo may begin to develop from more than one of them, a condition referred to as simple polyembryony. However the plural embryos are in intimate competition with each other. All save one are usually eliminated long before this embryo begins to form cotyledons and only a single embryo develops fully as the embryo of the seed.

Fig. 7 shows a tangle of suspensors originating from five fertilized eggs shown at the top. as they appear when dissected out about a month after fertilization. The largest embryo which has survived competition is shown at the tip and still is very small. Fig. 8 shows a similar seed at maturity. A single dicotyledonous embryo occupying a central position is surrounded by the endosperm (female gametophyte) and with the ovule wall, which now has a stony layer, forming the testa.



FROM CHAMBERLAIN. "ELEMENTS OF PLANT SCIENCE" (MCGRAW-HILL BOOK CO.)

FIG. 10.—DIOON EDULE

Seedling; all the part bearing secondary roots is the primary root. The stem, bearing the leaf and scale leaves, is so small at this stage that it is hidden by the emergent part of the cotyledons

Fig. 9 shows a seed of ***Dioon*** *edule* in germination. Fig. 10 is a seedling with its first leaf expanded. The stem bearing this leaf and the scale leaves is still so small that it remains hidden while the primary root bearing secondary branches has become fleshy.

GINKGOALES

This order of gymnosperms has only a single living representative: ***Ginkgo*** bilobu, the maidenhair tree. It is native to China, although it has not been found forming native forests in any part of Asia. The tree is frequently cultivated in temperate regions, and in China it is usually found at temples and shrines, or under circumstances which could account for it as escaped from such cultivation.

According to Hui-Lin Li. ginkgo was unknown to the ancient Chinese and appears in the literature for the first time in the 11th century. Not only was it brought into cultivation. but it was introduced into poetry and painting, where it remains an important object of representation. This early interest in the plant stems from its edible seed and its ornamental qualities. The literary name of the seed, the fleshy outer layer of which has a waxy bloom. is Silver Apricot. From these beginnings the ginkgo spread rapidly to Japan and to the western world. Today it is one of the most highly valued street trees because of its resistance to smoke, disease, and insects. Only the staminate trees should be planted for the seeds produced by the ovulate trees have an oil in the fleshy coat with a most offensive smell. Horticultural varieties are now available which combine, in a staminate tree. predominantly upright, rather than spreading, habit and a rich golden color of the leaves before they fall in the autumn.

The habit and general appearance of ginkgo is that of a conifer. The wood is similar to that of conifers; its wedge-shaped leaves, which are not evergreen. have dichotomous veins that remind one of the leaflets of the maidenhair fern, though they are much larger. thicker and show considerable variability in size, shape and lobing. In winter the tree is not conspicuously different from the trees of many deciduous angiosperms. However, a closer examination of the twigs shows that these are long shoots bearing many dwarf branches. The long shoots continue the growth on the end of long shoots of the previous year, bearing leaves that alternate in a spiral arrangement. Along these twigs two or more years old are the dwarf branches, which originated from buds in the axils of the leaves of the first year's shoots. These spurs vary in length with their age. and bear groups of leaves terminally that arise from the bud at the tip in annual succession for many years. Occasionally, the dwarf branches give rise to long shoots growing out from their tips. Dwarf branches have a relatively thick cortex and large pith with the wood zone correspondingly narrowed. and taken as individual units they are comparable to a miniature cycad trunk with its terminal crown of leaves. It is on these dwarf branches that the reproductive structures are borne. and like all living cycads. the trees are strictly dioecious. Fig. 11 shows these branches with ovule-bearing stalks and pollen cones near the time of pollination when the new leaves appearing in the spring are half grown. The ovules are always paired though it is not usual that both ovules are developed; more frequently only one of the pair enlarges to develop fully (fig 11 C) The aborted ovule remains as a scar at the base of the enlarged seed.

The reproductive morphology differs only in minor details from that of cycads The pollen is borne in sporangial appendages of which there are many that make up the pollen cone Each appendage bedrs a pair of deflexed sporangia on the end of a short stalk as shonn in fig. 11 E The pollen grains. formed from spore mother cells as in cycads. also have double spore coats with several cells formed internally at the time of pollination. Likewise, the pollen is wind borne with the pollen falling into pollination droplets which appear at the micropyles of the ovules. The ovules enlarge and are soon full grown as represented by fig 12 which shows a longisection through a fully enlarged ovule near the time of fertilization, in A and a matured seed in B.

After fertilization. which is accomplished as in cycads by motile sperms the proembryo initiates its development in the same manner However. after about 250 free nuclei have been formed, cell walls appear between all of the nuclei so that the entire egg cavity is filled with cellular tissue. The cells of the lower part of the proembryo divide rapidly. while those near the upper part begin to elongate and push the embryo downward into the gametophyte (which becomes the endosperm of the seed), but usually not farther than one-third the length of this tissue before the seed is shed The seeds usually fall from the tree in autumn before they are fully matured and the soft. outer, fleshy seed coat soon develops a very putrid odour If planted, the seed will not germinate for many months but this delay is due only to the immaturity of the embryo. A small percentage of the seeds may contain two embryos matured to the stage with cotyledons, which may develop internally in ihe ginkgo seed with someuhat less close competition in their earliest stages than in cycads This is due to the fact that the smaller archegonia are slightly separated and long coiled suspensors are not formed. Nevertheless,

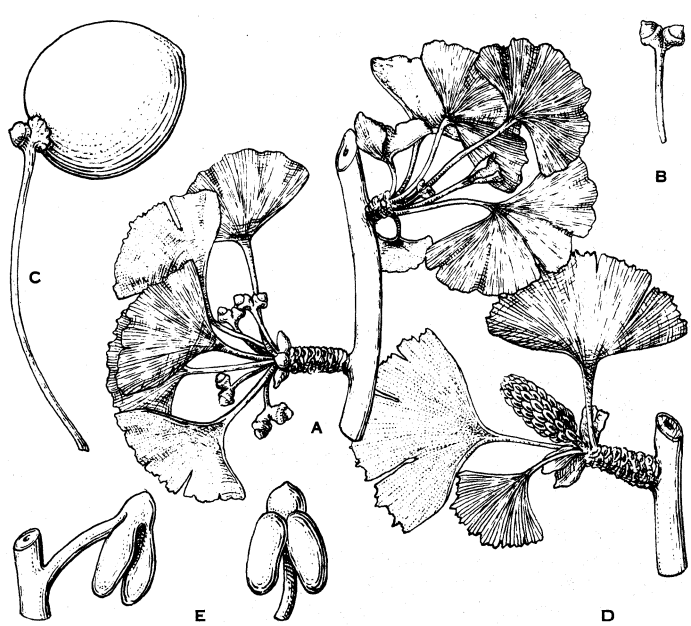


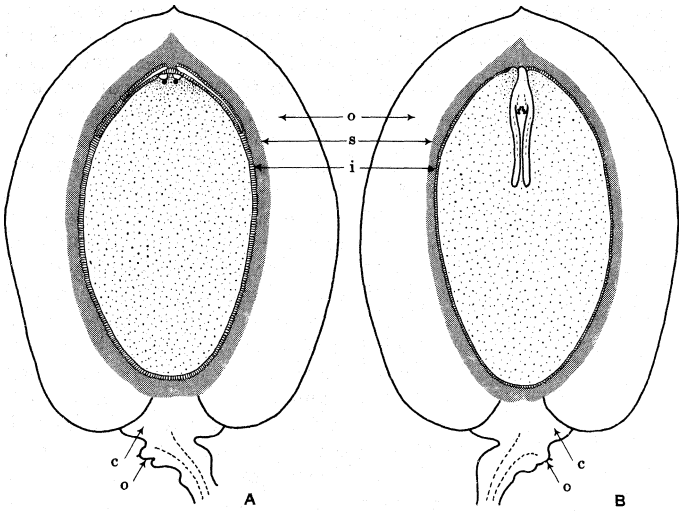
FIG. 11.—GINKGO BILOBA

Twigs bearing half-grown leaves on dwarf branches. with ovulate stalks in (A) and (B) as they appear at the time of pollination. (C) shows an ovule after enlargement. (D) shows a twig bearing a pollen cone, with its sporangia enlarged in (E)

the several embryos from simple polyembryony are usually eliminated; less than 2% of the ripe seeds contain more than a single embryo.

While the reproductive morphology of ginkgo has much in common with that of the cycads, they differ in other respects The stem anatomy aside from that of the spur shoots, is much

closer to that of the conifers; the long stems have relatively little pith, a narrow cortex and a very large volume of wood that grows rapidly from a cambium and forms distinct annual growth rings. In the spur branches the pith. wood zone and cortex are



FROM COULTER AND CHAMBERLAIN, "MORPHOLOGY OF GYMNOSPERMS" (UNIVERSITY OF CHICAGO PRESS)

FIG. 12. — GINKGO BILOBA

(A) longitudinal section of an ovule when fully enlarged, some time after pollination; (o), outer fleshy layer of integument: (s), stony layer of integument; (i), inner fleshy layer of integument; (c), collar; (o), (lower), abortive ovule. The inner fleshy layer and nucellus are shaded with lines; magnification about X2. (B) similar section with the stony layer hard, the inner fleshy layer dry and papery. An embryo has developed, shown as found after the seed has fallen from the tree; magnification about X2

proportioned more nearly as in a cycad trunk.

Ginkgo is regarded as a descendant of the Cordaitales (see PALAEOBOTANY; Plants of the Palaeozoic Era), to which it is linked by a series of many Mesozoic fossil forms—Baiera, *Ginkgoites*, etc.—found in widely scattered regions of North America, Europe and Asia.

TAXALES

The Taxales are a small order of gymnosperms usually included in the Coniferales. They are separated here since, according to the work of Rudolph Florin and others, the taxads proper have never had ovulate cones. That is, the ovules are borne terminally and singly on axes of the plant and are not aggregated into cone-like structures. Their evolutionary history can be traced back separately well into the Mesozoic. There are four or five genera recognized: *Taxus* (yew), Torreya (California nutmeg or stinking cedar), *Austrotaxus*, Amentotaxus, and Nothotaxus. All of them are shrubs or trees (rarely reaching a maximum height of go ft.).

The usually spirally arranged leaves are needlelike, but flat, fairly wide, and sharp pointed. The Upper Triassic genus *Paleotaxus* is similar to modern forms, and *Taxus* and Torreya extend hack to the Jurassic.

Taxus with about seven species is widely distributed in Europe, North Xmerica, eastern Asia and Asia Minor. It is the only member of economic significance, being extensively cultivated for ornament, having wood used for cabinetmaking. bows, etc., and having poisonous properties. Torreya has five or six species found in western Florida, California. China and Japan. while *Amentotaxus* has four species of subtropical regions of eastern Asia. *Austrotaxus* (Sew Caledonia) and Nothotaxus (eastern China! are monotypic.

Members of the Taxales are monoecious or often dioecious. The staminate cones are small and composed of a few peltate or radially symmetrical scales bearing several pollen sacs. The ovules are large and highly specialized and basically terminal. In *Taxus* there has been a relatively recent tendency toward aggregation of the ovules and thev are horne on reduced shoots and are sometimes crowded. The taxads have the ovules more or less enveloped in a so-called aril, a fleshy outgrowth from the axis. This may be bright red (as in the yews) or purple.

Development of both male and female gametophytes is specialized. The archegonia are often very small and may lack the ventral canal nucleus. Simple polyembryony prevails except in Torreya where cleavage polyembryony is retained.

GNETALES

These are perennial, normally dioecious plants with opposite simple leaves. The perianth of one or two whorls is distinctive, and sharply contrasts this division with other gymnosperms. The cones are more complex than in other forms, consisting of an axis bearing decussate pairs of bracts or a number of superposed whorls of bracts. each whorl connate in a cuplike form. In either case the ovulate or staminate structures, which for convenience we may call "flowers." are axillary to these bracts. The flower always consists of one or two pairs of free or connate scales, the perianth, enclosing either a single ovule with a long projecting micropylar tube, or from one to six stamens.

It is evident that it is the flowers of Gnetales, especially the ovulate flowers. which are equivalent to the cones of conifers (*e.g.*, compare the female cone of Torreya) and not the. whole "cone," which might well be called a compound cone, and which is also comparable to the catkinlike inflorescence of certain flowering plants.

The Gnetales are superficially similar to the angiosperms in their anatomy, for though the phloem remains typical of the gymnosperms in general, true vessels are associated with the typical gymnospermous tracheids and there are no resin canals. The tracheids have very large circular bordered pits and the vessels of Gnetales have evolved from them by the dissolution of the closing membrane of these pits. The cells. placed end to end. function as long tubes for the conduction of water. Vessels in the angiosperms have evolved from tracheids with an entirely different type of pitting and they are a completely independent acquisition.

The order Gnetales includes only three genera. which are so entirely different as to suggest that each should be regarded as the type of a different order. Perhaps such a taxonomic treatment would be preferable to that usually folloned; an intermediate course, recognizing each as the type of a family. will be followed here. The Gnetales, in the broad sense, have had only a very recent fossil history and the relationships of the plants are still imperfectly understood. It seems clear that none of the three can be regarded as ancestral to the flowering plants despite some interesting examples of convergent evolution. From the work of A. J. Eames there is considerable evidence that the Ephedraceae are related to the extinct Cordaitales; and there is some evidence that the other two families are not. Until the latter have been studied as thoroughly they are better lumped with the Ephedraceae in what is probably an unnatural order. The three families are characterized as follows:

The Ephedraceae includes only the genus Ephedra consisting of much branched. small-leaved xerophytic shrubs. The ovule has tn-o integuments containing a female gametophyte with archegonia. similar to that of the Coniferales.

Welwitschia is the only genus of the Welwitschiaceae and it contains a single species. The plants are large, tuberous and mostly underground. They develop only two enormously long and straggling parallel-veined leaves after the cotyledons. The ovule has one integument and no archegonia are formed.

The Gnetaceae are all put into the genus Gnetum and are either trees or large woody climbers with numerous net-veined leaves superficially indistinguishable from those of a dicotyledonous angiosperm. The ovule has two integuments and there are no archegonia in the female gametophyte.

Ephedra.—This largest genus of Gnetales has about 35 species, represented in America, Xsia and Europe. It is confined to more or less arid warm-temperature and tropical regions and one species is common on sand dunes along parts of the Mediterranean coast. The finer branches are green; the surface of the long internodes is marked by fine longitudinal ribs; and at the nodes are borne

pairs of small, partially connate scale leaves, the general appearance being similar to that of a stem of *Equisetum* or a twig of *Casuarina*. Some of the branches bear pairs of small cones in the axils of the scale leaves. The cone scales are broad and imbricate. Each staminate flower (fig. 13j consists of an inconspicuous perianth, composed of two more or less concrescent bracts. enclosing an axis projecting beyond the perianth and terminating in two (sometimes more. up to six or eight) sporangia. The resemblance of this structure to a stamen is obvious, but it is no less clearly homologous with the cone scale of conifers.

The ovulate flower is enveloped in a closely fitting perianth of two more or less connate bracts. as in the staminate flower. This perianth encloses a single ovule with two integuments, the inner, which is not more than two cells thick, prolonged upward as a beaklike micropyle, the outer. which is thicker and later becomes woody, only reaching about halfway up the micropylar beak. The micropyle secretes a pollination drop, as in conifers.

A prothallus is organized exactly as in conifers. the two to five archegonia being developed from separate superficial cells at the apex, and having long. multicellular necks. About the time when they first appear, the tip of the nucellus begins to break down, this disorganization proceeding downward until there is (when the archegonia are mature) a broad circular pollen chamber open to the top of the prothallus, thus permitting the pollen grains to rest on the necks of the archegonia. The development of the pollen grain is closely similar to that of *Larir* and it is shed in the five-nucleate condition.

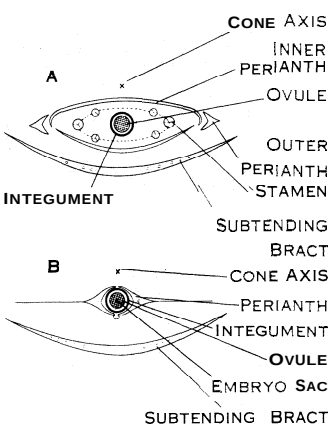
FROM ENGLER & PRANTL, "DIE NATURLICHEN PFLANZENFAMILIEN (ENGELMANN)

FIG. 13.—A STAMINATE FLOWER OF EPHEDRA FRAGILIS

Division of the body cell occurs immediately after pollination and the pollen tube forces its way between the neck cells and discharges its contents into the egg within a few hours. The fusion nucleus divides three times to form eight nuclei. some of which then become organized into walled cells, very loosely connected into a proembryo. Each of these cells. after division of its nucleus. elongates and cuts off a small embryonal cell containing one of the two nuclei, the larger cell remaining, the suspensor. elongating rapidly to thrust the embryo cell deep into the prothallus tissue. The embryo cell divides to form an ovoid mass of cells of which those next to the suspensor elongate in succession giving rise to embryonal tubes which add to the length of the suspensor. The whole process is strongly reminiscent of what takes place in *Actinostrobus* among the conifers where cleavage polyembryony prevails.

Welwitschia.—*W. mirabilis* is the only species of this remarkable genus and is found in two isolated and restricted areas of the coastal desert region of Damaraland in South-West Africa. It is by far the most remarkable member of the Gnetales not only in its habit but also both in the form of its flowers and the details of its development. Knowledge of these details is largely due to investigations carried out by H. H. W. Pearson.

An adult plant has somewhat the form of a gigantic radish 2 to 4 ft. in diameter, projecting less than 1 ft. above the ground, and terminating in a long taproot below. The two strap-shaped leaves trail along the ground to a length of 10 ft. or more, and become split into a number of narrow thonglike strips. They retain the power of growth at the base throughout the life of the plant which probably exceeds 100 years. The characteristics of the plant accord well with the interesting suggestion that it may represent an "adult seedling." Numerous circular pits occur on the concentric ridges of the depressed and wrinkled crown, marking the positions of former inflorescences, new ridges subsequently appearing outside the old ones. The inflorescences have the form of dichasially branched stalks bearing the cones, from 1 to 20 in the ovulate plant and up to 50 in the staminate. The ovulate cone is about ▮ in. long and scarlet in colour, the staminate smaller and more slender. Each consists of an axis bearing a large number of alternating pairs of overlapping bracts. in the axils of nhich are the flowers. The staminate flower (fig. 14 A) is enclosed by a perianth of two opposite pairs of bracts, surrounding a ring of six stamens united below but free above and each terminating in a trilocular anther. In the centre of the flower is an abortive ovule the integument of which projects upward as a spirally twisted tube with a stigmalike expansion at its apex. In the development of the pollen grain, a single prothallial nucleus is cut off. which disappears again about the time of pollination. There are only two further divisions resulting in a tube nucleus and two male nuclei, the formation of a stalk cell which occurs without exception in all conifers, as well as in *Ephedra*, being omitted. There is evidence that pollination is effected by insect agency. The ovulate flower consists of an erect ovule with two investments of which the outer is winged and represents the perianth, formed of a pair of completely connate bracts, the inner being the integument which has the usual long tubular micropyle (fig. 14 B). No pollen chamber is formed, but numerous pollen tubes grow downward in the nucellar cap. The spore begins to develop as usual, becoming filled with protoplasm containing over 1,000 nuclei before walls appear. The latter divide the whole sac into multinucleate compartments, those in the micropylar end containing fewer and larger nuclei! any of which may function as eggs. The remainder contain about a dozen nuclei each, all of which fuse together in the compartment, thus forming a tissue of uninucleate cells which then grows considerably and may be termed the endosperm.



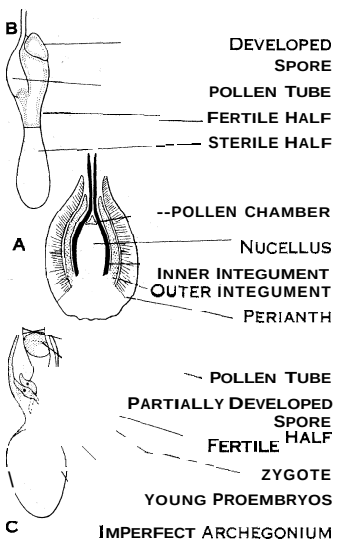
FROM H. H. W. PEARSON, IN THE "PROCEEDINGS OF THE ROYAL SOCIETY"

FIG. 14.— WELWITSCHIA
Cross section of floral structures. (A) staminate flower; (B) ovulate flower

The rnicropylar multinucleate cells put out long tubes which grow upward into the nucellar cap, and into which the egg nuclei pass. These ascending prothallial tubes meet, and fuse with the descending pollen tubes and at the point of fusion, fertilization occurs.

The fertilized egg forms a wall and elongates into a tube from which an embryo tip cell is cut off, the remainder of the tube being the suspensor which carries the embryo deep into the endosperm. Thus it appears that only a single embryo is produced from each zygote. in contrast with cleavage polyembryony in *Ephedra*. The further development is similar to that in *Ephedra*, including the formation of embryonal tubes from the young embryo

Gnetum.—This is represented by about 30 species, mostly climbers. found both in tropical America and in tropical regions of the old world. The oval leaves are 2 or 3 in long and are borne in pairs at the swollen nodes. The cones are long and cylindrical and bear uhorls of flowers at each node, accompanied by numerous sterile hairs. in the axil of cuplike concrescent bracts. In a staminate inflorescence very numerous flowers may be found, up to about 3,000 in one species, while in an- ovulate spike the number of flowers probably does not reach 100. The staminate flower consists of a perianth of



AFTER LOTSY IN THE "ANNALS DU JARDIN BOTANIQUE DE BINTENZORG" (E J BRILL)

FIG 15.—GNETUM GNEMON
(A) longitudinal section of ovulate flower; (B) prothallus at time of fertilization; (C) prothallus after fertilization

two concrescent bracts enclosing a slender axis projecting above the perianth and terminating in two sporangia. The pollen appears to be formed in precisely the same manner as that of *Welwitschia.* Incomplete ovulate flowers are often found in the staminate inflorescence containing ovules with one integument instead of two, but these rarely set seed.

A perfect ovulate flower (fig. 1j) consists of an ovule with three investments of which the outer is generally regarded as a perianth of two concrescent bracts. Of the other two the inner arises first and develops the long slender micropylar tube characteristic of all Gnetales and is followed by a much shorter outer covering. the outer integument.

Several spores may begin to develop in a young ovule. but only one attains full size. In all species the embryo sac, as in *Welwitschia,* becomes filled with numerous free nuclei, and in some species. probably in the large majority. fertilization occurs at this stage, the contents of pollen tubes being discharged into the embryo sac. any of the nuclei near the micropylar end apparently functioning as eggs. The lower half of the sac then becomes partitioned (as in *Welwitschia*) into multinucleate "cells," the nuclei of each cell subsequently fusing so that an endosperm of uninucleate cells results, into which the developing embryos penetrate.

Each zygote of *Gnetum gnemon* is stated to elongate and form a long tortuous multinucleate suspensor, from the lower end of which a small, also multinucleate, embryo cell is cut off. Walls are said to appear in this "cell" and so reduce it to a tissue of uninucleate cells.

While this account may not apply to all species of *Gnetum,* it is surprising to find certain resemblances to the embryogeny of some Cupressaceae, notably *Juniperus,* in which suspensor-embryo initial cells give rise to embryos in a specialized type of cleavage polyembryony.

The later development of the embryo is similar to that of *Welwitschia,* and in both genera a rodlike outgrowth is formed from the hypocotyl at its junction with the radicle. which serves as a feeder and draws nourishment from the endosperm during the germination of the seed.

The climbing species of *Gnetum* are characterized by the production of several concentric cylinders of wood and bast from as many successively formed cambium cylinders produced in the pericycle, as in *Cycas.* (J. T. Bz.; W. T. Sa.; R. W. H.; X.)

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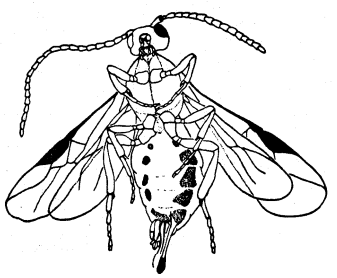
GYMPIE, a town of March shire. Queensland. Australia. 107 mi N. of Brisbane and 61 mi. S. of Maryborough by rail. Pop. (1954) 9.964. Gold was discovered by James Nash in 186; and mining continued up to 1930. The total gold yield was 4 500 000 oz.

Gympie became a municipality in 1880 and a city in 1905. The district is now one of the state's best dairying, agricultural and fruit-grot! ing areas.

GYNANDROMORPH (Gynander), a zoological term denoting an organism in which the body is of fundamentally different cunstitution in different regions. male in some, female in others, the areas being quite clearly demarked.

A hermaphrodite (*q.v.*) or an intersex may likewise show male characteristics in some parts of its body, female characteristics in others, but its mosaicism is only apparent. Fundamentally all parts are of the same sex.

Gynanders are reported in many invertebrates, especially in insects. In certain butterflies in which there is extreme sex difference in colour and wing form, they are very striking in appearance. In the fruit fly *Drosophila,* the genetic conditions of the formation of gynanders have been analyzed by use of mutant traits. In this fly most gynanders begin development as females with two sex chromosomes. One of these chromosomes is lost from a cell giving rise to part of the body, thus resulting in a patch of male tissue which may be large or small according to whether the loss occurred early or late in development. In other cases certain mutant genes cause elimination of a sex chromosome in many minute regions of the body surface. resulting in a gynander that is mostly female with many small male spots. Recessive mutant traits carried by the sex chromosomes supplement secondary sex characters in making the gynanders very conspicuous by their asymmetry in colour or form.



GYNANDER OF PARASITIC WASP HABROBRACON

Ventral view (X9); note the shorter antenna, the heavier structure of the abdomen and the elongate sting or ovipositor on the female side (right). The mother of this specimen had the mutant trait white eyes, shown on the fatherless male side. The dominant paternal black eye colour is visible on the female side

Many gynanders are reported in ants, bees and wasps, but some of these are undoubtedly intersexes. The genetic method of use of mutant traits has been employed in investigations with the parasitic wasp *Habrobracon.* Here the female parts are biparental, derived from a fertilized nucleus, while the male parts develop parthenogenetically (without fertilization) from a second egg nucleus or, much more rarely, from a second sperm nucleus.

Male regions of gynanders may be completely separated from female, as left *v.* right or anterior *v.* posterior. There may be one or more male islands in the female region or the reverse, or there may be considerable intermixture. These differences depend primarily upon chance distribution of the two types of nuclei in the insect egg preceding the formation of cells in the early embryo.

Reproductive reactions, mating, egg laying, etc., in the wasp *Habrobracon* have been shown to depend upon the sex type of certain regions of the head.

Tendency toward formation of gynanders is hereditary. Extensive breeding work with certain species of moths (*e.g.,* gypsy moth) has failed to reveal more than one or two gynandric individuals, while in other species (beeswax moth, silkworm moth) gynanders are frequent, especially in certain stocks. In moths both nuclei of the binucleate eggs must be fertilized in order that a gynander may develop.

In vertebrates there have been many reports of gynanders, but the cases are doubtful. In certain species of birds (pheasants and finches) in which the males differ strikingly from the females in form and colour of ieathers, a few apparent sex mosaics have been found, with male plumage on one side, female on the other. It has been suggested that a critical difference in rate of growth between the tno sides of the body resulting in a threshold effect may account for this condition.

Such birds would then be intersexes or hermaphrodites rather than gynanders. It is, nevertheless, possible that gynandrism may occur in vertebrates with its influence masked by sex hormones circulating in the blood. This would produce apparent symmetry of development despite a fundamental asymmetry of sex mosaicism.

See Sex.

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GYNECOLOGY is that branch of medicine which deals primarily with disorders of the female reproductive tract. The practice of gynecology requires skill in surgery, especially pelvic surgery; in obstetrics; in female urologic conditions, because the symptoms of diseases of the urinary tract and the genital tract are often similar; in endocrinology as it applies to gynecology; in gynecological pathology; and in dealing with minor psychiatric problems which commonly arise among gynecologic patients.

The anatomy and physiology of the female genital tract are discussed in the article REPRODUCTIVE SYSTEM. PREGNANCY and CHILDBIRTH are dealt with in those articles.

HISTORY

Gynecology is an ancient branch of medicine. The Papyrus Ebers, one of the oldest known works on medicine (1550 B.C.), contains reference to diseases of women, and it is recorded that specialism in this branch was known among Egyptian medical practitioners. The Vedas contain a list of therapeutic agents used in the treatment of gynecological diseases. The treatises on gynecology formerly attributed to Hippocrates (460 B.C.) are now said to be spurious, but the wording of the famous oath shows that he was at least familiar with the use of gynecological instruments. Writers of the Greco-Roman period of medicine who treated of this branch are Celsus, Soranus of Ephesus and Galen. It is evident that during this period much gynecological work was in the hands of female healers. Martial (Marcus Valerius Martialis) refers to these *feminae medicae* in his epigram on Leda. These women must not be confused with the midwives, who are always described as obstetrices. Throughout the Byzantine and medieval periods of medicine, which comprise a period of more than 1,000 years, gynecology shared in the general sterility and even decadence which accompanied medical and all other branches of scientific learning; such writers on gynecology as Oribasius (A.D. *c.* 325–*c.* 400) were mere compilers of the work of their predecessors. and practice was bound by ancient authority and tradition. The growth of interest in diseases of women during the Renaissance is shown in the huge "Gynecia" or encyclopaedia of gynecology issued by Caspar Wolf of Zurich in 1566. In the 17th century what has been described as the first work on operative gynecology in the modern sense was written by Hendrik van Roonhuze; it contains case reports on extrauterine pregnancy and rupture of the uterus and the description of a scientific operation for vesicovaginal fistula.

Among contributions to gynecology in the 18th century are William Hunter's proposal for excision of ovarian cyst and his description of retroversion of the uterus; Robert Houston's treatment of ovarian cysts by tapping; Matthew Baillie's description of dermoid cysts of the ovary; and John Bard's removal of an extrauterine pregnancy.

Operative gynecology, as an independent specialty, had no real existence until the first half of the 19th century. Its founders may be said to be Ephraim McDowell (1771–1830) of Kentucky and James Marion Sims (1813–83) of South Carolina. McDowell performed the first ovariotomy (removal of an ovarian cyst by abdominal section) in 1809 in Kentucky. Sims was a great surgical genius whose fame quickly spread over the whole civilized world because of his success in curing vesicovaginal fistula. Gradually in the medical centres of the world surgeons and obstetricians undertook a limited variety of gynecological operations. Outstanding among these pioneers were Thomas A. Emmet (1828–1919), plastic gynecologic surgery; Robert Battey (1828–95), removal of both ovaries; the brothers, John L. Atlee (1799–1885) and Washington L. Atlee (1808–78), removal of fibroids; Charles Clay (1801–93) and Sir Thomas Spencer Wells (1818–97), oophorectomy; Sir James Y. Simpson (1811–70), the uterine sound; Robert Lawson Tait (1845–99), salpingectomy ; Joseph Récamier (1774–1852), revival of speculum examination. It must be remembered that all these pioneers had to combat the violent prejudice of the public against any exposure or examination of the female organs. This prejudice, fostered at first by midwives, was supported by the clergy and by many members of the medical profession.

The two great advances which finally and in spite of vigorous opposition made all surgery generally available were anesthesia and antisepsis.

DISORDERS OF THE FEMALE REPRODUCTIVE TRACT

CONGENITAL ABNORMALITIES

Congenital abnormalities of the female reproductive tract are relatively rare. Among these abnormalities is absence of the vagina which may be complete or partial. In either case, the uterus may or may not also be absent. In most instances the uterus is absent, but the ovaries are present and the patient is completely feminine, with all the secondary sexual characteristics. When the uterus is present and the vagina partially or completely absent, there is no egress for the menstrual blood. which is retained within the uterus or an upper compartment of the vagina and often regresses through the tubes and into the peritoneal cavity. Complete absence of the vagina may be corrected by forming surgically, lining it with a skin graft from the thigh; such vaginas usually function well.

Septate vagina, with a tissue partition, is commoner than absent vagina. Such a double vagina may give no trouble, and the patient may be unaware of its presence. If it bothers the patient at intercourse, the septum may be excised easily.

Underdevelopment of the uterus may exist in all degrees, to the point of complete absence. Small uteri, two-thirds to one-half normal size, are not uncommon. Underdevelopment of the uterus is sometimes associated with infantile external genitalia and breasts, but in many cases the other genital organs are normal.

Double uterus is the result of failure of complete fusion of the bilateral Mullerian ducts which are present in the embryo. These are cordlike masses of tissue from which the tubes, uterus and vagina are formed. In the normal fetus the lower portions of these ducts unite to form the vagina and uterus; the upper ends, which do not fuse, form the two Fallopian tubes. When union fails completely, there results a double vagina and double uterus. All degrees of failure are encountered; thus the uterus may be completely double (didelphic) or partially united (bicornuate). Women with these abnormalities usually have great difficulty in carrying a fetus to term. Unification of the double uterus may be carried out by surgery, after which successful pregnancy may occur.

See also HERMAPHRODITE; GONADS, DISORDER OF.

COMMON DISORDERS OF MENSTRUATION

Amenorrhea.—Amenorrhea, or absent menstruation, occurs physiologically prior to puberty, with pregnancy, during lactation and at the menopause. Amenorrhea also occurs with absent uterus. When the uterus is present and the vagina completely or partially absent, there is no visible evidence of menstruation but hidden menstruation actually, occurs (cryptomenstruation). Hidden menstruation also occurs when the hymen is imperforate. At the start of menstrual life there may be long periods of amenorrhea before the regular monthly tempo is established. Likewise, in the late 40s, before menstruation ceases, there are often lapses of menstruation for variable periods of time (see MENOPAUSE). Constitutional causes of amenorrhea are undernutrition and severe illnesses such as tuberculosis and typhoid fever. Mental depressions are also frequently associated with a cessation of menstruation. Periods sometimes cease for months and even years when there is no demonstrable cause, in such cases, the cause must be ascribed to an endocrine disorder. In some such cases the endocrine disorder can be recognized (thyroid or adrenal disease), but in others the primary cause is thought to be malfunction of the pituitary.

Hypermenorrhea. — Hypermenorrhea or menorrhagia, is excessive bleeding at the time of the menstrual period. The flow of blood may be extremely profuse, prolonged or both. Menorrhagia may be a symptom of organic disease or may be simply functional, without any demonstrable cause. The commonest organic condition causing excessive bleeding is uterine fibromyoma (see Tu*mours,* below). When fibromyomas grow into the uterine cavity, they also may cause intermenstrual bleeding. Cancer of the cervix or the body of the uterus rarely manifests itself by excessive bleed-

ing at the periods. Functional uterine bleeding, in which there is no demonstrable organic disease, often manifests itself by menorrhagia, although it can also cause intermenstrual bleeding.

Metrorrhagia.—Bleeding between the periods may be an indication of organic or functional disease. Cancer of the cervix or body of the uterus in a premenopausal woman usually manifests itself by intermenstrual bleeding, which is thus more diagnostic of malignancy than is excessive bleeding at the time of the period. Intermenstrual bleeding. though not prima facie evidence of malignancy—often benign disease (as cervical polyp) manifests itself thus—always demands thorough investigation of the cause.

Dysmenorrhea. — Painful menstruation is present to some degree in a high percentage of menstruating women. The exact percentage is impossible to state, for it is difficult to determine just how much discomfort is required to be considered dysmenorrhea. Some women are truly incapacitated with real physical pain; others may complain bitterly when there probably is only slight discomfort. A small percentage of women have no discomfort whatever at menstruation, and an even smaller number state that they feel better at the time of menstruation than at any other time of the month. Causes of real menstrual pain are varied; among them are endometriosis (*see* below), salpingitis, myomata, cervical canal obstruction and, in some instances, retrodisplacement of the uterus, In the majority of cases of dysmenorrhea, however, the pelvic organs are anatomically normal, and the real cause of the pain is not known. There is undoubtedly often a great psychic factor. Cervical dilatation relieves the pain in cases of congenital or acquired obstruction in the cervical canal. Childbearing, which dilates the cervical canal better than is possible surgically, cures more cases of dysmenorrhea than all other procedures combined. In severe cases, the sensory nerves of the uterus may be cut surgically. Very rarely, hysterectomy is performed for severe dysmenorrhea in women past the age when childbearing is desired or feasible. When organic disease is present, surgery is indicated if the symptoms are sufficiently severe. In most cases, nonhabit-forming pain-relieving drugs are sufficient to give relief.

See also MENSTRUATION.

TUBAL (ECTOPIC, EXTRAUTERINE) PREGNANCY

Union of sperm and ovum normally takes place in the tube. If, for some reason, the migration of the fertilized ovum down the tube to the uterus is interfered with, the embryo develops within the tube. Previous inflammation within the tube (salpingitis), causing adhesions and partial blockage of the passage way, is the commonest cause, but many cases of tubal pregnancy occur in tubes in which there has been no previous infection; congenital abnormality of development may be responsible. The conditions under which the embryo develops within the tube are not so favourable to normal growth as those within the uterus, and for that reason the embryo is often cast from its site into the tube; or, as the embryo grows, the thin-walled tube is stretched and ruptures. Either of these eventualities results in hemorrhage from the tube into the abdominal cavity, with sudden severe pain and often with fainting from pain or loss of blood. The treatment is immediate surgery, the operation usually consisting of simple removal of the tube. Very rarely tubal pregnancies go to term, but the chances of this are so slight that the gnyecologist is not justified in gambling on the possibility.

ENDOMETRIOSIS

Endometriosis is a condition in which the uterine mucosa (endometrium) grows in places other than its normal habitat within the uterine cavity; no other benign tissue possesses this ability to invade other tissues. Understanding of the mechanism whereby endometrium is transported to these abnormal sites is not completely understood.

Endometriosis is of two types, internal and external. In internal endometriosis the endometrial tissue grows within the musculature of the uterus itself. Minor degrees of internal endometriosis occur frequently without symptoms, but when the condition is more extensive it may be responsible for excessive and painful menstruation. If the symptoms are sufficiently severe it can be cured by hysterectomy.

Of much greater clinical importance is external endometriosis, in which the endometrium grows outside the uterus, on and in various pelvic structures. Endometrium growing between the rectum and vagina was first described in 1897, and it was first discovered in an ovary in 1899. Since then it has been found on all the organs in the lower abdomen, and more rarely, at the umbilicus and in the vagina and vulva. As the uterine endometrium goes through a monthly cycle under the influence of the ovary, so do these bits of endometrium growing outside the uterus, and at menstrual periods they bleed, causing severe pain in some women. The sudden occurrence of menstrual pain or aggravation of menstrual pain in a woman in her 20s or 30s should always arouse a suspicion of endometriosis (although, of course. there are several other possible causes). The sterility rate is high in women with this condition.

J. A. Sampson in 1921 began a series of publications which made physicians aware of this disease. He also brought forth his theory of retrograde menstruation as its cause, suggesting that the particles of endometrium cast off at the time of menstruation. instead of going down through the cervical canal and into the vagina, might go out through the Fallopian tubes in a retrograde manner, then grow within the abdomen and be further disseminated. Sampson's ideas were objected to by some who believed that endometriosis was the result of morphological changes in the pelvic peritoneum; they contended that the particles of endometrium cast off with the menstrual blood were dead and incapable of growth. In 1950 R. W. TeLinde and R. B. Scott produced endometriosis in monkeys by surgical rearrangement of the uterus so that the monkeys menstruated directly into the peritoneal cavity. By this method they established the fact that the particles of endometrium as cast off at menstruation are capable of growth, thus greatly strengthening Sampson's theory.

Endometriosis that produces no symptoms requires no treatment, since the growth is benign. When treatment is required for the relief of pain or sterility, surgery may be conservative or radical, depending upon the age of the patient, her desire for further children, and the extent of the disease process. Many women have been relieved of their symptoms by conservative surgery and thereafter have borne children. In some instances, however, hysterectomy and removal of both ovaries is necessary. Endometrium in these abnormal positions, as in the uterus, requires the ovarian hormone estrogen for its growth, and removal of ovarian function by menopause, surgery or irradiation stops the progress of the growth.

INFECTION

Infections of the reproductive organs may be divided into two groups: those affecting the upper tract (the body of the uterus. the tubes and ovaries) and those affecting the lower tract (cervix, vagina and vulva). Upper tract infections are principally of three types: gonorrheal, puerperal and tuberculous. The incidence is in the order named.

Gonorrhea. — Gonorrhea1 infections result from sexual intercourse with an infected male. The lower tract is infected first, and the infection may remain there. In a certain percentage of cases, the infection spreads upward, involving first the uterine cavity and then the tubes. Gonococcal inflammation of the tubes (salpingitis) may be of varying degree: sometimes it is slight, leaving the tubes with very little damage; in other instances. the entire tube may become distended with pus (pyosalpinx). Such tubes usually become sealed off, and the patient is permanently sterilized. Gonococcal salpingitis is not the serious condition it once was. If recognized and treated early, the progress of the inflammation may be stopped and healing take place. The sulfonamide drugs were the first to prove effective against the gonococcus, and penicillin is even more so, penicillin therapy greatly reducing the percentage of cases in which surgical removal of the tubes is necessary. The ovaries, lying in close proximity to the tubes, are often involved in the inflammatory process. (*See* also VENEREAL DISEASES.)

Puerperal Infections. — These occur at childbirth or as a result of abortion. Use of antibiotics has greatly redured their in-

cidence. The usual infecting agent is the streptococcus, although other organisms may be involved. Puerperal infections are less likely than gonococcal infections to close the tubes and thus sterilize the patient; also surgery is less often necessary.

Tuberculosis. — Tuberculous infection of the pelvic organs almost always takes place through the blood stream rather than by way of the vagina, as in gonococcal and streptococcal infections. The blood stream is infected from a distant part of the body, usually the chest. The Fallopian tubes are generally the first organs involved in the pelvis, but in many cases the uterus and ovaries are also affected. Formerly, surgical removal of the involved organs was the only treatment, but in modern times the antituberculosis drugs are used in conjunction with surgery and in some instances are able to conquer the disease alone. (See also TUBERCULOSIS.)

Lower Tract Infections. — In the lower generative tract, the cervix, Bartholin glands and urethra may be infected by the gonococcus. Vigorous penicillin therapy helps prevent the spread of the disease into the uterus and tubes, where such infection is of more serious consequence. Gonococcal infection of the vaginal wall does not occur in adults, but it may be found in prepubertal girls. Nongonorrheal infection of the cervix is one of the commonest gynecological conditions. Many of these infections gain entrance to the cervix at the time of delivery, when the cervix is torn and the open wound is exposed to the bacteria which are ever present in the vagina. The cervix also may be infected in women who have never had children and even in virginal women. The infection has a tendency to irritate the mucus glands of the cervix and cause them to secrete an excess of mucus mixed with pus. This vaginal secretion, leukorrhea, is one of the commonest complaints of women. Often douching is sufficient to keep the woman comfortable; in severe cases eradication of the infected glands by cautery usually results in cure.

The vagina and vulva of adult women are frequently infected by Trichomonas vaginalis and by yeast, which may give rise to an irritating discharge that is often quite resistant to treatment. These infections are not venereal in origin, and they are of little consequence except for the annoying discharge.

TUMOURS

Vulva. — Benign growths of the vulva are rare. Fatty tumours and fibrous tumours occasionally attain such size as to inconvenience the patient and require removal. The only growth of importance in this region is cancer, which may arise in the skin or mucosa of the vulva; this is rare, however, representing only about 3% of the malignancies of the pelvic organs. It makes its appearance as a small lump or ulcer. usually in elderly women. The treatment is radical excision of the entire vulva, together with the lymph nodes in the groin.

Vagina. — Primary tumours of the vagina, either benign or malignant, are exceedingly rare. Benign fibromyomas and polyps are so unusual as to be almost curiosities. Primary cancer of the vagina, much less common than that of the vulva, usually becomes manifest by the appearance of a bloody discharge. Because of the proximity to the bladder and rectum, treatment by surgery or irradiation is difficult. For the most part irradiation treatment is used; there is a small rate of cure.

Cervix. — The cervix is commonly the site of small benign polyps. These small tumours appear as reddish, tonguelike growths projecting from the cervical canal. They commonly cause bleeding between the periods or, in older women, after the menopause. These small growths can usually be safely removed in the physician's office. They should be examined pathologically, but malignant change in them is exceedingly rare.

Cancer of the cervix is the second commonest malignancy in women, being exceeded in frequency only by breast cancer. It is most often a disease of middle life, the age of maximum occurrence being 48 years, but it is not uncommon in the 30s and not at all rare after the menopause. For unknown reasons it is extremely rare in Jewish women; it has been suggested that this is due to ritual circumcision of the males, but other peoples who practise circumcision regularly do not share this immunity. It is also rare in nuns, suggesting that infections in the cervix due to sexual contact may be a factor in the subsequent development of cancer.

The symptom of cervical cancer which should cause the woman to consult a gynecologist is bleeding, which in the premenopausal woman usually takes the form of spotting between periods. During the menopausal years any abnormal bleeding should arouse suspicion. It is true that bleeding at this time of life is more likely to be of benign origin but it is also true that the menopausal years are the years of the greatest incidence of cervical cancer. In a woman who has not menstruated for a year or more, the sight of even a small amount of blood from the vagina should arouse a suspicion of cervical cancer. Though the initial symptom of cervical cancer is usually slight bleeding, as the disease advances the bleeding may become profuse and the patient very anemic. Most, but not all, cases of cervical cancer are curable when the bleeding first appears. Late in the course of the disease, the signs and symptoms of advanced malignancy — anemia, loss of weight, weakness and pain — appear.

Cervical cancer has been classified into four stages, according to the extent of the growth. This was first done by the League of Nations, and Iater the classification was modified by an international committee of gynecologists, which to the original four stages added a stage zero, indicating preinvasive cancer. In this stage the individual cells which are involved have the typical appearance of the cells of invasive cancer, but they are found on the surface of the cervix and have not invaded the underlying tissue. It now appears quite certain that many invasive cervical cancers begin as the preinvasive condition, remaining on the surface for many years before invading the tissues. In the preinvasive stage, cervical cancer is almost 100% curable. If it could be detected in this stage in all women, invasive cancer could practically be eliminated, and there would be few if any deaths from cervical cancer.

Early detection of cervical cancer depends in great measure on the detection of cancer cells in the vaginal secretions. After the work of G. N. Papanicolaou and H. F. Traut, published in 1943, on the diagnosis of uterine cancer by the study of individual cells, there was an ever-increasing interest in this subject. Cytological examination of the vaginal secretions is a remarkably accurate diagnostic measure for early cervical cancer, the percentage of error in good laboratories being less than 1%. It is less accurate in diagnosing cancer of the body of the uterus, but many cases of cancer of this type are first suspected by this procedure. Diagnosis of cervical cancer is confirmed by curettage or cervical biopsy, or both. Not until the exact origin, location and extent of the malignant tissue are ascertained should definitive treatment be carried out.

Treatment of cervical cancer is not standardized. In early days the lesions were cauterized, with little success. E. Wertheim made popular a radical type of hysterectomy, but even after this over three-fourths of the women with cervical cancer died of the disease; also the Wertheim operation had a mortality rate, even in good hands, of about 10%. Soon after the discovery of radium cervical cancer was treated by it. Many early cases and a few advanced cases mere cured; in most cases, there was at least temporary alleviation. With the addition of deep X-ray therapy the number of five-year cures has increased until about 50% of properly treated cervical cancer patients remain well for at least five years. There is general agreement that advanced cervical cancer is best treated with irradiation, but there is no such uniformity of opinion regarding the treatment of the disease in stage I (limited to the cervix). Notable among the surgeons who have revived and modified the radical surgical approach is J. Meigs of Boston, Mass., whose five-year cure rate in selected cases equals that of the better clinics where irradiation is used as the primary treatment. In cancer limited entirely to the cervix. the five-year salvage by surgery or irradiation in the better clinics ranges from 70% to 80%. Most gynecologists are agreed that in stage O (preinvasive) the treatment of choice is hysterectomy; cures in this stage approach 100%.

Corpus Uteri. — There are only two tumours of the body of the uterus sufficiently common to warrant mention.

Fibromyoma.—Fibromyomas, commonly called myomas or fibroids, of the uterus are the commonest tumours in the female genital tract; in fact, they are the commonest tumours in women. Fibromyomas vary in size from pinhead to enormous tumours of 50 lb. or more. They are usually multiple but may occur singly. They are benign, but very rarely malignant change takes place in them. The incidence of malignant change in a large series removed at the Mayo clinic, Rochester, Minn., was 0.7%, and the incidence based on all existing tumours is much smaller than that. Fibroids grow under the influence of the ovarian secretion, estrogen. After the menopause, when the ovaries no longer secrete estrogen, fibroids fail to grow and usually shrink, sometimes to the point of disappearing completely. When they do grow after the menopause, it is almost a sure sign of malignant change.

Since fibroids are benign growths, they do not require removal unless they give rise to symptoms. A large proportion of them never do this. and the woman would be unconscious of their existence if she were not told of their presence by a physician. The symptoms for which removal is indicated are: (1) excessive bleeding, usually at the time of menstruation; (2) pain from pressure of large tumours; (3) symptoms of pressure on other organs (such as the bladder, causing frequency of urination); (4) distortion of the abdomen due to the large size of the tumour; (5) history of miscarriages for which, after proper endocrinological studies, it seems likely that the fibroids are responsible; (6) rapid growth or any growth after the menopause, which may indicate malignant change.

Treatment consists of removal of the tumour (or tumours) or hysterectomy. In young women who wish to have more children it is desirable and sometimes possible to remove the tumours and save the uterus (myomectomy). Since childbearing is usually past or has been found impossible in the late 30s or 40s when these tumours commonly occur. the usual treatment is hysterectomy. Total hysterectomy is preferable, for removal of the cervix is prophylaxis against cervical cancer. In selected cases in women approaching the menopause, successful treatment of small tumours can be carried out by radium implanted within the uterine cavity for a short time, or by X-ray therapy.

Carcinoma.—The malignant tumour occurring in the body of the uterus is carcinoma, which arises in the endometrium. It is less common than cervical cancer, the average ratio of uterine carcinoma to cervical cancer being 1 to 5 or 6. Carcinoma of the corpus uteri is essentially a disease of the postmenopausal years. The average age of occurrence is 58 years, approximately a decade later than that of cervical cancer; it may occur before the menopause, but its appearance in the 30s is rare. The commonest symptom is vaginal bleeding after the menopause. Often this is not profuse and is described by the patient as "spotting." Sometimes there occurs a watery discharge which contains too little blood to be recognized by the patient. When the disease occurs before the menopause. bleeding takes place between periods. The appearance of vaginal blood a year or more after the menopause is an indication for curettage without delay.

Treatment in most clinics is the administration of radium within the uterine cavity, followed by total hysterectomy and removal of both tubes and ovaries five to six weeks later. In a few clinics, the value of preoperative irradiation is questioned, and hysterectomy is done without the application of radium. Reports of five-year "cures" vary widely, salvage rates ranging from 50% to 90% being reported; the rate of cure exceeds that of cervical cancer by a fairly wide margin. In a few patients of very advanced age the risk of operation is greater than seems justifiable, and irradiation alone is used; salvage in these cases is about half that obtained by irradiation combined with surgery.

Ovaries.—Ovarian tumours, benign and malignant, are common in occurrence. They vary greatly in size; in former days tumours up to 100 lb. were reported, and though they seldom attain that size today, because surgical help is called for earlier, tumours of 15 to 20 lb. still are occasionally seen. Benign ovarian tumours are fortunately commoner than malignant ones. Ovarian tumours may be benign for years and secondarily become malignant, but it is probable that most ovarian cancers start as malignant growths. Unfortunately, ovarian tumours are generally silent growers until they get so large that they cause distortion of the abdomen or pressure symptoms. If the tumour is malignant this usually means that the condition is incurable. Both benign and malignant ovarian tumours may occur at any age, but in general the chances of malignancy are greater in advanced age. Of special interest are ovarian tumours which secrete hormones. Certain tumours secrete an excess of the feminizing hormone, estrogen, and when these occur in young children they cause precocious sexual development; in postmenopausal women they may cause uterine bleeding resembling a recurrence of menstruation. Ovarian tumours which secrete the male hormone, androgen, cause masculinizing changes, such as deepening of the voice and excessive growth of hair.

Treatment of ovarian tumours varies with the type of tumour and the age of the patient. Malignant tumours require removal of both ovaries, the tubes and the uterus, regardless of age. In some instances, such surgery is followed by deep X-ray therapy. When dealing with benign unilateral tumours in young women, it is usually sufficient to remove only the ovary involved, usually with the tube. In women past the menopause, the opposite ovary and uterus are also removed, whether the ovarian growth is unilateral or bilateral. In women in midmenstrual life, the question of conservative or radical surgery depends upon the judgment of the operator as to the probability of later tumour formation in the opposite ovary. Some tumours have a great tendency to bilaterality, while others have much less tendency to involve both ovaries.

See also CANCER; TUMOUR.

SURGERY OF THE FEMALE REPRODUCTIVE TRACT

Surgery is performed in the female pelvis chiefly for determining or ruling out the presence of malignancy; for removal of tumours, benign and malignant; for correcting malpositions of the uterus; and for reconstructing the vagina after damage resulting from childbirth or other trauma.

DILATATION AND CURETTAGE

Dilatation and curettage is the operative procedure most frequently performed in gynecology. Dilatation of the cervical canal may be done alone to permit easier egress of menstrual blood when the patient suffers from menstrual pain, but much more often dilatation and curettage are done concurrently. The cervical canal is dilated to permit the introduction of the curette, an instrument that might be described as a miniature hoe, with which the endometrium is scraped off. Curettage of the uterine cavity may be done for either diagnostic or therapeutic purposes; in some instances both are accomplished by the same operation. The uterus is most often curetted to establish the cause of abnormal uterine bleeding. The tissue obtained by curettage is prepared for examination in the pathological laboratory and examined microscopically. It is only by this study that the condition of the tissue can be determined and the cause of the bleeding established. When the bleeding is not due to malignancy, curettage frequently temporarily, and sometimes permanently, relieves the bleeding. Curettage is never a cure for malignancy. It simply permits the gynecologist to make an accurate diagnosis and plan definitive treatment. On some occasions, dilatation and curettage are done with therapeutic intent, as after incomplete abortion, when some of the products of conception remain in the uterus and cause bleeding; removal of these remnants stops the bleeding.

In most clinics biopsy of the cervix, to detect early cervical cancer, is done routinely at the time of curettage.

HYSTERECTOMY

Hysterectomy, removal of the uterus, is the most commonly performed major gynecological operation. The uterus is most commonly removed through an abdominal incision (abdominal hysterectomy), and must be so removed when tumours have caused the organ to be greatly enlarged. When the uterus is normal in size or only slightly enlarged, it can be removed through the vagina (vaginal hysterectomy). Although vaginal hysterectomy is often more difficult to perform than abdominal hysterectomy, there is

great advantage to the patient in having the operation done by this route, since recuperation is usually faster and there is no visible scar.

The uterus may be removed *in toto*, the body and the cervix. and this is known as total or complete hysterectomy. When only the body of the uterus is removed, leaving the cervix attached to the vagina. the operation is called subtotal hysterectomy. The obvious advantage of total hysterectomy is that the patient cannot subsequently develop cervical cancer. Most gynecologists do it almost routinely, but occasionally, for reasons of technical difficulty, subtotal hysterectomy. which is simpler and more quickly done. is performed. It is commonly believed that "complete hysterectomy" means removal of the entire uterus together with the tubes and ovaries; this is incorrect. Such an operation is properly called total hysterectomy and double salpingo-oophorectomy. Removal of the uterus naturally stops menstruation. but it does not precipitate early menopause, since the ovaries continue to function.

Oophorectomy

Oophorectomy, the surgical removal of the ovaries. is done most often for ovarian tumours or pelvic inflammatory disease. Bilateral oophorectomy in young women is a regrettable procedure, but in case of ovarian malignancy it is unavoidable and with bilateral benign ovarian tumours is usually necessary. When hysterectomy is done after the menopause for any reason it is customary to remove the tubes and ovaries also. It is almost certain that the ovaries are functionless after the menopause. and their removal is prophylaxis against ovarian malignancy. The younger the woman, the more conservative the surgeon should be in dealing with the ovaries.

Restoration of Uterine Position

Operations for the restoration of the uterus from retrodisplacement to its normal position were formerly done very frequently. Today the operation is performed occasionally when the symptoms are sufficiently severe and further childbearing is desired. When the uterus has fallen to a much lower level than normal (prolapse) it commonly causes bearing-down discomfort in the pelvis and may even annoy the patient by protruding from the vagina. Such a prolapse of the uterus is commonly associated with faulty support of the vagina. When the anterior vaginal wall lacks support. herniation of the bladder may occur (cystocele). When the posterior wall is defective, the rectum may bulge into the vagina (rectocele). There are many different operations for correction of uterine prolapse and restoration of the vaginal supports. Removal of the entire uterus or part of the uterus through the vagina is commonly done. When there are defects in the vaginal walls, simple removal of the uterus in whole or in part does not correct the condition. Under those circumstances, the supporting structures (fascias) of the vagina should also be repaired. Often the muscles forming the floor of the pelvis (levator ani) are separated or torn as a result of childbirth. Under these conditions they are restored to their normal position as part of the vaginal plastic operation.

See Obstetrics.

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GYÖR (German, *Raab*), Hungary, the capital of Gyor-Sopron county (megye), at the confluence of the Raab with an arm of the Danube, with the main stream of which it has communication by river steamers. The town occupies the site of the Roman *Arabona* and has always been an important regional centre and in earlier days a powerful fortress which the Turks captured by treachery in 1594 but retained for four years only. Throughout history it has been regarded as the key to passage east and west as is exemplified by the French storming in 1809 and that by the Austrians in 1849. In the 11th century the town was made a Roman Catholic bishopric, and its fine cathedral, dating from the 12th century in origin though rebuilt in 1639–54, gathered around it many important expressions of spiritual leadership; *e.g.*, the seminary for priests.

The modern functions are based upon its position at the contact of the old alluvial plain and the drained marshes, and mixed farming originated an active trade in cereals and horses, which was supplemented by milling, textile manufactures, linen and wool, and the distillation of spirits. Pop. (1960) 70,812 (mun.). About 11 mi. S.E. of Gyor on a spur of the Bakony forest lies the famous Benedictine abbey of Pannonhalma (Ger., St. Martinsberg; Lat. Mons Sancti Martini). one of the oldest and wealthiest abbeys of Hungary. It was founded by King St. Stephen, and the original deed from 1001 is preserved in the archives of the abbey. The present building is a block of palaces, containing a beautiful church, some of its parts dating from the 12th century, and is situated on a hill 1,200 ft. high. In the convent there are a seminary for priests, a normal school, a gymnasium and a library of 120,000 volumes. The chief abbot has the rank of a bishop.

GYPSUM, a common mineral consisting of calcium sulfate dihydrate, $CaSO_4.2H_2O$, named from the Greek *gypsos*, "chalk." a word used by Theophrastus to denote both the naturally occurring mineral and also the product of its calcination. plaster of paris (the hemihydrate. $2CaSO_4.H_2O$), which was used in ancient times, as it still is, as a plaster. In well developed crystals the mineral commonly has been called selenite, from *selene*, "the moon," probably in reference to the pale moonlike lustre of its faces, or, after legend, because it was found nocturnally when the moon was on the increase.' The mineral also occurs as anhedral granular aggregates (alabaster), as cross-fibre veinlets (commonly referred to as satin spar because of the silky lustre). and as impure earthy pulverulent masses (gypsite). The mineral may be scratched by means of the fingernail. having a hardness of only 2. Most gypsum is colourless to white, but because of impurities may be gray, yellowish, pink or brownish. The specific gravity is 2.317. The streak is white, the lustre suhvitreous; cleavage pieces show a pearly lustre. Gypsum is used in the crude form as a fluxing agent, fertilizer, filler in paper and textiles, and retarder in portland cement. About three-fourths produced is calcined for use as plaster of paris in molding. casting and pottery plasters and dental plasters; and as building materials in plaster, Keene's cement, board products and tiles and blocks. The granular form called alabaster (the alabaster of the ancients was a marble) is used for statuary and carved ornamental objects.

Most gypsum occurs in sedimentary strata associated with other evaporite minerals. such as rock anhydrite and rock salt. and also limestone and shale. Other minerals commonly present include anhydrite, calcite, dolomite. halite, sulfur, barite, quartz and clay, and many strata are relatively impure; fine- to coarse-grained. equigranular to heterogranular. The gypsum appears as fine grains, as large prismatic crystals, as large plates, as parallel fibrous aggregates and as spherulites. Very commonly it may replace anhytlrite. but the converse relation also has been noted. Individual strata of rock gypsum range from a few feet to hundreds of feet in thickness. In addition, gypsum also is an important constituent of cap rock. an anhydrite-gypsum rock forming a covering on salt domes (*q.v.*), especially in the Texas and Louisiana Gulf coast area, where it may be an important source of native sulfur. Gypsum also may be deposited directly from sea water by evaporation, at 30° C. and at a salinity of 3.35 times that of normal sea water. In sedimentary strata where gypsum has been formed by the replacement of anhydrite, the process gives rise to a 30% to 50% volume increase, resulting in intense, tight folding of the remaining anhydrite layers. This replacement is the result of hydration by surface and ground waters; thus in many cases gypsiferous strata grade downward into anhydrite rocks.

In addition. gypsum also occurs as a disseminated mineral in limestones and dolomitic limestones, especially with anhydrite, barite, celestite and fluorite, as well as in similar fashion in some shales. Unusual crystals of gypsum are known from solution

caves in limestone regions; some of these are highly twisted, others are of extraordinary size. It is a gangue mineral of some relatively low-temperature hydrothermal mineral deposits, and is found in deposits of native sulfur: as in Sicily, and results from the reaction of sulfureous gases and waters on calcium-bearing minerals around fumaroles and solfataras in volcanic regions. In the United States commercial sedimentary gypsum deposits occur in rocks of Silurian age in New York, in rocks of Mississippian age in Michigan. Other significant economic deposits occur in Virginia, Ohio. Iowa, Kansas, Texas, Nevada and southern California. In Canada gypsum is produced for export in Nova Scotia and New Brunswick. Deposits occur in many countries but the United States. Canada. France, Germany. the U.S.S.R. and the United Kingdom are leading producers. In France gypsum is common in Tertiary marls and clays of the Paris basin (hence the name plaster of paris), especially in Montmartre: in England near Chellaston in Derbyshire, Newark in Nottinghamshire and Fauld in Staffordshire. Crystals up to 5 ft. long have been found in caves in Naica. Chihuahua. Mex. Northern Italy is the leading source of alabaster, also found in England, Colorado and other localities.

Cpon calcination gypsum loses three-fourths of its water between 120° C. and about 165° C.. yielding the hemihydrate (plaster of parisj. When this is mixed with water it rehydrates and sets to a white solid mass of interlocking fibrous crystals of gypsum. Heating of gypsum for three hours at about 240° C. ("dead-burnt") expells all water to produce anhydrite (*q.v.*).

Crystallography. — Gypsum crystallizes in the monoclinic system. forming thin to thickly tabular crystals which commonly show coarse striations parallel with the c-axis. Crystals may also be lenticular. resulting from rounding of terminal faces. Other crystals are warped. with extreme examples bent into irregular or helical forms twisted about the c-axis. Twinning on (100) is very common as swallow-tailed or cruciform penetration twins or as multiple lamellar twins. The side pinacoid cleavage (010) is well developed and the front pinacoid cleavage (100) is distinct. Many crystals contain inclusions of sand or clay particles which may show crystallographically oriented concentrations, parallel with edges or certain faces.

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GYPSY (native name *Roma*, fem. *Romña;* popularized by George Borrow as Romaniesj. Gypsies were originally a low-caste people of India and are related by name to the Doms, a tribe of musicians and ropemakers.

Forced to leave northwestern India for unknown reasons about the first millennium A.D.. they migrated to Persia where they stayed probably until the time of the first Mongol inroads. These seem to have been their chief motive for wandering westward. first into Armenia. then into Ossetia. A number turned southward to Syria: Palestine and Egypt. The westward branch reached Greece via Anatolia by about 1300, for in 1322 they are found in Crete and by 1326 they had settled in Corfu. From the Balkans they spread rapidly beyond the Danube. for the Czech *Chronicle of Dalimil*, written in the early 14th century. quotes a Romany begging formula *kartas* boh (presumed to mean "we are hungry").

The Turkish invasions caused further migrations and many thousands must have found temporary asylum in Rumania. since most European Romany dialects are penetrated n-ith Rumanian words. Spreading westward through Hungary. Austria and Bohemia they reached Hesse about the year 1414. and were general throughout Germany by 1417. By 1418 a number had reached Hamburg and Augsburg. and in 1427–28 they were found in France and Switzerland. A band reached Bologna in 1422. By 1500 the first gypsies had reached England. First reactions to the newcomers seem to have been favourable. True. they had been regarded as serfs in the Balkan lands during the 14th century. But in 1496 Wladislaus II (Uászló II) of Hungary gave them the right of free circulation as a reward for "making rounds for shooting-tubes." and in 1505 James IV of Scotland gave to one described as an "earl of Little Egypt" certain letters of recommendation. A black period of gypsy history seems to be that from 1555 to 1780, when bestial acts were committed against gypsies in Britain and elsewhere. In 1768 Maria Theresa tried to settle them as peasants. Her son Joseph II abolished serfdom in 1781 and thereby released the gypsies from certain restraints. Archduke Francis Joseph entertained gypsies at his court and compiled a gypsy grammar.

Foundation of a Dynasty. — The only attempt by gypsies to found a dynasty is associated with the family of Kwiek. Gregory Kwiek. a kettlesmith of Polish origin, was born about 1856 and spent his early life in Italy or Spain. About 1883 he declared himself "king of the gypsies" and ruled them mainly from Poland. Having spent much of his lifetime between making kettles and touring the gypsy camps of Europe to gain favour and raise revenue, he abdicated in favour of his son, born at Bielcza in 1878 or 1886. In 1928 he became Michael II and was crowned near Warsaw in 1930. He tried to set up a Romany tribunal at Poznan. A brother Basil disputed the throne and a third brother, "kingmaker" Matthew returned from Spain to arbitrate, settling for Basil, with Rudolf as chancellor. The brothers Basil and Rudolf plotted to force Michael out of Poland. In 1934 Michael attended a gypsy congress in Rumania. returned, was confirmed king by a gathering at Lodz. but fearing vengeance fled to Czechoslovakia and was not heard of again. Matthew was murdered in 193j, and Basil reigned unchallenged until Rudolf transferred his favour to another brother Janusz, who in July 1937 was crowned Janusz I, "king of the gypsies" with great ceremony at the Warsaw stadium, in full view of 15,000 gypsies. The officiating priest was Orthodox Bishop Theodorowicz. The robes and regalia had been borrowed from the Warsaw opera house. Rudolf had meanwhile renounced all claim to the throne in return for an influential post in the cabinet; Sergej Kwiek became chief adviser, Alexander Kwiek was made president of the Federation of Gypsies and Zdunek became financial adviser. Once the ceremony was over Janusz demanded the takings from the stadium gathering. but this was refused by the authorities until expenses had been paid. King Janusz thus began his reign with an unbalanced budget. since he had promised to pay the expenses of his electors and musicians. Finally, impoverished, he returned to the village of Milanowky, his new home, to carry on his trade.

Janusz proclaimed himself ruler of the gypsies of Hungary, Spain, Germany, Bulgaria. Yugoslavia and Poland. and planned to go to Geneva to plead for a country for his people. But his rule was challenged about ten months later on the ground that the senate of only 17 members did not constitute a quorum. Other allegations were more nebulous, but the complaint that his election had not been unanimous was justified. At one point his subjects demanded free elections. At this Kmiek dismissed both cabinet and senate and regaled several hundred of his friends, who thereupon confirmed his "royal" status. His reign of about a year was followed by a shorter, that of another Matthew Kwiek.

Attempt at **Organization.**—Any political organization of gypsies was bound to cut across national frontiers and to operate in hostile territory. Mechanization and unemployment had caused unprecedented poverty among a people who could but make things n-ith their hands. The few existing gypsy lawyers were faced with the enormous task of presenting their case to the League of Nations and to the law courts of several countries. An attempt was made to organize the tribes locally under matriarchs known as "old mothers." whose duty it was to preserve morality, but who stubbornly refused to pay taxes when asked to do so.

In 1933 the president of the Burgenland assizes had complained of the unprecedented increase of gypsies in the province and had urged that all gypsies in Austria. Hungary. Yugoslavia and Czechoslovakia should be settled on an island in Polynesia. the League of Nations to supply the money. Neither Janusz's dream nor the demands of the Burgenland judge came true. With the outbreak of World War II frontier movements were halted and it was not long before the nazis decided upon a policy of extermination. Complete records are not available, but some of the worst atrocities were committed in Yugoslavia and Poland; thousands were done to death at Oswiecim (Auschwitz), among them gypsies from

Czechoslovakia, and 2,000 were killed in Belgium. Death camps existed at Treblinka, Belzec and Chelm in Poland, and many died at Buchenmald, Ravensbriick and Mauthausen, about 20,000 in all. Survivors joined the guerrillas. After World War II what remained of the gypsies in Poland rallied loosely round Rudolf Kwiek, who had spent some of the war years in Rumania. The fate of King Janusz is unknown. In 1946 Rudolf, content to be their president, made a rough census of Polish gypsies, finding 4,500 survivors out of a prewar total of more than 18,000. As president of the World Council of Gypsies he held congresses from time to time at Katowice, while continuing his trade of kettlesmith near Warsaw. He later called to his side an old gypsy called Zoga to be the gypsies' legal and spiritual leader.

A plan first voiced in 1875 for a Romany state was echoed in 1879 at the first gypsy congress, held at Kisztyal in Hungary, when the sole demand was for minority rights. From then on gypsy congresses became more frequent. One was held in Sofia, Bulg., in Jan. 1906, and another in 1919. Michael II summoned one to Cernaut, at which he demanded gypsy schools. The most elaborate was at Bucharest in 1933, when Lazarescu was elected president, but was later declared a tyrant and replaced by G. Niculescu, a flower seller. This energetic man set about making his people literate. and published at his own expense a weekly newspaper in Rumanian under the title *Glasul Romilor* (Voice of *the* Gypsies).

Distribution **and** Customs. — In general the gypsy population of Europe decreases from southeast, where it is greatest, to northwest, where it is least. The pressure of competition and mechanization in countries with a high standard of living is believed to have reduced their numbers. The small earnings of the skilled are in general sufficient to satisfy their simple needs in normal times, but they are beset by disease, especially tuberculosis, and their hunger is proverbial. A common gypsy conception of paradise is a place where there is plenty to eat.

The living conditions of gypsies are dictated by climate, geoggraphy and, above all, by the economic status of the host country, to which their own is often inferior. They are wealthiest in Sweden, poorest in the Balkans and southern Spain. Whatever their habitation, it is always in a sheltered spot, a sand pit, a quarry, a valley or a wood, away from wind. British, French and German gypsies live in painted caravans used mainly as sleeping quarters. Central European gypsies build one-room brick cottages in sand pits or on wasteland. Farther east and in the Balkans their dwellings are of wattle and daub or other crude materials. It is mainly the wanderers, despised by the settled gypsies, that live in tents. These roam in summer and pitch near towns in winter. Spanish gypsies build their houses partly in the hillside; some keep their children outside in covered pens flanked by wooden troughs to hold the bedding. Coastal wanderers of Spain sleep in the sandstone caves.

The one good daily meal of gypsies is a supper of' stew which is cooked on an outdoor fire. Autumn hedgehog is considered a delicacy.

Their crafts are most numerous in Yugoslavia, where they are smiths, farriers, tinkers, riveters, basketmakers, musicians, bear trainers and dealers in wool and cattle. In central Europe they are smiths, jugglers, musicians, bear trainers, horse dealers and circus players and there are a few lawyers. In England they make baskets, clothespins, paper flowers and other decorations and spend the summer months at casual outdoor labour. During World War II many were engaged in tree felling and simple agriculture — a sharp break with tradition. Some have become owners of traveling shows. Bargees form a separate clan.

Apart from their crafts gypsies have little special knowledge beyond that of horses and herbs. Illiteracy is high because they are always on the move, forcibly or otherwise, and their children cannot attend school.

European gypsies except those of the southeastern Balkans speak Wallachian Romany, to which Hungarian, Slavonic and German words have been added in its progress westward. The purest Romany in Britain is spoken in north Wales. Romany has given English the words *pal* and *cosh*. (See ROMANY LANGUAGE.)

All gypsies profess the dominant local religion. They chant their poetry, some of which is original, but their dances, music, folk tales and proverbs are of local origin. Their tribal customs sometimes have the force of law. Population figures are unreliable: Czechoslovakia's figure before World War II was given as 28,500; Austria's 24,000; Poland's 18,000 to 20,000. There may be 1,500 to 2,000 in Great Britain.

Gypsies tend to be swarthy with wavy black hair, being brachycephalous in central Europe and dolichocephalous in the maritime countries. The incidence of white gypsies in ascribable to associations with Europeans. (S. E. M.)

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UNITED STATES

Although most of the descendants of the gypsies who went to America in colonial times from Great Britain, the Netherlands, Germany and France were absorbed, there were by the end of the first quarter of the 20th century probably between 50,000 and 100,000 persons of Romany origin; and the number increased thereafter. The majority arrived during the last quarter of the 19th century. British gypsies, fairly numerous in the United States and Canada, differed little from those of the old world. After the decline of horse trading, their chief occupation was fortunetelling; some settled on farms and others peddled various products such as oilcloth, hand-made baskets and rustic furniture. Many used Romany (*q.v.*) as their native tongue. A large group settled at Braddock, Pa. Families of Turkish, Syrian, Bulgarian and Spanish gypsies were widely scattered.

The majority of gypsies in America might be classified vaguely as Vlachs (*q.v.*). There are two distinct varieties. The smaller is known as the Karavlase (Black Vlachs) or Baias (Gold Washers). What little Romany they acquired was picked up from Anglo-American gypsies. Rumanian is their "secret" tongue, though they lived in Serbia for a time before starting on their wide migrations. Of these a number became fortunetellers. The other variety forms the bulk of American gypsies. For lack of a better term, they are called the nomads. Among themselves they speak a relatively pure dialect of Romany, but the percentage of Rumanian loan words would indicate that at one time they wandered in Vlach countries. They may be met anywhere, from China to Africa, but many of them made the United States their home. Large numbers also went to South America. They subdivide themselves into tribes: the Macvaya, so named from a region in northern Serbia; the Kalderas, from their former profession as coppersmiths; Rusore, Ungeresore, etc., from the countries where they lived longest before coming to America. In spite of slight differences of dialect and customs, these tribes are homogeneous and mix with no other group, not even the Baias. They established their own courts (romano-kris), conducted in the manner of the gypsylike peoples of India. Taboos are strictly enforced and punished by fines or by expulsion from the tribe (*mahrimé*).

The large silk kerchief worn over the head by the married women, the necklaces of gold coins and the gay dresses are distinctive. They travel by train and motorcar and live by the fortunetelling of the women. Formerly most of them were coppersmiths. A few became professional musicians. They preserve many stories and songs in their own language. In summer they live in tents; in winter they move into cities, many living in stores. With prosperity they tended to become assimilated into the U.S. culture, though the Romany inclination to revert to age-old traits remained.

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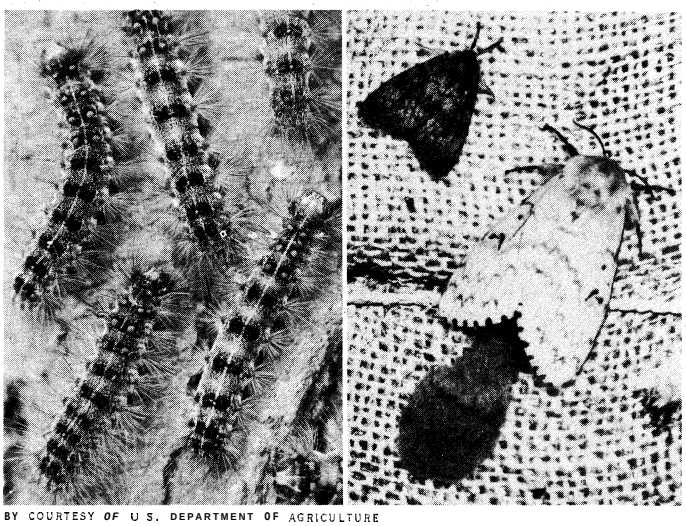
GYPSY MOTH, a European moth (Porthetria *dispar*) brought to the United States for experiment in 1869 but escaped from confinement, multiplied slowly and eventually became a serious pest of shade, fruit and woodland trees in New England.

The adult female moth is a heavy-bodied, light-coloured insect, with zigzag blackish marks on the wings. The body is so heavy that the female cannot fly. It has a wingspread of $2\frac{1}{2}$ in. The male is much smaller, dark in colour and flies readily. The winter is passed in the egg stage. The eggs are laid during July in clusters of 400 or more, on the bark of trees, fence rails, fallen logs. under loose bark, in cavities in tree trunks or branches and are sometimes placed on stones were they may be concealed from view. Each cluster is covered with buff-coloured hair.

With the appearance of the leaves in the following spring the eggs hatch and the young larvae feed rapidly, becoming full-grown early in July. When these ravenous eaters are numerous they may completely strip the trees before the end of June. At this time they are 2-in.-long, flattened, pale-brown caterpillars with long tufts of stiff brown and yellow hairs standing out from the sides of the body; a further distinguishing feature are the tubercles found in two rows down the back: five pairs of blue nodules followed by six pairs of red ones. The pupae or chrysalids, into which the larvae are changed, give out the adult moths after about ten days. There is one generation each year.

The gypsy moth spreads commercially on nursery stock, young trees, lumber, stone or other products likely to be sent away. They also spread as newly hatched caterpillars. in which condition they are blown to considerable distances by the wind on warm sunny days. In New England thousands of trees have been killed. Apple and oak have suffered more than other species, but pine and other coniferous trees have been killed when mixed with deciduous growth.

With the expansion of the infested area in the early 1900s the federal government took active part in the work and since then has co-operated with states in an effort to control and prevent its spread. These activities include the enforcement of a quarantine regulating the movement of articles which might carry the insect into new areas. The insect spread by natural means into new areas in the New England states, however, and in 1923 it was felt that natural spread to the west could best be prevented by eliminating all infestations which developed in an area along the eastern border of New York and adjoining states to the east. This barrier zone was maintained by the federal government and the state of New York.



BY COURTESY OF U S. DEPARTMENT OF AGRICULTURE

GYPSY MOTH (PORTHETRIA DISPAR)

Left: Leaf-eating caterpillars. Right: Male (upper), and female laying eggs

The insect by the 1950s was found throughout most of New England, in several counties in eastern New York and in an isolated area in Pennsylvania. Infestation varied greatly from year to year. Developments in the application of DDT sprays with aircraft greatly reduced the cost of artificial control operations. The remedial measures adopted after long investigation consisted of spraying with a suspension of lead arsenate, banding the trees to prevent the climbing of the caterpillars and treatment of the egg masses with creosote. Many species of parasites have been introduced from Europe and certain of these, especially the Braconids and the Tachina flies, have proved reasonably effective. A predatory beetle known as *Calosoma sycophanta* has also been introduced to good effect. These imported natural enemies have been the means of aiding very considerably in the control of the insect.

See ENTOMOLOGY: *Agricultural and* Forest *Entomology.*

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GYROCOMPASS or GYROSCOPIC COMPASS is a navigational instrument which makes use of a continuously driven gyroscope (*q.v.*) to accurately seek the direction of true (geographic) north. It operates by seeking an equilibrium direction under the combined effects of the force of gravity and the daily rotation of the earth. As such, it is immune to magnetic interferences such as those caused by ore deposits, steel structures or electric circuits. These properties make the gyrocompass a prime navigational device in ships and submarines It has found extensive use on ore ships on the Great Lakes. as the azimuth reference for gun and torpedo control on narships and as a reliable compass for navigation of any ship. It is not suitable as an aircraft compass because the speed of several hundred knots associated with such vehicles seriously affects the north-seeking properties of the instrument. (See also COMPASS)

Although the apparent effect of the earth's rotation on gyroscopes was first shown by Léon Foucault in 1852, the ability to construct sufficiently accurate units did not exist until the first decade of the 20th century. The first seaworthy gyrocompass was produced in 1908 by the firm of Hermann Anschutz in Germany, largely through the efforts of Max Schuler who developed the principles on which a practical ship borne gyrocompass depends. This compass was a marvel of mechanical ingenuity. In 1911 Elmer A. Sperry in the United States produced a gyrocompass that was easier to manufacture. In England, S. G. Brown, working with John Perry along somewhat the same lines as Sperry, produced a gyrocompass in 1916. Later the Arma corporation in the U.S. produced a unit that was a modification of the Anschiitz.

All gyrocoinpasses operate on the same basic principle. They differ in their methods of supporting the gyroscopic element (the spinning wheel)! of applying the pendulosity which is required for the north-seeking property and in the means used to damp out oscillations and thus cause the unit to settle on north.

Operating Principles.—One form of gyroscope is a spinning wheel mounted so that the direction of its spin axis has universal rotational freedom. The spin allows the mass, or inertial, properties of the material in the wheel to be used continuously and thereby gives rise to a relatively large gyroscopic momentum or inertia in a moderate sized wheel. The important property of a practical gyroscope is its angular momentum—the product of its spin and its inertia about the spin axis. This quantity is a vector, since it has both direction and magnitude. The angular momentum vector may be conveniently represented by curling the fingers of the right hand in the rotational sense of the spin! the extended thumb of the hand then pointing in the direction of the angular momentum vector. The angular momentum is nearly parallel to the spin axis in a practical gyrocompass.

In the same manner the moment of a force (torque, or turning

effect) is directed along the extended thumb of the right hand when the fingers of the hand curl in the sense of the rotation that the force is trying to produce. The following is the basic law of gyroscopics: when a torque is applied to a gyroscope, it will rotate (or precess) so as to attempt to align its angular momentum with the torque. The precession is with respect to inertial space, *i.e.*, a reference space that is nonrotating relative to the "fixed stars." Note that the earth is not part of inertial space because of its daily rotation. The magnitude of the precession is directly proportional to the magnitude of the torque and inversely proportional to the magnitude of the angular momentum. When no torque is applied, the spin axis remains motionless relative to inertial space; if aimed at a star it remains aimed at the star, and consequently one end of the axis appears to an earth observer, in the course of a day, to rise in the east and set in the west. This is shown in fig. 1 as the path encircling the pole. When an applied torque attempts to rotate a gyroscope about the vertical axis, the spin axis will rise or dip, *i.e.*, precess about a horizontal axis, as it attempts to align its angular momentum with the torque. Similarly, an applied torque about a horizontal axis will cause the spin axis to precess about the vertical axis.

A gyrocompass is a gyroscope having a frame with a mass unbalance giving it a pendulosity at right angles to the spin axis. In normal operation the spin axis will be nearly horizontal and pointed north, while the pendulosity is downward. Consider a gyrocompass started with its spin axis horizontal and pointing a few degrees east of north. The earth's rotation then causes the spin axis to rise above the horizon as seen by an earth observer (more accurately, the horizon dips below the spin axis, which initially

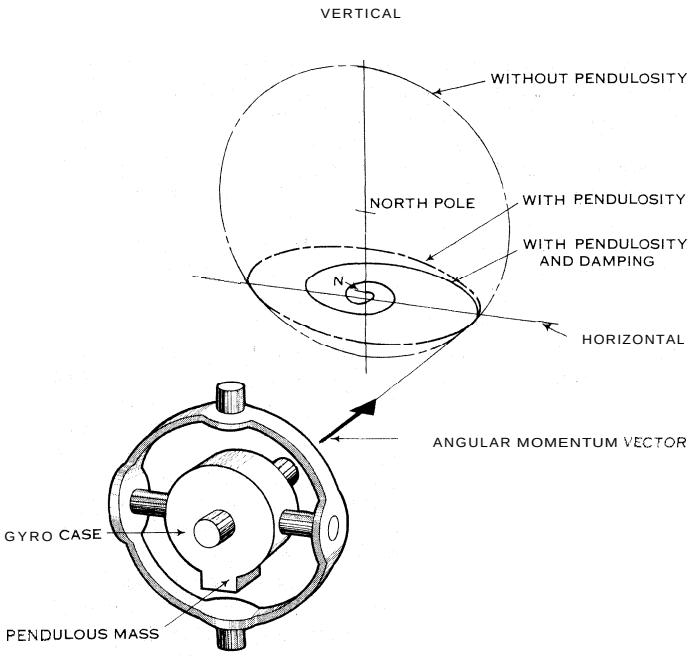


FIG. 1.— GEOMETRY OF GYROCOMPASS OPERATION

remains motionless in inertial space). This action produces a horizontal torque directed westward due to the effect of gravity on the pendulosity. The spin axis, obeying the basic law of gyroscopic precesses about the vertical toward the meridian, continuing to rise because of the earth's rotation until the meridian is reached. At this point the pendulous torque is maximum and the spin axis continues to precess through the meridian. When the spin axis is west of the meridian the earth's rotation causes the spin axis to set, thus reducing the pendulous torque. At the same distance west of north as the starting direction was east of north, the spin axis is horizontal again, but because of earth rotation continues to set. This causes the spin axis to dip below the horizon and produces an eastward pendulous torque. which causes the spin axis to precess toward the meridian again and eventually precess past the meridian and back to its starting direction, where this whole process is repeated. The spin axis thus traces out an ellipse about the meridian and horizontal, as shown in fig. 1. The flatness of the ellipse and the period of the oscillation depend on the strength of the pendulosity.

For a gyrocompass to point north, it is necessary that the oscillation be damped out so that the unit can settle on the meridian and not keep passing through it. Damping an oscillator involves changing its energy state by opposing the velocity of the body. Two methods for damping have been used. The first, used in all gyrocompasses except the Sperry, is due to Schuler. It consists in applying an antipendulous torque caused by the restricted flow of a viscous fluid responding to the tilt of the gyroscopic element. Viscosity and direction of flow through the constriction are combined so that the torque is applied in the proper phase for damping. The torque is horizontal and ideally is directed so as to precess the gyro toward the meridian at all times: *i.e.*, it points west when the spin axis is east of the meridian and east when the spin axis is west of the meridian. The combined action of pendulous and damping torques changes the previously mentioned elliptical motion of the undamped regime to a spiraling-in motion toward the meridian, as is shown in fig. 1. Viscous friction absorbs the energy withdrawn to effect the damping. The second method of damping is used in the Sperry gyrocompass. The Sperry compass is supported by a wire suspension with a pow-er-driven follow-up, known as a phantom ring: which is a type of servomechanism. Damping involves applying the pendulous torque in such a manner that its interaction with the phantom ring and follow-up motor produces a torque along the vertical axis. This attempts to reduce the tilt of the gyroscopic element. Since tilt and motion in the horizontal plane are coupled together in a gyrocompass, this method also serves to damp the spin axis toward the meridian. The energy for damping is furnished by the motor that operates the phantom ring. This system has antipendulous action and damping is obtained by adding energy to the system.

In its steady state a gyrocompass has a slight upward tilt on the north side of its spin axis in the northern hemisphere and a downward tilt in the southern hemisphere. This produces the torque required to precess the gyrocompass relative to inertial space about the vertical axis at the same rate that the meridian is rotating about that axis due to the earth rotation. This rate is zero at the equator and increases to full earth rate at the poles. Because of this equilibrium tilt the damping method used in the Sperry gyrocompass causes the spin axis to settle slightly east of the meridian in the northern hemisphere and west in the southern. This is a small known angle that is readily compensated for in the heading indication.

The Anschütz and Arma compasses are supported by flotation. The pendulous torque is obtained by simply mounting the unit with the centre of gravity below the pivot. Damping is obtained by restricted flow of a viscous fluid in a tube. The Brown compass is supported by a pulsing oil column. The pendulous torque is obtained by the flow of oil between two tanks. Air pressure generated by the spin of the gyro wheel forces the oil uphill to give it pendulosity, since it is naturally antipendulous or top-heavy. It is damped by restricted flow of a viscous fluid in a tube. The Sperry compass is supported by a wire suspension with a power-driven phantom ring to remove torsion from the wires. Surrounding the phantom ring is a frame called the ballistic. The pendulous torque is obtained by the flow of mercury between two tanks (the mercury ballistic). As this action is antipendulous, the equilibrium direction of the gyroscopic angular momentum is south. This combination of two potentially unstable components produces a stable system. It is damped by the follow-up motor, which receives a signal proportional to the displacement of the phantom ring from the wheel-supporting gimbal.

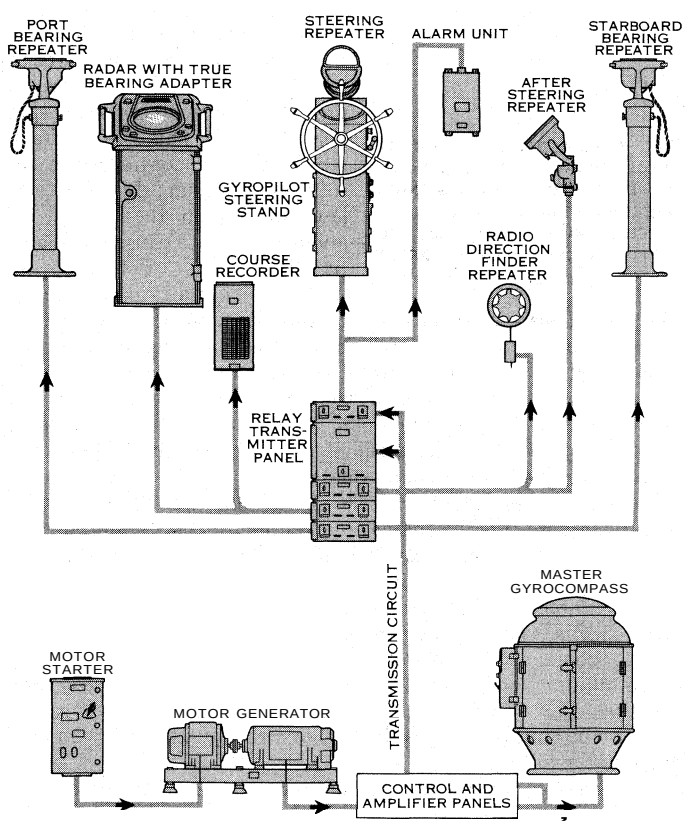
Dynamic Requirements (Schuler Tuning).—The period of oscillation of a gyrocompass is determined by the requirement that the compass operate usefully in an accelerated vehicle. The pendulosity that produces the north-seeking property responds to vehicle accelerations as well as to gravity. The torques associated with north-south accelerations (east-west accelerations are not important because of the system configuration) would cause a corre-

sponding wander of the gyrocompass about north and would render the instrument useless for navigation. Furthermore, when a vehicle travels north or south it acquires in its motion over the spherical earth an angular velocity relative to inertial, space that is perpendicular to the earth's daily rotation. This means that the apparent meridian. relative to which stars would appear from a moving vehicle to rise and set, is rotated about a vertical axis from the true meridian. westward for northerly velocity and eastward for southerly motion. The tangent of this angle of rotation is the vehicle's north-south speed divided by the product of earth rate (speed of a point on the equator: nine-hundred knots) and the cosine of the latitude. At ship speeds this angle is generally less than 4°. A major contribution by Schuler was the discovery that. when the period of oscillation is $2\pi\sqrt{\text{earth radius/gravity}}$, the heading precession of the gyroscope spin-axis due to acceleration is exactly the rate of change of the angle between the apparent and true meridians seen on a moving vehicle. The gyrocompass will then read true north at all times if its indicating reference is offset by the angle between these two meridians. The angle, at ship speeds. is a direct function of the north-south speed and is easily set into the system. The need for accurate speed measurement for this offset is the main reason why a gyrocompass is not usable in aircraft.

Description of Parts.—Only one type of gyrocompass is described because of space limitations; the Sperry unit is chosen as one that is representative and in extensive use at sea. The gyro wheel is electrically driven and mounted on spin-axis ball bearings within the rotor case. This case in turn is mounted to tilt on ball bearings about a horizontal, and nearly east-west, axis in the vertical ring. The vertical ring is pivoted about a vertical axis within the phantom ring, but its weight is borne by strands of steel wire from the phantom head. A follow-up system keeps the phantom ring aligned with the vertical ring, thus preventing torsion in the wires and reducing support friction about the vertical axis to a minimum. The compass card is mounted on the phantom head. The phantom is supported by thrust bearings in the spider which also carries the follow-up motor. This whole device is mounted with a small pendulosity in the binnacle within a covering case. The compass elements are thus protected and also free from the rolling of the ship. The mercury ballistic frame is pivoted to the phantom on horizontal and nearly east-west, bearings. The frame connects to the rotor case by a link that makes contact slightly east of the bottom of the case. The frame carries the tanks of mercury and the connecting tubes.

The master gyrocompass is usually installed in a compartment that will not be affected by the outside environment. Repeaters of its indication are mounted on the bridge and elsewhere as needed. The course recorder keeps a permanent record of the ship's heading. Fig. 2 shows a complete gyrocompass system.

Inertial Navigation.— Some of the principles of the gyrocompass were extended. starting in 1950, to a new method of navigation, known as inertial navigation, of submarines. In this method. the longitude, latitude and ground speed of the craft are indicated, as well as the direction of north.



BY COURTESY OF SPERRY GYROSCOPE COMPANY

FIG. 2.—COMPLETE GYROCOMPASS SYSTEM

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GYROPLANE: set: AERONAUTICS.

GYROSCOPE, a rotating wheel universally mounted: *i.e.,* mounted in such a manner that it is free to turn about any axis. In 1852 the French physicist Léon Foucault used such a device to demonstrate the rotation of earth and coined the word "gyroscope." This comes from two Greek words, *gyros* meaning "turn or revolution," and *skopein* meaning "to view." Thus a literal meaning of the word gyroscope is "to view the turning."

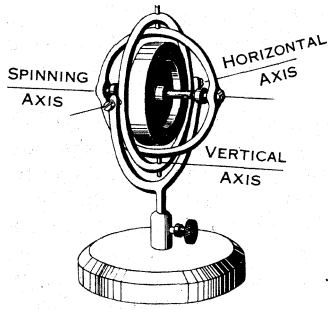
One of the first of these rotating devices was constructed about 1810 by G. C. Bohnenberger and is described in Gilbert's *Annalen* for 1818. It consisted of a heavy spheroid which could rotate on an axis passing through its diameter. which axis was mounted along the diameter of an outer circular ring. This ring with its contained spheroid was similarly made movable. inside a second ring. about an axis at right angles to the axis of the spheroid. In the same way the second ring with its contents could rotate. inside a third ring, about an axis at right angles to each of the others. From this it will be seen that the spheroid had all degrees of Tree rotation. one point only within it being fixed: namely, the intersection of the three axes.

In 1836. in a paper read before the Royal Scottish Society of Arts. Edward Lang suggested an experiment. with a universally mounted rotating wheel, by which the rotation of the earth on its axis could be directly proved. He said: "While using Trouphton's top an idea occurred to me that a similar principle might be applied to the exhibition of the rotation of the earth. Conceive a large flat wheel, poised on several axes all passing directly through its center of gravity. and whose axis of motion is coincident with its principal axis of permanent rotation, to be put in very rapid motion. The direction of its axis would then remain unchanged. But the directions of all surrounding objects varying, on account of the motion of the earth. it would result that the axis of the rotating wheel would appear to move slowly." This suggested experiment was actually carried out in 1852 by Foucault. probably without any knon-ledge of Lang's suggestion. Foucault's experiment for demonstrating the rotation of the earth by means of a gyroscope became widely known and stimulated much thought and research on the uses of the gyroscope.

In order to conduct these early experiments successfully it was necessary to construct the instruments with the utmost exactness. Further difficulty hindered the development of the gyroscope. in that rotation could not be kept up for any length of time without functional interference causing the rotor to be inaccurate. Consequently, the gyroscope remained largely an instrument used only for demonstration purposes. It was not until the latter part of the 19th century. when G. M. Hopkins introduced the first electrically driven rotor, that the utility of the gyroscope could be fully realized. It was about the turn of the century that Elmer A. Sperry visited France and became interested in the historic Foucault gyroscope. From this interest was built up the Sperry Gyro-

scope company which supplies ships and planes with gyroscopic devices for indicating direction, for steering and for stabilization.

Fundamental Principles of the Gyroscope.—The explanation of the phenomena displayed by a gyroscope can be given in terms of Newton's laws of motion. These laws are adapted to spinning objects without the introduction of any new physical laws, though new concepts are introduced. Newton's first law has to do with the fundamental property of all bodies that they have inertia. or mass. Inertia of a body causes it to stay at rest if initially at rest or to move with constant speed in a straight line unless some external force acts on the body. In a similar manner a gyroscope possesses inertia in that a freely rotating body will maintain its direction in space fixed.



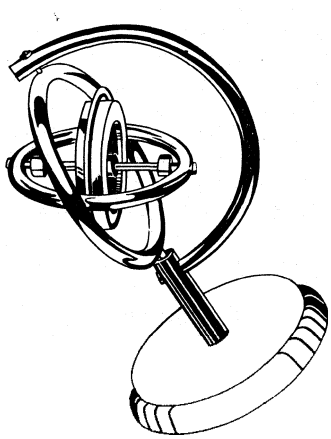
BY COURTESY OF THE SPERRY GYROSCOPE COMPANY

FIG. 1.—AN ELEMENTARY FORM OF GYROSCOPE THAT CAN SPIN WITH ITS AXES IN ANY DIRECTION

In order to change either the amount or the direction, or both, of the speed of a body. Newton's second law states that an external force is necessary. This force depends both on the inertia or mass of the body and the amount of the change of speed; *i.e.*, its acceleration. For a rotating body a torque is necessary to change the direction of the axis of spin of a gyroscope. A torque exists about an axis whenever a force exerts a turning action about the axis measured by the force times the perpendicular distance from the force to the axis or the lever arm. A torque on a rotating wheel causes a precessional motion about the torque axis. We may then say that the two fundamental properties of a gyroscope are inertia and precession.

In order to investigate these properties consider the gyroscope shown in fig. 1. The three degrees of freedom of this elementary gyroscope are: (1) The wheel is free to rotate (spin) about its "spinning" axis. the wheel's axle. (2) The wheel (with its axle and axle bearings) is free to rotate about the "vertical" axis, which axis is the plane of the wheel and intersects the spinning axis at right angles. (3) The wheel (with its axle, axle bearings, vertical axis and vertical axis bearings) is free to rotate about the "horizontal" axis. which axis intersects the vertical axis at right angles at the intersection with the spinning axis. The spinning and vertical axes are always at right angles to each other, as are also the horizontal and vertical axes. but the spinning axis may make any angle with the horizontal axis. The spinning axis may also be in any direction horizontally, and therefore in any direction relative to space.

The spinning wheel is made so that most of its mass, or weight, is near its periphery, or rim. This gives the wheel a large rotational inertia or moment of inertia. Rotational inertia is measured by the sum of the products of the masses of the body and the square of their distance from the axis of rotation. Thus as the rim of the wheel is made larger and heavier its moment of inertia is increased. Suppose the wheel of this gyroscope is set into rapid rotation and the system is tilted about the horizontal axis. If the wheel is perfectly balanced then, instead of its tilting with the base. it would maintain its original plane of rotation. As shown in fig. 2, no matter how the base is moved the original plane of rotation of the wheel is maintained in space so long as friction at the bearings does not become sufficiently great so as to reduce the spin velocity. This experiment demonstrates the phenomenon of gyroscopic inertia that so long as no torques act on the wheel of the gyroscope it will maintain its orientation in space.



BY COURTESY OF THE SPERRY GYROSCOPE COMPANY

FIG. 2.—TILTED GYROSCOPE SHOWING THAT THE ORIGINAL PLANE OF ROTATION IS MAINTAINED WHEN THE BASE IS MOVED

The second important property of a gyroscope is that of precession which occurs when a torque is applied to it. In order to demonstrate this, let us imagine a uheel, such as a bicycle wheel, hung up by a cord attached to the end of the axle, or preferably to an extension attached to the axle, as shown in fig. 3. If the wheel is held in a vertical plane and is not rotating, then immediately after release it will fall. The weight of the wheel, acting at its centre of gravity; *i.e.*, at its geometrical centre, exerts a torque, or moment of force, about the point where the cord is attached. The moment of this torque is the weight of the wheel multiplied by its lever arm, Wl (the distance between the centre of gravity and point of support when the axle is horizontal). This torque Wl, if the wheel were not spinning, would cause a clockwise rotation about O, or about an axis perpendicular to the plane of the page, if W and 1 are in the plane of the page. The direction of this torque is given by the direction in which a right-handed screw would progress if turned in the direction of the torque. This clockwise rotation of W about O, whose torque or moment is Wl, would be represented by a line perpendicular to and into the page.

Suppose that the wheel now is set into rotation with a large spin velocity s, in the direction shown in fig. 3. If a right-handed screu is turned in the direction of s, the screw would progress to the right so that the spin velocity s is represented by a line through the centre of the wheel to the right. The rotating wheel then has an angular momentum to the right which depends on the moment of inertia of the wheel and the spin velocity s. Placing a heavy lead strip on the outer rim of the wheel increases the moment of inertia and angular momentum of the wheel. Suppose the suspended spinning uheel is now released, then the wheel does not fall but starts to turn around the cord, or to precess. with a precessional spin velocity s'. This precessional motion may be considered in the following manner. Bv Newton's laws of motion the torque Wl about O tends to cause motion or produce angular momentum in the direction indicated by the arrow Wl. Thus the wheel tends to turn its spin velocity; *i.e.*, to precess into this direction. Specifically the arrow representing the spin velocity s of the wheel turns into the direction of the torque arrow. Now the precessional spin velocity s depends on the moment of inertia I, the spin velocity s of the wheel and the value of the torque Wl. If the moment of inertia of the wheel is increased then the precessional spin velocity s is correspondingly increased. In this case the precessional spin velocity s' is given by Wl/Is nhere Is is the angular momentum of the spinning wheel.

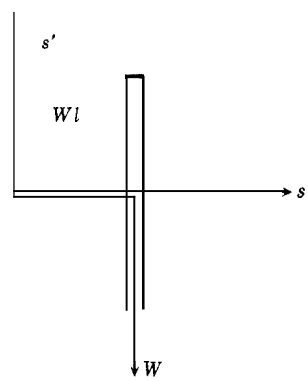


FIG. 3.—DIAGRAM SHOWING THE PRECESSIONAL PROPERTY OF A GYROSCOPE AS ADAPTED IN A SPINNING WHEEL SUSPENDED BY A CORD. THE PRECESSIONAL MOTION IS INDICATED BY S' (SEE TEXT FOR FURTHER INFORMATION)

Actually, the above analysis is only approximate for the case in nhich the angular momentum Is of the spinning wheel is considerably larger than that of the precessional spin angular momentum. If this is not the case, the axis of the wheel does not precess in a horizontal circle but wobbles about this circle with a motion called nutation, or nodding. This nutational motion is seen when the wheel slows down; *i.e.*, its angular momentum decreases. It may also be seen with a spinning top or a toy gyroscope having one point on the table.

The oldest known example of precession is that of the precession of the equinoxes, a term describing the gradual change in the direction of the earth's axis; that is, the axis of the earth describes a cone among the stars, moving in a circular path within a period

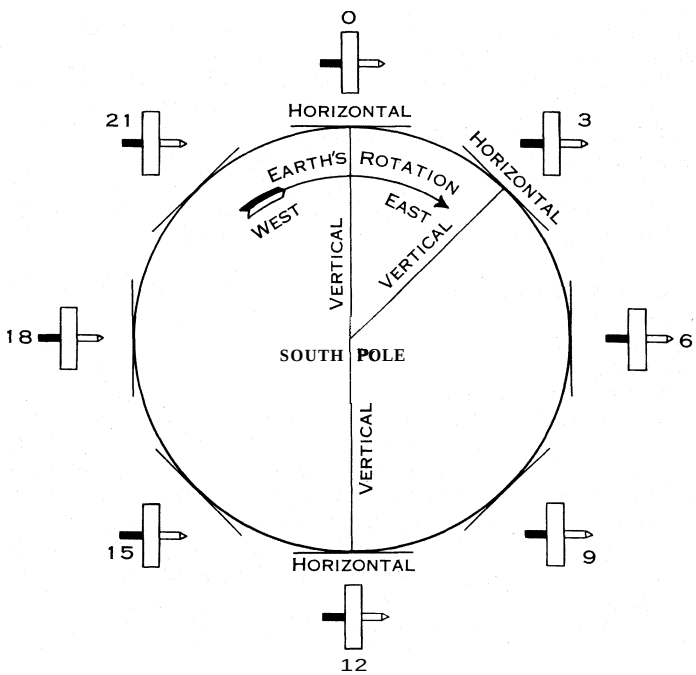
of 25.800 years. Despite the smallness of this effectit was known to the ancient astronomers who had available some careful measurements. The earth goes around the sun in a plane called the plane of the ecliptic. and the axis of spin of the earth makes an angle of 23° 27' with this plane. Our present polestar lies almost on the projection of the earth's axis into space and the stars in the sky appear to rotate about the polestar. With precession of the equinoxes the polestar changes but the axis of the earth remains at 23° 27′ to the plane of the ecliptic. The explanation of this precession is given in terms of gyroscopic action. A torque is exerted on the spinning earth by the gravitational attraction of the sun and moon on the earth. This torque arises on account of the equatorial bulge of the earth so that the forces of attraction of the sun and moon do not pass through the centre of mass of the earth. Just as a torque on the spinning wheel caused precession so a torque on the spinning earth produces precession. The calculation of this precession of the equinoxes requires much more analysis than is possible in this article and will be found in many advanced treatises on mechanics. Other gyroscopic phenomena are associated with the earth but these are too complicated to be described here.

Apparent Rotation of a Gyroscope on the **Earth.**—Suppose a gyroscope is placed at the earth's equator with its spinning axis horizontal in the east and west direction. The behaviour of this gyroscope is observed from a point in space looking at the earth's south pole, as shown in fig. **4.** In this figure only the wheel of the gyroscope is shown, the supporting rings being omitted for the sake of clarity. During the course of a day the gyroscope appears to rotate about a horizontal axis at right angles to the spinning axis. As seen from the earth at zero time the axis is along the horizontal while after three hours it is at 45° to the horizontal and after six hours it is along the vertical. making one rotation about the horizontal axis in a day. Actually. however, the gyro-spinning axis has remained parallel to its original direction in space. though the gyroscope has been carried along with the earth, including the revolution of the latter about its polar axis. Thus the rotation of the gyro axis is an apparent rotation just as in the case of the daily motion of the sun and stars. The horizontal rotation of the gyro axis at the equator is commonly referred to as the horizontal earth rate.

Suppose the gyro is placed, with its axis horizontal, at either the north or south poles of the earth. Again the gyro axis appears to rotate during the day but this time about a vertical axis. The vertical earth rate at the poles is again one revolution in **24** hours. An explanation of this is readily given in terms of gyroscopic inertia; *i.e.*, the fixed direction of the gyro axis relative to space. The earth turns while the gyro axis remains fixed in space so that the axis appears to turn under the earth at an equal and opposite rate to that of the earth. At the poles the vertical earth rate is a maximum. while at the equator the vertical earth rate is zero.

At places between the poles and the equator the gyro axis appears to turn partly about the horizontal axis and partly about the vertical axis. At intermediate places between latitudes oo and go" there is a component of rotation about both the horizontal and vertical axes. The component of vertical rotation is a maximum at the poles and zero at the equator and varies as the sine of the angle of latitude. Similarly the horizontal component varies as the cosine of the latitude, zero at go° (the polesj and maximum at o° (the equator). The horizontal earth rate causes the gyro axis to tilt while the vertical earth rate causes the gyro axis to move in azimuth. Since the gyro's axis is fixed in space it will continue to point at the same star and will describe a circle about the North Star. It is this rotation of the gyro's axis relative to the earth which enables us to apply the earth's gravitational force so as to convert the gyroscope into a north-seeking gyrocompass (*q.v.*).

It might be thought that since the gyro axis remains fixed in space this might be used to indicate direction. Unfortunately in practice the gyro axis does not remain fixed in space. Even while using the highest quality ball bearings and balancing the gyroscope carefully in gimbals so that there is no torque due to gravity. it has not been possible to reduce the rate of precession to zero. In fact in practice a precession of less than 2° per hour is very difficult to attain. For a short laboratory experiment this may seem negligible. but for practical use. for instance in steering a ship, it is not by any means good enough. If the gyro wandered only 2° per hour and in the same direction for a whole day it would change by 48°, which, of course, would render it useless for navigation.



BY COURTESY OF THE SPERRY GYROSCOPE COMPANY

FIG. 4.— GYROSCOPEWITH AXLE IN EAST-WEST DIRECTION AT THE EQUATOR OF THE EARTH APPEARS TO TURN ABOUT A HORIZONTAL AXIS ONCE EACH 24 HOURS

It is for this reason that a gyrocompass (*q.v.*) must make use of both the earth's rotation and its gravitational force.

In other applications, it must always be remembered that in practice the axis of the spinning gyro is not fixed in space but will deviate with time. It has been proposed at various times to use a gyroscope as a clock by setting it to point at some fixed star and then using its inclination with a fixed pointer to indicate time. If such a gyroscope really remained fixed with respect to space it could be used to indicate sidereal or star time. An error of 1% in a timekeeper amounts to about a quarter of an hour per day, and to keep time even as well as this the gyroscope would have to maintain its direction in space with a deviation of less than 4° per day, whereas we have seen that 2° per hour is better than we can guarantee.

PRACTICAL APPLICATIONS

Gyroscopic Gun Sights.—In an earlier section it was shown that the rate of precession of a gyroscope is equal to the applied torque divided by the angular momentum of the spinning wheel, or what is equivalent. the applied torque is equal to the rate of precession multiplied by the angular momentum. This principle is applied in the design of a naval gun sight which has been successfully used to defend ships against dive bombers. Suppose a gyroscope is mounted on the barrel of a gun with the spin axle constrained to be horizontal and at right angles to the barrel. Then when the gun is slued from one direction to another the gyroscope is slued with it, and if the wheel is spinning this sluing motion is. in fact, precession. The axle will only slue with the gun because a torque is being applied to the gyro about an axis parallel to the gun barrel. If the mounting is all solid and unyielding there is no means of knowing how great the torque is, but if the gyro is put in gimbals and the axle constrained to keep horizontal by a spring, then the pull of the spring will be shown by the tilt of the gyroscope. The pull on the spring will be a measure of the rate of precession of the gyro and therefore of the rate of sluing

of the gun. This pull on the spring will be proportional to the tilt of the gyroscope round the gun axis. From a measurement of the tilt the rate of slue can be obtained. In this case the precession initiates the torque, and the torque makes the precession go on. The information obtained from the gyro can be used either by reading the tilt and making calculations based on it, or better by making the tilt offset the gun sight by just the right amount required to make the shell hit the moving target instead of lagging behind it.

The first major tryout of gyroscopic gun sights produced during World War II occurred when the U.S.S. "South Dakota" virtually annihilated a force of attacking planes on Oct. 26, 1942. Since that time gyros have been used to compute the correct lead for guns, bombs or rockets fired from jet fighter planes. These were used in Korea. Gyros are also used to stabilize all types of fire control systems and as a controlling mechanism for guided missiles. (R. J. SN.)

Gyrocompass. — In the case of the marine gyrocompass (*q.v.*), both the gyroscopic inertia and the precession characteristics of the gyroscope are utilized, but the sensitive or rotating element is harnessed by the force of gravity so that the spinning axis of the gyro is brought into line with the north-south axis of the earth and is caused to remain there. The gyrocompass is a necessity in naval work where the great masses of iron and steel seriously impair the accuracy of the magnetic compass and where a high degree of accuracy is required for gun fire control. The gyrocompass is also in use in practically every large merchant fleet in the world because of the safety and added economy of navigation it affords. Vessels ranging from small power yachts to ocean liners use the gyrocompass.

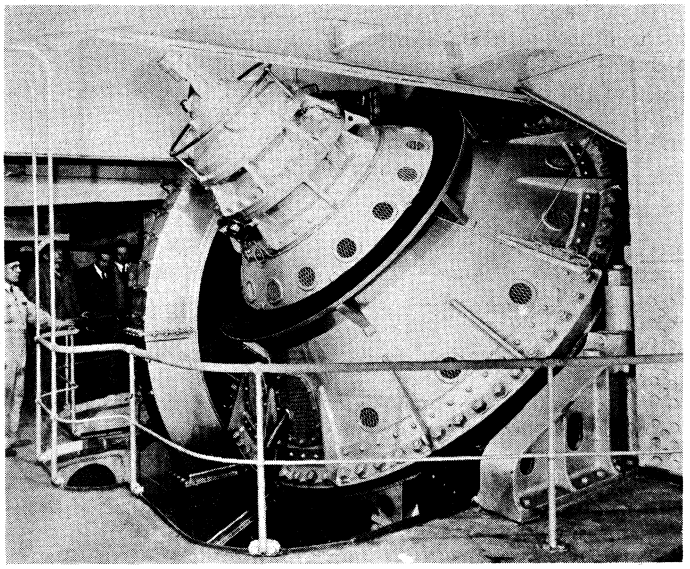
Gyropilot for Ships. — The gyropilot was originally developed (1921) to serve the single purpose of automatic steering. Its introduction was the logical step which followed as soon as the gyrocompass had established a fixed reference by which a ship could be steered. With such a reference available it was obvious that the purely mechanical function of steering could be more accurately performed by a machine than by a human being. The performance of the early models, however, was limited by the character and condition of the connecting medium between the wheelhouse and the steering engine room, and it soon became evident that this mechanism would have to be improved if the full value of automatic steering was to be realized.

A gyropilot was therefore produced (1925) having a control unit or steering stand, containing the gyrocompass repeater, on the bridge, and a power unit in the steering engine room attached directly to the steering gear control. With this arrangement the output of the steering stand in the wheelhouse is transmitted to the power unit aft by an independent electrical system which parallels the existing ship's telemotor. Through this system course changes may be effected while steering automatically, and the ship may also be steered manually through the electrical system by means of a wheel on the steering stand.

Facilities are provided in the equipment to take care of variable factors which influence the steering of the vessel. Under certain conditions, for instance, it is desirable to let the vessel have a small amount of "weather yaw." An adjustment is provided on the bridge unit for this purpose. Another adjustment varies the amount of rudder applied for a given amount of departure from the set course. It will be seen, therefore, that the gyropilot can steer a loaded ship as well as it can a light one and that it is effective in heavy weather as well as in a smooth sea.

Course Recorder. — The course recorder, operated electrically from the gyrocompass, automatically provides on a moving chart a chronological, graphic record of all movements of the ship's head in azimuth. From this record the quality of the steering, the mean course steered and the times and amounts of alterations of course may be ascertained, either at the time of recording or at any subsequent time. These course records have frequently proved invaluable in cases of litigation following accidents and collisions.

Gyrostabilizer for Ships. — In order to add materially to the pleasure and comfort of ocean travel, as well as to reduce the stresses and strains imposed on a ship's framework when rolling in a heaw sea. many different forms of apparatus have been devised, one of which is shown in fig. 5. The only kind which met with any great degree of success was the gyroscopic stabilizer developed by Sperry. This stabilizer is a compact unit generally located below decks on the centreline of the ship. It consists of a rotor of special steel and a supporting casing resting in horizontal "thwartships" gudgeon bearings. so that the rotor axle, when central, is vertical, with the ship on an even keel. The only apparent movement of the stabilizer other than the spinning of its rotor is a tilting or precessing, fore and aft in the thwartships bearings. In so doing, honever, the gyro exerts a righting force against the action of the wave as it tends to roll the vessel over. By dealing with each nave increment individually and by exerting a small counteracting force against it at just the right moment. the gyrostabilizer quenches the force of each wave and never allows the vessel to build up a roll averaging more than 3" or 4°. With the increase in ship size in the 20th century, the use of the gyroscopic stabilizer began to give way to retractable fins near the bottom of the hull on each side amidships. Gyroscopes were still used with the fins to control the angle of tilt needed to offset the roll of the ship.



BY COURTESY OF THE SPERRY GYROSCOPE COMPANY

FIG. 5.—SHIP GYROSTABILIZER. THE STABILIZER OPERATES UNDER THE DIRECTION OF A SMALL, SENSITIVE CONTROL GYROSCOPE MOUNTED ON ITS BASE BOTH INSTRUMENTS HAVE ROTORS OR SPINNING FLY WHEELS. THE CONTROL GYROSCOPE RESPONDS INSTANTLY TO THE SLIGHTEST ROLL OF THE SHIP. TRANSMITTING PRECESSION OR COUNTERACTING MOTION TO THE GYROSTABILIZER WHICH SERVES TO BALANCE THE SHIP'S HULL

Roll and Pitch Recorder. — This is an instrument employing a gyroscopic pendulum to determine the amplitude of a vessel's roll and pitch and the period of these motions. It consists of a small gyroscope with controlling mechanism for two pens, one of which makes a record of the roll, the other of the pitch of the vessel. A sheet of recording paper is automatically drawn under the two pens, and a third operated by clockwork makes marks on the paper at fixed intervals of time.

Gyroscopic Track Recorder. — A Sperry gyroscopic pendulum has also been used with success in a mechanism employed to record the condition of a railroad rail bed. It has been used to record differences of elevation of the two rails on both curves and straightaway track, magnitude and location of rail spreads, depressions, depth of low rail joints and other inequalities in the roadbed at the time the track is subjected to the actual impact of the car passing over the rails at normal speed.

Aircraft Instruments. — The most widespread applications of the gyroscope are to be found in aircraft, since the airplane travels in a medium which makes possible not only changes in direction but changes in altitude as well. The gyroscope has become indispensable in the control of aircraft. Two instruments in particular have long been standard for flying blind or without reference to the

earth. These instruments are the directional gyro and the artificial horizon.

The directional gyro is an excellent example of practical use being made of the property of a free gyroscope to maintain a fixed plane in space without reference to the earth. It is a small instrument which goes on the instrument panel in front of the human pilot. It consists of a small gyro spun by an air jet. This gyro is so mounted in gimbals as to have three degrees of freedom. The normal positions of this gyro are with its axes horizontal or parallel to the earth's surface. Around the vertical gimbal ring of this gyroscope is mounted an azimuth card. By means of a manual setting knob, this gyroscope, together with its azimuth card, may be moved so that the indication of the card at the plane's head will correspond with that of the magnetic compass. The gyro then maintains this specific directional line in space with a possible error caused by drift of possibly two or three degrees in each half hour that the gyro is left free. The utility of this instrument may appear to be very limited but it happens to complement the magnetic compass in a remarkable degree. By itself, neither is satisfactory as a directional reference, but a combination of the directional gyro with a magnetic compass gives the pilot complete and stable directional information. The magnetic compass is useful in an airplane only so long as the airplane continues on a straight course and in smooth air. While the airplane is making banked turns, the magnetic compass may have errors of go° or more. Therefore, if the pilot desires to change his course by a definite number of degrees, the magnetic compass will be of little use to him. On the other hand, the directional gyro is not affected by banked turns or rough air. It therefore gives a positive and gyrostabilized indication of the exact number of degrees of turn that the airplane may make at any time. Since its indication is not affected by rough air, it is possible for the human pilot to steer a straighter and more accurate course to his destination. The relatively slow drift of the directional gyro from its heading may be corrected manually from time to time by comparing its heading with that of the magnetic compass when the airplane is in straight and steady flight.

Another important aircraft instrument is the artificial horizon, which is used to give accurate indications to the human pilot of the bank and pitch attitude of his airplane. This instrument is also a small gyroscope mounted in such a manner as to have three degrees of freedom but with its axle maintained in a vertical position with reference to the earth by means of a gravity-actuated pendulum-type erecting system. Therefore, throughout any maneuvers of the airplane, the axle of the vertical gyro in the artificial horizon is always vertical and the indicating mechanisms attached to this gyroscope give the human pilot the exact bank, dive or climb angle at which his airplane is flying. This information to the human pilot is essential uhen flying blind, since human senses are not able to determine accurately the true direction of gravity without reference to the earth's surface by visual means.

The artificial horizon is a good example of the averaging ability of the gyro. The vertical position of the gyro axle in the artificial horizon is the average of all the positions assumed by the small pendulum-actuated erecting system which controls this gyroscope. Because of small changes of course or altitude caused, for instance, by rough air or turns, the pendulum is constantly swinging about the mean position which, in itself, is a true vertical. The artificial horizon gyroscope endeavours to follow these swings of the pendulum mechanism but does it so slowly that, for all practical purposes, the gyroscope remains with its axle fixed about the mean of all positions assumed by the erecting pendulum.

These two fundamental gyroscopes used in all aircraft are a basis of many control, calculating and indicating devices used on airplanes. The gyroscopes may be driven by air jets or by electric motors. By means of relays and pick-up mechanisms of various types angular indications may be secured from the basic gyro reference and used to actuate servo mechanisms by which complete automatic control of the airplane may be secured as in the automatic gyropilot. The information from these basic gyroscopes may be fed into calculating devices which will compute true ground speed, as in the ground speed meter, or may be used as a basis for taking celestial fixes, as in the gyro sextant, or they may be used to provide the basic directional information for the air position indicator which indicates constantly the latitude and longitude at which the airplane is located. Other gyroscopes of the same basic type are used for the control of many types of computing sights, stabilized gun turrets and other fire control mechanisms used on military aircraft.

In the final analysis. the vertical and the horizontal gyroscope form the basis by which the modern airplane is controlled and navigated from its starting point to its destination.

(R. E. G.; A. L. R.; R. J. SN.)

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GYTHIUM, the harbour and arsenal of Sparta, Greece (30 mi. distant), lies at the northwest extremity of the Laconian gulf, in a small fertile plain at the mouth of the Gythius. Its reputed founders were Heracles and Apollo, who frequently appear on its coins. In classical times it was a community of *perioeci,* politically dependent on Sparta. Subsequently it formed the most important of the Eleutherolaconian towns, a group of 24, later 18, communities leagued to maintain their autonomy against Sparta and declared free by Augustus. The highest officer of the confederacy was the general.

Pausanias (iii, 21 f.) has a description of the town in the reign of Marcus Aurelius, the agora, the Acropolis, the island of Cranae (Marathonisi) where Paris celebrated his nuptials with Helen, the Migonium or precinct of Aphrodite Migonitis (occupied by the modern town of Marathonisi or Gythium) and the hill Larysium (Koumaro) rising above it. Extant remains are all of Roman date; the theatre and the buildings partially submerged by the sea are noteworthy.

The modern town is a busy port with a good harbour protected by Cranae, now connected by a mole with the mainland; it is the capital of the prefecture (*νομός*) of Laconia with a population of 7,900 (1951 census).

H THIS letter corresponds to Semitic 𐤇 (chefh, consonantal) and Greek Η (eta). It may derive from an early symbol for fence. In the early Greek alphabets both the form 𐌇 with three horizontal bars and the simpler form Η were widely distributed. In Etruscan the prevailing form was 𐌇, and the same or a similar form occurs in very early Latin inscriptions, but the form Η came into general use in Latin, either from the Chalcidic Greek alphabet of Cumae or from some other source. The modern majuscule H is derived directly from the Latin. The cursive Latin form  resembled the modern minuscule, and the uncial form was  . Both these forms result from writing the letter without taking the pen from the paper, the right-hand vertical bar being thus foreshortened and the horizontal stroke rounded. From these came the Carolingian  and the modern minuscule *h*.

NAME OF FORM	APPROXIMATE DATE	FORM OF LETTER
PHOENICIAN	B.C. 1.200	
CRETAN	1.100-900	
THERAEAN	700-600	
ARCHAIC LATIN	700-500	
ATTIC	600	
CORINTHIAN	600	
CHALCIDIAN	600	
IONIC	403	
ROMAN COLONIAL	PRE-CLASSICAL AND CLASSICAL TIMES	
URBAN ROMAN		
FALISCAN		
OSCAN		
UMBRIAN		
CLASSICAL LATIN AND ONWARDS		

THE DEVELOPMENT OF THE LETTER "H" FROM THE PHOENICIAN THROUGH THE LATIN TO ITS PRESENT FORM

In the alphabets used to write the East Ionic dialect of Greek the letter became superfluous as a result of the disappearance of the aspirate which it represented in that dialect. It was accordingly put to a new use to indicate the open long e which had arisen through alteration of the primitive Greek long a. In a few inscriptions from Thera, Naxos, and several other localities the letter was used with syllabic value; that is, it included he, thus showing its old consonantal and its new vocalic value at the same time. But eventually, as a result of the spread of the Ionic alphabet, its use for the long vowel e or η became general throughout Greece, while its consonantal value as the aspirate h passed from the western Greek alphabets into the Etruscan alphabets and then into the Latin and other alphabets of ancient Italy. In the Romance languages the sound has largely disappeared, but the letter is still extensively used, partly with only etymological value, (*e.g.*, French homme), partly with fancied etymological value (*e.g.*, French haut from Latin *altus*, with h through the influence of hoh, the Old High German word of the same meaning), partly with special orthographical functions; for example, in Italian in combination with *c*, g to indicate the hard sound before a front vowel (*e.g.*, chi, ghetto).

In English, the initial h is pronounced in words of Germanic origin (*e.g.*, "hunt," "hook"); in some words of Romance origin, the h remains unpronounced (*e.g.*, "heir," "honour"), but in others it has been restored (*e.g.*, "humble," "humour"). The initial h often disappears in unaccented syllables (*e.g.*, "What did he say?").

In chemistry, H is the symbol for the element hydrogen.

(B.F.C.A.; J.W.P.)

In music in the German nomenclature, H stands for B natural, while the letter B is used for B flat. This confusing arrangement dates back to earlier centuries when, to get the semitone in the right place (between the 3rd and 4th notes) in the hexachord beginning on F, a new B, a half tone lower than the normal B, was introduced. This lowered B was called B molle (soft) and indicated by a rounded B (B *rotundum*) to distinguish it from the square sign of the natural B (B quadratum). B rotundum was later adopted as a general sign in the form of a flat (♭) to indicate the lowering of a note by a semitone, while B quadratum became the sign: in the form of a natural (♮), for a note not so lowered; and in this way, from the resemblance of the latter sign to an H, this letter came to be adopted in Germany for the natural or unlowered, B. In other words, H is here really an erroneous and misleading form of what was originally a square-shaped B.

HAAKON (Old Norse *Hákon*), the name of several kings of Norway, of whom the most important are the following:

HAAKON I, surnamed "the Good" (d. 961), was the youngest son of Harald Haarfager. He was fostered by King Aethelstan of England, who brought him up in the Christian religion, and on the news of his father's death in 933 provided him with ships and men for an expedition against his half-brother Erik, who had been proclaimed king. On his arrival in Norway Haakon gained the support of the landowners by promising to give up the rights of taxation claimed by his father over inherited real property. Erik fled, and was killed a few years later in England. His sons allied themselves with the Danes, but were invariably defeated by Haakon, who was successful in everything he undertook except in his attempt to introduce Christianity, which aroused an opposition he did not feel strong enough to face. He was killed at the battle of Fitje in 961, after a final victory over Erik's sons.

HAAKON IV, surnamed "the Old" (1204–1263), was declared to be the son of Haakon III, who died shortly before the former's birth in 1204. A year later the child was placed under the protection of King Inge, after whose death in 1217 he was chosen king; though until 1223 the church refused to recognize him, on the ground of illegitimacy, and the pope's dispensation for his coronation was not gained until much later. In the earlier part of

his reign much of the royal power was in the hands of Earl Skule, who intrigued against the king until 1239, when he proceeded to open hostility and was put to death. From this time onward Haakon's reign was marked by peace and prosperity, until in 1263 a dispute with the Scottish king concerning the Hebrides, a Norwegian possession, induced Haakon to undertake an expedition to the west of Scotland. A division of his army seems to have repulsed a large Scottish force at Largs (though the later Scottish accounts claim this battle as a victory), and, having won back the Norwegian possessions in Scotland. Haakon was wintering in the Orkneys. when he died on Dec. 15, 1263. A greater part of his fleet had been scattered and destroyed by storms. The most important event in his reign was the voluntary submission of the Icelandic commonwealth. Worn out by internal strife fostered by Haakon's emissaries, the Icelandic chiefs acknowledged the Norwegian king as overlord in 1262. Their example was followed by Greenland.

Haakon YII (1872–1957), the second son of Frederick VIII, king of Denmark. was born on Aug. 3. 1872, and was known as Prince Charles of Denmark. He married Maud. youngest daughter of Edward VII of England in 1896. In 1905 he accepted the throne of Norway and was crowned as Haakon VII in June 1906. In 1940. after the German invasion of Norway. he escaped to England, where he was able to act as a rallying-point for the Norwegian resistance. His return to Oslo in 1945 was warmly acclaimed. He died Sept. 21. 1957, at Oslo.

HAARLEM, a town of the Netherlands in the province of North Holland, on the Spaarne. Pop. (1957 est.) 167,264 (mun.).

Haarlem, a prosperous place in the middle of the 12th century, received its first town charter from William II, count of Holland and king of the Romans, in 1245. It played a considerable part in the wars of Holland with the Frisians. In 1492 it was captured by the insurgent peasants of North Holland and was retaken by the imperial stadholder, and deprived of its privileges. In 1572 Haarlem joined the revolt of the Netherlands against Spain, but in July 1573, after a seven months' siege, was forced to surrender to Alva's son Frederick. who exacted terrible vengeance. In 1577 it was recaptured by William of Orange and permanently incorporated in the united Netherlands. Haarlem was occupied by German troops in World War II.

Haarlem is the seat of the governor of the province of North Holland, and is a typical Dutch town, with numerous narrow canals and gabled houses. Of the ancient city gates the Spaarnewouder or Amsterdam gate alone remains. In the Frederiks park is a pump room supplied with a powerful chalybeate water from a spring, in the Haarlemmer polder. In the central market place are the old Fleshers' hall, built by Lieven de Key in 1603 and containing the archives: the town hall. the old Stadsdoelen, where the burgesses met in arms and the Groote Kerk ("Great Church"). This last, dedicated to St. Bavo, dates from the late 11th and early 16th centuries. Its great length (460 ft.) and the height and steepness of its vaulted cedarwood roof (1538) are very impressive. In the belfry are the damiaatjes, ("small bells") presented to the town, according to tradition, by William I, count of Holland (d. 1222), the crusader. The town hall was originally a palace of the counts of Holland. begun in the 12th century, and some old 13th-century beams still remain; but the building was remodeled in the beginning of the 17th century. Haarlem possesses a picture gallery celebrated for its fine collection of paintings by Frans Hals; there an exhibition was held in 1936, with contributions from all over the world. The town library contains several incunabula and a collection of early Dutch literature. At the head of the scientific institutions of Haarlem may be placed the Dutch Society of Sciences (Hollandsche *Maatschappij* van *Wetenschappen*), founded in 1752, and the Teyler society. Besides these there are the old weighhouse (1598) and the orphanage for girls (1608), originally an almshouse for old men, both built by the architect Lieven de Key of Ghent.

Cloth weaving and brewing declined in the beginning of the 16th century. A century later, silk, lace and damask weaving were introduced by French refugees, and became very important industries; but about the close of the 18th century this remarkable prosperity had also come to an end. and it was not till after 1830 that Haarlem began to develop the manufactures in which it is now chiefly engaged. Industries include cotton manufacture, dyeing, printing, bleaching, brewing, making of paint and type founding. One of the printing establishments has the reputation of being the oldest in the Netherlands, and publishes the oldest Dutch paper, De Opregte Haarlemmer Courant. Market gardening, especially horticulture, is extensively practised in the vicinity, so that Haarlem is the seat of a large trade in Dutch bulbs, especially hyacinths, tulips, fritillaries, spiraeas and japonicas.

HAARLEM LAKE (Dutch HAARLEMMER MEER), a commune of the province of North Holland, constituted by the law of July 16, 1855. It has an area of 70 sq.mi., and its population was 42,277 (mun.) in 1957 (est.). The commune was formerly a lake, which is said to have been a relic of a northern arm of the Rhine which passed through the district in the time of the Romans. In 1531 the Haarlemmer Meer and three smaller sheets of water in its vicinity had a united area of about 14,000 ac. The four lakes were formed into one by successive inundations and by 1647 the new Haarlem lake had an area of about 37,000 ac., which a century later had increased to more than 42,000 ac. As early as 1643 Jan Adriaanszoon Leeghwater proposed to endike and drain the lake; and similar schemes were brought forward from time to time. A furious hurricane in Nov. 1836 drove the waters as far as the gates of Amsterdam, and another on Christmas day sent them in the opposite direction to submerge the streets of Leiden. In Aug. 1837 the king appointed a royal commission of inquiry; the scheme proposed by the commission received the sanction of the second chamber in March 1839, and in the following May the work was begun. A canal was first dug round the lake for the reception of the water and the accommodation of the traffic which had previously been carried on. As the water from the lake had no natural outfall pumping by steam engines began in 1848, and the lake was dry by July 1852. The whole area of 42,096 ac. recovered from the waters brought in about £780,000, exactly covering the cost of the enterprise; so that the actual cost to the nation was only the amount of the interest on the capital. The soil is of various kinds, loam, clay, sand and peat; most of it is fertile, though in the lower portions there are barren patches where the scanty vegetation is covered with an ochreous deposit. Mineral springs occur containing a very high percentage of common salt; and a company was formed for working them. Corn, seeds, cattle? butter and cheese are the principal produce. Hoofddorp, Yenneperdorp or Nieuw Vennep, Abbenes and the vicinities of the pumping stations are the spots where the population has clustered most thickly.

HAAST, SIR JOHANN FRANZ JULIUS VON (1824–1887), German and British geologist, was born at Bonn on May 1, 1824. In 1858 he started for New Zealand to report on immigration possibilities. He assisted Hochstetter in his preliminary geological survey. The governments of Nelson and Canterbury then employed Haast to investigate the geology of those districts. He discovered gold and coal in Nelson, and carried on important researches with reference to the occurrence of *Dinornis* and other extinct wingless birds (Moas). His Geology of *the* Provinces of *Canterbury* and Westland, N.Z., was published in 1879. He was the founder and director of the Canterbury museum at Christchurch. He was surveyor-general of Canterbury from 1861 to 1871, and professor of geology at Canterbury college. He was elected F.R.S. in 1867; and he was knighted in 1887. He died at Wellington, N.Z., on Aug. 15, 1887.

HABAKKUK, the name borne by the eighth book of the Old Testament "Minor Prophets." Nothing is known of its writer, save what may be inferred from the book; legend connects him with Daniel ("Bel and the Dragon"). The book falls into three obvious parts, viz. (1) a dialogue between the prophet and God (i. 2–ii. 4); (2) a series of five woes pronounced on wickedness (ii. 5–ii. 20); (3) a poem describing the triumphant manifestation of God (iii.). There is considerable difficulty in regard to the interpretation of (1), on which that of (2) will turn; while (3) forms an independent section, to be considered separately.

In the dialogue the prophet cries to God against continued vio-

lence and injustice, though it is not clear whether this is done *within* or *to* Israel (i. 2–4). The Divine answer declares that God raises up the Chaldaeans, whose formidable resources are invincible (5–11). The prophet thereupon calls God's attention to the tyranny which He apparently allows to triumph and declares his purpose to wait till an answer is given to his complaint (i. 12–ii. 1). God answers by demanding patience, and by declaring that the righteous shall live by his faithfulness (ii. 2–4).

The interpretation of this dialogue which first suggests itself is that the prophet is referring to wickedness *within* the nation, which is to be punished by the Chaldaeans (*i.e.*, the Babylonians) as a Divine instrument; in the process the tyranny of the instrument itself calls for punishment, which the prophet is bidden to await in patient fidelity. On this view of the dialogue the subsequent woes will be pronounced against the Babylonians, and the date assigned to the prophecy will be about 600 B.C., *i.e.*, soon after the battle of Carchemish (605 B.C.) when the Babylonian victory over Egypt inaugurated a period of Babylonian supremacy which lasted till Babylon was overthrown by Cyrus in 538 B.C. It is strange, however, that the prophet should pass so abruptly in a single dialogue from the wickedness of Israel to that of Babylon, thus destroying his primary emphasis; moreover, the wickedness of i. 2 *seq.* and of i. 12 *seq.* seems identical. Possibly i. 5–11 is a misplaced earlier prophecy, whilst i. 2–4, 12 *seq.* refers to the Babylonian oppression of Israel (Giesebrecht, Nowack, Wellhausen), or it is a part of the Divine answer, following ii. 4, which would make the Babylonians the Divine instrument for punishing *Assyrian* tyranny (Budde). Duhm's theory (followed by Sellin) refers the whole book to the time of Alexander the Great, by the violent emendation of "Chaldaeans" to "Chittim" (= Greeks).

The most striking characteristic of the poem (iii.) lies in the superscription ("A prayer of Habakkuk the prophet. set to Shigionoth"), the subscription ("For the chief musician, on my stringed instruments"), and the insertion of the musical term "Selah" in three places (v. 3, g, 13). These liturgical notes make extremely probable the supposition that the poem has been taken from some collection like that of our present book of Psalms. The poem begins with a prayer that God will renew the historic manifestation of the exodus, which inaugurated the national history and faith; a thunderstorm moving up from the south is then described, in which God is revealed (3–7); it is asked whether this manifestation, whose course is further described, is against nature only (8–11); the answer is given that it is for the salvation of Israel against its wicked foes (12–15); the poet describes the effect in terror upon himself (16) and declares his confidence in God, even in utter agricultural adversity (17–19). There is nothing in this fine poem to connect it with the conception of the Chaldaeans as a Divine instrument. It is the nation that speaks through the poet (*cf.* v. 14), but at what period of its post-exilic history we have no means of inferring.

In regard to the theological teaching of the book: (1) the poem (iii.), though possibly latest in date, claims first consideration, because it avowedly moves in the circle of primitive ideas, and supplicates a Divine intervention, a direct and immediate manifestation of the transcendent God. He is conceived as controlling or overcoming the forces of nature; and though an earlier mythology has supplied some of the ideas, yet, as with the opening chapters of Genesis, they are transfigured by the moral purpose which animates them, the purpose to subdue all things that could frustrate the destiny of God's anointed (v. 13). The closing verses strike that deep note of absolute dependence on God, which is the glory of the religion of the Old Testament and its chief contribution to the spirit of the Gospels. (2) The prophecy of the Chaldaeans as the instruments of the Divine purpose involves a different, yet related, conception of the Divine providence. The philosophy of history, by which Hebrew prophets could read a deep moral significance into national disaster, and turn the flank of resistless attack, became one of the most important elements in the nation's faith. If the world powers were hard as flint in their dealings with Israel, the people of God were steeled to such moral endurance that each clash of their successive onsets kindled some new flame of devotion. Through the Chaldaeans. God worked a work which required centuries of life and literature to disclose its fulness (i. 5). (3) When we turn from this view of the Chaldaeans to the denunciation of their tyranny in "taunt songs" (ii. 5–20), we have simply a practical application of the doctrine of Divine government. God, being what He is, at once moral and all powerful, the immoral life is doomed to overthrow, whether the immorality consist in grasping rapacity, proud self-aggrandizement, cruel exaction, exulting triumph or senseless idolatry. (4) Yet, because the doom so often tarries, there arises the problem of the suffering of the innocent and the upright. How can God look down with tolerance that seems favour on so much that conflicts with His declared will and character? This is the great problem of Israel, finding its supreme expression for all time in the book of Job (*q.v.*). In that book the solution of the problem of innocent suffering lies hidden from the sufferer, even to the end, for he is not admitted with the reader to the secret of the prologue; it is the practical solution of faithfulness resting on faith which is offered to us. So here, with the principle of ii. 4, "the righteous shall live by his faithfulness." The different application of these words in the New Testament to "faith" is well known (Rom. i. 17; Gal. iii. 11; Heb. x. 38) though the difference is apt to be exaggerated by those who forget how much of the element of "faithfulness" lies in Paul's conception of "faith." In G. A. Smith's words, "as Paul's adaptation, 'the just shall live by faith,' has become the motto of evangelical Christianity, so we may say that Habakkuk's original of it has been the motto and the fame of Judaism: 'the righteous shall live by his faithfulness.' "

BIBLIOGRAPHY.—There are German commentaries by Nowack (1897), Wellhausen (1898), Marti (1904), Duhm (1906), and Sellin (1922); one in French by Van Hoonacker (1908), and English by Davidson *Cambridge Bible* (1896); G. A. Smith, *Expositor's Bible* (1898); Driver, *Century Bible* (1906); G. G. V. Stonehouse (1911); W. H. Ward, *International Critical Commentary* (1912); A. R. Gordon, *Peake's Commentary* (1919). (H. W. R.)

HABDALAH, in Judaism, the concluding ceremony of sabbaths and festivals. *See* KIDDUSH AND HABDALAH.

HABEAS CORPUS, in law, a writ issued by a judge or court of justice, commanding the person to whom it is directed to bring the body of a person in his custody before that or some other court for a specified purpose.

There are various forms of the writ, of which the most famous is that known as *habeas corpus ad subiiciendum,* the well-established remedy for violation of personal liberty. This is now the only important form of writ though there were originally many others. From the earliest records of the English law no free man could be detained in custody except on a criminal charge or conviction or for a civil debt. While the writ is a remedial mandatory writ—"of right." it is not "of course," and is granted only on application to the High Court or a judge thereof, supported by a sworn statement of facts setting up at least a probable case of illegal confinement. It is addressed to the person in whose custody another is detained, and commands him to bring his prisoner before the court immediately after the receipt of the writ, together with the day and cause of his being taken and detained, to undergo and receive (ad *subiiciendum et recipiendum*) whatsoever the court awarding the writ "may consider of concerning him in that behalf."

Writs of *habeas corpus* were issued before the Great Charter. The writ de *odio et atiâ* was used as early as the 12th century to prevent imprisonment on vexatious appeals of felony, and this writ is specifically mentioned in Article 36 of Magna Carta which provides that it shall issue gratuitously, and "not be refused." It played an important part in enabling a person to avoid trial by battle and obtain trial by jury. In the case of imprisonment on accusation of crime the writ issued from the court of king's bench (or from the chancery), and on its return the court judged of the legality of the imprisonment, and discharged the prisoner or admitted him to bail or remanded him to his former custody according to the result of the examination.

By the time of Charles I. the writ was fully established as the appropriate process for checking illegal imprisonment by inferior courts or by public officials.

In Darnel's case (1627) the judges held that the command of

the king was a sufficient answer to a writ of habeas corpus. The House of Commons thereupon passed resolutions to the contrary, and after a conference with the House of Lords the measure known as the Petition of Right was passed (1627, 3 Car. I c i.) which. inter alia, recited (s. j) that, contrary to the Great Charter and the good laws and statutes of the realm, divers of the king's subjects had of late been imprisoned without any cause shown, and nhen they were brought up on habeas *corpus* ad *subiiciendum*, and no cause was shown other than the special command of the king signified by the privy council, were nevertheless remanded to prison, and enacted "that no freeman in any such manner as is before mentioned be imprisoned or detained." By the Act of 1641 abolishing the Star Chamber, the right to a habeas corpus was given to test the legality of commitments by command or warrant of the king or the privy council.

The Act of 1679.—The reign of Charles II. was marked by further progress towards securing the freedom of the subject from wrongful imprisonment. Lord Clarendon was impeached, inter alia, for causing many persons to be imprisoned against law and to be conveyed in custody to places outside England.

Though the authority of the courts had been strengthened it was still rendered insufficient by reason of the insecurity of judicial tenure, the fact that only the chancellor (a political as well as a legal officer) and the court of king's bench had undoubted right to issue the writ, and the inability or hesitation of the competent judges to issue the writ except during the legal term, which did not cover more than half the year. A series of bills was passed through the Commons between 1668 and 1675, only to be rejected by the other House. In Jenkes's case (1676), Lord Chancellor Nottingham refused to issue the writ in vacation in a case in which a man had been committed by the king in council for a speech at Guildhall, and could get neither bail nor trial. In 1679, but rather in consequence of Lord Clarendon's arbitrary proceedings than of Jenkes's case, a fresh bill was introduced which passed both Houses and became the famous Habeas Corpus Act of 1679.

In the manner characteristic of English legislation the act is limited to the particular grievances immediately in view and is limited to imprisonment for criminal or supposed criminal matters, leaving untouched imprisonment on civil process or by private persons. It enacts in substance as follows: (1) When a writ of habeas *corpus* is directed to a sheriff or other person in charge of a prisoner, he must within 3. 10 or 20 days, according to the distance of the place of commitment, bring the body of his prisoner to the court, with the true cause of his detainer or imprisonment — unless the commitment was for treason or felony plainly expressed in the warrant of commitment. (2) If any person be committed for any crime — unless for treason or felony plainly expressed in the warrant — it shall be lawful for such person or persons (other than persons convicted or in execution by legal process) in time of vacation, to appeal to the lord chancellor as a judge, who shall issue a habeas corpus returnable immediately, and on the return thereof shall discharge the prisoner on giving security for his appearance before the proper court. unless the party so committed is detained upon a legal process or under a justice's warrant for a non-bailable offence. Persons neglecting for two terms to pray for a habeas corpus shall have none in vacation. (3) Persons set at large on habeas corpus shall not be recommitted for the same offence unless by the legal order and process of the court having cognizance of the case. (4) A person committed to prison for treason or felony shall, if he requires it. in the first week of the next term or the first day of the next session of oyer and terminer, be indicted in that term or session or else admitted to bail, unless it appears on affidavit that the witnesses for the Crown are not ready; and if he is not indicted and tried in the second term or session after commitment, or if after trial he is acquitted, he shall be discharged from imprisonment. (5) No inhabitant of England (except persons contracting. or, after conviction for felony, electing to be transported) shall be sent prisoner to Scotland, Ireland. Jersey etc , or any place beyond the seas. Stringent penalties are provided for ofienses against the act.

A judge delaying habeas corpus forfeits £500 to the party aggrieved. Illegal imprisonment beyond seas renders the offender liable in an action by the injured party to treble costs and damages to the extent of not less than £500, besides subjecting him to the penalties of praemunire and to other disabilities. "The great rank of those who were likely to offend against this part of the statute was," says Hallam, "the cause of this unusual severity." Indeed as early as 1591 the judges had complained of the difficulty of enforcing the writ in the case of imprisonment at the instance of magnates of the realm. The effect of the act was to impose upon the judges under severe sanction the duty of protecting personal liberty in the case of criminal charges and of securing speedy trial upon such charges when legally framed; and the improvement of their tenure of office at the revolution, coupled with the veto put by the Bill of Rights on excessive bail, gave the judicature the independence and authority necessary to enable them to keep the executive within the law and to restrain administrative development of the scope or penalties of the criminal law; and this power of the judiciary to control the executive, coupled with the limitations on the right to set up "Act of State" as an excuse for infringing individual liberty is the special characteristic of English constitutional law.

The habeas corpus ad *subiiciendum* was sometimes used in cases of illegal detention in private custody. In 1758 questions arose as to its application to persons in naval or military custody, including pressed men, which led to the introduction of a bill in parliament and to the consultation by the House of Lords of the judges. (See Wilmot's Opinions, p. 77.) In the same year the writ was used to release the wife of Earl Ferrers from his custody and maltreatment. But perhaps the most interesting instance of that period is the case of the Negro Somerset (1771) who was released from a claim to hold him as a slave in England.

The Act of 1816 (56 Geo. III. c. 100), does not touch cases covered by the Act of 1679. The object of it was to deal with cases of persons unlawfully detained in private custody. It enacts (1) that a writ of habeas corpus shall be issued in vacation time in favour of a person restrained of his liberty otherwise than for some criminal or supposed criminal matter (except persons imprisoned for debt or by civil process); (2) that though the return to the writ be good and sufficient in law, the judge shall examine into the truth of the facts set forth in such return, and if they appear doubtful the prisoner shall be bailed; (3) that the writ shall run to any port, harbour, road, creek or bay on the coast of England, although not within the body of any county. The last clause was intended to meet doubts on the applicability of habeas corpus in cases of illegal detention on board ship.

It will appear from the foregoing statement that the issue and enforcement of the writ rests on the common law as strengthened by the acts of 1627, 1640, 1679 and 1816, and subject also to the regulations as to procedure contained in the Crown *Office* Rules, 1906. The effect of tbe statutes is to keep the courts always open for the issue of the writ. It is available to put an end to all forms of illegal detention in public or private custody.

Suspension of the Act.—In times of public danger it has occasionally been thought necessary to "suspend" the Habeas Corpus act, 1679, by special and temporary legislation. This was done in 1794 (by an act annually renewed until 1801) and again in 1817, as to persons arrested and detained by his majesty for conspiring against his person and government. The same course was adopted in Ireland in 1866 during a Fenian rising. It has been the practice to make such acts annual and to follow their expiration by an act of indemnity. In cases where martial law exists the use of the writ is *ex* hypothesi suspended during conditions amounting to a state of war within the realm or the British possession affected (*e.g.*, the Cape Colony and Natal during the South African War), and it would seem that the acts of courts martial during the period are not the subject of review by the ordinary courts. The so-called "suspension of the Habeas Corpus act" bears a certain similarity to what is called in Europe "suspending the constitutional guarantees" or "proclaiming a state of siege," but "is not in reality more than suspension of one particular remedy for the protection of personal freedom."

A principle of the highest importance to the liberty of the subject was laid down by the house of lords in the case of Cox v. Hakes (1890), 15 A.C. 506, and further extended in the leading case of Ex *parte* Art *O'Brien* (1923), A.C. 603 This principle is that an appeal against the refusal of the writ may be taken by the applicant right up to the house of lords, but that an appeal by the crown against the grant of the writ by the divisional court cannot be taken any further. In other words, once the writ is granted, the crown cannot delay its operation or keep the applicant in custody by attempting to prosecute an appeal.

Furthermore it has been decided that it is no answer to the writ to plead that the person detained is no longer in the actual physical custody of the defendant; for example, mere power or control over a child is sufficient to justify the issue of the writ.

Scotland.—The writ of habeas corpus is unknown to Scots law, nor will it issue from English courts into Scotland. Under a Scots act of 1701 (c 6) provision is made for preventing wrongful imprisonment and against undue delay in trials. It was applied to treason ielony in 1848. The right to speedy trial is now regulated by

s. 43 of the Criminal Procedure Scotland act 1887. These enactments are as to Scotland equivalent to the English act of 1679. Under the Court of Exchequer Scotland act 1856 (19 and 20 V. c. 56) provision is made for bringing before the court of session persons and proceedings before inferior courts and public officers—which is analogous to the powers to issue *habeas corpus* in such cases out of the English court of exchequer (now the revenue side of the king's bench division). (W. F. C.; X.)

United States.—The common law of *habeas corpus* was inherited as part of the common law of the American states. The federal government as well as the states have founded their procedure upon the principles set forth in the act of 1679, most states specifically adopting its features by statutory enactment. The writ, as under the English system, is available to contest detention by public or private authority. The power of the court issuing it extends only to inquire into the jurisdiction of the court, administrative tribunal, or person detaining the prisoner, the legal sufficiency of the proceedings taken against him, or the validity of the judgment or order of commitment. No state or federal court can issue the writ beyond the territorial limits of its jurisdiction. The esteem with which the writ is regarded is illustrated by the embodiment of the provision in the federal constitution as well as in the constitutions of most states that the privilege of the writ "shall not be suspended unless when in cases of rebellion or invasion the public safety may require it." It is generally thought that the power to suspend the writ is vested in the legislative rather than the executive department of government Acting under such a theory during the Civil War, congress in 1863 granted the president the power of suspension whenever in his judgment the public safety demanded it. The proper exercise of such judgment by the president was held by the supreme court in Milligan's case (4 Wall. 2) to be subject to judicial review. In instances state supreme courts have regarded the privilege suspended by the state executives' proclamation that an insurrection existed in specified territory.

State courts have no power to issue the writ for the discharge of persons held under claim or colour of authority of any officer or court of the United States inasmuch as the federal government when acting within its sphere is supreme. Originally U.S. courts could not issue the writ to inquire into the cause of commitment by state courts. In 1833, however, due to the nullification movement in South Carolina resulting in resistance to the enforcement of federal revenue laws, congress extended the authority of the federal courts to inquire into any commitment for an act done in pursuance of a law of or authority under the United States. During the controversy over the Canadian boundary in 1842 this power was extended to authorize inquiry into the commitment of any foreign citizen for an act done under authority of a foreign state whose validity depended upon international law. In 1847 the power was again extended to all cases where a person was restrained of liberty in violation of the constitution, laws or treaties of the United States. This, however, does not permit the federal courts to obstruct the administration of justice in state courts whenever the accused claims that he is restrained in violation of a federal right. The state courts being themselves bound by the U.S. constitution, laws and treaties as the "supreme law of the land" can ordinarily be entrusted to determine the federal right, and in case the determination be contrary to the accused's contention he may resort by writ of error or *certiorari* to the U.S. supreme court. It is thus only in cases of peculiar urgency that the federal court will interfere in the first instance by *habeas corpus*. Such interference being an extremely delicate matter the supreme court has limited the issuance of *habeas corpus* to cases that concerned the authority or operations of the federal government, its obligations under international law to other nations or the vindication of a fundamental right in danger of violation before resort may be had to usual methods of appeal.

The various states have divergent views as to the accused's right of appeal from an order denying the issuance of habeas corpus The right where denied by judicial decision has commonly been granted by statute. It is also customary to provide by statute for a similar right of appeal on the part of the state. The original jurisdiction of the U.S. supreme court being limited by the constitution, it cannot issue the writ as an original matter except in cases within that jurisdiction. But in exercise of its appellate jurisdiction it may issue the writ to inquire into the validity of a detention under the authority of an inferior court to determine whether such court has acted without jurisdiction or exceeded its authority. (J. M. La.)

HABENARIA, a genus of plants of the orchid family (Orchidaceae), comprising in its most inclusive sense some 500 temperate and tropical species. In North America some 40 species occur, among which are the small purple-fringed orchis (*H. psycodes*), the white-fringed orchis (*H. blephariglottis*), the ragged orchis (*H. lacera*), the prairie fringed orchis (*H. leucophaea*), the yellow-fringed orchis (*H. ciliaris*), the white bog orchis (*H. dilatata*), the round-leaved orchis (*H. orbiculata*), the slender white orchis (*H. elegans*) and the western green orchis (*H. unalaschensis*). The frog orchis (*H. viridis*), scented orchis (*H. conopsea*) and butterfly orchis (*H. bifolia*) are native to the British Isles. *See* ORCHIDS.

HABER, FRITZ (1868–1934), German physical chemist, winner of the Nobel prize for chemistry in 1918 for his direct synthesis of ammonia from nitrogen and hydrogen, was born at Breslau. Dec. 9, 1868, and took his doctorate in organic chemistry at the Technische Hochschule, Berlin. He was essentially self-taught in his chosen field—physical chemistry with emphasis on technical application. His remarkable output of research began at Karlsruhe in 1894, beginning with a study of the thermal decomposition of hydrocarbons and combustion of gases in contact with cooled surfaces. This was a real contribution to the understanding of the cracking processes that have since become tremendously important.

Haber's work in electrochemistry was outstanding. He unraveled the complicated course of the electrolytic reduction of nitrobenzene. He was the first to demonstrate the significance of the electrode potential in oxidations and reductions, and developed the first general theory of electrochemical reduction. He destroyed the hopes that had been placed in fuel cells as a means for the direct electrochemical transformation of the energy of coal into electrical power. He showed that Faraday's law is valid for solid electrolytes. He worked out the theory of the glass electrode and developed its practical application. He provided standard methods for investigating and remedying the corrosion of underground gas and water mains due to stray currents from tramway systems. He studied beryllium compounds, the production of aluminum, the passivity of iron. the water gas equilibrium in the Bunsen flame, the speed of reaction in heterogeneous systems. the separation of gases by centrifugal force and the escape of electrons from metals. His studies of the optical analysis of gases led to the gas interferometer that bears his name. He devised a vibrating quartz manometer to measure low gas pressures, and constructed a fire damp whistle for use in mines. Among his later studies were: the chemical applications of Planck's quantum theory; the conditions determining the structure of precipitates; adsorption, chemiluminescence; chain reactions in gases; free radicals; the mechanism of combustion.

Haber's greatest achievement, which brought him the Nobel prize in 1918, was his successful synthesis of ammonia (*q.v.*). This was an outcome of his studies of the thermodynamics of gas reactions. He developed a small apparatus, but at first was quite skeptical about the feasibility of carrying out, on a technical scale, a reaction at red heat and under several hundred atmospheres of pressure. Eventually, he perfected his equipment so that the translation to the industrial scale, though still presenting gigantic problems, was far from hopeless. The credit for the large-scale development of the Haber process belongs mostly to Karl Bosch.

In 1911, Haber was called to direct the Kaiser Wilhelm Institut für Physikalische Chemie und Elektrochemie at Dahlem, Berlin. This research institute, which he headed until 1933, became the finest laboratory of its kind in the world, and mature chemists from all nations came there to work. In 1914, he placed his services at the disposal of the German imperial government, though he hated war and its horrors. He sensed at once that the issue could be decided by a lack of nitric acid, the essential raw material for high explosives. Haber's first efforts were to increase the supply of ammonia, which could then be oxidized to nitric acid. He also headed the organization of the gas warfare, and directed the chlorine gas attack at Ypres on April 22, 1915. He was made chief of the chemical warfare service in 1916.

Svante A. Arrhenius (*q.v.*) estimated that the oceans contain 8,000,000,000 tons of gold. When Germany was asked to pay in reparations the equivalent of 50,000 tons, Haber conceived the dramatic idea of securing the fabulous amount from the sea. He devised processes for the extraction of the metal from the water, whose gold content was believed to be at least five milligrams per ton. However, actual trials gave disappointing results, as it was discovered that the analyses had been erroneously high because of the gold content of the reagents and vessels. The actual content is about one-thousandth of a milligram per ton. The project was abandoned in 1928.

On a journey around the world, Haber spent two months in Japan, a nation with which he had great sympathy. In 1930 he

established the Japan institute, with headquarters in Berlin and Tokyo, to promote mutual understanding and cultural interests. The anti-Jewish policy of the nazi regime brought his resignation in 1933, and he accepted an invitation to work at the University of Cambridge. En route to Italy, to escape the dangers of the English winter, he suffered a heart attack at Basel and died on Jan. 29, 1934.

Besides his numerous scientific papers and published academic lectures, he was the author of: *Grundriss der technischen Elektrochemie auf theoretisclzer Grundlage* (1898); *Thermodynamik technische Gasreaktionen* (1905; English translation by Lamb, 1908); *Die elektrolytischen Prozesse der organischer Chemie,* with Moser (1910); *Beitrag zur Kenntnis der Metalle* (1919); *Aus Luft durch Kohle zum Stickstoffdünger, zu Brot und reichlicher Nahrung,* with Ramm and Caro (1920); *Über die Synthese des Ammoniaks* (1922); *Die Chemie im Kriege* (1922); *Fünf Vortrage aus den Jahren 1920–1923* (1924); *Über Die Herstellung des Ammoniaks aus Stickstoff und Wasserstoff* (1924); *Aus Leben und Beruf, Aufsatze, Reden, Vortrage* (1927).

See H. Kallmann, *Das Andenken von Fritz Haber* **(1946).**

(R. E. O.)

HABERL, FRANZ XAVER (1840–1910), German musical scholar and editor of ecclesiastical music. Born at Oberellenbach, Bavaria, April 12. 1840, he was ordained at Passau and in 1862 was appointed choirmaster of the cathedral. In 1867 he became organist at Sta. Maria dell'Anima in Rome, and in 1874 founded a school of ecclesiastical music at Regensburg which became an international centre of learning. He was appointed canon of the cathedral of Palestrina in 1879 and in the same year founded the Palestrina society. The publication of Palestrina's works had been begun in 1862, but Haberl discovered much new music and by 1894 had brought out 33 volumes of his works, followed by a supplement in 1907. He then began a similar publication of the works of Orlando di Lasso, in which he was assisted by Adolf Sandberger, who completed it (21 vol.; 1894–1927). Haberl wrote many works on the theory and practice of early ecclesiastical music, notably *Magister Choralis* (1864), and compiled a thematic catalogue of the archives of the Sistine choir. Toward the end of his life he was disappointed at seeing his studies of plain chant, on which he had spent 30 years, replaced by the official Vatican edition. His original research, particularly his editions of Palestrina and Di Lasso, remained the foundation of the work of later scholars. He died at Regensburg, Sept. 5, 1910.

See *Musica Sacra* ed. *by F.* Commer no. 10 and 12 (1910).

HABERLANDT, GOTTLIEB (1854–194j), Austrian plant physiologist best known for his studies in functional plant anatomy, was born at Ungarisch-Altenburg on Nov. 28, 1854. He received a doctorate from Vienna in 1876 and then studied under Simon Schwendener at Tiibingen. He became a *Privatdozent* of botany at Vienna in 1878, and in 1880 became professor of botany at Graz, where he remained until 1909. He visited the botanical gardens at Buitenzorg, Java, in 1891–92. His account of the journey appeared as *Eine botanische Tropenreise* (1893; 3rd ed., 1926). He accepted the chair of plant physiology at Berlin in 1909 and was founder-director of the plant physiology institute there until his retirement in 1923. He continued research as professor emeritus. He died at Berlin-Wilmersdorf on Jan. 30, 1945.

One of the foremost plant physiologists of his time, Haberlandt was the first to formulate the idea of plant-tissue culture (1902). However, his attempts at such culture were unsuccessful. He was also the first to present experimental evidence (1913, 1921) for the existence of "wound hormones" in plant tissues. He proposed several theories, *e.g.,* the "statolith theory," to explain geo- and phototropic movements of plants. *Pkysiologische Pflanzenanatomie* (1884; 6th ed., 1926), his best-known work, presents a classification of tissues based upon function, *i.e.,* dermal, photosynthetic, mechanical, absorptive, etc. Haberlandt's relating of physiology to anatomy had a profound influence on subsequent research and teaching.

See *Phyton* (article and bibliography), 6:1–14 (1955). Haberlandt's memoirs were published as *Erinnerungen: Bekenntnisse und Betrachtungen* (1933).

(J. W. Tr.)

HABIMA THEATRE, a Jewish theatrical group which was originally founded in Bialystok, Pol., in 1909 by Nahum L. Zemach, who wished to prepare a Hebrew acting group for eventual establishment in Palestine. This earlier venture was suppressed by tsarist police, but revived by Zemach in 1916 in Moscow, where the group's first efforts gained the support of Maksim Gorki, and Konstantin Stanislavski of the Moscow Art theatre. Evgheny Vakhtangov, assistant to Stanislavski, but critical of his extreme naturalism, became Habima's director. He found Jewish lore, especially Chassidic mysticism, congenial to his purpose and developed a new method, which he called fantastic realism, a dynamic theatricalism, applying music, dance and intense stylization to an essentially realistic intent. Characteristic Habima plays are Salomon Rappoport Ansky's *The Dybbuk,* Halper Leivick's *Der Golem,* David Pinski's *Wandering Jew* and Richard Beer-Hofmann's *Jacob's Dream.* Habima has applied its method to non-Jewish plays as well, especially since leaving Russia.

In Russia, Habima laboured under constant tension, even after the revolution. Hebrew was archaic; Zionism was even worse. Therefore, old themes, though criticized, were safer. In 1926, two years after the death of Vakhtangov, the group obtained permission to leave the country and tour Europe and America. It never returned. In 1928 it made a triumphant tour of Palestine. Habima. realizing completely the promise of its origin, settled permanently in Tel Aviv in 1931. Further tours abroad were made in 1937 and 1948. In 1945 a theatre building, including a dramatic school and library, was opened in Tel Aviv. (M. Rs.)

HABINGTON, WILLIAM (1605–1654), English poet whose best-known poems praise chastity and pure love, was born at Hindlip hall, Worcestershire, on Nov. 4, 1605. His best-known work is *Castara* (1634), a volume of rather frigid love poems. It was reprinted in 1635 with many additions: the third edition (1640) was further enlarged by the inclusion of some devotional poems, which show Habington at his strongest. He also wrote a tragicomedy, *The Queene of Arragon* (1640), and two prose works, *The Historie of Edward the Fourth* (1640) and *Observations Upon Historie* (1641). He died on Dec. 30, 1654.

HABIT, in psychology, a customary or automatic way of acting, usually as a result of frequent usage rather than of inborn origin. In a different sense "habit" is used to indicate the natural appearance, place and manner of growth of plants and animals. It is also a term for a coat or a form of clothing, especially one that is common to a species or is worn for a particular purpose. In botany and zoology "habit" may refer to innate tendencies and actions of plants or animals. Psychologists use "habit" to designate either a specific learned unit of behaviour or generically to refer to the several classes of acquired modes of acting or perceiving. Thus, a conditioned response is a habit, acquired and again modifiable. It shows variations in strength among individuals and in the same individual from one occasion to the next. Persons and animals exhibit changing tendencies to select and reorganize incoming stimulation from the environment. They acquire habitual rhythms of action that are independent of the immediate environment.

The acquisition and alteration of habits constitute topics of central concern in the study of behaviour. Psychologists and physiologists have concerned themselves with both the environmental and the organismic conditions and consequences of habit formation. They have shown that organisms differ in their susceptibility to the stimulus patterns which contribute to a change in behaviour. The social consequences of the use of habit-forming drugs have produced a highly specialized research area in applied psychophysiology.

The nature and optimum scheduling of reinforcement have been studied extensively in relation to the control of habitual activities of animals and people. Some investigators have stated that a full understanding of mechanisms of reinforcement promises to give a full understanding of how habits are changed. They assert that complexities of human behaviour arise out of the compounding of many habits based on many sources of reinforcement, some obvious and some extremely subtle. Other students of the subject have adopted an associationistic principle without recourse to a

"law of effect," the action of rewards or punishment being subsumed under a concept of motivation and acting only secondarily in habit formation.

William James discussed in his *Principles of Psychology* both the biological utility of habits as the means for conserving higher mental processes for more demanding tasks, and their more unfortunate consequences in behavioural inflexibility. He also theorized concerning their physiological basis in the nervous system. During the first half of the 20th century improved neurosurgical techniques and electrophysiological methods brought forth a sizable body of evidence on the structures necessary for habit formation, but answers to the fundamental biochemical questions remained elusive.

R. W. Sperry, R. E. Myers and their co-workers isolated visual and tactual discrimination habits to either half of the brain by cutting only certain essential nerve bundles that interconnect the right and left halves through the *corpus callosum*. Animals so prepared learned antagonistic habits depending upon which eye was uncovered or which paw was used in feeling the object. Careful experiments during 1955 to 1957 showed that cats so prepared developed independent sets of habits in the right and left hemispheres of the brain, where such habits were learned *following* the operation. Otherwise they behaved normally, as have human patients following similar brain surgery.

H. F. Harlow, D. O. Hebb and others showed that animals or children learn new habits with greater ease or difficulty depending upon previous experience in habit formation. The insightful solving of problems, once regarded by experts in the field of perception as being independent of previous learning, was shown to occur only after appropriate tool-using habits had been established. or, in the case of spatial detour problems, only after skills for discriminating relative positions in space had been developed. Spatial intelligence in man and animal depends in part upon early learning. Work in language and other symbol-using habits increased in response to the evidence that conceptual thinking requires prior acquisition of basic perceptual skills. One series of experiments in the 1950s showed that both early experience and frontal lobes of the brain are essential to the performance by dogs of spatial delayed-response problems.

The durability of emotional conditioning and the permanence of certain imprinted social discrimination habits in birds impressed scientists at mid-century with the need for continuing research on the effects of habits learned in infancy. *See* also ANIMAL BEHAVIOUR; BEHAVIOUR; CONDITIONING; LEARNING.

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HABITUAL OFFENDERS. A habitual criminal is one who has frequently been punished, who has manifested a settled practice in crime and who presents a danger to the society in which he lives. American, English, commonwealth and most European penal systems provide for the more protracted imprisonment of such criminals than would normally be imposed in respect of their last crimes. The primary purpose of such provisions is the greater protection of the community. (N. R. M.)

United States.—The lams of the federal government of the U.S. and of the several states differ markedly on the definition of a habitual offender and on the punishment to be afforded criminals who have previously been convicted of crime. Legislation providing for specialized treatment of habitual offenders in the U.S. dates back only to the late 19th century in the more populous states and is of even more recent origin in most of the others. Only Maryland, Mississippi, North Carolina and South Carolina by the latter 1950s did not have such legislation. In those states which had taken action, the differences extended even to the term of description, so that a person convicted of crime more than once might be termed a "multiple," "habitual" or "persistent offender," or a "previous ofiender" (New York), a "repeater" (Wisconsin), a "persistent violator of law" (Idaho) or a "habitual criminal" (Illinois). In general, the statutes provided that a habitual offender may or shall be sentenced to an additional number of years of imprisonment on proof of his earlier conviction or convictions. In some jurisdictions, the prior offense must have been a felony to warrant the increased punishment. Some states, for example New York, provided for an increase in the number of years of imprisonment to be imposed up to a life sentence, according to the number of prior convictions. Differences in law were also based on whether the additional sanction should be mandatory or at the discretion of the court; whether the judge or the jury was to make the finding of prior conviction; and whether the jury ought to be informed of the prior conviction before it concluded its deliberations on the question of guilt on the immediate offense charged. It was not possible to say that the statutes had accomplished their intended purpose, whether the intent was to remove the more dangerous criminal from society or to give the penologists additional time within which to rehabilitate such a prisoner. It is contended that the powers generally given to a criminal court to impose indeterminate sentences have obviated the necessity for or desirability of habitual offender legislation.

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English and European Law.—By the Prevention of Crime act, 1908, power was given to English courts to sentence habitual criminals to a period of preventive detention in addition to one of penal servitude in respect of their last conviction. Owing to procedural complexities and the reluctance of the courts to impose what seemed to be a double punishment, these provisions oi the 1908 act had fallen into desuetude when they were supplanted by section 21 of the Criminal Justice act, 1948. Under this section a court may sentence a habitual criminal to a prescribed period of preventive detention of irom 5 to 14 years, if it thinks such protracted segregation expedient for the protection of the public. To qualify ior such a sentence the criminal must be of or over the age of 30, convicted on indictment of an offense punishable with imprisonment for a term oi two years or more, and must have, since the age of 17, been convicted on at least three previous occasions of offenses so punishable and at least twice previously sentenced to prison or Borstal (*see* BORSTAL SYSTEM). Preventive detention is served in lieu of other punishment for the last crime.

From 1854, France had transported certain criminals to its penal colonies. In 1885 this punishment was made applicable to habitual criminals and, under the name of *relégation*, between that date and 1938 was extensively applied. No other European countries emulated the French practice and France too abandoned it.

The Swiss Draft Penal code of 1893, prepared by Carl Stoos, provided for the indeterminate detention of habitual criminals in institutions specially adapted to that purpose, such detention to take the place of punishment for their last offenses. He coined the phrase *mesure de sûreté* to describe this type of sentence. In 1937 this plan was accepted in Switzerland. though it had by then, with various modifications been applied widely throughout western Europe—Norway, in 1902, having been the first country to test it. The main differences between continental and English penal practice are the wider discretion which tends to be given to courts on the continent in determining which offenders may be punished as habitual criminals, and the wider discretion there held by the penal administrators or special administrative tribunals to determine the date of conditional or final release of the habitual criminal.

The purpose of sentences of this type being primarily to segregate and only secondarily to deter and reform, those administering European and English penal systems have endeavoured to ameliorate the penal conditions of such prisoners, particularly toward the end of their terms. Thus under the 1948 English act, preventive detainees pass through three stages of penal treatment; the first stage is served in a local prison under ordinary prison condition., the stcond in a central prison but to a degree separated from and with more privileges than the other prisoners. and the third in special prerelease conditions designed to fit the preventive detainee for release and to test his fitness therefor. The habitual criminal will normally be released on licence under the supervision of the Central After-Care association. (*See* also CRIMINOLOGY; RECIDIVISM.) (N. R. M.)

HABSBURG or HAPSBURG, the name of the family from which sprang the dukes and archdukes of Austria after 1282, kings of Hungary and Bohemia after 1526 and emperors of Austria after 1804. They were Roman emperors. 1438–1806, kings of Spain, 1516–1700, and held innumerable other dignities.

The name Habsburg was derived from the castle of Habsburg, or Habichtsburg (hawk's castle) on the Aar. near its junction with the Rhine. which was built in 1028 by Werner, bishop of Strasbourg, and his brother-in-law. Count Radboto. The founder of the house was probably Guntram the Rich, who has been identified with much probability with a Count Guntram who was involved in a rebellion under Otto I. Radboto's son Werner (d. 1096) and grandson Otto were called counts of Habsburg. Otto's son Werner (d. 1167) was father of Albert (d. 1199), who was count of Zürich and landgrave of Upper Alsace. His son Rudolph acquired Laufenburg and the protectorate over the "Waldstätte"

(Schwyz, Uri, Unterwalden and Lucerne). On his death in 1232, his two sons Albert and Rudolph partitioned his lands. The line of Habsburg-Laufenburg, Rudolph's descendants, became extinct in 1415, having previously sold back Laufenburg and other districts to the senior branch (Habsburg-Habsburg). Albert, founder of this branch, who died in 1239, had married Hedwig of Kyburg (d. 1260). Their son was Rudolph I. (*q.v.*), elected German king 1273.

Henceforward the history of the family of Habsburg is synonymous with that of their dominions. The present article will confine itself to stating the chief events in the history of the family as such. The attached genealogical tables show the ramifications of the family; its chief members are noticed in separate articles.

The earlier Habsburgs vested the government and enjoyment of their domains, not in individuals but in all male members of the family in common. Thus Rudolph I., as emperor, bestowed Austria and Styria on his two sons Albert and Rudolph, in common. By a family ruling of 1283, Rudolph renounced his share; but the question arose again after Albert's death. Owing partly to the representations of the Estates, a system of condominium was adopted, and the partition again avoided. In 1364 Rudolph made a fresh family compact with his younger brothers, which, while admitting the principle of equal rights, vested the rule and chief position de *facto* in the head of the house; but after his death, the partition was actually effected (agreement of Neuberg, 1379). Albert III. took the duchy of Austria, his brother Leopold III. Styria, Carinthia and the Tyrol, for himself and his descendants. Titles, arms and banner remained common to both lines, fiefs of the empire (Alsace) were held in condominium, and on the extinction of either male line, its dominions were to pass to the other.

This policy of partition was one of the main causes of the decline of Austria in the later Middle Ages. While the Austrian line was perpetuated only by one son in each generation until it became extinct on the death of Ladislaus Postumus in 1457, the domains then passing to the Styrian line, the latter had been again subdivided into an Inner Austrian and a Tyrolean line. The Emperor Frederick III. (*q.v.*) first acted, in his capacity as senior member of full age of his house, as regent both for Ladislaus Postumus in Austria and for Sigismund in the Tyrol; and as all the collateral lines now died out, his son Maximilian reunited all the Habsburg possessions in his own person.

During the period 1282–1493 the Habsburgs increased their dominions and dignities in many directions. The title of German king, held by Rudolph I., was held again by Albert I. (*q.v.*) from 1298–1308. Frederick the Fair, who assumed the title 1314–22, was the nominee of a minority of electors, and it then passed from the family until reassumed by Albert II. (*q.v.*) in 1438. From this date onward the titles of German king and Roman emperor remained in the Habsburg family uninterruptedly, with the single exception of the reign of Charles Albert, elector of Bavaria (1742–45), until their extinction. To the duchies of Austria and Styria, which the sons of Rudolph I. received in 1282, they and their successors were able to add the Tyrol, Vorarlberg. Carinthia, Carniola, and Gorizia. By the *privilegium maius* of 1453, they received a special status in the empire and the title of archduke (*q.v.*). On the other hand, a long series of reverses deprived them of practically all their possessions in Switzerland (Morgarten 1315, Sempach 1386, "perpetual peace" of 1474), and they were unable to retain the coveted crowns of Bohemia and Hungary. The crown of Bohemia, bestowed by Albert I. on his son Rudolph in 1306, was lost on Rudolph's death in the following year. It was again bequeathed, together with that of Hungary, to Albert II. by his father-in-law Sigismund of Luxemburg in 1437; but Albert died in 1439 and both crowns were lost when his son, Ladislaus Postumus, died unmarried in 1437.

Hitherto the Habsburgs had been identified only with the conduct of their Austrian dorninions, which, if increasing in extent, had certainly not added to their prosperity since the days of the Babenbergers; and with the somewhat equivocal title of German king and Roman emperor. Maximilian I. (q v j opened up a new era for his house. He restored and consolidated his Austrian dominions; and by his marriage with the heiress of Charles the Bold of Eurgundy, increased them by a second family domain on the other flank of the empire, consisting, as finally delimited, of the Netherlands, Artois, and the Franche Comté. His efforts to secure a foothold in Italy, after his second marriage with Bianca Sforza, daughter of the Duke of Milan, proved unsuccessful; but he more than compensated for many disastrous wars by the brilliance of his marriage policy. His only son, Philip I. (*q.v.*), married Joanna, daughter of Ferdinand and Isabella of Spain, and died in 1506, leaving two sons, Charles and Ferdinand. Charles succeeded his father in the Netherlands in 1506 and his grandfather in Spain in 1j16, becoming the emperor Charles V. (*q.v.*) on Maximilian's death in 1519. At the same time he succeeded to all the Habsburg dominions; but by the Treaty of Brussels (1522) he assigned to his brother Ferdinand (see FERDINAND I., Roman Emperor) the Austrian dominions. In the same year Ferdinand married Anne, daughter of Wladislaus, king of Hungary and Bohemia; and when his childless brother-in-law, King Louis, was killed at Mohacs (1526), he laid claim to Bohemia and Hungary both by right of his wife and by treaty. In each case the Estates denied the validity of the hereditary title; but those of Bohemia elected Ferdinand king in 1526. In Hungary he was also elected, but a counter-party elected John Zapolya (*q.v.*), with whom Ferdinand made a treaty in 1538, receiving north-western Hungary and the succession (afterwards repudiated) to Zapolya's dominions.

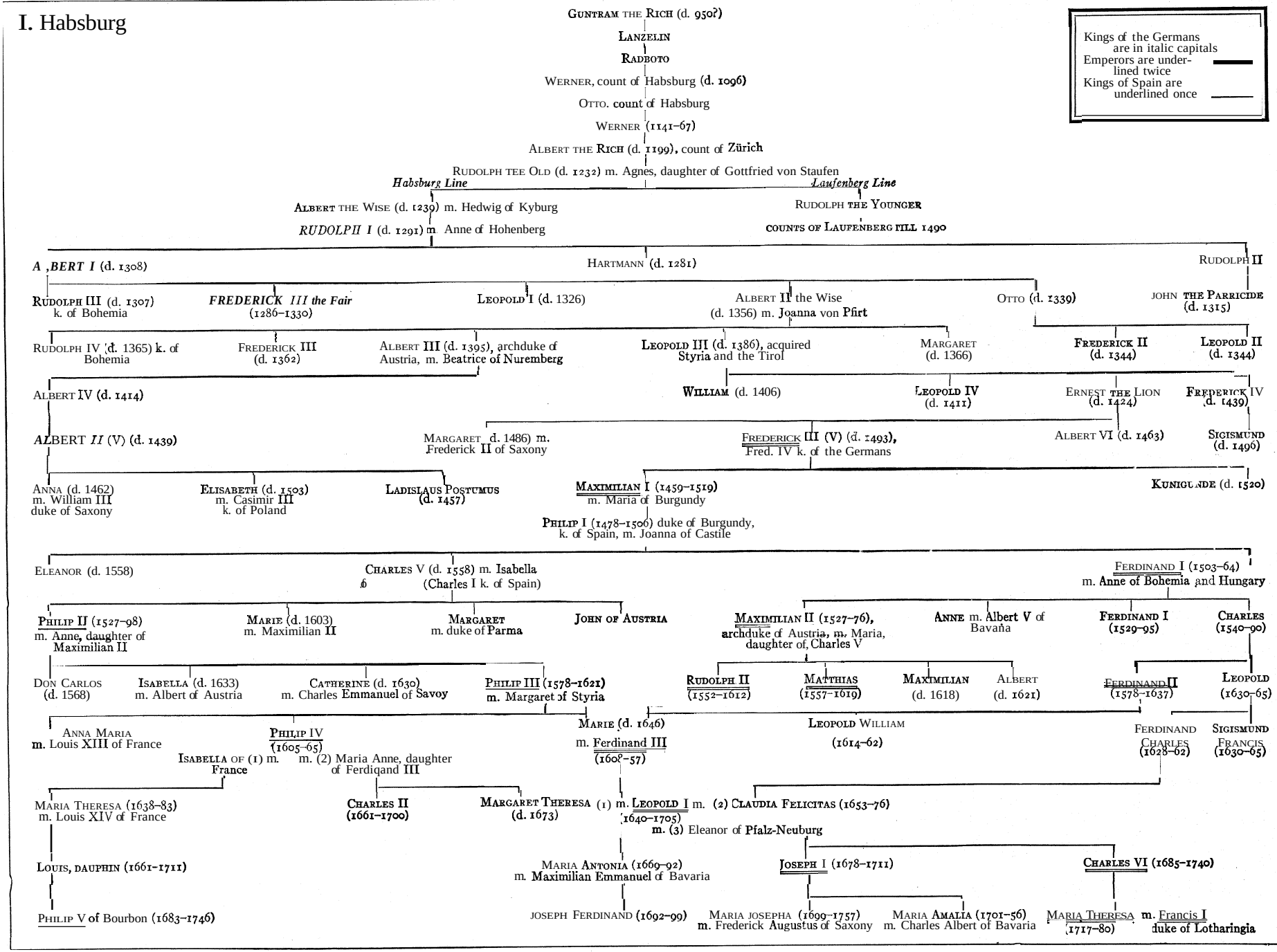
The Habsburgs had now reached the summit of their power. The prestige which belonged to Charles as head of the Holy Roman empire was backed by the wealth and commerce of the Netherlands and of Spain, and by the riches of the Spanish colonies in America. In Italy he ruled over Sardinia, Naples and Sicily, which had passed to him with Spain, and the duchy of Milan, which he had annexed in 1535; to the Netherlands he had added Friesland, the bishopric of Utrecht, Groningen and Gelderland, and he still possessed Franche-Comté and the fragments of the Habsburg lands in Alsace and the neighbourhood. Add to this Ferdinand's inheritance, the Austrian archduchies and Tirol, Bohemia with her dependent provinces, and a strip of Hungary, and the two brothers had under their sway a part of Europe the extent of which was great, but the wealth and importance of which were immeasurably greater.

When Charles V. abdicated he was succeeded as emperor, not by his son Philip, but by his brother Ferdinand. Philip became king of Spain, ruling also the Netherlands, Franche-Comte, Naples, Sicily, Milan and Sardinia, and the family was definitely divided into the Spanish and Austrian branches. For Spain and the Spanish Habsburgs the 17th century was a period of loss and decay, the seeds of which were sown during the reign of Philip II. (*q.v.*). The northern provinces of the Netherlands were lost practically in 1609 and definitely by the treaty of Westphalia in 1648; Roussillon and Artois were annexed to France by the treaty of the Pyrenees in 1659, Franche-Comté and a number of towns in the Spanish Netherlands by the treaty of Nijmwegen in 1678 Finally Charles II. (*q.v.*), the last Habsburg king of Spain, died childless in Nov. 1700, and by the peace of Rastatt (1714) which terminated the War of the Spanish Succession, Spain passed from the Habsburgs to the Bourbons. However, the Austrian branch of the family received the Italian possessions of Charles II., except Sicily, which was given to the duke of Savoy, and also the southern Netherlands, which are thus often referred to as the Austrian Netherlands; and retained the duchy of Mantua, which it had seized in 1708. In 1717 it received Sicily in exchange for Sardinia; but in 1735 had to cede Novara, Tortona and the two Sicilies, receiving in return the duchies of Parma and Piacenza.

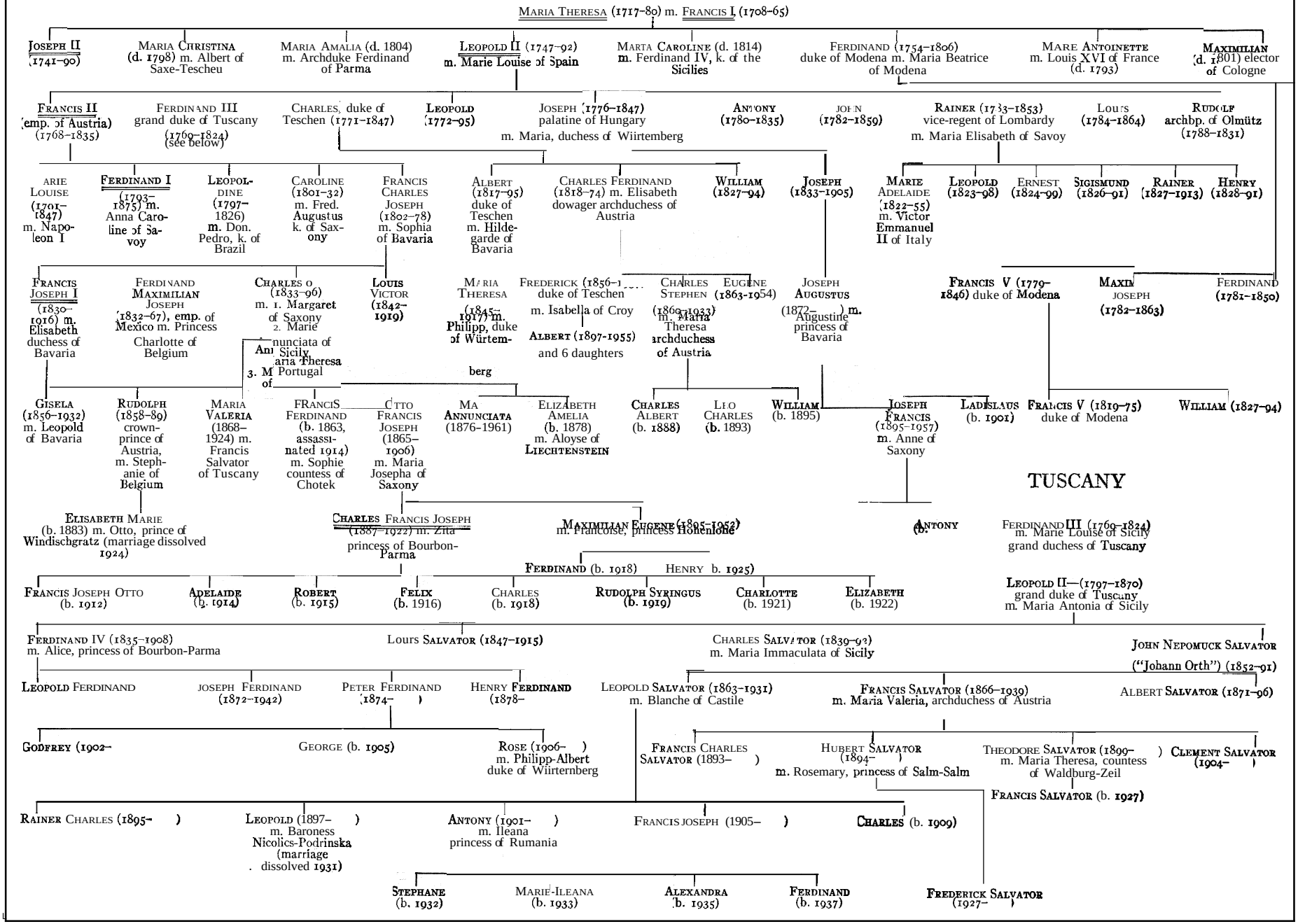
In the Austrian line fresh partitions were effected during the 16th and 17th centuries; but after 1665 this disastrous policy was finally abandoned in favour of that of primogeniture throughout the Austrian dominions.

The Thirty Years' War deprived the Habsburgs of Alsace, came near to ruining the empire, and forced the Habsburgs to devote themselves more and more exclusively to their family dominions. After breaking the resistance of the nobles, Ferdinand II. (*q.v.*)

I. Habsburg


Kings of the Germans are in italic capitals
Emperors are underlined twice
Kings of Spain are underlined once
GUNTRAM THE RICH (d. 950?)
LANZELIN
RADBOTO
WERNER, count of Habsburg (d. 1096)
OTTO, count of Habsburg
WERNER (1141–67)
ALBERT THE RICH (d. 1199), count of Zürich
RUDOLPH TEE OLD (d. 1232) m. Agnes, daughter of Gottfried von Staufen
Habsburg Line
Laufenberg Line
ALBERT THE WISE (d. 1239) m. Hedwig of Kyburg
RUDOLPH THE YOUNGER
RUDOLPH I (d. 1291) m. Anne of Hohenberg
COUNTS OF LAUFENBERG till 1490
ALBERT I (d. 1308)
HARTMANN (d. 1281)
RUDOLPH II
RUDOLPH III (d. 1307) k. of Bohemia
FREDERICK III the Fair (1286–1330)
LEOPOLD I (d. 1326)
ALBERT II the Wise (d. 1356) m. Joanna von Pfirt
OTTO (d. 1339)
JOHN THE PARRICIDE (d. 1315)
RUDOLPH IV (d. 1365) k. of Bohemia
FREDERICK III (d. 1362)
ALBERT III (d. 1395), archduke of Austria, m. Beatrice of Nuremberg
LEOPOLD III (d. 1386), acquired Styria and the Tirol
MARGARET (d. 1366)
FREDERICK II (d. 1344)
LEOPOLD II (d. 1344)
ALBERT IV (d. 1414)
WILLIAM (d. 1406)
LEOPOLD IV (d. 1411)
ERNEST THE LION (d. 1424)
FREDERICK IV (d. 1439)
ALBERT II (V) (d. 1439)
MARGARET d. 1486) m. Frederick II of Saxony
FREDERICK III (V) (d. 1493), Fred. IV k. of the Germans
ALBERT VI (d. 1463)
SIGISMUND (d. 1496)
ANNA (d. 1462) m. William III duke of Saxony
ELISABETH (d. 1503) m. Casimir III k. of Poland
LADISLAUS POSTUMUS (d. 1457)
MAXIMILIAN I (1459–1519) m. Maria of Burgundy
KUNIGUNDE (d. 1520)
PHILIP I (1478–1506) duke of Burgundy, k. of Spain, m. Joanna of Castile
ELEANOR (d. 1558)
CHARLES V (d. 1558) m. Isabella (Charles I k. of Spain)
FERDINAND I (1503–64) m. Anne of Bohemia and Hungary
PHILIP II (1527–98) m. Anne, daughter of Maximilian II
MARIE (d. 1603) m. Maximilian II
MARGARET m. duke of Parma
JOHN OF AUSTRIA
MAXIMILIAN II (1527–76), archduke of Austria, m. Maria, daughter of Charles V
ANNE m. Albert V of Bavaria
FERDINAND I (1529–95)
CHARLES (1540–90)
DON CARLOS (d. 1568)
ISABELLA (d. 1633) m. Albert of Austria
CATHERINE (d. 1630) m. Charles Emmanuel of Savoy
PHILIP III (1578–1621) m. Margaret of Styria
RUDOLPH II (1552–1612)
MATTHIAS (1557–1619)
MAXIMILIAN (d. 1618)
ALBERT (d. 1621)
FERDINAND II (1578–1637)
LEOPOLD (1630–65)
ANNA MARIA m. Louis XIII of France
PHILIP IV (1605–65)
ISABELLA OF FRANCE (1) m.
m. (2) Maria Anne, daughter of Ferdiqand III
MARIE (d. 1646) m. Ferdinand III (1608–57)
LEOPOLD WILLIAM (1614–62)
FERDINAND CHARLES (1628–62)
SIGISMUND FRANCIS (1630–65)
MARIA THERESA (1638–83) m. Louis XIV of France
CHARLES II (1661–1700)
MARGARET THERESA (d. 1673)
(1) m. LEOPOLD I (1640–1705) m. (2) CLAUDIA FELICITAS (1653–76) m. (3) Eleanor of Pfalz-Neuburg
LOUIS, DAUPHIN (1661–1711)
MARIA ANTONIA (1669–92) m. Maximilian Emmanuel of Bavaria
JOSEPH I (1678–1711)
CHARLES VI (1685–1740)
PHILIP V of Bourbon (1683–1746)
JOSEPH FERDINAND (1692–99)
MARIA JOSEPHA (1699–1757) m. Frederick Augustus of Saxony
MARIA AMALIA (1701–56) m. Charles Albert of Bavaria
MARIA THERESA (1717–80) m. Francis I duke of Lotharingia

II. HOUSE OF HABSBURG-LORRAINE



declared the thrones of Bohemia (1627) and Moravia (1628) hereditary in his dynasty. Half a century later the Turks were driven back out of Hungary. The Diet of Pressburg (1687) recognized the male line of the Habsburgs in primogeniture as hereditary kings of Hungary; the Peace of Karlovitz (1699) gave them *de facto* possession of most of Hungary, including Transylvania, which had already accepted their rule. The Banat was added in 1718.

Leopold I. (*q.v.*) had made arrangements with his two sons, Joseph and Charles, for a fresh partition of the Spanish and Austrian dominions. The former were, however, lost to the Habsburgs after the War of the Spanish Succession. Joseph I. (*q.v.*) died without male issue, and Charles VI. (*q.v.*), who succeeded him as emperor in 1711, was also without sons. In 1713 he issued (as an unilateral expression of his will, communicated to his Privy Council) his wish that all his dominions should form an indivisible whole, and should pass as such to his male descendants in primogeniture, after them to his female descendants, after them to Joseph's daughters, after them to the other branches of his family. This "Pragmatic Sanction," the most famous of the Habsburg dynastic instruments, was that by which their relation within the dynasty and with their subjects were regulated until the fall of the dynasty. The formal acceptance of it was received in various forms by the Estates of all Charles' dominions from 1720 onward; it was publicly promulgated in 1724, and guaranteed by the imperial diet in 1731 and by the main European powers severally. With Charles' death in 1740, the true line of the Habsburgs became extinct; but his daughter, Maria Theresa (*q.v.*), who in 1736 had married Francis Stephen, duke of Lorraine (*see* FRANCIS I.) succeeded him, becoming founder of the house of Habsburg-Lorraine. The Pragmatic Sanction was respected within her dominions, but not outside them. Maria Theresa lost most of Silesia to Prussia, but later acquired part of Poland, while in Italy she surrendered Parma and Piacenza to Spain and part of Milan to Sardinia but acquired Tuscany through her husband. Under Joseph II. (*q.v.*) the Innviertel and the Bukovina were gained, and the Polish frontier revised, but the Netheriands rebelled successfully.

The Habsburgs emerged from the many changes brought about during the Napoleonic era shorn of the Netherlands, but in possession of Galicia and Lodomeria, Salzburg, Dalmatia and the kingdom of Lombardy-Venetia. The title of Holy Roman emperor had been abandoned by Francis II (*q.v.*) in 1806, but in 1804 he had assumed the title of emperor of Austria as Francis I. In addition, the family of Habsburg possessed certain lands in Italy which formed no part of the Austrian empire. These were the grand duchy of Tuscany, which passed on the death of the emperor Francis I., by special arrangement, to his younger son Leopold, and after his succession to the empire as Leopold II. (*q.v.*) to a third brother, Ferdinand, under whose rule and that of his son Leopold it remained until incorporated in the kingdom of Sardinia in 1859; and the duchy of Modena, acquired by the emperor Leopold II.'s younger son Ferdinand by his marriage with Mary Beatrice d'Este, which was also lost in 1859. The Modena-d'Este line of the Habsburgs became extinct with the death of Francis V. (*q.v.*) in 1875.

Francis I. was succeeded as emperor by his son Ferdinand I. (*q.v.*), who abdicated after the revolution of 1848 in favour of his young nephew Francis Joseph (*q.v.*). In the course of his long reign, Francis Joseph lost the Lombard-Venetian kingdom to Italy (1859, 1866), but acquired Bosnia and the Hercegovina (mandate of occupation 1877, annexation 1908). In 1867 his relations with Hungary were reorganised under the Compromise of that year; while in 1915 the title of "Austrian empire" was granted to his remaining dominions. A remarkable but short-lived extension of the Habsburg dominions was formed by the assumption in 1863 of the title of Emperor of Mexico by Francis Joseph's brother Maximilian (*q.v.*).

Fall of the Habsburgs.—Francis Joseph was succeeded in 1916 by his great-nephew Charles I. (*q.v.*). At that time his subjects still protested loyalty to the dynasty; but during the collapse of Oct. 1918, consequent on the World War, the Poles, Ruthenians, Czechoslovaks and Yugoslavs repudiated his authority. On Oct. 27 Count Andrássy, the Austro-Hungarian foreign minister, accepted President Wilson's demands "regarding the rights of the peoples of Austria-Hungary, particularly those of the Czechoslovaks and Yugoslavs." The states of Poland, Yugoslavia and Czechoslovakia soon after came formally into being, and although Charles never renounced his sovereign rights in these territories, the Habsburg family afterwards made no serious claim to reassert them. The treaties of Saint Germain and Trianon perpetuated the boundaries of these States, and confirmed Italy and Rumania in the possession of their parts of the former Habsburg monarchy.

There remained only German-Austria and Hungary. On Nov. 11, 1918, Charles issued a proclamation in which he stated:

> Still, as ever, filled with unchanging love towards all my peoples, I will not oppose my person as an obstacle to their free development. I recognise in advance the decision which German-Austria will take on its future form of State. The people has assumed the government through its representatives. I renounce any share in the affairs of State. At the same time I remove my Austrian Government from its office.

The provisional Government of German-Austria proclaimed a republic on the following day. On March 12, 1919, following the elections, the first national assembly repeated this declaration. Charles, however, refused to abdicate in his own name and that of his dynasty. Thereupon the national assembly, by decree of April 2, 1919, banished all Habsburgs from Austria acd confiscated the family property for the benefit of the war invalids. Habsburgs who renounced all rights other than ,those of private citizens were, however, allowed to live unmolested in Austria, and several of them did so. The legitimist movement in Austria has been very weak since these events. Austrian republicans claim that Charles's acceptance in advance of the republic was equivalent to a renunciation of the throne.

Charles issued a similar proclamation to Hungary on Nov. 13 which Karolyi answered by proclaiming the Hungarian republic on Nov. 16. When, however, the Right regained power in Hungary after Karolyi's and Kun's régimes, it proceeded by Act I. of 1920 to abolish all legislation passed by these two Governments. Hungary, therefore, reverted to the status of a kingdom, and controversy arose whether or not Charles's action had annulled the pragmatic sanction.

On Feb. 2, 1920, during the discussions on the draft treaty of Trianon, the Allied and Associated Powers declared that a Habsburg restoration in Hungary would be a matter of international concern and that they would neither recognise nor tolerate such a restoration. They attempted to insist on Hungary's styling herself a republic, but finally, in view of the objections raised by the Hungarian delegation, compromised on the word "Hungary."

Charles returned to Hungary and attempted to assert his claim on March 27 and Oct. 26, 1921 (see HUNGARY). After the second coup, under pressure from the Powers and the Little Entente. the Hungarian Parliament passed a decree (Nov. 3, 1921) whereby the sovereign rights of Charles and the pragmatic sanction were declared forever abrogated and the right of the Hungarian nation to elect its king by free choice restored. On Nov. 10 Hungary addressed a note to the Powers consenting only to elect its king in agreement with the Powers and accepting the notes of Feb. 2 and April 3, 1921. The Legitimist party, however, continued to look on Otto, Charles's eldest son, as the legitimate king after Charles's death on April 1, 1922.

Despite their unique career, the Habsburgs produced no statesman of great ability, with the exception of Charles V., and perhaps of Joseph II. Several members of the family displayed marked traces of insanity, and during the last century of their rule they were proverbial for their scandals and eccentricities. With hardly an exception, they were strongly conservative and intensely convinced upholders of the monarchical tradition. From the 16th century onward, they were nearly all extreme supporters of the Catholic idea; the title of Apostolic Majesty, which they wore as kings of Hungary, represented a very real attitude. The few exceptions—Joseph II., the Crown Prince Rudolph, and "Johann Orth"—all came to mysterious and unhappy ends. The

family tradition was exceedingly strict among them to the last, as was well exemplified when the Archduke Francis Ferdinand (*q.v.*) contracted his morganatic marriage. They owed their position chiefly to outward circumstance and to a series of marriages so adroit and successful as to give rise to the proverb *"Bella gerant alii, tu, felix* Austria, *nube"* (Let others wage war, do you, happy Austria, marry). As a family they succeeded in amassing great wealth, the fortunes accumulated by the Modena and d'Este branch and their heirs being particularly brilliant. After the fall of their dynasty they lost all valuables and estates owned in virtue of their rank.

For the origin and early history of the Habsburgs *see* G. de Roo, *Annales rerum ab Austriacis Habsburgicae gentis principibus a Rudolpho I. usque ad Carolum V. gestarum* (Innsbruck, 1592, fol.); M. Herrgott, *Genealogia diplomatica augustae gentis Habsburgicae* (Vienna, 1737–1738); E. M. Fürst von Lichnowsky, *Geschichte des Hauses Habsburg* (Vienna, 1836–1844); A. Schultè, *Geschichte der Habsburger in den ersten drei Jahrhunderten* (Innsbruck, 1887); T. von Liebenau, *Die Anfänge des Hauses Habsburg* (Vienna, 1883); W. Merz, *Die Habsburg* (Aarau, 1896); W. Gisi, *Der Ursprung der Häuser Zähringen und Habsburg* (1888); and F. Weihrich, *Stammtafel zur Geschichte des Hauses Habsburg* (Vienna, 1893). For the history of the Habsburg monarchy *see* Langl, *Die Habsburg und die denkwürdigen Stätten ihrer Umgebung* (Vienna, 1895); and E. A. Freeman, *Historical Geography of Europe* (1881). (C. A. M.)

HACHETTE, JEANNE, French heroine. Jeanne Laisné, or Fourquet, called Jeanne Hachette, was born about 1454, and is known solely for an act of heroism which on June 27, 1472, saved Beauvais when it was on the point of being taken by the troops of Charles the Bold, duke of Burgundy. The town was defended by only 300 men-at-arms, commanded by Louis de Balagny.

A Burgundian man-at-arms had actually planted a flag upon the battlements when Jeanne, a small axe (*hachette*) in hand, flung herself upon him, hurled him into the moat, tore down the flag and revived the drooping courage of the garrison. Louis XI of France instituted a procession in Beauvais (called the Procession of the Assault) and married Jeanne to her chosen lover Colin Pilon, loading them with favours.

See Georges Vallat, *Jeanne Hachette* (Abbeville, 1898).

HACHETTE, LOUIS CHRISTOPHE FRANÇOIS (1800–1864), French publisher, was born at Rethel in the Ardennes on May 5, 1800. In 1826 he established in Paris a publishing business for the issue of works adapted to improve the system of school instruction, or to promote the general culture of the community. He published manuals in various departments of knowledge, dictionaries of modern and ancient languages, educational journals, and French, Latin and Greek classics annotated with great care by the most eminent authorities. After 1850, in conjunction with other partners, he published a cheap railway library, scientific and miscellaneous libraries, an illustrated library for the young, libraries of ancient literature, of modern foreign literature, and of modern foreign romance, a series of guide-books and a series of dictionaries of universal reference. In 1855 he founded the weekly *Le Journal pour tous.* He died July 31, 1864.

HACHINOHE, Japanese city in southeastern Aomori prefecture (extreme northeastern Honshu), has been transformed from a castle town into Aomori's leading industrial centre, with large chemical (fertilizer), iron and cement works and small-scale shipbuilding. Its modernized port enables it to import coal and raw materials and to rank with Shiogama (Miyagi prefecture) as the most important fishing port of northeastern Honshu. Commercially, Hachinohe is the main centre for eastern Aomori and northeastern Iwate prefectures. Pop. (1955) 141,771. (J. D. Ee.)

HACHIOJI, Japanese city in the southwestern Kanto plain west of Tokyo. was in feudal times a fortified post and market town on a main highway leading from Edo (modern Tokyo) to the Honshu interior. It has emerged as a silk thread and cloth centre with a large labour force and many small and medium-sized factories. Pop. (1955) 133,447. (J. D. Ee.)

HACHURE, the term (French for "hatching") for the conventional lines used in hill or mountain shading upon a map (*q.v.*) to indicate the slope of the surface, the depth of shading being greatest where the slope is steepest. The method is less accurate than that of contour lines, but gives an indication of the trend and extent of a range or mountain system, especially upon small-scale maps.

HACKBERRY, a popular shade tree. *Celtis occidentalis,* of the family Ulmaceae (*q.v.*), to which also belong the elms (*Ulmus*). The wood is occasionally sold under the name of beaverwood and sugarberry. although the latter name is usually reserved for another closely related species, *C. laevigata.* Hackberry is a medium-sized tree, usually 40 to 60 ft. tall but occasionally attaining 130 ft. The ovate leaves, with long tapering apices, asymmetrical bases and sharply serrate marginal teeth (sometimes entire below the middle), are from three to five inches long, and soft-pubescent below. The tree bears both unisexual and bisexual flowers. which appear with leaf emergence. The fruit is a dark red or purple, thick-skinned edible drupe one-quarter inch in diameter. with a thin, slightly astringent flesh and large roughened pit containing a single seed.

The bark is tough, fibrous and features conspicuous corky excrescences and ridges. The wood is grayish white to yellow, coarse-grained and sometimes fragile. It is used for boxes. baskets, planing mill products, furniture and wooden novelties. The root contains a dye principle suitable for dyeing linen. Hackberry ranges over eastern U.S. and occurs sparingly in southern Canada in the vicinity of the Great Lakes. It is also grown in Europe. It attains its best development on rich, moist, alluvial soils. (E. S. Hr.)

HACKENSACK, a city of northeastern New Jersey, U.S., on the Hackensack river, 13 mi. N. of Jersey City; the seat of Bergen county.

The site was settled first by the Dutch, who called it New Barbadoes, and later by the British. Its name is supposedly of Indian origin, variously spelled Achkinchesacky, Hockumdachque and in other ways. A popular theory is that the town was named aiter the Hock and Sack, an old tavern. Many streets still bear pioneer Dutch family names. The Green, opposite the county courthouse, was the camping ground of both British and American troops during the American Revolution. The community was chartered as a city in 1921 with the official name of Hackensack although it had been called Hackensack by people for many years.

Located in the geographical centre of the county. Hackensack serves a densely populated area of 1,186,873 within the Paterson-Clifton-Passaic standard metropolitan statistical area. Its business establishments consist of a wide variety of small industries, insurance companies and banks. The river is not of primary importance but rather the great network of highways that link adjacent communities to the city. For comparative population figures *see* table in New Jersey: *Popztlation.* (S. He.)

HACKETT, JAMES HENRY (1800–1871), U.S. actor, whose importance lies chiefly in his encouragement of the native American drama. was born in New York city. March 15, 1800. Upon leaving Columbia university because of ill health, he tried various businesses. In 182 j, after Hackett lost his money in speculation. his wife, a former actress, returned to the stage, and the following year Hackett. who had achieved a social reputation for impersonations. began playing character parts. In 1828 his Falstaff, in *Henry* IV, part 1. mas successful, remaining one of his most popular roles. His *Rip* Van *Winkle* (1830) was the best prior to Joseph Jefferson's.

In answer to a prize competition established by Hackett, James Kirke Paulding submitted in 1831 his *Lion of the West,* a comic satirization of Davy Crockett, and as Nimrod Wildfire in this play, Hackett was successful in the U.S. and in England. He was manager of the Astor Place opera house at the time of the Macready riot (*see* Forrest, Edwin).

In 1863 he published his *Notes and Comments on Shakespeare,* which included a correspondence between himself and John Quincy Adams. He died Dec. 28, 1871. (S. W. H.)

HACKNEY, a metropolitan borough (1900) on the northeastern boundary of the county of London, Eng., with Stoke Newington and Islington on its west; Shoreditch, Bethnal Green and Poplar on its south. Pop. (1951) 171,342. Area 5.1 sq.mi. The

borough includes the districts of Clapton, Homerton. Dalston. Stamford Hill and part of Kingsland. On the east is the much-branching river Lea, in whose valley lie Hackney marshes where Dick Turpin and other 18th-century highwaymen had a hideout. Bones of prehistoric animals, flint tools and Roman remains have been found in the district, which has been inhabited since early times when it was densely forested. The name is said to derive from *Haca's eyot* or island. The manor, probably part of that of Stepney, was held by the bishop of London from about 1290 to 1550, and in 1652 it was detached. Brooke house. the manor house, dates from 1409 but was much damaged in World War II. The Knights Hospitallers and the Knights Templars held extensive property; the Templars owned the manor of Wyke (Wick), now remembered in Hackney Wick, and probably built the church of St. Augustine, where several of Daniel Defoe's children were christened and of which only the tower survives, near the 18th-century parish church of St. John. Hackney was popular in Elizabethan times; the 16th-century Sutton place at Homerton now belongs to the National trust. Joseph Priestley, the discoverer of oxygen, was Unitarian minister at South Hackney. 1791–94. and John Howard, the prison reformer, was born in Clapton about 1726.

Hackney's chief products are paints, essences, chemicals, briar pipes, furniture and clothes. Of its three parliamentary divisions, two are partly outside the borough.

HACKNEY, originally a riding horse (from Fr. *haquenée*, an ambling horse or mare, especially for ladies to ride; the English "hack" is simply an abbreviation). Now, however, the hackney is bred for driving as well as riding *(see* HORSE: *Breeds of Horses).* From the hiring out of hackneys, the word came to be associated with employment for hire (so a "hack" or "drudge"); *e.g.*, hackney chair, hackney boat. The hackney coach, a coach with four wheels and two horses, was a hired public conveyance *(see* CARRIAGE).

HADAD, the name of a Syrian deity, is met with in the Old Testament as the name of several human persons; it also occurs in compound forms such as Benhadad and Hadadezer. The divinity primarily denoted by it is the storm god who was known as Addu Ramman. The word Hadadrimmon (Zechariah xii. 11) has been a subject of much discussion. According to the older interpreters, the mourning for something that occurred at a place called Hadadrimmon (Maximianopolis) in the valley of Megiddo is meant, the event alluded to being held to be the death of Josiah. More recently it has been thought that Hadadrimmon is another name for Adonis (*q.v.*) or Tammuz. the allusion being to the mournings by which the Adonis festivals were usually accompanied.

HADAMARD, JACQUES SALOMON (1865–), French mathematician, distinguished for his work in various branches of pure mathematics, was born at Versailles on Dec. 8, 1865. He studied at the Ecole Kormale and the École Polytechnique, and became a professor at the Collège de France, the Ecole Polytechnique and the École Centrales des Arts et Manufactures. In 1911, he became a member of l'Institut de France (Académie des Sciences).

Hadamard's early work contained many important contributions to the theory of functions of a complex variable, in particular to the general theory of integral functions and to the theory of the singularities of functions represented by Taylor's series. In 1896, Hadamard proved the prime number theorem at the same time as de la Vallée Poussin but independently of him. He also obtained important results in connection with the partial differential equations of mathematical physics.

Hadamard's work on the calculus of variations helped to lay the foundations of the modern theory of functional analysis, and in particular he introduced the name functional. Moreover, a result of Hadamard's on determinants is important in the theory of integral equations.

Hadamard's books include *La Série de Taylor* (1902); *Leçons sur la propagation des ondes et les équations de l'hydrodynamique* (1903); *Leçons sur le calcul des variations* (1910); *An Essay on the Psychology of Invention in the Mathematical Field* (1945). (M. L. C.)

HADDINGTON, EARLS OF. In 1627 Thomas Hamilton, earl of Melrose (1563–1637), was created earl of Haddington, in the Scots peerage. He was a lawyer who had become a lord of session as Lord Drumcairn in 1592. He was on very friendly terms with James VI and was one of the "Octavians" appointed to manage the finances of Scotland in 1596. Hamilton became secretary in 1612 and was raised to the peerage as Lord Binning in 1613. In 1616 he became lord president of the court of session and in 1619 was created earl of Melrose. a title exchanged in Aug. 1627 for that of earl of Haddington. He had by then ceased to be lord president, but in Oct. 1627 he was appointed lord privy seal, and resigned his secretaryship. James referred familiarly to his friend as "Tam o' the Cowgate," his Edinburgh residence being in this street.

The earl's eldest son. THOMAS, the and earl (1600–40), was a covenanter and a soldier. His sons. THOMAS (*c.* 1625–45) and JOHN (1626–69), became respectively the 3rd and 4th earls of Haddington, and John's grandson THOMAS (1680–1735) succeeded his father. CHARLES (1650–85), as 6th earl in 1685, although he was his second son. Charles had married Margaret (d. 1700), the heiress of the earldom of Rothes. It was agreed that the two earldoms should be left separate; thus the elder son. John. became earl of Rothes while Thomas became earl of Haddington. He is chiefly remembered as a tree planter and agrarian improver.

THOMAS (1780–1858j, 9th earl. was lord lieutenant of Ireland (1834–3j) under Sir Robert Peel. and in Peel's second administration (1841–46) he was first lord of the admiralty and then lord privy seal. At his death (Dec. 1. 1858) the earldom passed to his kinsman GEORGE BAILLIE (1802–70), a descendant of the 6th earl. He took the name of Baillie-Hamilton, and his son GEORGE (1827–1917) became 11th earl of Haddington in 1870. In 1917 he was succeeded by his grandson GEORGE. 12th earl.

See Abbotsford Club, *State Papers of Thomas, Earl of Melrose* (Edinburgh, 1837); Sir W. Fraser, *Memorials of the Earls of Haddington,* 2 vol. (Edinburgh, 1889); Sir J. B. Paul, *The Scots Peerage,* 9 vol. (Edinburgh. 1904–14). (G. S. P.)

HADDINGTON, a royal and small burgh and the county town of East Lothian (Haddingtonshire). Scot. Pop. (1951) 4.498 It is on the left bank of the Tyne, 16½ mi. E. of Edinburgh by road. The town, originally built round a triangular space. consists mainly of Georgian gray stone buildings; the town house (1748–1831), with its 170-ft. steeple. stands where Court street branches into Market and High streets. In the early 15th century Haddington was Scotland's largest town. On the right bank of the river lies the old industrial suburb of the Nungate, which contains the Giffordgate. where John Knox is believed to have been born, and the 12th-century church of St. Martin. St. Mary's church is a 14th-century building in red and gray sandstone; the nave. restored in 1892, is used as the parish church, but the choir and transepts are roofless, though otherwise kept in repair. In the ancient vestry is a fine monument in alabaster of John. Lord Maitland of Thirlestane (1545–95), chancellor of Scotland. and his wife, with a laudatory sonnet by James VI. John, duke of Lauderdale (1616–82), is also buried there. In the choir is the tombstone which Thomas Carlyle erected over the grave of his wife, Jane Welsh. a native of the town. Samuel Smiles (*q.v.*) was born in the burgh. The corn exchange (1854) next to that of Edinburgh is the largest in Scotland. The Knox memorial institute was erected in 1879 to replace the old and famous grammar school, where John Knox. William Dunbar, John Major and possibly George Buchanan and Sir David Lyndsay were educated. The town is a shopping centre for the surrounding countryside. The chief industries are fellmongery. flour milling. malting and the manufacture of agricultural machinery, textiles and woollens: its grain markets (Fridays). once the largest in Scotland, are still of considerable importance.

Haddington was created a royal burgh by David I. It also received charters from Robert the Bruce, Robert II and James VI. In 1139 it was given as a dowry to Ada. daughter of William de Warenne, earl of Surrey, on her marriage to Prince Henry. only son of David I. .Alexander II was born there in 1198. Lying in the direct road of the English invaders. the town was burned by King John in 1216 and by Henry III in 1244. Fortified in 1348 by Lord

Grey of Wilton, it was besieged the next year by the Scots and French, nho forced the garrison to withdraw.

HADDOCK (*Melanogrammus aeglefinus*), a fish distinguished from its relative, the cod, by the smaller mouth and the blackish lateral line From Iceland it ranges southaard on both sides of the Atlantic; in the North sea it constitutes nearly half the total weight of fish taken in the trawl It feeds mainly on molluscs and crustaceans. It grows to a length of three feet, but specimens of this size are exceptional.

HADEN, SIR FRANCIS SEYMOUR (1818–1910), English etcher whose unaffected use of the lessons learned from the great masters place some of his works among the undeniable masterpieces of printmaking. He was born on Sept 16, 1818, in London. the son of Charles Haden, a surgeon. After pursuing a medical education in England and France, Haden became in 1842 a member of the Royal College of Surgeons

In 1843–44 he traveled in Italy and made his first sketches from nature. He studied the works of the great original engravers, Durer, Lucas van Leyden and Rembrandt, and these studies influenced his own efforts, leading to his important monograph (1897) on the etchings of Rembrandt. In 184; he married the sister of James McNeill Whistler. He received the Grand prix in Paris in 1889 and 1900 and was made a member of the Institut de France, Académie des Beaux-Arts and Société des Artistes Français. He was knighted in 1894. He retired in 1887 from his London medical practice and went to live in the neighbourhood of Alresford. Hampshire, where he died, on June 1, 1910.

Of Haden's original etched plates, more than 250 in number, one of the most notable is the large "Breaking Up of the Agamemnon." Some of his early and most beautiful etchings are "Thames Fishermen," "Sub Tegmine" and "Early Morning—Richmond." Other notable works, long popular with collectors, are "A By-Road in Tipperary," "Combe Bottom," "Shere Mill Pond" (both the small study and the larger plate), "Sunset in Ireland" and "Evening Fishing, Longparish." Toward the end of his life Haden began to practise mezzotint, and he also produced some charcoal drawings of landscape subjects. In recent years his plates have lost much of their popularity with collectors perhaps because of a fashion for other styles and manners. He wrote several well-known monographs. including *About Etching* (1878–79) and *The Art of the Painter-Etchers* (1890).

See H. Nazeby Harrington, The *Engraved Work of Sir* **Francis** *Seymour Haden* (1910). (H. Es.)

HADENDOA: *see* BEJA.

HADERSLEV, a town of Denmark in the *amt* (county) of the same name. Pop.. (1955) 18,867. It lies in a valley on the Hadersleben fiord, which is about 9 mi. in length, and communicates with the Little Belt, and is also an important railway junction. The beautiful church of St. Mary dates from the 13th century. The industries are iron founding, tanning and the manufacture of tobacco and gloves. The harbour is accessible only to small vessels.

Haderslev is first mentioned in 1228, and received municipal rights from Duke Waldemar II in 1292. It suffered considerably during the wars between Slesvig and Holstein in the 15th century. In Nov. 1864 it passed with Slesvig to Prussia, returning to Denmark with North-Slesvig by the plebiscite held in 1920 under the terms of the treaty of Versailles.

HADFIELD, SIR ROBERT ABBOTT (1858–1940), British metallurgist, was born in Sheffield, Eng., Nov. 29, 1858. Educated at Sheffield Collegiate school, he interested himself at an early age in metallurgy, subsequently becoming chairman of Hadfields, Ltd., Hecla and East Hecla works, Sheffield, and director of other important companies. In 1883 he patented his process for the production of manganese steel *(see* IRON AND STEEL) and became famous as the inventor and improver of various metallurgical processes, including low hysteresis steel and many other special ferrous alloys. He became a member of many scientific committees and was president of the Iron and Steel institute (1905–07), of the Faraday society (1914–20) and of the Society of British Gas Industries (1917–18), besides being master cutler of Sheffield, 1899–1900.

In 1908 he was knighted, the following year became F.R.S., and was created a baronet in 1917. Hadfield received many honours from learned societies. He published more than 220 scientific and technical papers. His book *Metallurgy and Its Influence on Modern Progress: With a Survey of Education and Research* (1925) became a standard work of reference. In 1932–33 he was manager of the Royal institution.

In 1894 Hadfield married Frances Belt, daughter of Col. Samuel Morris Wickersham, of Philadelphia, Pa. In 1914, soon after the beginning of World War I, they founded a hospital at Wimereux, Fr. Hadfield died in London on Sept. 30, 1940.

HADHRAMAUT, a region on the south coast of Arabia, bounded west by Yemen, east by Oman and north by the Rub al Khali. Its actual limits are generally understood to include also the Mahra and Qara country between 51° and 56° E., where the desert and the coastal range come close down to the sea.

The province, consisting of the Qu'aiti state of Shihr and Mukalla and the Kathiri state of Saiun, is comprised in the eastern Aden protectorate. Mukalla on the coast is the seat of the Qu'aiti state; Saiun is the capital of the Kathiri state. The province is bounded on the west by the Wahidi sultanates and on the east by the Mahri sultanate, all of which are in protective treaty relations with Great Britain.

The main body of Hadhramaut is a wadi which rises in the highlands of southwest Arabia about 45° E. and extends eastward for 400 mi. in a gentle curve, receiving numerous affluent from the northern slopes of a mountain range which extends eastward from Yemen and attains, in parts, a height of 8,000 ft. Between this range and the sea is a coastal plain of varying width, scored by the channels of wadis rising on its southern slopes. The principal ports are Mukalla and Ash Shihr, which are the centres of a considerable trade carried on with India and Java. There are also a number of fishing villages along this coast, while the valleys of the coastal plain support some fertile oases irrigated by springs and seasonal torrents.

The southern escarpment of the main range is steeper than the northern slope, which forms a plateau descending to the main wadi beyond it. The most westerly settlement in the latter is Shabwa, a former capital, now almost buried by the advancing sand. Farther east lies a group of important oasis settlements, of which the chief are Shibam, Saiun and Tarim in the main wadi; and Hauta near its junction with Wadi Du'an. Besides these there are numerous settlements, both in the main wadi and its affluents, with prosperous palm groves and other cultivation, which practically ceases below Qasm, the most easterly settlement of any importance. At some distance east of Qasm stands the shrine of Nabi Hud, a pre-Islamic saint, whose grave is an important centre of pilgrimage. A similar shrine is that of Nabi Salih in Wadi Sirr, near Shibam.

Except after rain, there is no running water in the Hadhramaut valleys, but springs and wells are numerous, and the principal crops are dates, wheat, millet, indigo and tobacco of excellent quality known as *hummi*, which is widely exported. Other exports are salt, coffee, gums and hides. The chief imports are fuel oil, cottons, coal and provisions.

The Mahra country, mainly desert, is ruled by a sultan residing at the coastal village of Qishn and, until 1886, owning the island of Socotra, under British protection. The mountains of this tract and of the adjacent Qara district come close down to the coast, and rise in parts to 4,000 ft. They are, in places, covered with gum-bearing forests producing myrrh and frankincense. This tract was visited and surveyed in 1894 by the Bents, who found Sabaean ruins near Dhufar (Dhafar), and a remarkable harbour at Khaur Raury, possibly the Moscha of antiquity.

The name of Hadhramaut is of great antiquity, and occurs in Genesis as Hazarmaveth, son of Joktan. Greek accounts of the incense country contain mention of Adramytta and Chadramotites.

The region certainly enjoyed great prosperity and a highly advanced civilization in ancient times, as evidenced by numerous ruins found in Wadi Du'an and 'Adim. Its peopie are, in the main, of Qahtan or south Arabian stock, though the population

contains a large element of Saiyids (descendants of the Prophet through his grandson Husain) and other immigrants of northern stock, as well as a considerable mixture of African (originally and to some extent still slave) blood.

The total population of the tract may be about 150,000, or rather more if all the Bedouins are included. The Saiyids, organized in families, each under a Mansab, are regarded as the religious leaders, and constitute a sort of aristocracy, owning much land but cultivating it through slaves or hired labourers. The tribesmen, partly nomad and partly settled, are divided into two main sections: the Qu'aiti, being by far the larger, and the Kathiri. The latter, formerly the more powerful, occupy Saiun, Tarim and their dependent settlements. The Qu'aiti, a branch of the Yafi' tribe in southwest Arabia, originally came in at the invitation of the Saiyids to protect them from marauding tribes, but became the virtual rulers of the whole country, with their capital at Mukalla.

The chiefs of this tribe long enjoyed a special hereditary status as jemadar or commander in chief of an Arab levy maintained by the Indian state of Hyderabad. Many of these tribesmen sought service in this levy, while the Kathiris, after the beginning of the 19th century, emigrated on a large scale to Java and Sumatra. A large share of the trade of Mukalla and Ash Shihr passed into the hands of Parsees and other Indians.

The Qu'aiti sultan Ghalib ibn-'Iwadh ibn-'Umar, who died in 1924, was a staunch supporter of Great Britain and a man of progressive tendencies. An endemic feud between him and the Kathiri sultan had been patched up by a treaty in 1918, but Capt. W. H. Lee-Warner was impressed by the conviction that progress in the Hadhramaut could be assured only by the elimination of the Kathiri sultans, whose tyranny and rapacity were the subject of much local complaint, while their intrigues made for unrest in the Qu'aiti territory. In both sections of the region the executive administration is in the hands of hereditary wazirs, who are thus the virtual, though not the nominal rulers. By treaties of 1938 and 1939, respectively, a British resident adviser was appointed to the Qu'aiti state of Shihr and Mukalla and the Kathiri state of Saiun.

Until World War I, knowledge of the region was mainly derived from the Bents and Leo Hirsch (who reached Tarim in 1893), but in 1919 much fresh inforniation was collected by Lee-Warner, who entered the country on a mission to the Kathiri sultans on behalf of the British government. At Ghail Ba-Wazir he found the chief centre of the *hummi* tobacco cultivation and followed up Wadi Himam. In 1919–20 further light was thrown on the Hadhramaut by O. H. Little *(The Geography and Geology* of *Makalla,* Cairo, 1925), who made a geological reconnaissance of great value of the coastal plain and southern slopes of the mountain range between Ghail Ba-Wazir and Wadi Hajr, south of 14° 45' N. Several journeys were made through a large portion of the country and yielded interesting and instructive literature.

The xenophobia of the Hadhramaut people long jealously guarded the country from the intrusion of European explorers, but the few who penetrated into its recesses made it possible to form a fairly complete idea of the whole.

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HADING, JANE (1864–1941), French actress, whose real name was Jeanne Alfrédine Tréfouret, was born on Nov. 25, 1864, at Marseilles, where her father was an actor at the Gymnase. She was trained at the local conservatory and was engaged in 1873 for the theatre at Algiers, and afterward for the Khedivial theatre at Cairo, where she played, in turn, coquette, soubrette and *ingénue* parts. When she returned to Marseilles she sang in operetta, besides acting in *Ruy Blas.* Her Paris début was in La *Chaste Suzanne* at the Palais Royal, and she was again heard in operetta at the Renaissance. In 1883 she had a great success at the Gymnase in Le *Maître de forges.* In 1884 she married Victor Koning (1842–94), the manager of that theatre, but divorced him in 1887. In 1888 she toured the U.S. with Coquelin. Her later repertoire included *Le Demi-monde,* Capus's *La Châtelaine,* Maurice Donnay's *Retour de Jérusalem, La Princesse Georges* by Dumas *fils,* and Émile Bergerat's *Plus que reine.*

HADITH. The name given to a compilation of the teachings and life of the prophet Mohammed, which with the Koran forms the supreme authority on matters connected with the Mohammedan religion and legislation. This enormous literature of traditions, which was primarily meant for personal guidance and edification, has coloured the whole method and fabric of Moslem thought.

(See ISLAMIC LAW.)

HADLEIGH, a market town and urban district in the Sudbury and Woodbridge parliamentary division of Suffolk, Eng., 10 mi. W. of Ipswich by road, on the Brett. a tributary of the Stour. Pop. (1951) 3,089. Area 6.7 sq.mi. Hadleigh, the capital city of the East Angles, was called by the Saxons Heapde-leag and appears in Domesday Book as Hetlega. About 886 Aethelflaed. with the consent of Aethelred. her husband. gave Hadleigh to Christ Church, Canterbury. The dean and chapter of Canterbury have held it since the Dissolution. Flemings arrived in mediaeval times to make cloth and in the 17th century Hadleigh was famous for woollen manufacture. The town was incorporated in 1618, and in 1635. in a list of the corporate towns of Suffolk to be assessed for ship money, Hadleigh is named as third in importance. It declined after the plague in 1636 and in 1687 mas deprived of its charter; an unsuccessful attempt to recover it was made in 1701.

James I granted fairs on Monday and Tuesday in Whitsun week and confirmed an ancient fair at Michaelmas and a market on Monday. The church of St. Mary the Virgin is Perpendicular. with an Early English tower and Decorated spire. The Deanery tower. a turreted gatehouse of brick, dates from 1495 and has associations with the Oxford movement. The Guild hall nearby is a Tudor building and the High street contains many half-timbered houses. Coir matting. sacks. malting, milling, egg packing and agriculture are the main trades.

There is a Hadleigh in Essex near Southend-on-Sea.

HADLEY, ARTHUR TWINING (1856–1930), **U.S.** political economist and educator, president of Yale university, was born in Kew Haven, Conn., on April 23, 1856, the son of James Hadley, the philologist. He graduated from Yale in 1876 as valedictorian. having taken prizes in English, classics and astronomy; he studied history and political science at Yale and in Berlin; was a tutor at Yale in 1879–83, instructor in political science in 1883–86, professor of political science in 1886–91, professor of political economy in 1891–99 and dean of the graduate school in 1892–95; in 1899 he became president of Yale university, the first layman to hold that office.

He retired as president emeritus in 1921 but continued to act as director of various railroads. He was commissioner of the Connecticut bureau of labour statistics in 1885–87. As an economist he first became widely known through his investigation of the railway question and his study of railway rates, which antedated the popular excitement as to rebates. His *Railroad Transportation, Its History and Laws* (1885) became a standard work, and appeared in Russian (1886) and French (1887); he testified as an expert on transportation before the senate committee which drew up the interstate commerce law; and wrote on railways and transportation for the ninth and tenth editions (of which he was one of the editors) of the *Encyclopædia Britannica,* for Lalor's *Cyclopaedia of Political Science, Political Economy, and Political History of the United States,* 3 vol. (1881–84), for the *American Railway* (1888) and for the *Railroad Gazette,* of which he was associate editor in 1887–89, and other periodicals. His idea of the broad scope of economic science, especially of the place of ethics in relation to political economy and business, is expressed in his writings and public addresses. In 1907–08 he was Theodore Koosevelt professor of American history in the University of Berlin. He also lectured in England. He died at Kobe, Japan, on March 6, 1930. Among his publications

are: *Economics: an Account of the Relations between Private Property and Public Welfare* (1896); *The Education of the American Citizen* (1901); *The Relations between Freedom and Responsibility in the Evolution of Democratic Government* (1903); *Undercurrents in American Politics* (1915); *Economic Problems of Democracy* (1923); and *The Conflict between Liberty and Equality* (1925).

HADLEY, HENRY KIMBALL (1871–1937), American composer, was born in Somerville (Mass.), on Dec. 20, 1871. He studied in Boston and Vienna. In 1904 he went to Germany, where he was Kapellmeister at the Mainz Opera House for two seasons, and in 1909 produced his opera *Safie*. Hadley toured Europe in 1908 as a guest conductor, presenting his tone poem *Salome*, after Oscar Wilde's tragedy. He was conductor of the Seattle Symphony Orchestra (1909–11) and of the San Francisco Symphony Orchestra (1911–15) and became associate conductor of the N Y. Philharmonic Orchestra in 1921. He has composed four other grand operas: *A Night in Old Paris, Azora* (Chicago Opera Company), *Bianca* (Society of American Singers), and *Cleopatra's Night* (Metropolitan Opera House); ode music for the Worcester (Mass.) Festival (60th anniversary) and *Resurgam* for the Cincinnati Festival, 1923, in addition to four symphonies, overtures and cantatas, five tone poems, ballet suites and more than 150 songs. In 1923 he conducted in London, Stockholm and Amsterdam. He conducted a season, 1927, in Buenos Aires and in 1930 was guest conductor of the Tokyo Symphony Orchestra. In 1934, he organized the Berkshire Symphonic Festivals.

HADLEY, JAMES (1821–1872), American scholar, was born March 30, 1821, in Fairfield (N.Y.). He graduated from Yale in 1842, studied in the theological department of Yale, and in 1844–45 was a tutor in Middlebury college. Then at Yale he was tutor, assistant professor, and professor of Greek, from 1851 until his death in New Haven, Nov. 14, 1872. Although he knew many ancient and modern languages, he published little. He was also an able mathematician.

His most original written work was an essay on Greek accent, published in a German version in Curtius's *Studien zur griechischen und lateinischen Grammatik*. Hadley's *Greek Grammar* (1860; revised by Frederic de Forest Allen, 1884) long held its place in American schools. In 1873 were published his *Introduction to Roman law* (ed. by T. D. Woolsey) and his *Essays, Philological and Critical* (ed. by W. D. Whitney).

See the memorial by Noah Porter in *The New Englander*, vol. xxxii., p. 35–55 (Jan. 1873); and the sketch by his son, A. T. Hadley, in *Biographical Memoirs* of the National Academy of Sciences, vol. v. (1905), p. 247–254.

HADOW, SIR WILLIAM HENRY (1859–1937), British scholar and musician, was born at Ebrington, Glos., Dec. 27, 1859. He was educated at Malvern and Worcester College, Oxford, and after taking his degree remained at Oxford as a tutor and fellow of his college. In 1909 he became principal of Armstrong College, Newcastle, retaining this post until 1919, when he became vice-chancellor of Sheffield University. He was in 1918 appointed assistant director of education for the troops by the War Office and also worked for the Y.M.C.A. He was knighted in 1918 and was made a C.B.E. in 1920. In 1922 he became Stevenson Lecturer to the University of Glasgow and in 1927 he presided over a committee which investigated the possibilities of adult education by means of broadcasting.

Sir Henry Hadow first took up the study of music at Darmstadt in 1882. When his *Studies in Modern Music* appeared (vol. i. Berlioz, Schumann, Wagner, 1894; vol. ii. Chopin, Dvořák, Brahms, 1895), they were received with enthusiasm as representing a layman's wider outlook on, and keen insight into, subjects usually left to professional writers on music. In *A Croatian Composer* (1897) he contributed a valuable theory on the Slavonic origin of Haydn's melodic material. He also wrote *Sonata Form* (1896); the volume "The Viennese Period" (1904) in *The Oxford History of Music*, of which he was the editor; *Citizenship* (1923); and *Music* (1924) in the Home University Library. His compositions include songs, piano pieces and incidental music to Robert Bridge's *Demeter* (1905).

HADRIA [mod. *Atri* (*q.v.*)], an ancient town of Picenum, belonging to the Praetuttii. It became a colony of Rome in 286 B.C. and remained faithful to Rome. The family of Hadrian came from here. The crypt of the cathedral of the modern town was originally a large Roman cistern; another forms the foundation of the ducal palace; and in the eastern portion of the town there is a complicated system of underground passages for collecting and storing water.

HADRIAN (PUBLIUS AELIUS HADRIANUS), Roman emperor A.D. 117–138, was born on Jan. 24, A.D. 76, at Italica in Hispania Baetica, where his ancestors, originally from Hadria in Picenurn, had been settled since the time of the Scipios. On his father's death in 85 or 86 he was placed under the guardianship of two fellow-countrymen, his kinsman Ulpius Trajanus (afterwards the emperor Trajan), and Caelius Attianus (afterwards prefect of the praetorian guard). He spent the next five years at Rome, but at the age of fifteen he returned to his native place and entered upon a military career. Trajan sent for him to Rome in 93, and after filling the usual minor civil posts he started serious military service as tribune to the IInd legion, stationed at Buda-Pesth (95). He spent four years on that frontier, being sent to Trajan with the army's congratulations in 97, and returned to Rome with Trajan in 99. In 100 the Empress Plotina arranged a marriage between him and Vibia Sabina, Trajan's great-niece. In 101 Hadrian was quaestor, in 105 tribune of the people, in 106 praetor. He served with distinction in both Dacian campaigns; in the second Trajan presented him with a valuable ring which he himself had received from Nerva, a token of regard which seemed to designate Hadrian as his successor. In 107 Hadrian was *legatus praetorius* of lower Pannonia, in 108 *consul suffectus, legatus* in the Parthian campaign (113–117), in 117 *consul designatus* for the following year, in 119 consul for the third and last time only for four months. When Trajan, owing to a severe illness, decided to return home from the East, he left Hadrian in command of the army and governor of Syria. On Aug. 9, 117, Hadrian, at Antioch, was informed of his adoption by Trajan, and, on the 11th, of the death of the latter at Selinus in Cilicia. Whether he ever was formally adopted cannot be established. The army and the senate confirmed his succession, and he took office with danger threatening the empire on nearly every side.

Emperor.—Hadrian's first important act was to abandon as untenable the conquests of Trajan beyond the Euphrates (Assyria, Mesopotamia and Armenia), a recurrence to the traditional policy of Augustus. Mesopotamia and Assyria were given back to the Parthians, and the Armenians were allowed a king of their own. Some time after this there arose trouble in Dacia from the Roxolani. Whether Hadrian set out from Antioch to suppress it, or whether he had by then already reached Rome, is disputed. In any case, while he was in Dacia occurred the conspiracy of the four consulars, generals of Trajan's, discontented at the abandonment of the conquests of the last reign. The four were killed by order of the senate, and Hadrian left Turbo with a joint command of Dacia and Pannonia and hurried to Rome, where the affair had created an atmosphere of suspicion. He threw the responsibility for the executions upon the prefect of the praetorian guard, and swore that he would never punish a senator without the assent of the entire body, to which he expressed the utmost deference and consideration. Trajan's scheme for the "alimentation" of poor children was carried out upon a larger scale under a special official called *praefectus alimentorum*.

Travels Round the Empire.—The record of Hadrian's journeys[1] through all parts of the empire forms the chief authority for the events of his life down to his final settlement in the capital during his last years. They can only be briefly touched upon here. His first great journey probably lasted from 121 to 126. After traversing Gaul he visited the Germanic provinces on the Rhine, and crossed over to Britain (spring, 122), where he built the great rampart from the Tyne to the Solway, which bears his name.

[1]The chronology of Hadrian's journeys—indeed, of the whole reign—is confused and obscure. In the above the article by von Rohden in Pauly-Wissowa's *Realencyclopädie* has been followed. Weber's (see Bibliog.) is the most important discussion.

(See BRITAIN: *Roman.)* This part of the journey was mainly occupied with military inspections.. He returned through Gaul into Spain, and then proceeded to Mauretania, where he suppressed an insurrection. A war with the Parthians was averted by a personal interview with their king (123). From the Parthian frontier he travelled through Asia Minor and the islands of the Aegean to Athens (autumn, 125), where he introduced various political and commercial changes, was initiated at the Eleusinia, and presided at the celebration of the greater Dionysia. After visiting Central Greece and Peloponnesus, he returned by way of Sicily to Rome (end of 126). The next year was spent at Rome, and, after a visit to Africa, which produced measures for the encouragement of African agriculture, he set out on his second great journey (September 128). He travelled by way of Athens, where he completed and dedicated the buildings (see ATHENS) begun during his first visit, chief of which was the Olympieum. In the spring of 129 he visited Asia Minor and Syria, where he invited the kings and princes of the East to a meeting at Samosata; Chosroes of Parthia declined. Having passed the winter at Antioch, he set out for the south (spring, 130). He ordered Jerusalem to be rebuilt (see JERUSALEM) under the name of Aelia Capitolina, and made his way through Arabia to Egypt, where he restored the tomb of Pompey at Pelusium with great magnificence. After a short stay at Alexandria he took an excursion up the Nile, during which he lost his favourite Antinous. From Egypt Hadrian returned through Syria to Europe (his movements are obscure), but was obliged to hurry back to Palestine (spring, 133) to deal with the Jewish revolt that broke out in 132. (See art. JEWS; also E. Schiirer, *Hist.* of the *Jewish* People, Eng. tr., div. 1, vol. ii. p. 288; and S. Krauss in *Jewish* Encyc. *s.v.* ('Hadrian.") For a while he probably commanded in the field himself, then in 134, leaving the conduct of affairs in the hands of Julius Severus, he returned to Rome. The remaining years of his life were spent partly in the capital, partly in his villa at Tibur. His health now began to fail, and it became necessary for him to choose a successor. There were rumours that Servianus would be appointed, but he and his grandson Fuscus were put to death in 136. Why, is not known. Against the advice of his relatives and friends he adopted L. Ceionius Commodus under the name of L. Aelius Caesar, who was in a feeble state of health and died on Jan. 1, 138, before he had an opportunity of proving his capabilities. Hadrian then adopted Arrius Antoninus (see ANTONINUS PIUS) on condition that he should adopt M. Annius Verus (afterwards the emperor Marcus Aurelius) and the son of L. Aelius Caesar, L. Verus (afterwards co-emperor). Hadrian died at Baiae on July 10, 138.

Work of the Reign. — He was without doubt one of the most capable emperors who ever occupied the throne, and devoted his great and varied talents to the interests of the state. One of his chief objects was the abolition of distinctions between the provinces and the mother country, finally carried out by Caracalla, while at the same time he did not neglect reforms that were urgently called for in Italy. Provincial governors were kept under strict supervision; extortion was practically unheard of; the ius Latii was bestowed upon several communities; special officials were instituted for the control of the finances; and the emperor's interest in provincial affairs was shown by his personal assumption of various municipal offices. New towns were founded and old ones restored; new streets were laid out, and aqueducts, temples and magnificent buildings constructed. In Italy itself the administration of justice and the finances required special attention. Four iuridici of consular rank were appointed for Italy, who took over judicial functions formerly exercised by local magistrates. The judicial council (*consiliarii* Augusti, later called consistorium), composed of persons of the highest rank (especially jurists), became a permanent body of advisers, although merely consultative. Roman law owes much to Hadrian, who instructed Salvius Julianus to draw up an *edictum perpetuum,* to a great extent the basis of Justinian's Corpus *iuris.* (See M. Schanz, Geschichte der *römischen* Literatur, iii. p. 167.) In the administration of finance, in addition to the remission of arrears already mentioned, a revision of claims was ordered to be made every fifteen years, thereby anticipating the "indictions." (See CALENDAR; CHRONOLOGY.) Direct collection of taxes by imperial procurators was substituted for the system of farming, and a special official (advocatus *fisci*) was instituted to look after the interests of the imperial treasury. The gift of "coronary gold" (*aurum coronarium*), presented to the emperor on certain occasions, was entirely remitted in the case of Italy, and partly in the case of the provinces. The administration of the postal service throughout the empire was taken over by the state, and municipal officials were relieved from the burden of maintaining the imperial posts. Humane regulations as to the treatment of slaves were strictly enforced; the master was forbidden to put his slave to death, but was obliged to bring him before a court of justice; if he ill-treated him it was a penal offence. The custom of putting all the household to death when their master was murdered was modified. In military matters Hadrian was a strict disciplinarian, but his generosity and readiness to share their hardships endeared him to the soldiers. During his reign an advance was made in the direction of creating an organized body of servants at the disposal of the emperor by the appointment of equites to important administrative posts, without their having performed the *militiae* equestres. (See EQUITES.) Among the magnificent buildings erected by Hadrian mention may be made of the following: In the capital, the temple of Venus and Roma; his splendid mausoleum, which formed the groundwork of the castle of St. Angelo; the pantheon of Agrippa; the Basilica Neptuni; at Tibur the great villa 8 m. in extent, a kind of epitome of the world, with miniatures of the most celebrated places in the provinces. Athens, however, was the favourite site of his architectural labours; here he built the temple of Olympian Zeus, the Panhellenion, the Pantheon, the library, a gymnasium and a temple of Hera.

Hadrian was fond of the society of learned men — poets, scholars, rhetoricians and philosophers — whom he alternately humoured and ridiculed. His taste, however, was curious; he preferred Cato the elder, Ennius and Caelius Antipater to Cicero, Virgil and Sallust, the obscure poet Antimachus to Homer and Plato. As a writer he displayed great versatility. He composed an autobiography, published under the name of his freedman Phlegon; wrote speeches, fragments of two of which are preserved in inscriptions (a panegyric on his mother-in-law Matidia, and an address to the soldiers at Lambaesis in Africa). In imitation of Antimachus he wrote a work called *Catachannae,* probably a kind of miscellanea. The Latin and Greek anthologies contain about a dozen epigrams under his name. The letter of Hadrian to the consul Servianus (in Vopiscus, Vita *Saturnini,* 8) is no longer considered genuine. Hadrian's celebrated dying address to his soul may here be quoted (David Magie, Scriptures *Historiae* Augusti, Loeb Classical Library. Harvard University Press):

O blithe little soul, thou, flitting away,
Guest and comrade of this my clay,
Whither now goest thou, to what place
Bare and ghostly and without grace?
Nor, as they wont was, joke and play

Character. — The character of Hadrian exhibits a mass of contradictions. well summed up by Spartianus (14, 11). But it is doubtful nhether a good deal of this mas not rather due to the defeated imaginations of his contemporaries, whom his reserved nature entirely baffled Whatever his real character was like. the Empire under him enjoyed its golden age. The permanent marks he left. in addition to his legal and administrative reforms, were the towns he built and his contribution to the frontier system.

The chief ancient authorities for the reign of Hadrian are: the life by Aelius Spartianis in the *Scriptores historiae Augustae* (see AUGUSTAN HISTORY and bibliography); the epitome of Dio Cassius (Ixix.) by Xiphilinus; Aurelius Victor, *Epit.* 14, probably based on Marius Maximus; Eutropius viii. 6; Zonaras xi. 23; Suidas, *s.v.* 'Αδριανός; and numerous inscriptions and coins, The autobiography was used by both Dio Cassius and Marius Maximus. Modern authorities: C. Merivale, *Hist.* of the Romans under the Empire, ch. Ixvi; H. Schiller, Geschichte der romiscken *Kaiserzeit,* i. 2, p. 602 (1883); J. B. Bury, The Student's Roman Empire (1893), where a concise table of the journeys is given; P. von Rohden, *s.v.* "Aelius" (No. 64) in Pauly-Wissowa's *Realencyklopädie,* i. 1 (1894); J. Dürr, *Die Reisen* des Kaisers Hadrian (1881); F. Gregorovius, *The* Emperor Hadrian (Eng. tr. by Mary E. Robinson, 1898); A. Hausrath,

Neutestamentliche Zeitgeschichte, iii. (1874); W. Schurz, *De mutationibus in imperio ordinando ab imp. Hadr. factis,* i. (Bonn, 1883); J. Plew, *Quellenuntersuchungen zur Geschichte des Kaisers Hadrian* (Strassburg, 1890); O. T. Schulz, "Leben des Kaisers Hadrian," *Quellenanalysen* [of Spartianus' *Vita*] (1904); E. Kornemann, *Kaiser Hadrian und der letzte grosse Historiker von Rom* (1905); W. Weber, *Untersuchungen zur Geschichte des Kaisers Hadrianus* (1908); H. F. Hitzig, *Die Stellung Kaiser Hadrians in der römischen Rechtsgeschichte* (1892); C. Schultess, *Bauten des Kaisers Hadrian* (1898); G. Doublet, *Notes sur les oeuvres littéraires de l'empéreur Hadrien* (Toulouse, 1893); J. B. Lightfoot, *Apostolic Fathers,* ii. 1, 476 *seq.;* Sir W. M. Ramsay, *Church in the Roman Empire,* pp. 320 *seq.;* V. Schultze, in Herzog-Hauck's *Realencyklopädie,* vii. 315; histories of Roman literature by Teuffel-Schwabe and Schanz. On Aelius Caesar, see *Class. Quart.,* 1908, 1. *See* also B. W. Henderson, *Life and Principate of the Emperor Hadrian* (1923); M. I. Rostovtzev, *Social and Economic History of the Roman Empire* (1926).

HADRIAN'S WALL, the name usually given to the remains of the Roman fortifications which defended the northern frontier of the Roman province of Britain. It extends from Wallsend on the estuary of the Tyne to Bowness on the Solway, about 73½ English miles, and was erected by order of the emperor Hadrian under Platorius Nepos, governor of Britain about A.D. 122–126. The complete work was not built to a single plan, but reached its final form (probably within the years stated) by three stages: (1) a series of detached forts, each holding 500 men, four miles apart, on an average, lying in front (to the north) of an earthwork (the Vallum) which served as a visible delimitation of the civil

REECE WINSTONE

HADRIAN'S WALL, WHICH MARKED THE FRONTIER OF THE ROMAN EMPIRE IN BRITAIN. THE WALL STANDS 4 FT. HIGH AND IS 5 FT. WIDE

frontier of Rome; (2) the enlargement of certain of these forts to hold 1,000 men; (3) the connection of the forts by a stone wall, and the provision of smaller fortified posts at every mile (Milecastles) with intervening turrets. This wall was designed rather as a fortified sentry beat than as a defensive fortification. At certain points traces have been found of a wall of turf, which preceded the stone wall; this has yet to be elucidated fully, but may be a temporary step in the development between stages 2 and 3.

No definite evidence has yet been found that the wall was held by the Romans after A.D. 383.

See further BRITAIN: *Roman.*

HADRUMETUM, a town of ancient Africa on the southern extremity of the *sinus Neapolitanus* (mod. Gulf of Hammamet) on the east coast of Tunisia. The site is partly occupied by the modern town of Sousse (*q.v.*). The form of the name Hadrumetum varied much in antiquity; the Greeks called it Ἀδεύμης, Ἀδεύμητος, Ἀδεαμύτης, Ἀδεάμητος: the Romans *Adrumetum, Adrimetum, Hadrumetum, Hadrymetum,* etc.; inscriptions and coins gave *Hadrumetum.* The town was a Phoenician colony founded by Tyrians long before Carthage (Sallust, *Jug.* 19). It became subject to Carthage, but lost none of its prosperity. Often mentioned during the Punic Wars, it was captured by Agathocles in 310, and was the refuge of Hannibal and the remnants of his army after the battle of Zama in 202. During the last Punic War it gave assistance to the Romans; after the fall of Carthage in 146 it received an accession of territory and the title of *civitas libera* (Appian, *Punica,* xciv.; *C.I.L.* i. p. 84). Caesar landed there in 46 B.C. on his way to the victory of Thapsus (*De bello Afric.* iii.; Suetonius, *Div. Jul.* lix.).

In the organization of the African provinces Hadrumetum became a capital of the province of Byzacena. It was a busy port and the centre of a fertile country. Trajan made it a Latin colony under the title of *Colonia Concordia Ulpia Trajana Augusta Frugifera Hadrumetina;* a dedication to the emperor Gordian the Good, found at Sousse gives these titles to the town, and at the same time identifies it with Sousse. Quarrels arose between Hadrumetum and its neighbour Thysdrus in connection with the temple of Minerva situated on the borders of their respective territories (Frontinus, *Gromatici,* ed. Lachmannus, p. 57); Vespasian when pro-consul of Africa had to repress a sedition among its inhabitants (Suetonius, *Vesp.* iv.; Tissot, *Fastes de la prov. d'Afrique,* p. 66); it was the birthplace of the emperor Albinus. At this period Hadrumetum was after Carthage, the most important town in Roman Africa. Its bishops are mentioned at the councils of 258, 348, 393 and even later. Destroyed by the Vandals in 434 it was rebuilt by Justinian and renamed Justinianopolis (Procop. *De aedif.* vi. 6). After the Arabic invasion of the 7th century the place became the haunt of pirates. The Arabic geographer Bakri gave a description of the chief Roman buildings which were standing in his time (Bakri, *Descr. de l'Afrique,* tr. by de Slane, p. 83 *et seq.*). The modern town of Sousse, despite its commercial prosperity, occupies only a third of the old site.

There remains a fragment of the fortifications of the Punic town and of the substructions of the Byzantine acropolis, the circus, the theatre, the water cisterns and of other buildings, notably an interesting Byzantine basilica. In the ruins have been found numerous columns of Punic inscriptions, Roman inscriptions and mosaic, among which is one representing Virgil. In the large Christian catacombs are numerous sarcophagi and inscriptions painted or engraved of the Roman and Byzantine periods. There are also Punic and Pagan-Roman cemeteries. The town had no Punic coins, but under the Roman domination there were coins from the time of the Republic. These are of bronze and bear the name of the city in abbreviations, HADR or HADRVM accompanying the head of Neptune or the Sun. We find also the names of local duumvirs. Under Augustus the coins have on the obverse the imperial effigy, and on the reverse the names and often the effigies of the pro-consuls. After Augustus the mint was closed.

HAECKEL, ERNST HEINRICH (1834–1919), German zoologist, well known for his early adoption of the doctrine of evolution and for his confident construction of genealogical trees of living organisms, was born at Potsdam on Feb. 16, 1834. He studied medicine and science at Würzburg, Berlin and Vienna under such men as Johannes Müller, R. Virchow and R. A. Kölliker. In 1862 he became professor of comparative anatomy and director of the zoological institute at Jena, where a chair of zoology was created for him in 1865. He spent his life at Jena, with the exception of the time devoted to various tours. As a field naturalist (he coined the term ecology in 1866), Haeckel had extraordinary power and industry, displayed in his publications on *Radiolaria* (1862), *Siphonophora* (1869), *Monera* (1870) and *Calcareous Sponges* (1872), as well as several *Challenger* reports, viz., *Deep-Sea Medusae* (1881), *Siphonophora* (1888), *Deep-Sea Keratosa* (1889) and *Radiolaria* (1887).

Darwin believed that Haeckel's enthusiastic propagation of the doctrine of organic evolution was the chief factor in the success of the doctrine in Germany. His *General Morphology* (1866) was a suggestive attempt to work out the practical application of evolution to its final results. *Natürliche Schöpfungsgeschichte* (1867; 10th ed., 1902; Eng. trans., *History of Creation,* 1892) laid particular stress on the "fundamental biogenetic law" that ontogeny recapitulates phylogeny, that the organism in its development is to a great extent an epitome of the form modifications

undergone by the successive ancestors of the species in the course of their historic evolution. Haeckel's well-known "gastraea" theory is an outcome of this generalization. He divided animal creation into the Protozoa or unicellular animals, and the Metazoa or multicellular animals. In the Metazoa the single primitive egg cell is transformed by cleavage into a globular mass of cells (morula), which first becomes a hollow vesicle and then changes into the gastrula. The simplest multicellular animal resembles this gastrula with its two primary layers, ectoderm and endoderm, and the earliest hypothetical form of this kind, from which the higher animals are probably descended, may be called the gastraea.

Haeckel's genealogical constructions culminated in the paper he read before the fourth international zoological congress, held at Cambridge in 1898. when he traced the descent of the human race in 26 stages from organisms like the still existing Monera, simple structureless masses of protoplasm, and the unicellular Protista through the chimpanzees and the *Pithecanthropus erectus,* which he regarded as the link between primitive man and the anthropoid apes.

Haeckel's attempt to apply the doctrine of evolution to the problems of philosophy and religion appeared in *Die Welträtsel* (1899; Eng. trans., *The Riddle of the Universe,* 1900). Adopting an uncompromising monistic attitude, he asserted the essential unity of organic and inorganic nature. For him the chemico-physical properties of carbon in its complex albuminoid compounds are the sole and the mechanical cause of the specific phenomena of movement which distinguish organic from inorganic substances, and the first development of living protoplasm, as seen in the Monera, arises from such nitrogenous carbon compounds by spontaneous generation. Psychology he regarded as merely a branch of physiology. Every living cell has psychic properties, and the psychic life of multicellular organisms is the sum total of the psychic functions of the cells of which they are composed. Moreover, just as the highest animals have evolved from the simplest forms of life, so the highest human faculties have evolved from the soul of animals. Consequently Haeckel denied the immortality of the soul, the freedom of the will and the existence of a personal God.

Haeckel occupies no serious position in the history of philosophy, and it can be held that in the formulation of his ideas he was somewhat unscrupulous in his treatment of scientific facts. He is thus exposed to criticism, but he was very widely read in his own day and was very typical of the school of extreme evolutionist thought. He died at Jena on Aug. 8, 1919.

Haeckel's other works include: *Die systematische Phylogenie* (1894), which has been pronounced his best book; *Anthropogenie* (1874; 5th ed.. 1903; Eng. trans., 1879), dealing with the evolution of man; *Über unsere gegenwärtige Kenntnis vom Ursprung des Menschen* (1898; Eng. trans., *On Our Present Knowledge Regarding the Origin of Men,* 1898); *Der Kampf um den Entwickelungsgedanken* (1905; Eng. trans., *The Struggle Over Ideas Concerning Evolution,* 1906); books of travel such as *Indische Reisebriefe* (1882; 6th ed., 1922) and *Aus Insulinde* (1901). *Kunstformen der Natur* (1904), in 11 parts; consists of exceptionally fine paintings of protozoan organisms. Haeckel was an excellent artist but tended to be led by his imagination.

See W. Bolsche, *E. Haeckel. Ein Lebensbild* (1900; Eng. trans., 1906); H. Schmidt (ed.), *Was wir Ernst Haeckel verdanken,* 2 vol. (1914).

HAEMATOCELE, a medical term used to designate a collection of blood in a pre-existing sac or cavity. It usually results from injury but may occur from such a condition as ectopic pregnancy.

The blood may or may not become encapsulated. It is closely related to haematoma and the two may be associated.

(F. L. A.)

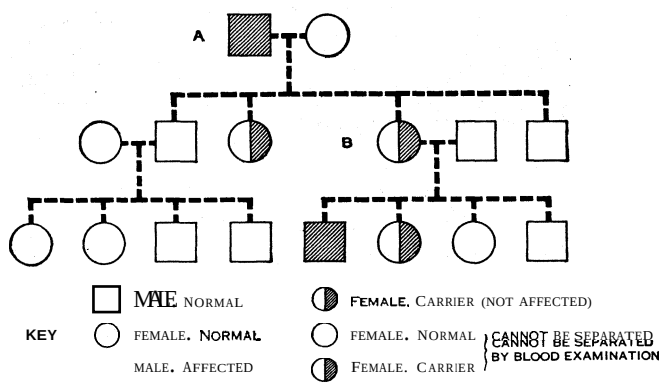
HAEMATOPODIDAE: *see* OYSTER-CATCHER.

HAEMOPHILIA. The word haemophilia means literally an affinity or liking for blood. Actually the term is used to designate a specific form of bleeding disease occurring in males and usually in certain male members of affected families; transmission taking place through female members of the same families. The disease has been known since biblical times and was noted in the Talmud by Hebraic writers, particularly in the unusual degree of bleeding which occasionally complicated ritual circumcision. Credit for the first clear delineation of the disease must be given to a U.S. physician, John C. Otto of Philadelphia, Pa., who described in 1803 . . . "an hemorrhagic disposition existing in certain families." He wrote as follows: "It is a surprising circumstance that the males only are subject to this strange affection . . . Although the females are exempt, they are still capable of transmitting it to their male children. . . ." It became popularly known as the "bleeder's" disease, or the "disease of kings," because of its common occurrence in the inbred royal families of Europe.

Only about half the cases give a well-defined history of "bleeders" in the family; there can be no doubt that there occur typical cases in which a history of familial disease is completely lacking. In the hereditary cases, the bleeders are always present in the mother's family; *i.e.,* in her brothers, her father or her uncles. Women transmit the disease through a recessive X-chromosome but are themselves free from it; careful studies have failed to demonstrate a specific abnormality. Sons of haemophiliacs are free from the disease and cannot transmit it. The actual hereditary defect which is transmitted is not completely clear. It is probable that the plasma either lacks a normal material in its globulin fraction (antihaemophilic plasma globulin) or that there is an excess of a circulating anticlotting material. The weight of the evidence now at hand is in favour of the former concept.

The fundamental abnormality of haemophilia is recognized by a great increase in the coagulation (clotting) time of the blood. Normally, if blood taken from a vein is placed in glass test tubes, it clots in from 5 to 15 min. In a haemophiliac, the clotting time is greatly increased, usually from 30 min. to several hours or even longer.

This diminished tendency of the blood to clot places the affected individual at a great disadvantage, since slight injuries such as occur during normal exertion (shovelling snow, striking at a golf ball) may result in uncontrollable bleeding. A relatively insignificant cut may lead to bleeding for days. Operations, even such simple ones as dental extractions, may be followed by uncontrollable bleeding, which in some cases is fatal. A child romping about and falling on its knees or elbows develops bleeding into the joints; this may eventublly lead to chronic swelling and finally to crippling deformities. Gross bleeding in the urine is common. The haemophiliac may be said to be constantly vulnerable, since at any moment his life may be endangered by what is to most persons a relatively insignificant situation.



TRANSMISSION OF HAEMOPHILIA: A. MATING OF AFFECTED (HAEMOPHILIC) MAN AND NORMAL WOMAN — ALL SONS NORMAL AND ALL DAUGHTERS CARRIERS. B. MATING OF CARRIER WOMAN AND NORMAL MAN — HALF OF SONS NORMAL AND HALF AFFECTED; HALF OF DAUGHTERS CARRIERS, HALF NORMAL

The increased tendency to bleed becomes noticeable very early in life. Large bruises of the skin and soft tissue are almost always present. The teeth become carious because dentists are naturally loath to carry out even ordinary procedures. Few haemophiliacs escape crippling joint disease. The diagnosis of the disease is usually readily made, especially if a history of bleeding disease

in the family is obtained. The only abnormality which is found in the blood is a well-defined increase in the coagulation time with simultaneously normal tests for platelets and other blood constituents.

The treatment of haemophilia depends upon reduction of the coagulation time, which is best performed by transfusing the patient with fresh, normal blood. A case with active bleeding may require several transfusions within a period of a week or more. Fresh normal liquid plasma or dried plasma derived from fresh blood have the same effects as whole blood. Also of some value is the material known as "antihaemophilic plasma globulin." derived from fractionation of the normal plasma. This substance is effective in very small amounts (100 to 300 mg.). When given by intravenous injection, however, it has no particular merit over the use of whole blood or fresh plasma, and indeed in some cases appears to have been responsible for the development of infectious jaundice. Attempts are continually being made to obtain a material which can be injected by the affected individual himself to reduce the clotting time, much as insulin is now injected by the diabetic patient to reduce the blood sugar. (W. DK.)

HAEMORRHAGE, a general term for the escapk of blood from a blood vessel. It may result from obvious damage to blood vessels by cutting or tearing or there may be spontaneous loss where no trauma is apparent but some disturbance of blood coagulation or blood vessel walls is at fault. Haemorrhage may be from an artery (where bright red blood is rapidly lost in a pulsating stream), from a vein (where darker blood is lost less rapidly as a steady stream) or from capillaries (where generalized oozing of blood from a raw surface takes place). Internal haemorrhage is loss of blood from vessels into a body cavity or organ and external haemorrhage is direct loss outside the body. Internal haemorrhage may be spontaneous (*e.g.*, ectopic pregnancy, bleeding peptic ulcer) or secondary to abdominal injuries (*e.g.*, ruptured spleen). Haemorrhage may occur into one of the body passageways and then later the blood may escape from a natural orifice. Thus, blood may be passed in vomitus (haematemesis), with the faeces (melaena), in the urine (haematuria), with sputum from the lungs (haemoptysis) or from the nose (epistaxis). In haematemesis and melaena the colour may be dark brown or black as a result of the action of gastric and intestinal secretions. Haemorrhage may also take place into or under the skin producing a bruise, or ecchymosis, or a petechial haemorrhage, where red pinhead-size spots are seen. A haematoma is a pocket of blood lying in the tissues. In severe fractures (*e.g.*, that of the femur) extensive blood loss may occur in the tissues without external bleeding.

The consequences of haemorrhage are varied and depend on the amount and rapidity of the blood loss. A very slow and prolonged loss may lead to a deficiency of red blood cells (anaemia) but a larger and more sudden loss may lead to profound circulatory disturbances (see SHOCK AND COLLAPSE) resulting in death unless the bleeding can be stopped and proper treatment administered. In healthy adults the loss of a pint of blood, the amount usually taken from blood donors, causes no harmful effects, but the sudden loss of a quart usually causes symptoms of mild shock. If a sizable temporary haemorrhage occurs, the body compensates for the loss by constricting vessels in some parts of the body, thus making the remaining blood available for circulation to vital organs such as the brain and heart wall. The body then makes up the deficient blood volume, first, by the addition of fluid from the tissues and later by addition of newly produced blood proteins and. finally, newly produced blood cells.

Haemorrhage may cease without treatment as a result of coagulation of blood over the open vessels, retraction and constriction of the severed blood vessels, or lowered blood pressure caused by the blood loss. Haemorrhage can usually be controlled temporarily by direct pressure on the bleeding point and elevation of the bleeding part. Haemorrhage from a large artery may necessitate use of a tourniquet which should be released momentarily every 1 j min. In surgical operations bleeding is controlled by clamping and ligating blood vessels or by the application of agents to enhance blood coagulation; *e.g.*, oxidized cellulose gauze, gelatin sponges and purified thrombin. Heat will also produce coagulation. Cold is sometimes applied to an intact part to minimize ecchymosis by constricting vessels.

There are a number of diseases in which a defect in blood coagulation may convert a trivial injury into a serious situation. The bleeding tendency in jaundice and in prothrombin deficiency resulting from other causes may be overcome by the administration of vitamin K. In haemophilia, the intravenous injection of fresh whole blood or of a specially prepared globulin fraction of human plasma will temporarily correct the defect. In thrombocytopenic purpura, removal of the spleen is of great benefit.

The essential features in the treatment of haemorrhage are control of bleeding and prompt replacement of blood loss by blood transfusions. If blood is not available immediately, the intravenous administration of plasma, albumin, gelatin or saline is helpful temporarily in restoring the circulating blood volume. In addition, a supine posture is always preferable to a sitting or erect one since the compensatory mechanisms which maintain blood volume and blood pressure are more effective in the supine position. Indeed, a partially head-down posture may be indicated to improve blood flow to the brain. (I. S. R.)

HAEMORRHOIDS, or HEMORRHOIDS, commonly called piles, swellings formed by the dilatation of veins of the lowest part of the bowel, or of those just outside the margin of its aperture. The former, internal piles, are covered by mucous membrane; the latter, external piles, are just beneath the skin. As the veins of the lining of the bowel become dilated they form definite bulgings within the bowel, and, at last increasing in size, escape through the anus when a motion is being passed. Growing still larger, they may come down spontaneously when the individual is standing or walking, and they are apt to be a grave source of pain or annoyance. Eventually they may remain constantly protruded; nevertheless, they are still internal piles because they arise from the interior of the bowel. Though a pile is sometimes solitary, there are usually several of them. They are apt to become inflamed, and the inflammation is associated with heat, pain, discharge and general uneasiness; ulceration and bleeding are also common symptoms, hence the term bleeding piles. The external pile is covered by the thin, dark-coloured skin of the anal margin. Severe pressure upon the large abdominal veins may retard the upward flow of blood to the heart and so give rise to piles; this is apt to happen in the case of disease of the liver, malignant and other tumours within the pelvis or abdomen, and pregnancy. Probably the anatomical arrangement of veins at the lower end of the rectum and habitual constipation are predisposing causes of piles. It is often said the exciting cause may be vigorous straining at stool or exposure to damp, as from sitting on the wet ground, but there is little solid evidence for the statements. Piles are often only a symptom, and in their treatment this fact should be kept in view: if the cause is removed the piles may disappear. Moreover, if they indicate the existence of cancer of the rectum the whole aspect of the case is altered. The appearance of piles or of haemorrhage assumed to be from piles for the first time in a person of middle age or over is highly suggestive of the major disease. Sometimes when a pile has been protruded, as during defaecation, it is tightly grasped by spasmodic contraction of the circular muscular fibres which guard the outlet of the bowel, and it then becomes swollen, engorged and extremely painful; the strangulation may be so severe that the blood of the vessels coagulates and the pile mortifies. This, indeed, is nature's attempt at curing a pile; but it is distressing, and, as a rule, it is not entirely successful.

The palliative treatment of piles consists in obtaining a daily and easy action of the bowels, in rest, cold bathing, astringent injections, lotions and ointments. The radical treatment consists in their removal by operation, but this should not be contemplated until palliative treatment has failed. If, for one reason or another, no operation is to be undertaken, and the piles are troublesome, relief may be afforded by warm sponging and by sitz baths, the pile being gently dried afterward by a piece of soft linen, smeared with vaseline and then carefully returned into the bowel.

Under surgical advice, cocaine or morphia may be brought in

contact with the tender parts, either in the form of lotion, suppository or ointment. If, as often happens, blood coagulates in the vein of an external pile, the small, hard, tender swelling may be treated with anodyne fomentations, or it may be rendered insensitive by the ether spray and opened by a small incision, the clot being turned out.

HAEMOSPORIDIA, an order of parasitic single-celled animals (Protozoa, *q.v.*) which live in the red blood corpuscles of vertebrates, and gradually destroy them. Prominent among the Haemosporidia are certain species of *Plasmodium,* organisms which cause the various kinds of malaria (*q.v.*).

HAFIZ (SHAMSUDDIN MOHAMMED) **(c.** 1325–1389 or 1390), the most famous lyric poet of Persia, was born at Shiraz, where he lived all his life. Never a man of substance, he lectured on Koranic and other theological subjects (his surname of Hafiz designates one who has learned the Koran by heart) and wrote commentaries on a number of religious classics. As a court poet, he enjoyed the patronage of several rulers of Shiraz and of other distinguished men, all of whom are mentioned in his poems.

Hafiz lived in troubled times; sovereigns were overthrown, Shiraz was taken by force more than once, and over the last years of his life loomed the menacing shadow of the world-conqueror Timur (Tamerlane). There are many echoes of these events in his poems; but they tell more of the "café" life of Shiraz, of the vagaries of his princely patrons and of his disputes with his orthodox and sectarian contemporaries. For the guiding influence in Hafiz's own life was Sufism, the mystical movement that demanded of its adherents complete self-abandonment to the pursuit of union with the Ultimate Reality, and the rejection of the restraints of conventional religion and morality.

Hafiz' principal medium of expression, and one that he brought to a perfection never achieved before or since, was the *ghazal,* a lyric poem of 6 to 15 couplets linked by unity of thought and symbolism rather than by a logical sequence of ideas. Traditionally the *ghazal* dealt with love and wine, motifs that, in their association with ecstasy and freedom from restraint, lent themselves naturally to the expression of Sufi ideas. Hafiz' achievement was to give these conventions a freshness and subtlety that completely relieves his poetry of tedious formalism. The western reader can appreciate this, even if he misses the hidden associations that make the imagery so potent to the sophisticated Persian audience.

It has been well pointed out that almost any poem of Hafiz can be read on at least three levels of significance — at its face value as an expression of the gay and civilized life of medieval Shiraz, as a tribute to his princely patron and, lastly and above all, in terms of Sufi mystical theology.

The extraordinary popularity of his poetry in all Persian-speaking lands, however, is to be sought rather in his simple and often colloquial language. free from artificial virtuosity, and his unaffected use of homely images and proverbial expressions. Above all, his poetry is characterized by love of humanity, sympathy for the problems of ordinary men, contempt for hypocrisy and mediocrity and an ability to universalize everyday experience and to relate it to the mystic's unending search for the reality of God. It is for these qualities that Hafiz' poems are sung even by the Persian villager. His wide appeal in the west is indicated by the fact that apart from several complete translations of his works, German and English, numerous translators (including 30 in England alone) published translations of selections of his poems.

The best edition of the Persian text of the poems is by Mohammed Qnzvini and Qasem Ghani (1941); there are English translations by H. Wilberforce Clarke, *Hafiz Shirazi. The Divan . . .* (1891), and by John Payne, *The Poems of Shemseddin Mohammed Hafiz of Shiraz* (1901). English translations of selected poems include those by Sir William Jones, with introductory notes, in *Grammar of the Persian Language* (1771); by Gertrude L. Bell, *Poems from the Divan of Hafiz,* 2nd ed. (1928); by A. J. Arberry, *Fifty Poems of Hafiz* (1947), which includes many Samples of earlier translations; and by Peter Avery and John Heath-Stubbs, *Hafiz of Shiraz. Thirty Poems* (1952).

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HAFNIUM, a metallic element (atomic number 72), which was a laboratory curiosity for many years, became an important material of construction for certain nuclear power reactors in the early 1950s. Here its particular virtues of moderate strength, excellent corrosion resistance and high neutron absorption capacity make it an excellent regulator to control the rate of burn-up of atomic fuel (see *Use and Production,* below).

Hafnium is a metal having the symbol Hf. It is a higher homologue of zirconium, its atomic number being 72 and its atomic weight 178.58. Hafnium has six stable isotopes with the mass numbers 174, 176, 177, 178, 179 and 180, the last-named isotope being the most abundant (abundance 35%). The arrangement of electrons in the outer levels (*O* and *P*) and sublevels is: $5s^2$, $5p^6$, $5d^2$, $6s^2$.

DISCOVERY AND OCCURRENCE

The element was discovered by D. Coster and G. C. de Hevesy in 1923 and was named hafnium, the Latin name of Copenhagen (earlier G. Urbain and A. Dauvillier had given the name celtium to the element of atomic number 72, for which Urbain obtained some evidence from X-ray spectra in 1911). The missing element 72 had been considered to be a member of the rare-earth group, but Niels Bohr, in putting forward his views on the electronic arrangement in the atom (*q.v.*), reached the conclusion that the number of rare-earth elements, including cerium, could not exceed 14. Cerium having the atomic number 58, the last rare-earth element must have the atomic number 71 and, correspondingly, element 72 must belong to the titanium group, IVa in the periodic system, which includes zirconium, and should have properties, resembling the latter rather than the rare earths.

This conclusion induced Coster and De Hevesy to search for the missing element in zirconium minerals. The investigation of the X-ray spectra emitted by samples of Norwegian and Greenland zircons revealed the presence of element 72.

Later investigations showed the presence of hafnium in each zirconium mineral and in every commercial zirconium preparation; in no other case is the "camouflage" phenomenon more pronounced. The lowest hafnium content is shown by the zircons in nepheline syenites with low silica content, such as the zircons of Brazil. Zirconium/hafnium ratios up to 700:1 are found there. In the products of siliceous residual crystallization, on the other hand, there is sometimes a very appreciable decrease in the above ratio.

Altered zircons like some alvites and cyrtolites, products of residual crystallization, show an atomic ratio even as low as 6:1 (the $ZrO_2 + HfO_2$ content of such minerals amounting to about 50%). The highest hafnium content (17% HfO_2) was found in cyrtolite from Rockport, Mass. Hafnium-bearing zirconium minerals are found in beach sands and river gravels along with monazite, rutile, etc. Commercial sources exist in the United States (principally Florida), Australia, Brazil, French West Africa and India. The share of hafnium in building up the earth's crust is about $\frac{1}{180,000}$. The presence of hafnium vapour in the solar atmosphere has been ascertained.

USE AND PRODUCTION

Nuclear Energy Regulator. — An atomic bomb is simply an uncontrolled reactor while a power producing reactor, in its simplest sense, is a slow burning atomic bomb. In the construction of nuclear reactors it is important that a material of low neutron absorption capacity be used as a protective material for the atomic fuels because neutrons are the "bullets" that make possible splitting of the atom. Zirconium, with a specific absorption of 0.18 barns, is almost an ideal cladding material for reactors using thermal neutrons (it must be emphasized in this application that the absorption figures are for thermal neutrons, *i.e.* the lowest speed neutrons used in nuclear energy work). Conversely, a material of high neutron absorption capacity is needed to regulate the rate of burn-up of atomic fuel.

Hafnium with a specific absorption of 105 barns makes an excellent throttle or regulator; by raising or lowering the control

rods of hafnium metal properly inserted in a nuclear pile, the neutron density which controls the atomic reaction can be exactly controlled. For such special purposes, the cost of $7j a pound for sponge hafnium can be tolerated.

Separation from Zirconium. — As noted at the Geneva conference on peaceful uses of atomic energy in 1955, the separation of hafnium from zirconium can be accomplished in five different ways: (1) fractional crystallization; (2) selective extraction; (3) ion exchange; (4) fractional precipitation; and (5) disproportionation or fractional distillation.

The first hafnium salts in the late 1920s and early 1930s were prepared by fractional crystallization. In this method the difference in solubility of, say, the phosphate or fluoride salts is used to precipitate a less soluble from a more soluble salt. The method is laborious and in general does not lend itself to modern continuous production procedures. Selective extraction, which involves the preferential solubility of hafnium or zirconium in an organic liquid, has been the preferred commercial separation method. The two best known processes are the thiocyanate-isobutyl ketone and the tributyl phosphate-nitric acid separation systems. In either case a hafnium hydroxide is obtained which is calcined to produce pure hafnium oxide.

Production. — The commercial production of hafnium metal is accomplished by the use of both the Kroll and De Boer-Van Arkel processes. The Kroll process, developed by William J. Kroll for the production of ductile titanium, consists essentially of the reduction of titanium tetrachloride by molten magnesium under an inert atmosphere of helium or argon to produce titanium metal and magnesium chloride; the resultant magnesium chloride can be melted and distilled to leave behind the pure metal. The process can be used with hafnium tetrachloride: the conversion of hafnium oxide obtained by separation, as explained above, to hafnium tetrachloride can be accomplished in two ways: (1) by heating with carbon at a temperature above 800° C. the hafnium oxide can be made into hafnium carbide which is then chlorinated in a simple vertical shaft furnace to produce hafnium tetrachloride and carbon monoxide; or (2) the hafnium oxide can be briquetted with a sugar solution and lamp black and chlorinated directly at temperatures above 700° C. to produce hafnium tetrachloride. The latter method is preferred commercially. Hafnium chloride is a white solid that sublimes at 320°–330°. Before reduction, hafnyl chloride ($HfOCl_2$) must be removed from the chloride since it contains oxygen. This is performed by heating under helium and partial vacuum at temperatures up to zoo° C. After the chloride purification, the material is transferred to another furnace in the bottom of which is a container holding the calculated amount of magnesium required to accomplish the reduction $HfCl_4 + 2M_g \rightarrow Hf + 2M_gCl_2$ plus 40% excess. After evacuating the reduction furnace and backfilling with helium, the magnesium is melted and the chloride of hafnium is heated to a temperature above 3jo° C. to force it to sublime. As it passes over the molten magnesium surface it is reduced to hafnium metal which settles to the bottom of the pot and the resultant magnesium chloride remains as an intermediate layer in the pot. At the end of the reduction stage, the material is allowed to cool and is then removed to a second furnace where the pot is placed upside down in the top of a vertical furnace and heated under vacuum to a temperature of about goo° C. The magnesium chloride melts and is collected in a suitable container in the lower portion of the furnace. Residual magnesium and magnesium chloride in the final stages are removed by so-called vacuum distillation. The resulting sponge metal is cleaned of surface contamination or residues and then further purified by the iodide purification process.

Due to its higher atomic weight hafnium does not have the same tolerance for a given amount of oxygen as does titanium and zirconium. Consequently, the Kroll process sponge hafnium, which contains 1,000 to 1,500 p.p.m. (0.01% = 100 p.p.m.) oxygen must be purified by the iodide (De Boer—Van Arkel) process to reduce this level to 200 to 500 p.p.m. to obtain ductile hafnium metal.

The purified bars of hafnium must be melted under special conditions to avoid contamination. The molten metal reacts with virtually every refractory container known to man as well as with oxygen and nitrogen of the atmosphere. The only satisfactory method is that of consumable electrode arc melting in a water-cooled copper crucible under an inert gas cover. If necessary, alloying elements can be added during the course of melting. The resulting ingot freezes at the copper wall without sticking or contamination.

Once melted. the dense metal offers less surface for oxidation and can be heated for forming purposes to temperatures of the order of 1.000° C. It is then shaped by standard metallurgical methods of forging, rolling and welding to produce control rod material for nuclear reactors. Several tons of hafnium are used each year for this purpose. (E. T. H.)

PHYSICAL AND CHEMICAL PROPERTIES

In the laboratory the reduction of K_2HfF_6 with potassium, that of hafnium tetrachloride with sodium or of zirconium oxide with calcium and sodium leads to the formation of hafnium powder. Hafnium metal, even ductile single crystals, may be prepared by reducing hafnium tetraiodide, prepared from hafnium powder and iodine, on glowing tungsten mire. Physical constants of hafnium and zirconium metals are seen in Table I.

TABLE I.—*Some Physical Constants of Hafnium and Zirconium Metals*

Properties	Hafnium	Zirconium
Density (g./ml.)	13.31	6.52
Atomic volume (ml.)	13.42	13.97
Electrical resistance at 0° C., $p \times 10^4$ (in ohm cm.)	0.30	0.41
Temperature coefficient of the resistance p X 10^2	0.44	0.44
Temperature of the maximum resistance (° K.)*	1,775	1,150
Temperature of the minimum resistance (° K.)*	1,900	1,430
Maximum resistance, $p \times 10^4$ (in ohm cm.)	1.75	1.44
Minimum resistance, $p \times 10^4$ (in ohm cm.)	1.62	1.26
Melting point (° K.)*	2,500	2,130
Work necessary to release the electrons: above the transition point (in ev)	3.53	4.13
below the transition point (in ev)	3.20	....

*Kelvin, or absolute temperature (*q.v.*), scale.

The structure of hafnium, like that of zirconium, is hexagonal, the value of a being 3.223, and $c = 5.123$, the log of vapour pressure is determined by

$$\log p = \frac{-30\,200}{T} + 9.46.$$

Hafnium is not superconductive at 1.35° K. on the absolute temperature scale; between 4.12° K. and 1.35° K. the resistance does not change and is 0.0947 of the resistance at o° C. Hafnium attains its maximum resistance (1.75 X 10^{-4} ohm) at 1,775° K., and its minimum (1.62 $\times$ 10^{-4} ohm) at 1,goo° K. The resistance (maximum and minimum) of hafnium indicates the existence of allotropic modifications which unfits this metal for use in lamps and valves.

Hafnium was first isolated by fractional crystallization of the hexafluoride, the hafnium concentrating in the mother liquor. Commercial hafnium compounds, available previous to World War II, were prepared by this method. Another method is based on the fractional precipitation of complex phosphates or fractional precipitation of the phosphates from concentrated sulfuric acid. A further method of isolation is the crystallization of the oxychloride from about 10 N hydrochloric acid. Separation of zirconium and hafnium as negative fluo-ions has been obtained by using anion exchange resins, or as perchlorate applying a cation exchanger. Hafnium in zirconium may be reduced to less than 0.1% by passing a solution of the chlorides in methanol through a silica gel column.

The ions of hafnium are tetravalent; in many compounds the hafnyl (HfO^{++}) ion is present. Prolonged ignition of sulfate and oxychloride leads to the formation of a monoclinic modification of the oxide, while by heating the hydroxide to about 400° C. a tetragonal modification (mol. vol. = 20.10, density = 6.13,

melting point = 2,812° C.) is obtained the production of which is accompanied by the emission of light. When ignited above 1,000° C., a third modification of the oxide can be obtained, this time in the cubic system. The molecular volumes of zirconium oxide and hafnium oxide of tetragonal type are identical within 0.5% and the molecular volumes of the monoclinic modifications of the two oxides differ by less than 0.8%. These data illustrate the very close resemblance between the hafnium and the zirconium.

Atoms of different nuclear charges show practically the same behaviour provided the quantum numbers of the valency electrons differ sufficiently to compensate exactly the effect of the difference in the nuclear charge. Hafnium and zirconium are examples of such atoms, the compensation of the effect of the difference in the nuclear charge being due to the appearance of the 14 rare-earth elements. Without the existence of these elements, the hafnium ion would show the properties of the ceric ion, which is the pseudo homologue of the zirconium ion.

The diamagnetic susceptibility of the oxide is 0.110×10^{-6}. Hafnium peroxide, which has the formula $Hf(OOH)(OH)_3$, is scarcely soluble in ice-cold alkaline hydrogen peroxide. The ratio of oxide: active oxygen: water is 1:1:2. The melting point of hafnium carbide (HfC) is 4,160° K.; the specific resistance of HfC ($w_{18°} \times 10^{-4}$) is 1.09. The mixture of four molecules of tantalum carbide and one molecule of hafnium carbide was found to melt at 4,215° K. No higher melting point is known for any substance. The melting point of hafnium boride was found to be 3,335° K.

Hafnium nitride has been prepared from a mixture of hafnium tetrachloride, nitrogen and hydrogen. When a glowing filament was introduced into this mixture hafnium nitride formed in the vicinity of the filament and was deposited thereon. The bromide was prepared in a similar manner, substituting boron tribromide for the mixture of nitrogen and hydrogen. The crystal structure of

TABLE II.—*Solubility of Hafnium and Zirconium Fluorides at 20° C.*

Compound	Solvent	Solubility (mol. per litre)
$(NH_4)_2ZrF_6$	Water	1.050
$(NH_4)_2HfF_6$	Water	1.42
$(NH_4)_3ZrF_7$	Water	0.551
$(NH_4)_3HfF_7$	Water	0.558

hexafluoride is similar to that of K_2PtCl_6; that of the heptasalts, such as $(NH_4)_3HfF_7$, is regular; its molecular volume is 125.7. The solubility of the hafnium and zirconium fluorides is seen in Table II.

The refractive indexes of the corresponding zirconium and hafnium salts show only slight differences, as may be seen from Table III.

Hafnium tetrachloride is prepared through the action of chlorine on a mixture of hafnium oxide and charcoal. Above 200° C. tetrachloride sublimes. The tetrachloride hydrolyses immedi-

TABLE III.—*Refractive Indexes of Hafnium and Zirconium Fluorides*

		n	Δn
(1)	K_2ZrF_6 monoclinic twins n (max.)—1.466; n (min.)—1.455 K_2HfF_6 monoclinic twins n (max.)—1.461; n (min.)—1.449		
(2)	K_3ZrF_7 regular octahedron	1.408	0.005
	K_3HfF_7 regular octahedron	1.403	
(3)	$(NH_4)_3ZrF_7$ regular octahedron	1.433	0.007
	$(NH_4)_3HfF_7$ regular octahedron	1.426	

ately when coming in contact with water, leading to the formation of the fairly stable $HfO(4H_2O)^{++}$. Hafnium oxychloride crystallizes in tetragonal needlelike crystals. The refractive index of the needlelike crystals of $HfOCl_2.8H_2O$ is $n(\omega) = 1.557$; $n(\epsilon) = 1.543$. With increasing hydrochloric acid concentration the solubility of the oxychloride first decreases and then increases after a concentration of eight mols per litre is reached. Hafnium tetrachloride prepared through the action of bromine vapour on a mixture of hafnium oxide and sugar charcoal was used in the determination of the atomic weight of hafnium. The solubility of hafnium oxybromide decreases with increasing hydrobromic acid concentration. The heat of decomposition of hafnium sulfate is 110 cal. per mol. Hafnium phosphate $HfO(H_2PO_4)_2$ is the phosphate of lowest solubility known. Solubility figures are given in Table IV.

TABLE IV.—*Solubilities of Zirconium and Hafnium Phosphates*

Concentration of HCl (N)	Weight of residue ignited per 100 cu.cm of solution (gram)	$M^{IV}O(H_2PO_4)_2$ per litre of solution (mol)
	Zirconium phosphate	
10.00	0.0061	0.00023
6.01	.0033	.00012
	Hafnium phosphate	
10.48	0.0046	0.00013
10.21	.0043	.00012
5.94	.0031	.00009

Hafnium acetylacetonate $[Hf(C_6H_7O_2)_4.10H_2O]$ crystallizes in strongly birefringent monoclinic crystals. The density of the compound is 1.670; its melting point, 194° C. In a vacuum of 0.001 mm. a slight sublimation is observed at 82° C. One litre of ethylene bromide dissolves at 25° C., 0.620 mol of the salt. Hafnium can best be estimated and determined by X-ray spectroscopy. Optical spectroscopy is also applied in the estimation of hafnium in the arc spectrum; the strongest persistent Hf I line has the wave length of 4093.17 Å (Å = angstrom = 10^{-8} cm.); and the strongest Hf II line, 3399.80 Å (4093.17 Å is the *raye ultime* of neutral hafnium; and 2773.37 Å, for ionized atoms). The determination of the density of the zirconium oxide-hafnium oxide mixture is a suitable method to determine the hafnium content of zirconium. Denoting the density of the mixed crystal by d, the atomic ratio is

$$\frac{HfO_2}{ZrO_2} = \frac{d - 5.73}{9.74 - d}$$

A pure or very concentrated hafnium preparation shows a slightly different behaviour toward rufigallic acid, the colouring being more quickly obtained in the presence of hafnium. The absence of the formation of $Hf_2O_6SO_4.8H_2O$ when hydrogen peroxide is added to an acid hafnium solution, in contrast with the formation of a corresponding zirconium compound, can also be used to distinguish between a pure or concentrated hafnium and a zirconium preparation.

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(G. C. DE H.)

HAFSTEIN, HANNES THORDUR (1861–1922), Icelandic statesman and poet, was born on Dec. 4, 1861. As a young man he became known as a lyrical poet. In 1901 he was elected a member of the althing, and soon became a leader of the Home Rule party. It was chiefly because of his influence that Denmark consented, in 1903, to the transfer of the residency of the minister for Iceland from Copenhagen to Reykjavik. On Jan. 31, 1904, Hafstein was appointed to this office and inaugurated a new era of practical reform. His first work was to arrange a telegraphic cable to Great Britain and a net of telegraphs and telephones all over the island. His efforts, however, were hampered by the extremists, who demanded greater political independence from Denmark. Their obduracy led to his resignation in 1908. On the victory of the Home Rulers in 1911, Hafstein again became minister in 1912, but had to resign in 1914 after new and fruitless effortsto effect reconciliation. He lived, however, to see the full reconciliation between the two countries in 1918, and the recognition of Iceland as an independent state in union with Denmark. He died on Dec. 13, 1922.

HAFTARAH (pl. haftaroth), in synagogue services, selected readings from the Prophets, following the readings from the Pentateuch. The word means literally "conclusion," signifying the end

of the scriptural lesson. The custom of adding a chapter from the Prophets to the pentateuchal reading long antedated the destruction of the Temple. It derived additional significance from the fact that it implied the sanctity of the prophetic books of the Old Testament, in opposition to the Samaritans who accepted only the five books of Moses. In the New Testament, the custom of preaching on the Haftarah is mentioned. (Acts xiii, 15. Luke iv. 17.)

In the modern synagogue, boys are usually trained to chant the haftarah on the Sabbath of their *Bar Mizvah.* (J. B. A.)

HAGEDORN, FRIEDRICH VON (1708–1754). German poet whose fables, love songs and anacreontics introduced a new lightness and grace into his country's poetry. was born on April 23, 1708, at Hamburg, where his father was Danish ambassador. In 1729 he became unpaid private secretary to the Danish ambassador in London. He returned to Hamburg in 1731, and in 1733 was appointed secretary to the *Englischer Hof,* an English trading company established there in the 13th century. He died at Hamburg, Oct. 28, 1754.

His first collection of verse appeared in 1729: most of the best of it—fables and tales in verse which stand comparison with those of his master La Fontaine both in neatness of form and lightness of touch, and love lyrics echoing Horace—appeared in *Versuch in poetischen Fabeln und Erzählungen* (1738) and *Oden und Lieder,* 3 vol. (1742–52). Hagedorn's works were edited by J. J. Eschenburg, 5 vol. (1800).

See H. Stierlung, *Leben und Bildnis Friedrichs von Hagedorn* (1911); *K.* Epting, *Der Stil in den lyrischen und didaktiscken Gedichten Hagedorns* (1929).

HAGEN, JOHANNES GEORG (1847–1930), Austrian Jesuit priest and astronomer known especially for his work on variahle stars. was born at Bregenz, on March 6, 1847. Educated at Feldkirch in Austria and at Münster and Bonn in Germany, he did some of his theological studies in England. He became director of Georgetown observatory, Washington, D.C.. in 1888. In 1906 Pope Pius X appointed him director of the Vatican observatory. Hagen died in Rome on Sept. 6, 1930, while still engaged in research.

His many publications include: *Atlas Stellarum Variabilium* Ser. i–vii (1890–1908); *Astrographic Catalogue* of *the Vatican Zone,* 10 vol. (1914–28). (D. J. K. O.)

HAGEN, a town of Germany, in the *Land* of North Rhine-Westphalia. Pop. (1959 est.) 191,635. It lies at the confluence of the Ennepe with the Volme, 15 mi. N.E. of Elberfeld. Hagen has extensive iron and steel works, large cotton print works, manufactures of leather, paper, tobacco. and iron and steel wares, sugar, breweries and distilleries. There are large limestone quarries in the vicinity and also an alabaster quarry.

HAGERSTOWN, a city of Maryland, U.S., and seat of Washington county, 70 mi. W.N.W. of Baltimore, is a commercial centre for the rich Cumberland valley between the Blue Ridge and Allegheny mountains.

Wide diversification of manufacturing includes pipe organs, aircraft, blast-cleaning and dust-collecting equipment, refrigerator doors, furniture, shoes and textiles.

Scotch-Irish and Germans moved into the valley from Pennsylvania in the 1730s. In 1762 Jonathan Hager, a German. laid out the town around his stone farmhouse which is still standing near the centre of the city. He named it Elizabeth Town after his wife, but neighbours soon called the place Hagerstown, under which name it was incorporated in 1814. Ft. Frederick (1756) in the state park of the same name is nearby, and is said to be the only fort of the French and Indian War remaining with its original walls. In the 1820s the town became a major stopping point on the Cumberland road to the west, and subsequently it became a railroad centre. It changed hands several times during the American Civil War, and within 30 mi. are a number of battlefields including Harpers Ferry and Gettysburg. About 5,000 Confederate soldiers are buried in the city.

Artisan labour, neat farmland and distinctive architecture give the area a typically German mellowness. Symbol for the city is "Little Heiskell," a tin soldier weathervane which has stood on successive town halls since 1769. The city has a fine library and an outstanding art museum. For comparative population figures *set* table in MARYLAND: *Population.* (G. H. CT.)

HAGFISH, a blind, eel-shaped. parasitic marine fish less than two feet long, that feeds on other living fish by boring its way into the flesh and devouring almost everything but skin and bones Along with its close relative the slime eel *(see* MYXINE) the hagfish constitutes one subclass of the primitive class Cyclostomata *(see* CYCLOSTOME). Several species infest the coastal waters of western North America, Japan, Chile, New Zealand and South Africa. They cause considerable damage by feeding on fish caught in nets and on set lines. When held in a container they excrete an unbelievably large quantity of mucus. (C. L. Hs.)

HAGGADAH ("narrative"), with Halakhah ("conduct"), two varieties of Midrash or scriptural exegesis. The former constitutes the poetical element and the latter the legal, though the two often are closely connected.

See MIDRASH.

HAGGAI, the tenth in order of the "minor prophets," whose writings are preserved in the Old Testament. The book contains four short prophecies delivered between September and December of the second year of Darius; that is, Darius Hystaspis (521–485 B.C.). The language of the prophet in ii. 3 has suggested that he was so old as to have seen the Temple of Solomon which had been destroyed in 586 B.C. This would agree with the shortness of the period covered by his book, and with the fact that his contemporary Zechariah, who began to prophesy in the same autumn, afterwards appears as the leading prophet in Jerusalem (Zech. vii. 1–4).

In his first prophecy (i. 1–11) Haggai addresses Zerubbabel and Joshua, rebuking the people for leaving the temple unbuilt. The prevalent famine and distress are due to Yahweh's indignation: let them build the house and Yahweh will take pleasure in it and acknowledge the honour paid to Him. The people thereupon began to work at the temple, strengthened by the prophet's assurance that the Lord was with them (i. 12–15). In a second prophecy (ii. 1–9) delivered in the following month, Haggai forbids the people to be disheartened by the apparent meanness of the new temple. The silver and gold are the Lord's. He will soon shake all nations and their choicest gifts will be brought to adorn His house. Its glory shall be greater than that of the former temple, and in this place He will give peace. A third prophecy (ii. 10–19) contains a promise, enforced by a figure drawn from the priestly ritual, that God will remove famine and bless the land from the day of the foundation of the temple onwards. Finally. in ii. 20–23, Zerubbabel is assured of God's special love and protection in the impending catastrophe of kingdoms and nations to which the prophet had formerly pointed as preceding the glorification of God's house on Zion.

The characteristic features of the book are three. (1) The importance assigned to the personality of Zerubbabel, who, though a living contemporary, is marked out as the Messiah. The hopes fixed on Zerubbabel, the chosen of the Lord, dear to Him as His signet ring (*cf.* Jer. xxii. 24), indicate the importance of the house of David. But in the book of Zechariah Zerubbabel is falling into the background, and the kingship is yielding to the priesthood. After the foundation of the temple Zerubbabel disappears from history and lives only in legend, which continued to busy itself with his story, as we see from the apocryphal book of Esdras. (2) An almost sacramental significance is attached to the temple. Haggai argues that material prosperity was conditioned by zeal in worship: the prevalent suffering was an indication of divine anger. While the temple lay waste, the people and all their works and offerings were unclean (ii. 14). In this Haggai stands in contrast to those prophet5 who warn their hearers against attaching intrinsic importance to the temple (*e.g.,* Isa. lxvi 1). and he betrays his affinity with Ezekiel, who taught that it was by the possession of the sanctuary and priesthood that Israel was sanctified (Ezek. xxxvii. 28). Finally (3) what is the cause of the indifference of the Jews to the desolate condition of their sanctuary? Neither Haggai nor his contemporary Zechariah mentions or implies any return of exiles from Babylon. and the view is accordingly held that the return under Cyrus described

in Ezra i.–iv. is unhistorical, and that the community addressed by Haggai consisted, in the main, of the Judaeans that had been left in Jerusalem and its neighbourhood after the majority had gone into exile or fled to Egypt (Jer. xliii.).

From the prophecies of Haggai and Zechariah it would never be supposed that about 50,000 Jews had returned when Cyrus became king of Babylon and showed high favour to the exiles (Ezra i.). Even if their enthusiasm had melted away under the stress of bad seasons. the enmity of jealous neighbours, and other troubles, the contrast which Zechariah draws between Yahweh's past wrath and his imminent intervention on behalf of his people, points to the approach of new conditions. And in fact the Jews everywhere were not likely to have been unmoved by the revolts which broke out in the Persian empire at the accession of Darius. Haggai accordingly sees a shaking of the nations which seemed destined to spread; and with the characteristic tendency of Hebrew prophecy to estimate history only in its bearing upon the destiny of Yahweh's people, he looks for an age when Yahweh's enemies would be overthrown, there would be peace, Yahweh's temple would be enriched by willing nations, and Zerubbabel would occupy the highest place of honour. *See* JEWS: *Exile and Restoration: Restoration of Judah.*

BIBLIOGRAPHY.—Haggai is usually treated along with Zechariah or with the rest of the minor prophets: *see* the bibliographies to these.

(W. R. S.; S. A. C.)

HAGGARD, SIR HENRY RIDER (1856–1925), English novelist, was born at Bradenham Hall, Norfolk. At the time of the first annexation of the Transvaal (1877), he was on the staff of the special commissioner, Sir Theophilus Shepstone, and then became a master of the High Court there. After the cession of the Transvaal to the Dutch he returned to England and read for the bar. He gained a great popular success with the novels *Dawn* (1884); *The Witch's Head* (1885), which contains an account of the British defeat at Isandhlwana; *King Solomon's Mines* (1886), suggested by the Zimbabwe ruins; and *She* (1887), another fantastic African story. The scene of *Jess* (1887) and of *Allan Quatermain* (1888) was also laid in Africa. A long list of other stories followed. Haggard showed great interest in rural and agricultural questions, being a practical gardener and farmer on his estate in Norfolk. He dealt with land questions in *Rural England* (2 vols., 1902); the report of an inquiry into colonial land settlement, in *The Poor and the Land* (1905), with suggestions for a scheme of national land settlement in Great Britain itself; and in *Rural Denmark and its Lessons* (1911). Haggard was knighted in 1912. He died in London on May 14, 1925.

HAGGIS. A dish consisting of a calf's, sheep's or other animal's heart, liver and lungs, and also sometimes of the smaller intestines, boiled in the stomach of the animal with seasoning of pepper, salt, onions, etc., chopped fine with suet and oatmeal. It is considered peculiarly a Scottish dish, but was common in England till the 18th century. The derivation of the word is obscure.

HAGIOLOGY, that branch of the historical sciences which is concerned with the lives of the saints (Gr. aytos, saint, Xbyos, discourse). If hagiology be considered merely in the sense in which the term has come to be understood in the later stages of its development, *i.e.*, the critical study of hagiographic remains, there would be no such science before the 17th century. But the bases of hagiology may fairly be said to have been laid at the time when hagiographic documents, hitherto dispersed, were first brought together into collections. The oldest collection of this kind, the *συναγωγὴ τῶν ἀρχαίων μαρτυρίων* of Eusebius, to which the author refers in several passages in his writings (*Hist. Eccl.*, v. proem 2; v. 20. 5), and which has left more than one trace in Christian literature. is unfortunately lost in its entirety. The *Martyrs of Palestine*, as also the writings of Theodoret, Palladius and others, on the origins of the monastic life, and, similarly, the *Dialogues* of St. Gregory (Pope Gregory I.), belong to the category of sources rather than to that of hagiologic collections. The In *gloria martyrum* and *In gloria confessorum* of Gregory of Tours are valuable for the sources used in their compilation. The most important collections are those which comprise the Acts of the Martyrs and the lives of saints, arranged in the order of the calendar. In the Greek Church these are called menologies (from Gr. *μήν*, month, Xbyos, discourse), and their existence can be traced back with certainty to the 9th century (Theodore of Studium, *Epist.* i. 2). One of them, the menology of Metaphrastes, compiled in the second half of the 10th century, enjoyed a universal vogue (*see* SYMEON METAPHRASTES). The corresponding works in the Western Church are the *passionaries* or *legendaries*, varieties of which are dispersed in libraries and have not been studied collectively. They generally draw from a common source, the Roman legendary, and the lives of the local saints, *i.e.*, those specially honoured in a church, a province or a country.

Development in 16th Century.—Hagiology entered on a new development with the publication of the *Sanctorum priscorum patrum vitae* (Venice and Rome, 1551–1560) of Aloysius Lipomanus (Lippomano), bishop of Verona. As a result of the cooperation of humanist scholars a great number of Greek hagiographic texts became for the first time accessible to the West in a Latin translation. The Carthusian, Laurentius Surius, carried on the work of Lippomano, completed it, and arranged the materials strictly in the order of the calendar (*De probatis sanctorum historiis*, Cologne, 1570–1575). What prevents the work of Surius from being regarded as an improvement upon Lippomano's is that Surius thought it necessary to retouch the style of those documents which appeared to him badly written, without troubling himself about the consequent loss of their documentary value.

The actual founder of hagiologic criticism was the Flemish Jesuit, Heribert Rosweyde (d. 1629), who, besides his important works on the martyrologies (*see* MARTYROLOGY), published the celebrated collection of the *Vitae patrum* (Antwerp, 1615), *a* veritable masterpiece for the time at which it appeared. It was he, too, who conceived the plan of a great collection of lives of saints, compiled from the manuscripts and augmented with notes, from which resulted the collection of the *Acta sanctorum* (*see* BOLLANDISTS). This last enterprise gave rise to others of a similar character but less extensive in scope.

Present Status.—To realize the present state of hagiology, the *Bibliotheca hagiographica*, both Latin and Greek, published by the Bollandists, and the *Bulletin hagiographique*, which appears in each number of the *Analecta Bollandiana* (*see* BOLLANDISTS), must be consulted. Thanks to the combined efforts of a great number of scholars, the classification of the hagiographic texts has in recent years made notable progress. The criticism of the sources, the study of literary styles, and the knowledge of local history now render it easier to discriminate in this literature between what is really historical and what is merely the invention of the genius of the people or of the imagination of pious writers (*see* H. Delehaye, *Les Légendes hagiographiques*, 2nd ed, pp. 121–141, Brussels, 1906 and art. "Hagiography" in the *Catholic Encyclopaedia*). "Though the lives of saints," says a recent historian. "are filled with miracles and incredible stories, they form a rich mine of information concerning the life and customs of the people. Some of them are 'memorials of the best men of the time written by the best scholars of the time.'" (C. Gross, *The Sources of Literature of English History*, p. 34, 1900.)

HAGIOSCOPE, in architecture, any opening, usually oblique, through the side or front malls of a church chancel to enable the congregation in transepts, chapels or other portions of the church, from which the altar would not otherwise be visible, to witness the elevation of the host during mass. Similar openings are sometimes furnished to allow an attendant to ring the sanctus bell at the proper time. or to permit someone in a vestry vision of the service so that he can notify the bell ringer. Hagioscopes or squints are more common in England than on the continent of Europe.

HAGUE, THE (Dutch, 's-GRAVENHAGE or DEN HAAG; Fr., LA HAYE), the seat of the government of the Netherlands and capital of the province of South Holland, lies on a plain about 2 mi. from the North sea. Pop. (1957 est.) 605,751 including Scheveningen, Loosduinen and Kijkduin. Area 25.1 sq.mi.

The city grew up around the castle. built by Count William II in 1248, which was the first of a group of buildings called the

Binnenhof ("inner court"). Of the great halls around this courtyard, the Knight's hall (c. 1280) is now the throne room. and the northwestern and southeastern sides of the square are occupied by the states-general and contain the Armistice or Truce hall. designed by Daniel Marot in 169;. The states-general sat in The Hague from the establishment of the republic until the revolution in 1795. and again from 1815 until 1830, during which time they sat alternately in Brussels and The Hague. The Binnenhof is surrounded by 15th to 18th-century buildings, and remnants of post 14th-century architecture are still to be found in the spacious layout of the Buitenhof ("outer court"). Plaats. Lange Vijverberg, Kneuterdijk and Lange Voorhout. In the 13th and 14th centuries a commercial district grew up around the central buildings, still to be seen in the shopping streets. such as Veenestraat, Spuistraat. Gravenstraat and Hoogstraat. At the beginning of the 17th century wide avenues and canals. lined by imposing aristocratic mansions. were constructed on the eastern side of this district (Tournooiveld. Korte Vijverberg, Korte Voorhout, Herengracht and Plein); to the southeast there grew up the Spui (craftsmen's district) and small inner harbours; and to the west the Prinsegracht (wealthy middle class) which was connected to the Westland by the Loosduinse canal. Under Prince Maurits, a belt of canals was constructed from 1613 to 1619 as a fortification for the town. Within this belt there was ample space for town development until long after the period of French domination.

In the first half of the 20th century a town grew up, characterized by broad avenues, parks and public gardens, in the surroundings of Nieuwe Parklaan, Laan van Meerdervoort, Weimarstraat, Bezuidenhoutseweg and Laan van N.O. Indië. In the north the Benoordenhout quarter was built, and near Wassenaar the fine residential park district of Marlot. In the southwest the Zuiderpark districts were laid out, containing many blocks of flats. Along the dunes in the west and near the Laan van Meerdervoort and Loosduinseweg small villas were built. and the Bomen and Bloemen district and the Fruit quarter (for middle-class people) were laid out. Between 1930 and 1940 radical improvements took place in Scheveningen. Old slums disappeared and were replaced by the new fishermen's district of Duindorp.

Surrounded as The Hague is by the North sea, the water works in the dunes, the adjoining municipalities and the nurseries of the horticultural area, called the Westland, the city had extended almost to its limits after World War II. The only possibility of expansion was toward the southeast, in the polders. Three feet under sea level, there arose a new town quarter for more than 100,000 inhabitants.

The Buitenhof is one of the centres of the town's activities, and contains several hotels and restaurants. The original entrance to it was the Gevangenpoort ("prisoners' gate"). which was built about 1400 and consists of a tower and a gate; it is a museum. Just north of the Binnenhof lies the Hofvijver, a big rectangular sheet of water, with a small island in the centre. Close by is the Church of the Old Catholics (1722) with a beautiful Baroque interior. The former royal palace in the Noordeinde was first built in the 16th century. The present building dates from 1640 and was designed by Pieter Post and Jacob van Campen. Northeast of the Binnenhof is the Mauritshuis (1633–44) originally built for Prince Johan Maurits van Nassau, governor of Brazil, and now the great Royal Museum of Painting of The Hague. Other artistic collections are contained in the municipal museum, housing modern paintings, musical instruments. etc.; the Mesdag museum, with European paintings of the 19th century; the Bredius museum (1645), with old pictures of the Dutch school; and many others. The royal library, designed by Marot in 1798, contains a collection of 800,000 volumes. The Renaissance town hall of 1564 stands southwest of the Buitenhof. It was enlarged in 1733 and again during the 19th century, but-as it eventually proved too small, a new one was completed in 1953. Near the old town hall stands the Great Church of St. James (11th and 16th centuries). which has a hexagonal tower and a richly decorated late Gothic choir: the new spire, designed as a copy of an old one and completed in 1957, has the largest carillon in the Setherlands (51 bells). The Royal theatre, in the Korte Voorhout, with its elegant façade by Peter de Swart, was originally the Nassau-Weilburg palace. The Nieuwe Kerk ("new church"), built between 1649 and 1656, contains the tombs of the De Witt brothers, who were murdered in the city in 1672, and of the philosopher Spinoza. The Peace palace (1907–13) is the seat of the International Court of Justice and of the Permanent Court of Arbitration. The more striking modern buildings include the Shell building (1941) and the K.L.M. building (1949). Beyond an extensive wooded area. the Haagse Bos, to the east of the Binnenhof. is the restored royal palace Huis ten Bosch built in 1645 by P. Post and containing a beautiful hall with a domed roof designed by Van Campen.

A considerable part of The Hague is composed of woods, public gardens, parks and recreation grounds, chief among which are Westduin park (617 ac.), Zuiderpark (210 ac.), Scheveningen woods (210 ac.) and Westbroek park (25 ac.) with an exhibition garden. There is a variety of educational institutions including the International school. the American school. the Royal Conservatory of Music, the Academy of International Law and the Institute of Social Studies in the former royal palace in the Noordeinde.

The city has rail connections with Amsterdam. Utrecht. Rotterdam and Paris, and there are also waterway communications with various parts of the Netherlands. The airfield is at Schiphol near Amsterdam., The main industries are metallurgy (electrical appliances, hardware, stoves, coachwork). building. and the manufacture of foodstuffs. clothing, luxury articles, chemicals, pottery and glass, and printing. The Hague is the headquarters of a large number of international firms. including more than 30 oil companies, and is a centre for international conferences.

Scheveningen, which is the Netherlands' principal herring harbour, is also an important seaside resort. At Loosduinen there are extensive horticultural grounds from which early fruit and vegetables are exported by air.

See Municipal Publications, *Enige grondslagen van de Stedebouwkundige ontwikkling van 's-Gravenhage* (1948), *The Hague, City in Expansion* (1957). (*D. P. M.*)

HAGUE CONFERENCES, the two international conferences held at The Hague in the Netherlands in 1899 and 1907, known also as the Hague Peace conferences. The first was called at the instance of Tsar Nicholas II of Russia, by a note of the Russian minister of foreign affairs; Count Mikhail N. Muraviev, under date of Jan. 11. 1899. addressed to the diplomatic representatives at St. Petersburg, in which the purpose of the conference was stated to be that of "a real and lasting peace and, above all, of limiting the progressive development of existing armaments." followed by details with respect to the regulation of specific instruments of warfare. Twenty-six states were represented at the conference. which sat from May 18 to July 29, 1899. Only two American states, the United States and Mexico, took part.

The conference failed to attain its chief objective of the limitation of armaments: the larger powers, particularly Germany. opposing any specific measures. Instead, two conventions dealing with the regulation of war were adopted, one concerning the laws and customs of war on land and a second adapting the principles of the Geneva convention of 1864 to maritime war (see GENEVA CONVENTIONS). Three declarations were adopted, one prohibiting the discharge of projectiles from balloons. a second prohibiting the use of asphyxiating gases and a third prohibiting the use of expanding bullets. More important, however, was the Convention for the Pacific Settlement of International Disputes creating the Hague Permanent Court of Arbitration, a list of judges from which the parties in controversy might select the members of an arbitral tribunal for their particular case. (See ARBITRATION, INTERNATIONAL.)

The conference of 1907, likewise called by the tsar after Pres. Theodore Roosevelt had first taken the initiative. was attended by representatives of 44 states and sat from June 15 to Oct. 18. Again the proposal of a limitation of armaments failed of acceptance. But two constructive steps were taken—the revision of the Convention for the Pacific Settlement of International Dis-

putes and a new Convention Respecting the Limitation of the Employment of Force for the Recovery of Contract Debts. Eleven additional conventions were signed, two of them revising and renewing the conventions on the laws of war on land and the adaptation of the principles of the Geneva convention to maritime war; and nine others dealing respectively with the commencement of hostilities (calling for a declaration of war). the rights and duties of neutral powers and persons in war on land, the status of enemy merchant ships at the outbreak of hostilities, the conversion of merchant ships into warships, the laying of automatic submarine contact mines, bombardment by naval forces in time of war, restrictions on the exercise of the right of capture in maritime war, the establishment of an international prize court and the rights and duties of neutral powers in maritime war. *(See* also CONTRABAND.) The conference renewed the declaration of 1899 prohibiting the discharge of projectiles and explosives from balloons; but the declarations of 1899 with respect to asphyxiating gases and expanding bullets were not renewed. the United States having opposed both declarations and Great Britain having signed them only on the eve of the conference.

The final act of the conference proclaimed the unanimity of the delegates in admitting the principle of compulsory arbitration and expressed a number of *voeux* (resolutions), the first of which declared the advisability of adopting the draft Convention for the Creation of a Judicial Arbitration Court and the last recommending the assembly of a third peace conference within another period corresponding to that between the first and second conferences. The other *voeux* dealt with topics that had not been included in the conventions. namely, relations between the inhabitants of the belligerent states and neutral countries. the position of foreigners in respect to military service and the future codification of the laws and customs of naval war.

The conference planned for 1915 failed to meet because of the outbreak of war in 1914, no provision having been made to meet emergencies. At the close of the war the more highly organized League of Nations replaced the Hague conference system. In the light of history the Hague conferences failed because they accepted war as inevitable and merely sought to reguiate it as a legal procedure. *See* also WAR; AGGRESSION; INTERNATIONAL LAW, PUBLIC. (C. G. FK.)

HAHN, AUGUST (1792–1863), German minister, was born on March 27. 1792, near Eisleben, and studied at Leipzig. In 1819 he was nominated professor extraordinarius of theology and pastor of Xltstadt in Konigsberg, and in 1820 received a superintendency in that city. In 1822 he became professor ordinarius and in 1826 moved as professor of theology to Leipzig. There he published two treatises, *De rationalismi qui dicitur vera indole et qua cum naturalismo contineatzir ratione* (1827) and also *Offene Erklärung an die Evangelische Kirche zunächst in Sachsen und Preussen* (1827). in which he sought to convince the rationalists that it was their duty voluntariiy and at once to withdraw from the national church. In 1833 Friedrich Wilhelm III summoned him to Breslau as theological professor and consistorial councilor, and in 1843 he became general superintendent of the province of Silesia. where he reintroduced the Augsburg Confession. He died at Breslau on May 13, 1863. His *Lehrbuch des christlichen Glaubens* (1828, 2nd [amended] ed. 1857) explains his position. Among his other works the most important is *Bibliothek der Symbole und Glaubensregeln* (1842; 3rd ed. 1897).

HAHN, OTTO (1879–), German chemist, who received the Nobel prize in 1944 for splitting the uranium atom, was born March 8, 1879, in Frankfurt am Main, and studied at the universities of Marburg and Munich, receiving his doctorate at the former in 1901. For many years Hahn was the outstanding radiochemist in Germany. His early interest in this field brought him to Sir William Ramsay's laboratory in London in 1904–05, and in the following year to Lord Ernest Rutherford's institute in Montreal, Que. Upon his return to Germany he worked first at the chemistry laboratory of the University of Berlin, headed at that time by Emil Fischer, and from 1912 on as member and later (1928–44) as director of the Kaiser Wilhelm Institute for Chemistry in Berlin-Dahlem. Hahn's co-operation with Lise Meitner, the physics partner of this group, started in 1907 in Fischer's institute and lasted until 1938 when the Hitler regime forced her to leave the country. The high lights of Hahn's scientific career were the detection of radiothorium. mesothorium, protactinium with Lise Meitner (1917) and finally uranium and thorium fission with Fritz Strassmann (1938). The latter discovery *(see* ATOMIC ENERGY) is the basis for all methods to tap atomic energy, including the development of the atomic bomb. Hahn had a foreboding that his discovery could be used for military purposes but, as his publications indicate, fervently hoped this would prove impossible. After World War II he became president of the Max Planck Gesellschaft in Gottingen, which took over the functions of the Kaiser Wilhelm institute in west Germany.

In April 1957 he joined with 17 other west German nuclear physicists in stating that they would refuse to co-operate in any way in the development of atomic weapons, and in the same month supported Albert Schweitzer in urging that world opinion demand the ending of atomic bomb tests.

Hahn's writings include: *Applied Radiochemistry* (1936); *Kiinstliche Atomumwandlungen und die Spaltung schwerer Kerne* (1944); *Die Kettenreaktion des Urans und ihre Bedeutung* (1948); *Die Nutzbarmachung der Energie der Atomkerne* (1950); *New Atoms* (1950); *Cobalt 60* (1955). (Js. F.; X.)

HAHN, REYNALDO (1875–1947), French composer of light operas and songs in the tradition of Offenbach and Messager. Born at Caracas, Venez., Aug. 9, 1875, he went to Paris when a child and studied at the Conservatoire under Massenet. In 1898 his *L'Île du rêve* was given at the Opéra Comique, and from then until 1939 he produced many light operas, the best of which is *Ciboulette* (1923), ballets (notably *La Fête chez Thérèse*, 1910) and *Le Dieu bleu* (1912), and incidental music for plays by Edmond Rostand. Sacha Guitry and others. His songs include the *Chansons grises* and the *Chansons latines* and the well-known "Si mes vers avaient des ailes." He was also known as a conductor of the operas of Mozart and gave *Don Giovanni* at Salzburg. His piano suite, *Portraits de peintres,* was inspired by early poems of Marcel Proust who portrayed Hahn in his novel *Jean Santeuil.* He was music critic of *Le Figaro* from 1934 and was appointed director of the Paris Opéra in 1945. His work is melodious, usually slender, but gracefully written. With André Messager he was responsible during his day for the main developments in the French operetta which had been established by Offenbach. His memoirs, *Journal d'un musicien* and *Thèmes variés,* are valuable sources for the musical and literary life of his time. He died in Paris, Jan. 28. 1947.

See Marcel Proust, *Lettres à Reynaldo Hahn,* ed. by Philippe Kolb (1956). (E. LR.)

HAHNEMANN, (CHRISTIAN FRIEDRICH) SAMUEL (1755–1843), German physician. founder of homeopathy was born at Meissen. Saxony. on April 10, 1755. He studied medicine at Leipzig and Vienna and settled in Leipzig in 1789. In the following year. while translating W. Cullen's *Materia medica* into German, he was struck by the fact that the symptoms produced by quinine on the healthy body were similar to those of the disordered states it was used to cure. This observation led him to assert the truth of the "law of similars." *similia similibus curantur; i.e.,* diseases are cured (or should be treated) by those drugs which produce symptoms similar to them in the healthy. He promulgated his principle in a paper published in 1796, and four years later. convinced that drugs in much smaller doses than were generally employed effectually exerted their curative powers, he advanced his doctrine of their potentization or dynamization. His chief work. *Organon der rationellen Heilkunst* (1810), contains an exposition of his system, which he called homeopathy. His *Reine Arzneimittelehre* (6 vol., 1811) detailed the symptoms produced by "proving" a large number of drugs; *i.e.,* by systematically administering them to healthy subjects. In 1821 the hostility of established interests, and especially of the apothecaries, forced him to leave Leipzig. and at the invitation of the grand duke of Anhalt-Cöthen he went to live at Cöthen. Fourteen years later he moved to Paris. where he practised until his death on July 2, 1843. Statues were erected to his memory at Leipzig and at Cöthen. *See* also HOMEOPATHY.

See T. Bradford, ***Life*** *and Letters of* ***Dr.*** *Samuel Hahnemann* (1912).

HAHN-HAHN, IDA, COUNTESS VON (1805–1880), German author, was born at Tressow, Mecklenburg-Schweriri, June 22, 1805, daughter of Count Karl Friedrich von Hahn (1782–1857). She married in 1826 her cousin Count Adolf von Hahn-Hahn. The marriage was unhappy, and in 1829 she procured a divorce. She traveled, produced some poetry indicating true lyrical feeling and in 1838 published *Aus der Gesellschaft,* a title given to a whole series of her novels, the book being renamed *Ida Schönholm.* The countess's patrician affectations at length drew upon her the merciless ridicule of Fanny Lewald in a parody of her style entitled *Diogena, Ronzan von Iduna H . . . H . . .* (2nd ed., 1847), and after the 1848 revolution she retired to a convent. *Ulrich* and *Gräfin Faustine* (1831) are her best works. Her *Gesammelte Werke* were published in 45 volumes (1903–04) with an introduction by O. von Schaching. She died at Mainz, Jan. 12, 1880.

See A. Jacoby, *Ida Gräfin Hahn-Hahn* (1894).

HAIBAK, a town of Afghanistan. province of Mazar-i-Sharif, famed in Persian legend. The valley of Haibak, 3.100 ft. above sea level, is fertile and richly cultivated. The inhabitants called themselves Jagatais, a Tutki race, now generally mixed with Tajiks and speaking Persian. Near Haibak are some typical Buddhist ruins. Haibak derives its importance from its position on the main line of communication between Kabul and Afghan Turkistan.

HAI BEN SHERIRA (939–1038), last of the outstanding Babylonian geonim *(see* GAON), under whose presidency the Pumbeditha academy reached its greatest heights. Though the office of gaon was not necessarily hereditary, Hai was the fourth in a direct line, in a family which traced its origin to the Davidic dynasty, to occupy the Gaonate of Pumbeditha, situated in Baghdad since the late 9th century. Hai first assisted his father, Sherira ben Hanina, in teaching and later as chief of court of the academy. A false accusation caused the imprisonment of father and son (997), but when they were proved innocent and freed, Hai was appointed Gaon (998) during the lifetime of his father.

Close to 1,000 *responsa* (advice or decisions on points in the Talmud) written by Hai. equaling the number of extant *responsa* written by all other geonim, have come down to modern times. He steered a middle course between the rationalistic and fundamentalist philosophical schools, explaining all anthropomorphisms as metaphors and upholding free will against predetermination. He couched his *responsa* in the same languages (Hebrew, Aramaic or Arabic) in which the questions were written. Hai died at the age of 99 on the eve of the last day of Passover 1038, and was eulogized by the famous Judaeo-Spanish poets Solomon Ibn Gabirol and Samuel haNagid as one who left no children but countless disciples in all countries of the world. (S. K. M.)

HAIDA, the natives of Queen Charlotte Islands. B.C. The Kaigani are an 18th-century offshoot on Prince of Wales Island. With the Tlingit and Tsimshian. the Haida constitute the Indians that have carried the peculiar native culture of the North Pacific coast Indians to its highest pitch. (See INDIANS, NORTHWEST COAST.) Their speech, usually considered distinct, has been linked with Tlingit (*q.v.*) and Athapaskan (*q.v.*) into a proposed larger Na-Dene family. In 1841, after decline had begun, the population was estimated at 8,300; in 1880, 2,000–2,800; in 1905, 900, and in 1951, 767.

HAIDER, KARL (1846–1912), German landscape painter, born in 1846. He studied at Munich under Anschütz and was a contemporary and friend of Wilhelm Leibl. who painted his portrait in a picture called "The Art Critics" in 1868. Although he lived and worked in the midst of genre painters, Haider turned to landscape and became a great linear stylist. His remarkable smoothness of line lent austerity to his pictures, which usually convey an impression of intense stillness.

HAIDUK, a term probably derived from the Turkish *haidud* ("marauder"). The Haiduks of Serbia and Bulgaria were political outlaws and guerrilla champions of liberty; and the national movement in these countries was first led by bands of Haiduks. In Hungary the name was applied to a class of mercenary foot soldiers of Magyar stock. In 1605 these Haiduks were rewarded for their fidelity to the Protestant party *(see* HUNGARY: *History)* with titles of nobility and territorial rights over a district situated on the left bank of the river Tisa known thenceforward as the Haiduk region. This was enlarged in 1876 and converted into the county of Hajdú. In Austria-Hungary, Germany, Poland, Sweden and some other countries, Haiduk came to mean an attendant in court of law, or a male servant, dressed in Hungarian semimilitary costume. It is also occasionally used as a synonym for footman or lackey.

HAIFA, a city in Israel at the foot of Mt. Carmel at the southern end of the Bay of Acre. Though Haifa never played a great role in history, it has lately grown into the most important port of Israel, with a thriving industrial and trading population. Its good roadstead has been transformed into a large modern port with depth for the greatest vessels. It is a terminal point of three railroads, one standard gauge double-track railroad to the Suez canal and Egypt, built immediately after World War I, an older narrow gauge one-track link with the Hejaz railroad, connecting with Damascus and Jordan and a new standard gauge rail to Beirut and Turkey, built during World War II. Haifa has also become the terminal of one of the two pipelines bringing the Iraq oil to the Mediterranean. The population of Haifa has grown from 35,000, mainly Arabic, in 1928 to 182.007 in 1961. The new immigrants have been mostly Jewish who have built and settled modern suburbs on the slopes and on the top of Mt. Carmel and in the plain northeast of the town, where they have founded large textile, cement and soap factories and flour mills.

(H. Ko.)

HAIG, DOUGLAS HAIG, 1ST EARL (1861–1928), British soldier, was born in Edinburgh, June 19, 1861, son of John Haig, of Cameronbridge, Fife. He was educated at Clifton and Brasenose college, Oxford, and in 1885 joined the 7th Hussars. He was promoted captain in 1891, afterward passed through the staff college and was employed with the Egyptian army in 1898 during the Nile campaign, for which he was given a brevet majority. On the outbreak of hostilities in South Africa in 1899, he went out to Natal on the staff, and was present during the opening engagements near Ladysmith. He was afterward chief staff officer of the cavalry division during Lord Roberts' victorious advance from Cape Colony through tlie Orange Free State into the Transvaal, and was promoted brevet lieutenant colonel for his services.

In the later phases of the struggle he was in command of a column and later was controlling groups of columns; at the close of the war he was appointed A.D.C. to the king, promoted brevet colonel, and given the C.B. Col. Haig subsequently commanded the 17th Lancers for a year, after which he went to India as inspector-general of cavalry; this appointment he held until 1906, having been promoted major general in 1905, in which year he married the Hon. Dorothy Vivian, daughter of the 3rd Lord Vivian. From 1906–09 he was a director in the war office, and during this time he was intimately concerned in the development of the general staff and the improvements effected in the organization of the army, which were set on foot while Lord Haldane was secretary of state. In 1907 he published a volume of *Cavalry Studies.* His next appointment was that of chief of the general staff in India, which he held for three years, being promoted lieutenant general in 1910. In 1912 he was brought home to take the command in Aldershot, and in 1913 he was made a K.C.B.

On the mobilization of the expeditionary force in 1914, Sir Douglas Haig took the field as commander of the 1st army corps, which he led during the Mons, Marne and Aisne operations, and the first battle of Ypres; he was promoted full general in November for his services. On the division of the British expeditionary force into two armies at the beginning of 1915, he was placed at the head of the first. On the front of his army during 1915 there took place the battles of Neuve Chapelle, Festubert and Loos, and at the end of the year he succeeded Sir John French in the chief command. He had been made a G.C.B. in the autumn.

At this time the armies were passing through a period of transition. The regular army, with the exception of its cavalry, had almost ceased to exist and the first need was to weld its remnants, the new armies created by Lord Kitchener and the territorial army, into a whole capable of combined action both in attack and in defense. This involved the organization of an elaborate system of training for which it was necessary that a certain

number of divisions should be placed sufficiently far behind the line to allow them the ground and the opportunities for gaining experience.

This policy often brought Sir Douglas Haig into discussion both with the French generals and with the French statesmen, who were continually pressing him to take over a large extent of front. Sir Douglas Haig pointed out that it was not possible to compare a national army created during the course of the war with one which had been long established in time of peace, and that the Germans throughout the war maintained a greater density of men opposite the British lines than they did elsewhere. In the event, his policy was justified by the fact that in the latter half of 1918 the British army was, as a whole, at least as efficient as any which was then fighting in the war.

The campaigns and battles of the British army in France and Belgium are dealt with elsewhere and it is here only necessary to refer to the principles which guided Sir Douglas Haig in certain of the crises of the war. The first of these during his command arose out of the German attack on Verdun during the first half of 1916. On that occasion he assisted the French by relieving their troops in the front and by preparing for the battle of the Somme. While that battle disclosed defects both of preparation and of execution, its results convinced Sir Douglas Haig that it had caused such exhaustion of the German armies as should be exploited at the earliest possible moment. He therefore agreed with Joffre to renew the battle early in 1917.

But the battle of the Somme had caused grievous losses and the gains of ground as shown on the maps appeared trifling, Therefore, neither French nor British statesmen were prepared to agree to a policy which to their minds seemed likely to exhaust their resources before it caused the enemy to yield. The consequence of this was the replacement of Joffre by Nivelle and the assembly of an Allied Conference at Calais at the end of Feb. 1917, at which it was decided to give Nivelle the general direction of the British army, while he was at the same time to be in active command of the French army. This arrangement, militarily unsound, early produced friction. For Nivelle, who was ill-informed of events on the British front, issued to Haig instructions which were inappropriate both as to form and substance. These differences were adjusted at a further conference in London, but they created the impression that Haig was opposed to any form of unity of command, which was not true.

The direct result of the failure of Nivelle's campaign was a wave of depression which spread through the French armies and resulted in serious mutinies. Pétain, who had succeeded Nivelle, appealed to Haig to keep the Germans occupied while he was restoring the morale of the French troops. To this appeal Haig responded by opening in the summer of 1917 a campaign in Flanders, which began with Plumer's victory at Messine and was followed by the battle of Passchendaele. It was only with difficulty that Haig won the consent of the British Government to this campaign. By the middle of October of that year Pétain was able to tell Haig that the French army was sufficiently restored to be able to look after itself; and it might have been wiser to have stopped the battle of Passchendaele then, as no adequate return was gained for the exhaustion caused by the prolongation of the attack in execrable weather.

The crisis brought about by the success of the German-Austrian attack on the Italians at Caporetto following on the collapse of Russia, resulted in the creation in Nov. 1917 of the Supreme War Council, the first meeting of which was held at the end of the following January. This meeting had been preceded by a renewal of French demands for an extension of the British front, which Haig eventually met by agreeing to take over a portion of the line at and south of Peronne with his V. Army. At this meeting a difference of policy between Haig and his Government was disclosed. The commander-in-chief anticipated an early attack by the Germans and asked for reinforcements; the Prime Minister wished for an offensive campaign in Palestine, and won his way; and at this same conference, it was decided to create an Allied general reserve on the Western front under the control of the military representatives of the Supreme War Council with Foch as chairman. During Feb. 1918 Haig became more than ever convinced that a great German attack on his front was imminent, in which he differed from the military representatives, who did not expect it before May. When the military representatives applied to him for divisions for the general reserve, he answered that in view of the lack of reinforcements, the extension of his front and the massing of German troops, he would be unable to furnish these divisions, and the formation of the general reserve broke down.

With what calm determination Haig met the great German offensive of the spring of 1918 is described elsewhere. In the most critical days of that offensive it was Haig's direct intervention with the British Government which brought Lord Milner to France, a visit which resulted eventually in giving Foch direct control of the Allied armies. With Foch Haig's relations were as harmonious as they had been with Joffre, and in the late summer of 1918 the British commander-in-chief reaped at last the reward of his patient policy. When in Aug. 1918 Rawlinson's IV. Army won the victory of Amiens, Foch desired that Rawlinson should follow up his success. Haig, convinced that this would result in another deadlock, and confident now in the superior morale and efficiency of his army, persuaded Foch to agree to an extension of the battle northwards, and so came about the breaking of the Hindenburg line which made it clear that victory could be won in 1918. For his great services Sir Douglas Haig was raised to the peerage as Earl Haig and Baron Haig of Bemersyde and was given a grant of £100,000. The Order of Merit was also conferred upon him, and the ancestral home of the Haigs at Bemersyde was purchased by national subscription and presented to him. On returning home he was for a short time commander-in-chief in Great Britain, but when that position was abolished he refused other offers of employment and devoted himself wholly to the welfare of ex-service men. Before leaving France he had learned that many disabled and discharged soldiers were in distress, and he refused to accept any reward for himself until the Government had made better provision for the men who had served under him. Being satisfied that official provision must be supplemented by private benevolence he succeeded in uniting the various organizations of ex-service men into the British Legion (*q.v.*), of which he became president. By organizing the sale of poppies on November 11th, which became known as "Poppy Day," he created a large fund for the benefit of ex-service men. He also created and became president of the British Empire Services League, a union of the ex-service men's organizations of Great Britain and the dominions; he was also appointed chairman of the United Services fund, which, together with the British Legion fund, forms one of the largest benevolent organizations in Great Britain. He died on Jan. 29, 1928, and was buried at Dryburgh Abbey, Scotland, after national tributes to his memory had been paid at Westminster Abbey and St. Giles's cathedral, Edinburgh.

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HAIK, a piece of cloth, usually of coarse hand-woven wool, worn by Arabs, Moors and other Mohammedan peoples (Arabic *hak*, to weave). It is generally 6 to 6½ yd. long, and about 2 yd. broad. It is either striped or plain, and is worn equally by both sexes, usually as an outer covering, but it is often the only garment of the poorer classes. Women arrange the "haik" to cover the head and, in the Presence of men, hold it so as to conceal the face. A thin "haik" of silk, like a veil, is used by brides at their marriage.

HAIL consists of ice balls or lumps ranging from one-fifth to two or more inches in diameter, composed of clear ice or alternating layers of clear ice and opaque, snowlike layers. Hail occurs almost exclusively in violent or prolonged thunderstorms and

never with the ground temperature below freezing. Hail is most frequent in middle latitudes. in the interior of continents and during the summer season. On the New York-Denver airway, one thunderstorm in 800 produces hail as large as walnuts and one in 5,000 as large as baseballs. Hail is often found in the clear air surrounding the storm. Large hail may seriously damage aircraft. Hailstones are formed on a snow pellet nucleus (graupel or soft hail) and grow by collisions with supercooled cloud and raindrops in much the same manner that ice forms on aircraft. Large hailstones require large vertical air velocities, a large amount of water in suspension and a cloud which extends for a considerable distance above the freezing level. Although the hailstone may have an irregular path, it is not necessary that it be repeatedly carried below and above the freezing level, as was once thought. See THUNDERSTORMS. (H. G. HN.)

HAILE SELASSIE I: *see* MAKONNEN, RAS TAFARI.

HAILSHAM, a market town and rural district of East Sussex, Eng.. 8 mi. N.N.W. of Eastbourne by road. It is a centre for agriculture and market gardening with rope and twine factories and a large egg-packing station. From the 15th-century Perpendicular church of St. Mary the curfew is still rung. At Michelham. 2 mi. W., was an Augustinian priory. now a private residence. with gatehouse and crypt remaining. There was a Premonstratensian house at Otham, 3 mi. S.

HAINAN ISLAND, China's second largest offshore possession, is that country's most extensive tropical area. Long known but little explored. it is rich in iron ore. tin and hardwoods, and has a great potential for commercial crops. That it has been so sparsely settled by Chinese despite ample agricultural opportunities and convenience to the coast and southeast Asia trade routes is a puzzle of geographic and historic interest.

The island lies south of the Leichou (Luichow) peninsula, between 19° g' and 20° 15′ N. latitude. extending 160 mi. east-west and go mi. north-south. Hai-k'ou (Hoihow), the main port on the north coast. is 2jo mi. E. of Haiphong in Vietnam and 300 mi. W. of Hong Kong. In total area. Hainan is slightly smaller than Formosa (Taiwan), having 13,500 sq.mi. in contrast with Formosa's 13,886, with 647,100 ac. of cultivated land in 1946. Total population in 1941 was estimated as 2,500,000.

Structurally, Hainan is the southern side of a graben, in the lowest part of which is Hainan strait. 50 mi. long and from 10 to 14 mi. wide. Both the sandy coastal plain and the lateritic red clay lowlands behind the plain show scoriaceous lava that may have poured out when the graben was formed. In the southern half are the Five Finger mountains and associated northeast-southwest ranges of granites and porphyries, of which the crest peak is 6.800 ft. above sea level. They form the watershed of the streams that run into the South China sea in all directions, as well as the refuge of flora, fauna and aboriginal tribes not widely distributed in other parts of the island. Only 2j mi, from the southwest corner, a familiar landmark to mariners is Mt. Etna (Chien Feng Ling), a steep crater 4,967 ft. high.

The tropical climate provides a 12-month growing season. with temperature averages for lowland areas of 65° F. for January and 85° F. for June. Rainfall at Ch'iung-shan, the capital. on the north coast totals 62 in. a year, two-thirds falling from June to October from the monsoon and strong autumn typhoons, augmented in summer by intense afternoon thunderstorms.

Important natural vegetation includes six types of palm trees, rattan, bamboo: banyan. mahogany, rosewood and fragrant woods used in Chinese medicines. Tropical fruits, both wild and cultivated, are also abundant: date, fig, jack fruit, orange, lime. pomelo, pineapple, banana, mango. papaya and litchi. The native iauna is likewise varied, being notably different from that on the mainland: bear, leopard, deer, monkeys, squirrels, lizards, python. cobra and many species of birds and insects. Both streams and offshore waters abound in edible fish.

Under Japanese occupation, 1939–45, the rich mineral deposits were worked steadily. Approximately 2,700,000 tons of 60% iron ore were extracted from T'ien-tu. 10 mi. N.W. of Yü-lin harbour, and Shih-lu. 35 mi. N.E. of the improved harbour of Pei-li on the west coast! the latter a haematite deposit estimated at 35.000.000 tons. At Na-ta in the northwest from 200 to 300 tons of 70% alluvial tin were obtained yearly. while rich bauxite deposits near Yai-hsien on the south coast and salt pans farther east were also worked. Yü-lin was transformed into a naval base.

Agricultural improvement is promising. Two and three rice crops yearly are common. but rice has usually been imported because of drought. flood, typhoon winds and costly inland transport. Hong Kong has been the major market since 1876 for pigs, raw sugar. eggs, sesame seed. hemp. hides, glue, firewood, seafood products and salt. with shipments to Canton and southeast Asia of betel nut, coconut, copra and fruit.

In 1910 two Chinese companies from Singapore started rubber plantations. but ceased operations after 1920 because of low prices and insufficient capital. In 1943 the Japanese revived the industry, planning for 75.000 tons annually by 1948; in 1950 some of the output was shipped to Shanghai. Commercial prospects exist for coffee. pepper, sisal, ramie, peanuts. beef and processed fish.

With such favourable conditions. Hainan's lack of development is striking. Following Chinese subjugation of Kuangtung in the Early Han dynasty (206 B.C.–A.D. 8), Li tribes moved south to the island. Later Chinese settlements on the coastal plain compressed them toward the forested mountain interior. repeating the mainland pattern of economic control and suppressing their frequent uprisings. Thereafter they were interspersed with smaller and later Miao tribes from southwest China. living by hunting. gathering, shifting hillside farming and settled wet rice cultivation.

During the past 19 centuries various Chinese groups have migrated to Hainan in small numbers: the Hoklo from south Fukien, clustered around Wen-ch'ang in the northeast. providing the main source of Hainese emigrants to Thailand and Singapore and the standard "Hainan dialect"; Hakka from Kuangtung. mostly at Na-ta in the northwest; a Mandarin-speaking enclave at Tan-hsien, probably descendants of Hunanese troops landed in 1885: about 2.000 Chinese-Li Mohammedans at San-ya in the south believed to be descended from shipwrecked Arabs; and merchant families from Canton. Swatow and Hong Kong. From the T'ang dynasty (A.D. 618–906) to the Republic (1911), Hainan was a place of political exile from court, the most famous exile (A.D. 1098–1100) being the Sung poet. Su Tung-p'o. Distance from the mainland culture (yet not enough to prevent official control of venture capital), coastal pirates' interruption of contact with Canton, malignant malaria and frequent tribal outbreaks all discouraged sizable Chinese immigration and development.

Western contact began under Portuguese Jesuits: 1630. being resumed after their expulsion from China by French Jesuits in 1849 American Presbyterians started at Hai-k'ou in 1881. Foreign commercial residence began in 1876, but never expanded into a large settlement. Hainan was held by a foreign power only once —by the Japanese, 1939–45, when 180 mi. of narrow-gauge railway were built.

In April 1950 Hainan came under the Chinese People's Republic, and on July 1. 1952, the tribal areas in the mountainous south were designated the Li-Miao Autonomous district for the 270,000 non-Chinese tribesmen there. In Sept. 1951 a rubber-goods factor>-was opened at Hai-k'ou, and in Dec. 1951 a government plan was announced to increase existing rubber plantings of 3.000 ac. to 74.000 by 1961. In May 1953 two mountain reservoirs were finished that would raise rice output by 200 tons through irrigation. Mining was reported continuing, and naval and air bases expanded at Yü-lin.

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(TE. H.)

HAINAUT, a province of Belgium. based on the ancient county of Hainaut. There are about 110,000 men and women employed in the coal and iron mines. and about 10,000 in iron and steel works. The chief towns are Nons, the capital, Charleroi, Tournai. Soignies and Thuin. The rivers are the Scheldt

and Sambre. There are 6 administrative arrondissements, 33 cantons and 443 communes. Pop. (1955) 1,261,125.

Under the successors of Clovis, Hainaut formed part, first of the kingdom of Metz, and then of that of Lotharingia. It afterward became part of the duchy of Lorraine. The first to bear the title of count of Hainaut was Reginar "Long-Neck" (c. 875), who made himself master of the duchy of Lorraine and died in 916. His eldest son inherited Lower Lorraine, the younger, Reginar II, the countship of Hainaut, which remained in the male line of his descendants, all named Reginar, until the death of Reginar V in 1036. His heiress, Richildis, later married Baldwin VI of Flanders, and, by him, became the ancestress of the Baldwin (VI of Hainaut) who in 1204 was raised by the Crusaders to the empire of Constantinople. The emperor Baldwin's elder daughter Jeanne brought the countship of Hainaut to her husbands Ferdinand of Portugal (d. 1233) and Thomas of Savoy (d. 1259). On her death in 1244, however, it passed to her sister Margaret, on whose death in 1279 it was inherited by Jeanne's grandson, John of Avesnes, count of Holland (d. 1304). The countship of Hainaut remained united with that of Holland during the 14th and 15th centuries. It was under the counts William I "the Good" (1304–37), whose daughter Philippa married Edward III of England, and William II (1337–45) that the communes of Hainaut attained great political importance. Margaret, who succeeded her brother William II in 1345, by her marriage with the emperor Louis IV brought Hainaut with the rest of her dominions to the house of Wittelsbach. Finally, early in the 15th century, the countess Jacqueline was dispossessed by Philip the Good of Burgundy, and Hainaut henceforward shared the fate of the rest of the Netherlands.

HAIPHONG, a chief seaport of Vietnam, lies 16 mi. from the Gulf of Tonkin on the Cua Cam, 63 mi. S.E. of the capital, Hanoi. Pop. (1954 est.) 217,000. Haiphong, which became a seaport in 1874, has few historic remains. A canal separates the northern part of the city from the southern part. Docks, harbour facilities and ship repair yards were restored and modernized following the end of Franco-Vietnamese hostilities in 1954, but in the early 1960s dredging was still required to keep open a channel for large vessels. Haiphong is connected by road, rail and river with Hanoi and other towns. Near Haiphong are the important Hongay coal mines; the town itself is an industrial centre, with a cement plant, a rice mill, textile, glass, chemical and fish-canning factories. (VN. T.)

HAIR, in mammals, the characteristic threadlike outgrowths of the outer layer of skin (epidermis) forming the coat or pelage. By analogy the filamentous bristles on nonmammalian forms and on plants are often called hairs.

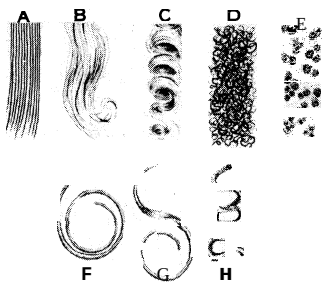
See also SKIN; FIBRES and allied articles; BALDNESS; FUR; LEATHER.

Anthropology.— One of the traditional bases for racial classifications of man has been the characteristics of hair—its growth, form and microscopic appearance. Although the general structure of all human hairs is similar, some variation occurs among ethnic groups. In fact, differences occur even among hairs of the same region of any person.

The hair of the scalp (capillus) has been studied more exhaustively than hair of other regions of the body, perhaps because of its greater abundance and accessibility. Its length, colour and type are gross characteristics seen with the naked eye, which are useful to the anthropologist in distinguishing ethnological groups. Microscopic studies have disclosed differences which are correlated with the gross characteristics. Certain of the microscopic differences, if found in the large majority of hairs of an adequate sample, are sufficiently specific to determine racial origin. Further, a single hair can be shown to have come from only one of a number of individuals of the same ethnological group. Thus, hair provides evidence for individual as well as racial identification.

Peter A. Browne of Philadelphia in 1853 was the first to demonstrate a relationship between the form and behaviour of hair and to correlate different forms with specific races. Ten years later M. Pruner-Bey published similar observations in Paris and to him the credit was almost invariably given until C. H. Danforth in 1926 pointed out the discrepancy. The form of the hair was said to be crisped or frizzled and the shape of a cross section of the hair was said to be circular or oval. In the latter part of the 19th century anthropologists classified hair as leiotrichous (including straight and wavy) and as ulotrichous (crisp, woolly or tufted). Early in the 20th century a third term was introduced, cymotrichous to stand between the other two and to include the wavy and curly hair.

As the 20th century has progressed there has been a slow and gradual change in the point of view of students of hair and with it the nomenclature of hair types has been expanded. The tendency has been away from the two or three large groupings and toward smaller and more clearly defined categories. Thus, in Hrdlicka's Practical *Anthropometry* the following classification was recommended: (1) straight, (2) wavy (slightly or markedly), (3) curly (slightly or markedly), (4) frizzly, (5) woolly, (6) peppercorn, *i.e.*, in more or less widely separated close spirals, en rouleux ("in little rolls").



(A B C D E) MODIFIED FROM RUDOLPH MARTIN, "LEHRBUCH DER ANTHROPOLOG E" (VOL. I) (F, G, H) BY COURTESY OF C. H. DANFORTH

FIG. 1.— TYPESOF HAIR

Diagrammatic sketches: (A) straight, (B) wavy, (C) curly, (D) woolly and (E) pepper-corn hair; single hairs: (F) wavy, (G) curly and (H) woolly

Likewise, the study of race differentiation has produced evidence of many overlapping characteristics which have resulted in a less rigid classification. In 1944 W. Howells wrote that no two persons would classify races in the same way. He pointed out that the three familiar great racial stocks (yellow, black and white) obviously represent an ancient separation and that the fourth, the Australian aborigines, is the most primitive of all races. The hair of the yellow race is straight, lank. long and coarse, round or nearly so in section, with a medulla usually present, and dark brown or black in colour (Chinese, American Indians) Frizzly, woolly and peppercorn hair of dark brown or black is found in the black race (African Negroes). It is short, coarse and crisp, elliptical or kidney-shaped in section, with a medulla which is masked by dense pigment granules.

Wavy and curly hair is smooth and silky, oval in section, with a medulla present more often than not. This is the hair of the white race (Europeans) and varies in colour from ash blond (Scandinavians) through the different tones of brown to black (Greeks, southern Italians) and is occasionally red. In length, wavy and curly hair holds an intermediate position. The hair of the Australian aborigines, although wavy or curly and oval in section like that of the white race, is consistently dark brown or black in colour and coarse like that of the black and yellow races. (*See* fig. 2.)

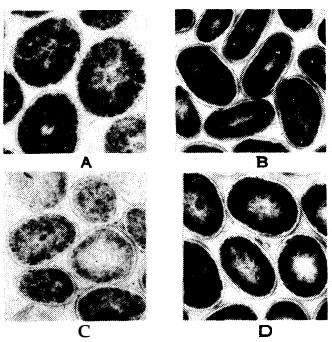


FIG. 2.— CROSS SECTIONS OF HAIRS

Exemplifying four races: (A) Mongoloid, from a Thai. Bangkok; (B) Negroid, from a Comorian, Madagascar; (C) Caucasoid. from a French Canadian, Quebec; and (D) Australoid, from an Australian aborigine, Cairns, Qsld. (enlarged approx. 50X)

The index of the hair (the figure determined by multiplying the smallest transverse diameter of the hair's shaft by roo and dividing by the largest diameter) is used to indicate the form of the hair or the degree of flattening. The index of straight and wavy hair varies generally between 80 and 100; of curly and frizzly hair between 75 and 80; and of the woolly and peppercorn form between 50 and 75. Hairs that grow side by side on the same head may vary in their index by 30 points or more. Although there is much variation in form among hairs of the same head there does exist an undeniable connection between cross section and

form. Also, the degree of curliness of the shaft is believed to be determined by the degree of obliquity of the hair follicle. The follicles are straight in races with straight and wavy hair and their direction is more or less parallel: the hairs leave them at the surface of the skin at an acute angle. In the curly haired the direction is not uniform and there is convergency toward many little centres at the surface. The follicle of Negro hair is strongly curved or sabre shaped.

Since this suggested relationship between the direction of the follicle and the form of its hair is borne out only in a general way, Danforth called attention to other factors which, if not the fundamental cause of the iorm of the hair, undoubtedly contribute to it, viz., a slight inequality between the two sides of the more or less flattened shaft and a twisting of the shaft on its long axis. To the former is due the primary curl seen in wavy hair and to the latter the change in direction of the primary curl from one side to the other seen in curly, frizzly, woolly and peppercorn hair. The degree of kinkiness increases as the number of twists along the shaft increases.

Other morphologic and genetic features that are used in classifying races may be found in ANTHROPOLOGY and RACES OF MANKIND.

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HAIR IN MAMMALS

The most important function of hair in most mammals is that of insulation against cold. A second function is that of a sensory organ—snout hairs or whiskers sensitive to touch (vibrissae) are very helpful to many night-prowling animals. Man's eyelashes consist of sensory vibrissae which cause the reflex shutting of the eyelid when a speck of dust hits them. Important from the standpoint of survival is the coloration and pattern of coats which serve both as a camouflage to enemies and as an allurement to mates.

Mammalian hairs are developed in relatively deep pits in the skin, the hair follicles, which extend downward into the thickness of the dermis, or even into the subcutaneous tissue. In man the hair rudiments begin to appear about the third or fourth month of fetal life as small solid down growths from the Malpighian layer of the epidermis, their growth being completed about the fifth or sixth month, when they constitute the very delicate hairy covering, the lanugo, which is entirely shed either before birth or soon after. The hairs constituting the downy lanugo are fine, slender, faintly or not pigmented, with large cortical scales and no medulla, and possess some of the characteristics of wool.

At birth the hairs of the eyelashes, eyebrows and scalp, though still soft and more or less retaining the characteristics of lanugo, already show a much more vigorous growth and may be pigmented. During the first iew months of infancy this growth is shed, being replaced by the typical coarser hair of the eyebrows and head, while over the rest of the body grows the fine, short, generally unpigmented down hair or vellus. Finaliy, at and following puberty, coarse, longer and more heavily pigmented hair (terminal hair) is developed in armpits (axilla), pubes, certain areas of the trunk and limbs, and in males on the upper lip and chin.

The amount of terminal hair varies according to race, sex and even individual, though generally more abundant in males, the greater part of the body in adult females still being covered by vellus. While there are little or no sexual differences distinguishing the auxiliary hairs, slight differences are observed in the pubic hairs, which appear rather longer and more abundant in men, and relatively coarser in women. One characteristic human trait is that most of the body hairs never develop beyond more or less rudimentary vellus, whereas in other mammals the coarser forms predominate, and, in addition, tactile hairs (sensory vibrissae) are present. The total area of really hairless skin in man is relatively small, being confined to the palms of the hands, soles of the feet, undersurface of the fingers and toes, the margin of the lips, areolae of the nipples, umbilicus and immediate vicinity of the urogenital and anal openings.

The Hair Follicle.—This structure, which is essentially a recess of the skin, is composed of two tissue elements—one, of epithelial origin, closely invests the hair root, while the second is connective tissue. A cross section of a hair follicle shows that the epithelial layer consists of an outer layer of polyhedral cells forming the outer root sheath, and an inner, horny stratum, the inner root sheath, composed of three layers, known respectively as Henle's layer (the outermost) of horny, fibrous, oblong cells; Huxley's layer, consisting of polyhedral, nucleated cells containing pigment granules; and the cuticle of the root sheath, composed of a layer of downwardly imbricated scales (overlapping as roof tiles) that fit over the upwardly imbricate scales of the hair proper.

The connective tissue element consists internally of a vascular layer separated from the root sheath by a basement membrane, the hyaline layer of the follicle, and externally has a more open texture corresponding to the deeper part of the cutis containing the larger branches of the arteries and veins.

A small muscle, the arrector pili, is attached to each hair follicle. It passes from the superficial part of the corium, on the side to which the hair slopes, obliquely downward, to be attached near the bottom of the follicle to a projection formed by localized hypertrophy of the outer root sheath. If this muscle is contracted, the hair becomes more erect and the follicle is dragged upward to cause a prominence on the general surface of the skin, producing that temporarily roughened condition popularly called "goose skin."

Process of Growth.—The hair grows upward from the bottom of the follicle by multiplication of the soft cells which cover the papilla and these become elongated and pigmented to form the fibrous substance of the hair shaft, and are otherwise modified to produce the central medulla and cuticle of the hair.

The hair shaft is chiefly composed of a pigmented, horny, fibrous material, which consists of long, tapering, fibrillated cells that have coalesced. Externally this fibrous substance is covered by a delicate layer of imbricated scales forming the cuticle. In many hairs, the centre of the shaft is occupied by an axial substance, the medulla, formed of angular cells containing granules of eleidin (a substance allied to keratin) and frequently in addition, minute air bubbles which give the cells a dark appearance.

The medullary cells tend to be grouped along the central axis of the hair as a core; continuous or interrupted in single, double or multiple columns. The variations in the medulla may be summarized as: (a) the continuous type, which may be homogeneous, as in the chimpanzee, or nodose (having a knotty appearance) as in the gelada baboon; (b) discontinuous medullas, which in simple forms may be ovate, elongated, or flattened (in the gibbon it is discontinuous and elongated); (c) a fragmental type, as in the langur, *Semnopithecus.*

Cuticular Scales.—The delicate cuticular scales are most varied in shape and size and constitute the most important microscopical structure of the mammalian hair, for they possess definite and constant specific characters. The dominant form is an imbricate scale, like a tile of irregular shape, having its edges rounded, minutely notched or flattened. There are many varieties of the imbricate scale, each typical of its species; thus in man, chimpanzee, gorilla and orang-utan, the hairs have imbricate scales which are, however, quite distinctive in size, shape and structure of the edge—slightly oval in chimpanzee, slightly ovate and shallowly notched in man and gorilla, with more deeply notched edges in orang. The second type of cuticular scale is the coronal in which each individual cuticular cell completely encircles the

hair shaft and may have a smooth or saw-toothed edge. While the imbricate scale is typical of the higher Primates. the coronal scale in its simpler form is present in the Lemuridae and *Tarsius;* becoming in the Insectivora more specialized, with saw-tooth edges.

In some Indian bats the cuticular scales are developed as leaflet-like processes arranged in whorls at regular intervals along the hair shaft. In many deer *(Cervus),* the cortical substance is nearly indistinguishable, almost the entire hair appearing to be composed of thin-walled polygonal cells. In the peccary the cortical envelope sends inward radial prolongations. the interspaces being occupied by medullary substance; and this, on a larger scale, is the structure of the porcupine's "quills." One of the most remarkable mammalian hairs is that of the Australian platypus, *Ornithorhynchus,* in which the lower portion of the shaft is slender and woollike, while the free-end terminates as a flattened, spear-shaped, pigmented hair with broad imbricated scales. In the three-toed sloth *(Bradypus tridactylus),* a microscopic alga grows between the cuticular scales of the hairs and would appear to be symbiotic, inasmuch that its presence, giving a curious greenish-gray hue to the coat of the sloth, helps to disguise the animal among the trees, giving it when viewed from the ground almost the appearance of a mass of moss.

Tactile Hairs.—These occur in all mammals except man, and are large, stiff hairs of pre-eminently sensory character, having highly specialized follicles, the root being embedded in a mass of true erectile tissue *(corpus cavernosum, corpus spongiosum pili),* and having a rich sensory nerve supply, presumably controlled by the sympathetic nervous system. These specialized hairs are few in number, their distribution being chiefly confined to the lips, cheeks and supraorbital regions, occasionally occurring elsewhere.

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HAIRPIECE: *see* WIG.

HAITI (RÉPUBLIQUE D'HAÏTI), a republic occupying the western third, (10,656 sq.mi.) of the Caribbean island Hispaniola. which it shares with the Dominican Republic. This article deals with Haitian history, people, administration, social conditions and economy. The geography of Haiti is treated unitarily with that of the Dominican Republic in the article HISPANIOLA.

History.— The aboriginal Indians, probably fewer than 1,000,000 Arawaks. called the entire island Quisqueya or Haiti. On Dec. 6, 1492, Columbus landed at Môle Saint-Nicolas on the northwestern tip and named the island Española, later anglicized to Hispaniola. By the end of the 16th century most of the Indians had been exterminated either through the hardships of slavery or in battle. Since few Spaniards had settled in the western part of Española, French buccaneers from Tortuga Island gained permanent footholds, which subsequently led to the founding of Port-de-Paix (1664). The treaty of Ryswick (1697) recognized French possession of the western third, which France named Saint-Domingue. In the 18th century the export of sugar, coffee, indigo, cotton, cacao and dyewoods made Saint-Domingue one of the most prosperous colonies in the new world. This prosperity was largely the result of Negro slave labour which the Spanish and later the French continually brought in from Africa. On the eve of the French revolution (1789) Saint-Domingue had a population of about 32,000 Frenchmen, 24,000 freedmen of mixed ancestry and almost 500,000 Negro slaves. A relatively small percentage of Frenchmen and freedmen owned most of the plantations and slaves.

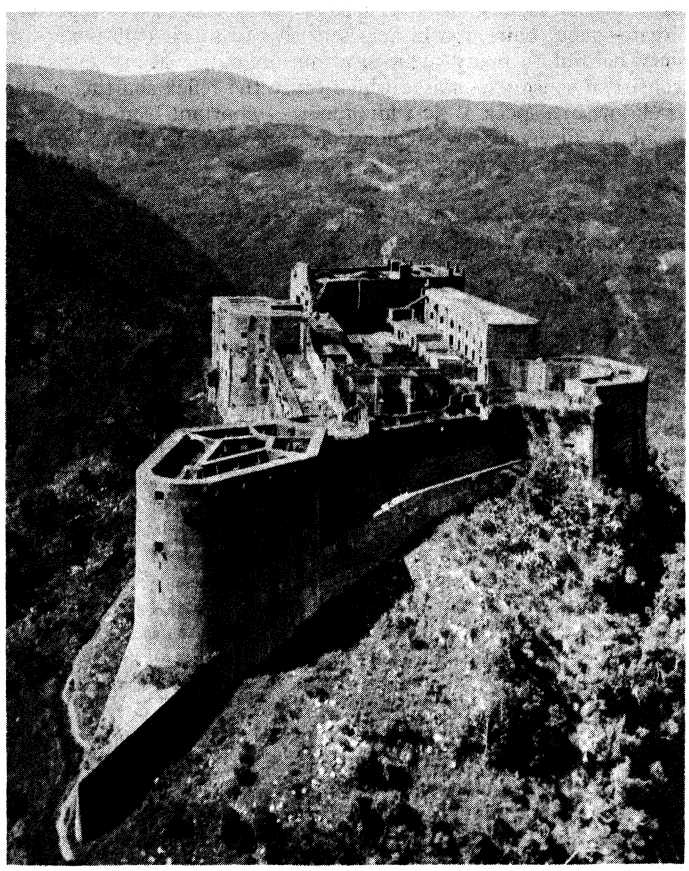
The slogan of the French Revolution, "Liberty, Equality and Fraternity," precipitated the revolution which ended colonial rule in Saint-Domingue. On Aug. 14, 1791, the slaves launched an insurrection. After 1793, France fought Great Britain and Spain for control of Saint-Domingue. Partly inspired by the need for additional troops, France decreed emancipation, Feb. 4, 1794. In May 1801, Pierre-Dominique Toussaint l'Ouverture (*q.v.*), a former slave, proclaimed a constitution, which named him governor general for life, without submitting it for ratification to Napoleon Bonaparte. Late in 1801 Bonaparte sent Gen. Charles Leclerc with a veteran force, including Alexandre Sabbs Pétion and other mulatto officers, to crush the "First of the Blacks."

The French captured Toussaint by a ruse and sent him to France where he died a prisoner in Fort de Joux. April 7. 1803. Negro generals in the French army, notably Jean Jacques Dessalines, Henry Christophe (*q.v.*) and mulatto generals, fearful that Bonaparte in 1802 planned to restore slavery in Saint-Domingue, renewed the bitter war against the French. Arms and supplies furnished by American merchants helped the hard-fighting former slaves and freedmen to turn the tide. The critical situation in Saint-Domingue and the likelihood of the renewal of war in Europe led Bonaparte to sell Louisiana to the United States, April 30, 1803. *(See* LOUISIANA PURCHASE.)

Decimated by yellow fever, the last of the French troops under Gen. Jean Baptiste Rochambeau, who took command after Leclerc died of the fever, surrendered on Nov. 9, 1803. An armistice was signed Nov. 18, 1803, providing for complete evacuation of French troops. Dessalines on Jan. 1, 1804, declared the independence of the entire island with the aboriginal name of Haiti, sometimes spelled Hayti. In Oct. 1804, Dessalines was proclaimed Emperor Jacques I.

Independence.—The 12-year war had destroyed most of the irrigation system and plantation machinery, the principal basis of the colony's economy, and added to the colonial legacy of hatred and fear of whites. The death or expulsion of practically all whites by Dessalines' military oligarchy deprived Haiti of much-needed intellectual and technical aid and capital. Hostility between black and light-coloured Haitians, rooted in the colonial period and strengthened by the service of mulattoes in Leclerc's army, increased after Dessalines' tyrannical acts led to his assassination, Oct. 17, 1806.

Civil mar ensued, especially between the mulatto Pétion. who was elected president in Port-au-Prince and was trying to organize a republic in the south, and the black Christophe, proclaimed King Henry I in the north. Pétion granted farm lands to the officers



BYRON CORCNEOS—PIX FROM PUBLIX

CITADEL OF HENRI CHRISTOPHE, SOUTH OF CAP HAITIEN

and soldiers of the army of independence but the small size of the farms aggravated the agrarian problems. Like Christophe, Pétion engaged a few foreign teachers. In the meantime, Christophe used forced labour to restore economic productivity and to build the palace of Sans Souci and a citadel (Citadelle Laferrière) erected on the summit of Bonnet à l'Evêque. After a general revolt against his despotism he committed suicide in 1820.

Jean Pierre Boyer, a mulatto, succeeded Pétion on his death in 1818 and after Christophe's suicide became president of a reunited Haiti. In 1822 a Dominican revolt against Spanish authority and internal strife facilitated Boyer's seizure of the eastern part of the island, which had proclaimed its independence Nov. 30, 1821. Boyer abolished slavery, but he also "africanized" the short-lived Dominican Republic, closed the University of Santo Domingo and despoiled monasteries and churches. Many Dominican nriters emphasized the destructive aspects of his policy in order to foment animosity against Haiti. Boyer lost control over the whole island when the Dominicans revolted and declared independence in 1844.

The hostility of many nations aggravated Haiti's inherent problems. Although Pétion had twice given aid to Simón Bolivar, Haiti was not invited to the congress of Panama, 1826. France, the first country to recognize Haiti's independence (1825), exacted in return an indemnity reduced in 1838 from 150,000,000 fr. to 90,-000 000 fr. The payment of this debt, liquidated in 1887, reduced funds available for schools, roads and general welfare. Great Britain recognized Haiti in 1833. The United States permitted trade with Haiti, but slave owners prevented recognition until 1862, after the secession of the southern states.

Boyer's overthrow in 1843 inaugurated a cycle of ephemeral and strong leaders. There mere 16 rulers who held office between Dec. 1843 and Aug. 1911, and 11 were overthrown by revolution. In 1847, the former Negro slave Faustin Élie Soulouque (Emperor Faustin I), illiterate but wily and despotic, seized power. He resumed the policy of seeking control over the Dominican Republic. Temporarily halted in 1851 by the tripartite intervention of Great Britain, France and the United States, he renewed his invasions. His defeat in 1855 by a much smaller Dominican army eventually resulted in his overthrow as emperor of Haiti in 1859 by Fabre Geffrard, a more enlightened ruler who signed a concordat with the Vatican in 1860 for the organization of the Catholic clergy.

Haiti permitted Union warships to refuel and undergo repairs during the American Civil War. Haitian presidents suspected American designs on the republic but nevertheless continued to offer coaling stations and other concessions to the United States in order to maintain themselves in power. A treaty between Haiti and the Dominican Republic (1874) engaged each of the republics not to alienate any of its territory to a foreign nation.

Prolonged civil strife in Haiti, the attempt of American shipping interests to gain special concessions and the desire of the United States to obtain Môle Saint-Nicolas as a coaling station, led to an abortive U.S. naval intervention in 1891. Shortly before World War I, U.S. bankers obtained shares in the Haitian bank, which extensively controlled the government's fiscal policies, and participated in a loan to the Haitian government. U.S. capitalists were granted concessions to build a railroad and to develop banana plantations. The total amount of the loan was a small fraction of U.S. foreign investments but it loomed large in the Haitian economy. The United States government renewed its strategic interest in Haiti as the Panama Canal neared completion.

U.S. Occupation.—Between Aug. 1911 and Feb. 1915 one Haitian president was blown up in his palace, one died by poison and three were overthrown by revolutions. On July 27, 1915, a mob seized Pres. Vilbrun Guillaume Sam in the French legation and butchered him. The next day, U.S. marines began an occupation which lasted until Aug. 1934. The U.S. government justified the intervention in the name of the Monroe Doctrine and of humanitarianism. Haitian and other critics accused the United States of protecting business interests and seeking a base to guard one of the main approaches to the Panama canal. Under pressure, Haiti signed a ten-year treaty with the U.S., which became effective in May 1916. The treaty. which was later extended to 1936, established a United States political and financial protectorate. In 1918, U.S. marines supervised a farcical plebiscite for a new constitution, which for the first time permitted aliens to hold land.

The balance sheet of the U.S. occupation is difficult to establish. Haitians resented the racial attitudes of many Americans, the racial implications of the emphasis placed upon vocational training at the expense of the French tradition, the funding of the national debt by U.S. loans (1922), the use of force to impose law and order and the virtual exclusion of Haitians from their own government. But the U.S. occupation provided efficient and honest fiscal control: it reduced the national debt from about $36,000,000 in 1915 to around $19,000,000 in 1928; and it organized and trained a militarized police force. Roads and schools were built and the telephone and telegraph service improved. Perhaps the most notable achievement was the public health service rendered by the U.S. navy medical corps (attached to the marines) with the assistance of the Rockefeller foundation. The corps improved sanitation, introduced modern methods in the few hospitals, set up rural clinics and dispensaries and also reduced the incidence of malaria and yaws (frambesia). The occupation did little, however. to improve the nation's economy. Pres. Louis Eustache Borno announced in 1929 that there would be no elections in 1930 of senators and deputies, who sitting together as the national assembly, would choose a new president.

Americans joined Haitians in demanding a new policy. Pres. Herbert Hoover in 1930 sent a mission to liquidate the U.S. occupation and another to recommend improvements in the educational system. In Oct. 1930, the people elected the first national assembly to sit since 1918. This assembly, controlled by opponents of the occupation, elected Sténio Joseph Vincent to the presidency. Haitians took over control of public works, public health, agricultural and technical services. In Aug. 1934, Pres. Franklin D. Roosevelt under an agreement signed with Haiti on Aug. 7. 1933 and in accordance with the good-neighbour policy, terminated the occupation and ordered the withdrawal of the marines. U.S. direct fiscal control continued until 1941 and indirect fiscal control until 1947 when, by an internal loan, the Haitian government liquidated the 1922 loans.

Later Developments.—Vincent, in 1939, toward the end of his second term. planned to have the constitution amended to allow him a third term. Yielding to opposition in Haiti and probably influenced by the United States, he withdrew in favour of Élie Lescot, who mas elected by the national assembly, April 1 j, 1941. After Lescot had the constitution amended to permit his re-election, he was overthrown by student strikes and mob violence. A military triumvirate ensured election of a national assembly, which chose Dumarsais Estimé as president on Aug. 16, 1946. When the senate refused to amend the constitution to permit his re-election in April 1950, the triumvirate which had overthrown Lescot seized power and allowed Estimé to leave the country. Col. Paul E. Magloire, a member of the triumvirate, was elected president by the people, Oct. 23. 1950. Magloire also sought to remain in office after the end of his constitutional term. but the army compelled him to resign on Dec. 13, 1956 and to leave the country. After a prolonged period of strikes, mob violence, recurrent closing of business houses and the overthrow of several provisional presidents, the people elected François Duvalier as president on Sept. 22, 1957. But considerable unrest continued and a poorly organized revolt was crushed on July 29, 1958.

The long-standing controversies between Haiti and the Dominican Republic erupted in Oct. 1937, in the massacre by Dominicans of several thousand Haitians who had sought employment east of the border. nhich was all-defined despite a treaty of March 9, 1936. Dominican workers denounced the lower salaries accepted by Haitians, their lower standard of living, and their "inferior, African" culture. The Dominican government agreed on Jan. 31, 1938, to pay $750,000 to the families of the victims; however, it paid only a part. An agreement, ratified in April 1952, regulated the seasonal employment of Haitians. Intellectuals and politicians in both countries kept alive the controversy until a common fear of invasion from Cuba after the advent to power of Fidel Castro, led to at least a temporary friendship. See DOMINICAN REPUBLIC for further aspects of Haitian history.

The People. — Haiti is one of the most densely populated of the American republics. Its first official census (1950, with the aid of the U.S. census bureau), revealed a population of 3,097,220 or 291 per square mile. A 1958 estimate showed a total of 3,407,438 or 313 per square mile. Since at least two-thirds of Haiti is mountainous, its population density in terms of arable land is closer to 1,000 per square mile. About 90% of the population is black or dark brown; the others are light and almost white. Resident foreigners number only a few thousand — principally Syrians, Lebanese and after the 1930s European refugees. Haiti's literacy rate, 11%, is the lowest of the Latin-American nations. The official language of the country is French but the vast majority of Haitians are illiterate peasants who speak and understand a sonorous patois known as Creole. The vocabulary of this dialect was derived largely from the Norman French spoken by the 17th-century buccaneers, and includes some Spanish, African tribal and a few Arawak Indian words. The pronunciation is slurred and the syntax informal.

Roman Catholicism is the predominant Christian religion and there is complete freedom of religious worship. Many peasants practise Vodun or Voodoo (*q.v.*), a folk religion of African beliefs, fascinating dances, rituals and superstitions, with its own priests and priestesses and a tendency to resist Catholic influence. Formal marriages are almost as rare as they were during the colonial period. Family life, however, is the dominant characteristic of peasant life.

Haiti lacks a middle class as the term is usually understood in more developed countries. In the 1950s it consisted of about 40,000 business, agricultural and industrial workers; 12,000 lox-er-scale government employees; and 60,000 domestic servants. In the 1940s struggling trade unions, first recognized in Feb. 1946, strengthened this middle class.

The aristocracy or elite, perhaps 5% of the population, consists of business and professional men, owners (usually absentee) of landed estates, members of the legislature and the upper bureaucracy — civil and military. The aristocracy are not only a class, but almost a caste. Most of them live in Port-au-Prince and Cap Haitien (*qq.v.*) and in the smaller urban agglomerations. Many frequently speak Creole in private and to servants, but they take great pride in their precise knowledge of the French language, their distinguished French names. their sophisticated appreciation of French fine arts, dress, customs and food. As writers they have produced some outstanding works of literature, history and jurisprudence. And in the 1950s, a Haitian art movement was started under the auspices of the Centre d'Art.

Most of the elite are Roman Catholics, at least nominally, and a few are Protestants. A small number have faith in Vodun, but since it is folk religion, they do not publicly manifest it. Those who can afford to do so send their children to Catholic schools. They marry formally, but some also have common-law wives.

The black and dark-brown elite are increasingly resenting the efforts of the light-coloured and almost-white elite to manipulate power, enjoy the social prerogatives and siphon off for their personal advantage a disproportionate amount of revenues of the nation's slim resources. Many of the civil wars and revolutions were essentially struggles for power between the two elite groups. But the colour line has become increasingly blurred, especially since the black and dark-brown men tend to marry lighter women. While President Vincent was almost white and President Lescot a copper brown, Estimé, Magloire and Duvalier were black. Two members of the triumvirate which overthrew Lescot and Estimé were almost white. The U.S. government furthered this blurring of the colour line by taking black and dark-brown as well as light-coloured Haitians to the United States for university education, for training in industry and in government departments. Abroad, Haitian black diplomats were received as cordially as the light coloured. The latter, therefore, reassessed their own values. Moreover, the black masses increasingly realized that the black elite had little more capacity or desire than did the light-coloured elite to solve the nation's basic problems. Despite the blurring of the colour line, it remained, in the early 1960s, a continuing problem.

Living Conditions. — Most of the peasants live in primitive wooden frame huts with mud-daubed wattle malls and thatched roofs; they sleep on the floor or on mats made of banana branches. The huts lack running water and sanitary facilities and are usually lighted by candles. The majority of farms are too small to provide more than a family subsistence. The typical Haitian peasant has only a hoe and a machete for farming tools. Diet is often close to the starvation level; malaria, tuberculosis and the diseases of malnutrition are rife. Peasant women perform the usual domestic duties, work in the fields and carry marketable goods, except coffee, to the markets. Heavy loads on their heads frequently flatten their cranial bones, bend their spines and damage their internal organs. Both peasant owners and workers on the banana, sugar and sisal plantations live at about the same level. The cost of living (Port-au-Prince) rose steadily in the 1950s (1953 = 100, 1958 = 112).

Administration. — '4 constitution, adopted by a constitutional assembly on Nov. 25, 1950, granted woman suffrage for the first time. Previously restricted to municipal elections, women over 21 years of age voted in the 1957 presidential election. The president is elected for six years by a majority of adult voters in a secret ballot. Legislative authority resides in the national assembly comprising a chamber of deputies and the senate, which has the sole power to amend the constitution; 37 deputies and 21 senators are indirectly elected for four and six years respectively. In case of serious controversy between the two houses and the president and his cabinet, the president has the power to dissolve the legislature and hold new elections within three months. The chamber of deputies initiates la s concerning the budget, taxes and other government revenues, but the president has control over public expenditures. The cabinet consists of a minimum of five members; a council of government of nine members, also appointed by the president, advises him on proposed laws and administrative matters. An independent agency (Grand Conseil Technique des Ressources Nationales et du Développement Economique) appointed by the president and a bureau of the budget, work in liaison under him. The budget bureau prepares receipts and expenditures, supervises their administration, and seeks to promote the national economy. The president is authorized to make treaties, international conventions, and executive agreements, subject to ratification by the national assembly. Judicial power is vested in a court of cassation. courts of appeal and lower courts of justice. The president appoints all justices and justices of the peace. Haiti's legal system is based on the Napoleonic code. As from April 1963, the constitution of 1957 provides for a single-chamber legislature of 67 deputies elected for six years.

For administrative purposes Haiti is divided into nine departments: L'Artibonite, Centre, Nord-est, Nord-ouest, Ouest, Sud, Sud-est, Grand Anse and Nord. These are subdivided into *arrondissements* which are made up of *communes.* The national capital is Port-au-Prince (*q.v.*) which is also the chief port and commercial centre. The second city of the republic is historic Cap Haitien (*q.v.*).

Education. – –Primary education is free and compulsory although the law is not strictly enforced and only about one-fifth of the children attend school. There are a number of schools maintained by religious orders. Secondary and higher education is free to all. According to the 1950 census 89.3% of those 10 years of age and over were illiterate.

Economy. — Haiti's economy is basically agricultural with coffee, sisal, cotton, castor beans, cacao, plantains, sugar and essential oils as the main products. As a French colony it was one of the most productive regions in the Caribbean. However, during the bloody wars for independence and the revolutions that followed, the large colonial estates and irrigation systems were destroyed. (See History above.) Thousands of peasants owning small parcels of land struggle against erosion. Constant planting of the same crops has depleted the soil. The stripping of mountain tops and steep slopes of their protective forest cover brought new land into cultivation, but rains quickly carried off the thin layer of fertile soil. Agricultural reconstruction has therefore become a vital necessity, and advances in irrigation and land reclamation projects have been made.

The irrigation of the Artibonite river valley, projected during the colonial period, and the construction and projection of hydroelectric power facilities during the 1940s and 1950s aroused great hopes for overpopulated, poverty-stricken Haiti. At the end of 1956 the Peligre dam was completed, but considerable work remained to be done in building secondary and tertiary canals and in preventing soil erosion. Choosing the most efficient utilization of 80,000 ac. of land, representing about 22,000 farms, was a major problem. Cotton, rice and yellow corn were the most promising crops. Other possibilities were bananas, sugar cane, dairy farms and beef cattle. By the late 1950s the cost of the project had reached approximately $40,000,000, most of it in the form of loans by the U.S. Export-Import bank and grants from the C.S. International Cooperation administration. The Artibonite Valley Development authority. established by law on June 9, 1958, is governed by the ministers of agriculture, finance and public works, and is headed by a Haitian administrator, with a U.S. technical director. A contract was signed on Aug. 3, 1959, with the International Engineering company of San Francisco to complete the irrigation project. The construction of a hydroelectric project was postponed. Since Oct. 1949 when a law was passed giving industries certain tax exemptions and duty-free entry of raw materials, a number of small manufacturing plants have made articles for local consumption such as compound-lard, cotton textiles, soap, ice, shoes and handbags. A flour mill began production in 1958.

Trade and Finance.— *In* the 1950s, Haiti's per capita income of about $70 was one of the lowest of the American republics. The total value of exports fluctuated considerably ($38.479.928 in 1950, $55,532,626 in 1954, $32,932,480 in 1957). The chief exports were coffee (about 62%), sisal (18%), raw sugar (8%), cacao (2%) and essential oils (2%). **A** small quantity of bauxite, the only mineral resource actively exploited, was exported in the late 1950s. Imports, also subject to fluctuation, were $36,200,294 in 1950, $47,556,494 in 1954 and $38,297,991 in 1957.

Foods, including wheat flour. and textiles usually constitute about one-half of the total value of imports; chemicals and pharmaceuticals, oil products, iron and steel, agricultural machinery and motor vehicles, less than one-fifth. It was hoped that the opening of the first flour mill in 1958 would reduce flour imports. In the 1950s, actual government revenues for the fiscal years averaged about $30,000,000, expenditures mere slightly higher. About 71% of the revenue was derived from customs duties and 29% from internal revenue. About 70% of the appropriations went for government ordinary expenditure, 5% toward the national debt and a5% for investments. The monetary unit is the gourde, valued in 1958 at 20 cents U.S. currency, official rate.

Transport and Communications.— *The* one passenger railway, Compagnie Nationale des Chemins de Fer, is government owned and runs from Port-au-Prince to Verrettes. Other railways are privately owned and serve mainly to carry freight. Roads, some of which are asphalted, link the various towns and are important to the farmers of the interior as the means for transporting their produce. Air services link Port-au-Prince with other Caribbean islands and New York and a domestic airline, Corps d'Aviation de la Garde d'Haiti. serves the interior. Haiti's 12 seaports are served by U.S.. British. Dutch, German and Panama shipping lines. World-wide cable and telegraph communications are maintained.

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(R. W. LN.)

HAKE, EDWARD (*fl.* 1579), English Puritan satirist, who resided in Gray's Inn and Barnard's Inn, London. and held civic office at New Windsor. is known for *Newes out of Powles Churchyard* (1567?; 2nd ed. 1579), a dialogue between Bertulph and Paul, who meet in the aisles of the cathedral. It is in rhymed 14-syllable metre and divided into eight "satyrs," dealing with the 'corruption of the higher clergy, and of judges, the greed of attorneys, the tricks of physicians and apothecaries, the sumptuary laws, extravagant living, Sunday sports and the abuse of St. Paul's cathedral as a meeting place for business and conversation, usury, etc. Hake's other works include a translation of Thomas à Kempis, *The Imitation, or Following of Christ* (1567, 1568); another satire, *A Touchestone for This Time Present* (1574); and Of *Colds Kingdome* (1604), a collection of pieces in prose and verse, inveighing against the power of gold.

HAKE (*Merluccius merluccius*), an important food fish of the Mediterranean and the Atlantic coast of Europe, most abundant south of the British Isles. It differs from other fishes of the cod family (Gadidae) in skeletal characters, and is, perhaps, best placed in a separate family. It is a slender fish, with long, acute snout, large terminal mouth and sharp teeth, and reaches a length of 4 ft.; it is a voracious fish. living in rather deep water; the flesh is soft. Other species of *Merluccius* are known from both coasts of North America, and from Chile and Patagonia, South Africa and New Zealand.

HAKKAS ("guests" or "sojourners"), a people of South China, found in Fu-kien, Formosa, Kwangsi and Hainan—however, their main centre of influence is Kai-Yen district, Kwangtung province, of which Kit-Yang is the seat. According to tradition they were found in Shantung and other provinces north of the Yangtze river as early as the 3rd century B.C. They fled south of the Yangtze to escape the Tatar, Mongol and other invasions of China. They would not submit to foreign rule, so were considered rebels and there was constant warfare with the prevailing powers. The Hakkas are the Highlanders of China, and their speech is a form of ancient Mandarin. (P. C. ME.; X.)

HAKLUYT, RICHARD (*c.* 1552–1616), British geographer and publicist, was born in or near London about 1552. The Hakluyts were of some standing in the Welsh Marches and held property at Eaton, near Leominster in Herefordshire. A Richard Hakluyt of a cadet branch was apprenticed to a member of the Skinners' company in 1510, and was himself later admitted to the company. He died in 1557, leaving his family, Richard Hakluyt the geographer being his third son, to the care of a cousin, another Richard Hakluyt. This Richard, a lawyer of the Middle Temple, had numerous friends among prominent city merchants, geographers and explorers of the day and was expert in overseas trade and economics. He was well placed to assist the future geographer in his life work.

Young Richard, with the help of various exhibitions, was educated at Westminster school. and Christ Church, Oxford, entering in 1570 and taking his M.A. degree in 1577. His interest in geography and travel had been aroused some years earlier on a visit to the Middle Temple when his cousin, supported by "certain books of cosmographie, an universall mappe, and the Bible," had discoursed on the recent discoveries and the new opportunities for trade. The schoolboy had thereupon resolved to "prosecute that knowledge and kind of literature" at the university. Some time before 1580 he took holy orders. "My exercises of duty first performed. I fell to my intended course and by degrees read over whatsoever printed or written discoveries and voyages I found extant" in several languages.

Hakluyt also gave public lectures—he is regarded as the first professor of modern geography at Oxford—and was the first to display "both the old imperfectly composed and the new, lately reformed maps, globes. spheres and other instruments of this Art for demonstration in the common schools." He made a point also of getting to know "the chiefest Captains at sea, the greatest merchants. and the best Mariners of our nation." This was the time when English attention was fixed on the northeast and northwest passages, and on Francis Drake's circumnavigation. Hakluyt was concerned with the activities of Sir Humphrey Gilbert and Martin Frobisher, was consulting Abraham Ortelius and Gerardus Mercator on cosmographical problems and was gaining the approval of Lord Burghley, Sir Francis Walsingham and Sir Robert Cecil (later earl of Salisbury). He thus embarked upon his career as a "publicist and a counselor for present and future national

enterprises across the ocean." His policy, constantly expounded, was the exploration of temperate North America in conjunction with the northwest passage, the establishment oi England's claim to possession based on the discoveries of the Cabots and the foundation of a "plantation" to foster national trade and national well-being. These views are first set out in the preface to a translation of Jacques Cartier's voyage to Canada, which he induced John Florio to make from G. B. Ramusio's *Viaggi* in 1580, and are further developed in his first work of importance, *Divers Voyages touching the Discouerie of America* (1582). In this he pleaded also for the establishment of a lectureship in navigation: In 1583 Walsingham sent him to Paris as chaplain to Sir Edward Stafford. There he served also as a kind of intelligence officer, collecting information on the fur trade of Canada and on overseas enterprises from French and exiled Portuguese pilots. In support of Walter Raleigh's colonizing project in Virginia, he prepared a report, known briefly as *The Discourse on the Western Planting* (1584), which set out very forcefully the political and economic benefits from such a colony, and the necessity for state backing. This was presented to Queen Elizabeth I, who rewarded Hakluyt with a prebend at Bristol but took no steps to help Raleigh. *The Discourse*, a secret report, was not printed until 1877. In Paris, Hakluyt also edited an edition of the *Decades* of Peter Martyr, so that his countrymen might have knowledge of the early successes and failures of the Spaniards.

Hakluyt returned to London in 1588. The outbreak of war having put an end to the need for overseas propaganda. he began work on a project which he had had in mind for some time. This was *The Principall Navigations, Voiages and Discoveries of the English nation* . . . , and the first edition. in one volume, appeared in 1589. In 1590 he married Douglas Cavendish, a relation of Thomas Cavendish, the circumnavigator, and was presented to the living of Wetheringsett in Suffolk. Until after the death of his wife in 1597, little is heard of any geographical work, but he then completed the greatly enlarged second edition of *The Principall Navigations*, which appeared in three volumes between 1598 and 1600. Shortly before its completion, he was granted by the queen the next vacant prebend at Westminster, that he might be at hand to advise on colonial affairs. He gave information to the newly formed East India company, and continued his interest in the North American colonizing project. being a patentee of the Virginia company in 1606 and contemplating a voyage to the colony. Nor did his belief in the possibility of arctic passages to the east fade, for he was also a charter member of the North-west Passage company of 1612. In 1613 appeared the *Pilgrimage* of Samuel Purchas (*q.v.*), in spirit a continuation of his own work, and the two editors probably became acquainted. I'urchas procured some of Hakluyt's manuscripts after his death and was able to use them in *Purchas His Pilgrimes* of 1625. Hakluyt died on Nov. 23, 1616, and was buried in Westminster abbey.

Works by Hakluyt in addition to those mentioned above include translations of Antonio Galvão's *The Discoveries of the World* . . . (1601), and of Fernando de Soto's account of Florida, under the title *Virginia richly valued by the description of . . . . Florida* (1609). But it is the *Voyages* which remain his memorial. This, "the prose epic of the English nation," is more than a documentary history of exploration and adventure; with tales of daring it mingles historical, diplomatic and economic papers to establish British right to sovereignty at sea and to a place in overseas settlement. Its overriding purpose was to stimulate, guide and encourage an undertaking of incalculable national import. At the same time he was not blind to the profits arising from foreign trade. Sir Thomas Smith asserted that the income of the East India company was increased by twenty thousand pounds through a careful study of Hakluyt's *Voyages*.

BIBLIOGRAPHY. — The *Principall Navigations* were reprinted with additional matter as *Hakluyt's Collection of the Early Voyages, Travels, and Discoveries of the English Nation*, 4 vol. (1809–12), and for the Hakluyt Society with a preface by Walter Raleigh, 12 vol. (1903–05). The *Divers Voyages* was edited by the Hakluyt Society (1850). The best text of *The Discourse on the Western Planting* is in E. G. R. Taylor (*see* below). Many narratives from Hakluyt's collection have been republished by the Hakluyt Society (founded 1846). For his life, the dedications to the two early editions of *The Principall Navigations* should be consulted (*see* above). *See* also G. B. Parks, *Richard Hakluyt and the English Voyages* (1928); E. G. R. Taylor, *The Original Writings and Correspondence of the Two Richard Hakluyts*, Hakluyt Society, 2nd ser., vol. 76, 77 (1935): J. A. Williamson, "Richard Hakluyt," in *Richard Hakluyt and His Successors*, Hakluyt Society, 2nd ser., vol. 93 (1946). (G. R. CE.)

HAKODATE, a town on the south of the island of Hokkaido (Yezo), Japan, for many years regarded as the capital of the island until Sapporo was officially raised to that rank. Pop. (1960) 243,012. The town is built along the northwestern base of a rocky promontory (1,157 ft.), which forms the eastern boundary of a bay and is united to the mainland by a narrow isthmus.

Hakodate is one of the ports originally opened to foreign trade. The bay of Hakodate, an inlet of Tsugaru strait, is completely landlocked, easy of access and spacious, with deep water almost up to the shore. The Russians formerly used Hakodate as a winter port. The staple exports are beans, pulse and peas, marine products, sulfur, furs and timber; the staple imports. comestibles (especially salted fish), kerosene and oil cake. Hakodate was opened to foreign commerce in 1854, but it has lost its former importance in foreign trade and shipping, though it remains an important point of transit between Hokkaido and the main island.

HAKO-NIWA: *see* MINIATURE LANDSCAPE.

HALAKHA: *see* MIDRASH.

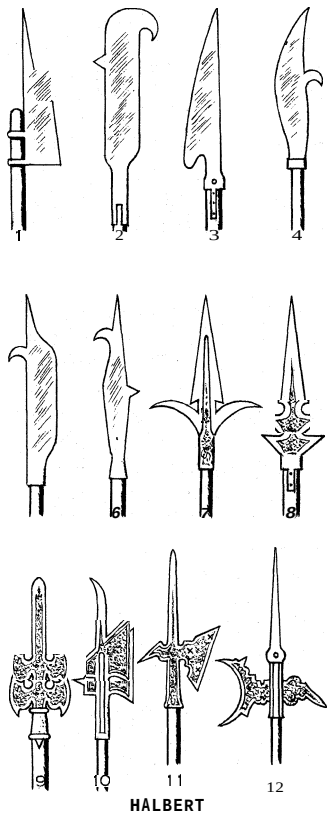
HALBERSTADT, a town in the district of Magdeburg, Ger., 56 mi. N.W. of Halle. It lies north of the Harz mountains, on the Holzemme. Pop. (1959 est.) 44.699. The history of Halberstadt begins with the transfer to it, in 820, of the see founded by Charlemagne at Seligenstadt. At the end of the 10th century it received a charter and the bishops were granted by the emperors the right to exercise temporal jurisdiction over their see, which became one of the chief ecclesiastical principalities of the empire. In 1648 it was converted by the treaty of Westphalia into a secular principality for the elector of Brandenburg. By the treaty of Tilsit in 1807 it was annexed to the kingdom of Westphalia, but came again to Prussia on the downfall of Napoleon. The town has many old houses decorated with woodcarving still surviving. The Gothic cathedral (now Protestant), dating from the 13th and 14th centuries, is remarkable for the great height of the interior, with its slender columns and lofty, narrow aisles. The treasure. preserved in the former chapter house. is rich in reliquaries, vestments and other objects of medieval church art. The Liebfrauenkirche (Church of Our Lady), a basilica. with four towers, in the later romanesque style, dating from the 12th and 13th centuries and restored in 1848, contains old mural frescoes and carved figures. The other old buildings are the town hall, of the 14th century and restored in the 17th century, with a crypt, and the Petershof, formerly the episcopal palace. The principal manufactures of the town are sugar, cigars, paper, gloves, boots, leather and machinery. About $1\frac{1}{2}$ mi. distant is the Klusberge, with prehistoric cave dwellings in the sandstone rocks.

HALBERT, HALBERD or HALBARD, a weapon consisting of an axe blade balanced by a pick and having an elongated pike head at the end of the staff, which was usually about 5 or 6 ft. in length. The utility of such a weapon in the wars of the later middle ages was that it gave the foot soldier the means of dealing with an armoured man on horseback. The pike could do no more than keep the horseman at a distance. This ensured security for the foot soldier but did not enable him to strike a mortal blow, for which a long-handled, powerful weapon capable of striking a heavy cleaving blow, was required. Several different forms of weapon responding to these requirements are described and illustrated below; it will be noticed that the thrusting pike is almost always combined with the cutting-bill hook or axehead, so that the individual billman or halberdier should not be at a disadvantage if caught alone by a mounted opponent, or if his first descending blow missed its object. It will be noticed further that, concurrently with the disuse of complete armour and the development of firearms, the pike or thrusting element gradually displaced the axe or cleaving element in these weapons, until there evolved the court halberts and partisans of the late 16th and early 17th centuries and the so-called "halbert" of the infantry officer and

sergeant in the 18th, which can scarcely be classed even as partisans.

Figs. 1–6 represent types of these long cutting, cut and thrust weapons of the middle ages, details being omitted for the sake of clearness. The most primitive is the vouge (fig. 1), which is simply a heavy cleaver on a pole, with a point added. The next form, the gisarme (fig. 2), appears in infinite variety but is always distinguished from vouges, etc., by the hook, which was used to pull down mounted men, and generally resembles the modern agricultural bill hook. The glaive (fig. 3) is a broad, heavy, slightly curved sword blade on a stave; it is often combined with the hooked gisarme as a glaive-gisarme (fig. 4). A gisarme-vouge is shown in fig. 5.

The weapon best known to Englishmen is the bill, which was originally a sort of scythe blade, sharpened on the convex side (whereas the glaive has the cutting edge on the convex side), but in its best-known form it should be called a bill-gisarme (fig. 6). The partisans, *ranseurs* and halberts proper developed naturally from the earlier types. The feature common to all is the combination of spear and axe. In the halberts the axe predominates *(see* figs. 10, 11, 12). In the partisan the pike is the more important, the axeheads being reduced to little more than an ornamental feature. A south German specimen (fig. 9) shows how this was compensated by the broadening of the spearhead, the edges of which in such weapons were sharpened. Fig. 8, a service weapon of simple form, merely has projections on either side, and from this developed the *ranseur* (fig. 7), a partisan with a very long and narrow point, like the blade of a rapier, and with forklike projections intended to act as "sword breakers," instead of the atrophied axeheads of the partisan proper.



HALBERT

(1) Vouge; (2) gisarme; (3) Late German glaive; (4) Burgundian glaive-gisarme. *c.* 1480; (5) Swiss gisarme-vouge, 14th century; (6) bill-gisarme; (7) ranseur; (8) service halbert; (9) German partisan, 1615; (10) Swiss halbert, early 15th century; (11) Swiss halbert, mid-16th century; (12) German court halbert, mid-16th century

The halbert played almost as conspicuous a part in the military history of middle Europe during the 15th and early 16th centuries as the pike. (*See* TACTICS: *Longbow and Halberd.)* But, even in a form distinguishable from the vouge and the glaive, it dates from the early part of the 13th century, and for many generations thereafter it was the special weapon of the Swiss. It was also in the 15th and 16th centuries that the halberts became larger; the blades were formed in many varieties of shape, often engraved, inlaid or pierced in open work and exquisitely finished as works of art. This weapon was in use in England from the reign of Henry VII to the reign of George III, when it was still carried (though in shape it had certainly lost its original characteristics and had become half partisan, half pike) by sergeants in the guards and other infantry regiments. It is still retained as the symbol of authority borne before the magistrates on public occasions in some of the burghs of Scotland. The Lochaber axe may be called a species of halbert furnished with a hook on the end of the staff at the back of the blade. The godendag (Fr. *godendart)* is the Flemish name of the halbert in its original form.

HALCYONE: *see* ALCYONE.

HALDANE, JOHN SCOTT (1860–1936), English scientist, was noted for his contributions to health and safety in mining and for his fundamental work on respiration. Born in Edinburgh, Scot., May 3, 1860, he was the son of Robert Haldane of Cloanden, a writer to the signet, who was also the father of Viscount Haldane (*q.v.*) and Elizabeth Sanderson Haldane. John Haldane studied at Edinburgh university, where he was graduated in medicine in 1884. and the University of Jena. From 1885 he was engaged in scientific investigation and teaching. He was a demonstrator in physiology at University college, Dundee, and in 1887 became a demonstrator at Oxford university where he was a reader in physiology from 1907 until he resigned in 1913. He also lectured at Yale university (1916), Glasgow university (1927–28) and Dublin university (1930).

Haldane investigated the action of gases that caused suffocation in coal mines and the physiological effects of the carbon monoxide present after a mine explosion. His report to the home secretary on the causes of deaths in mine explosions and fires (1896) was an important contribution to mine safety, and from that time he was a member of several government advisory committees and commissions. In 1912 he became director of a mining research laboratory founded near Doncaster by the mine owners; when it was transferred to Birmingham university in 1921, he became an honorary professor of mining there. He was also president of the Institution of Mining Engineers, 1924–28. Haldane did work on such mining problems as rescue equipment and pulmonary disease, and in 1907 he developed a method of stage decompression which made it possible for a deep-sea diver to ascend to the surface safely. He developed apparatus for the investigation of respiration and for blood-gas analysis. In 1905 he reported his fundamental discovery that the regulalion of breathing is usually determined by the effect of the tension of carbon dioxide in the blood on the respiratory centre in the brain. In 1911 he led an expedition to Pikes Peak, Colo., where he studied the effect of low barometric pressure.

His publications include *Organism and Environment* (1917); *Respiration* (1922); *The Sciences and Philosophy* (1929); and *The Philosophy of a Biologist,* 2nd ed. (Oxford, 1936). He died at Oxford at midnight, March 14–15, 1936.

HALDANE, RICHARD BURDON HALDANE, 1ST VISCOUNT (1856–1928), British statesman and philosopher, born July 30, 1856, was educated at the universities of Edinburgh and Gottingen. He was called to the bar in 1879. and took silk in 1890. In 1885 he entered parliament as liberal member for Haddingtonshire; he was re-elected continuously up to and including 1910. He was included in 1905 in Sir H. Campbell-Bannerman's cabinet as secretary for war, and carried out the reorganization of the British army. To Lord Haldane was due the decision of the dominion conference in 1907, accepting the principle of an imperial general staff, by which co-operation between armies drawn from all parts of the empire was made possible. In 1910 he was appointed chairman of the royal commission on university education in London. In March 1911 he was raised to the peerage and appointed a member of the judicial committee of the privy council. He aided in raising the committee to a commanding position.

Haldane was responsible, under the cabinet, for the conversation with France which laid down the lines of British and French co-operation in case of need. Simultaneously he acted as the agent of the cabinet in seeking an understanding with Germany which would prevent the outbreak of war. In 1906 he attended the German military manoeuvres, and at that time he visited the German war office, and studied German staff methods. On Feb. 8–12, 1912, he went on a definitely diplomatic mission to Berlin. with instructions to discuss all outstanding questions, including Morocco, the Baghdad railway and naval armaments. On his return he reported to the cabinet information he gathered there as to the attitudes and conditions of those then guiding the policy of Germany. Something resulted from the mission, but the war party in Germany prevailed. Haldane accepted the thwarting of the full result he had looked for with characteristic courage and dignified silence. In 1912 he succeeded Loreburn as lord chancellor.

Practical reasons and popular prejudice (his visits to Germany and his known preoccupation with German philosophy were used by the ignorant as a basis for a charge of pro-Germanism) account for his absence from the first Coalition Ministry in 1915, when he

received the Order of Merit. He was not given the opportunity of developing in wartime the army of which he had laid the firm foundation in peacetime. He was free—as free as any patriot of his nature and temperament could be in such stressful days—to return to the philosophical studies which had been interrupted by his long term of office. In 1903 he had published his *Pathway to Reality*, the Gifford lectures delivered by him at St. Andrews. They were a restatement of the Hegelian doctrine in the light of modern scientific work. He published in 1921 *The Reign of Relativity*, a masterly presentment of profound, scientific and metaphysical thought, and in 1922, *The Philosophy of Humanism*, an abiding memorial of the dictum *Das Geistige allein ist das Wirkliche*. Always eager to promote national education. Haldane now devoted much time and energy to the Workers' Educational association, which owed much to his support and counsel.

Haldane was lord chancellor in the Labour ministry of Ramsay Macdonald (1924), and working chairman of the committee of imperial defense. where his experience, tact and indefatigable industry were invaluable, and, on the fall of the Labour ministry, Baldwin invited him to continue his long association with it. The report of the machinery of government committee (Cd. 9230, 1918), of which Haldane was chairman, pointed out that "Further provision is needed in the sphere of civil government for the continuous organization of knowledge and the prosecution of research in order to furnish a proper basis of policy." Accepting this declaration of principle. Baldwin established in 1925 the committee of civil research, on which Haldane served as a member. Thus, through every department of state, in education. in university life, in the army. in the law and in industry are found the effects of his master mind, of his clear vision, of his resolute adherence to first principles and of his practical philosophy. Elected first chancellor of Bristol university, he was also lord rector of Edinburgh, and received many honorary degrees. His book, *Before the War*, gives an account of his political activities at that time. Haldane never married. He died at Cloan on Aug. 19, 1928.

HALDEN (formerly FREDRIKSHALD), **a** town in the county of Östfold in the south of Norway. It is situated at the mouth of the Tista river near the border of Sweden. Pop. (1950) 9,939. In early times there existed a settlement called Halden on the same site. The town was founded in 1661, and from 1665 was called Fredrikshald; in 1928 the name was changed back to Halden. The fort, Fredriksten, was begun in 1659, and repeatedly had to take the brunt of the conflicts between Sweden and Denmark-Norway. There in the siege of 1718, Charles XII was killed. In 1906, after the separation of Norway and Sweden, the fort was dismantled and hence was not able to offer effective resistance to the Germans in 1940. The most important industries of Halden are the mills for sawing and for making pulp and paper from the great timber production of the area. Boots, shoes and textiles are also manufactured, and quarries produce granite for export. The town has good facilities for shipping by boat or rail. (F. D. S.)

HALDER, FRANZ (1884–), German army officer, outstanding German staff officer in World War II, was born in Würzburg. Bavaria. on June 30, 1884. He was chief of operations in 1936 and was appointed chief of the general staff by Hitler on Sept. 1, 1938. Fearing that a disastrous war would arise from the Sudeten crisis, he joined General von Witzleben in a plot to overthrow Hitler, but the plan was dropped after Hitler's triumph at Munich. Halder supervised the planning of the Polish, French and Russian campaigns but had increasingly bitter disagreements with Hitler over the latter's amateurish interference; these led to his dismissal in Sept. 1942. He was arrested after the assassination plot of 1944, and although he was not involved was held prisoner until May 1945. After the war he devoted himself to research in military history and served as occasional military consultant to the west German government. He wrote *Hitler als Feldherr* (1949), published in English as *Hitler as War Lord* (1950). (P. N. T.)

HALDIMAND, SIR FREDERICK (1718–1791), British general and administrator, was born at Yverdun, Neuchâtel, Saitz., on Aug. 11, 1718, of Huguenot descent. He entered the British service in 1754 and later was naturalized as a British citizen. In 1778 he succeeded Sir Guy Carleton (afterward Lord Dorchester) as governor general of Canada. His measures against French sympathizers with the Americans have incurred extravagant strictures from French-Canadian historians, but he really showed moderation as well as energy. In 1785 he returned to London. He died at his birthplace on June 5, 1791.

HALE, EDWARD EVERETT (1822–1909), U.S. clergyman and author, is best remembered for his short story *The Man Without a Country* (1863), "a document of the Civil War." Hale was born in Boston, April 3, 1822, a grandnephew of the Revolutionary martyr, Nathan Hale, and a nephew of Edward Everett, the orator. Trained on his father's newspaper, the *Boston Daily Advertiser*, Hale turned early to letters. For 70 years newspaper articles, historical essays, short stories, pamphlets. sermons, and novels poured from his pen. He was intimately associated with the *North American Review*, *Atlantic Monthly* and *Christian Examiner*. From 1870 to 1875 he published and edited the Unitarian journal *Old and New*. "My Double and How He Undid Me" (1859) established the vein of realistic fantasy which was Hale's forte and introduced a group of loosely related characters figuring in *If, Yes, and Perhaps* (1868), *The Ingham Papers* (1869), *Sybaris and Other Homes* (1869), *His Level Best* (1872), and other collections. *East and West* (1892) and *In His Name* (1873) were his most popular novels.

Hale became pastor of the Church of the Unity at Worcester, Mass., in 1846. He married into the crusading Beecher family and took an active interest in western emigration and the Kansas-Nebraska controversy. In 1856 he became pastor of the South Congregational (Unitarian) Church of Boston. His forceful personality, organizing genius and liberal theology placed him in the vanguard of the "social gospel" movement. Many of his 150 books and pamphlets were tracts for such causes as emigrant aid, Negro education. workmen's housing and world peace. A moralistic novel, *Ten Times One Is Ten* (1871), inspired the organization of several young people's groups. The reminiscent writings of his later years are rich and colourful: *A New England Boyhood* (1893), *James Russell Lowell and His Friends* (1899), and *Memories of a Hundred Years* (1902). His *Works*, in ten volumes, appeared in 1898–1900. In 1903 he was named chaplain of the United States senate. He died at Roxbury, Mass.. June 10, 1909.

See E. E. Hale, Jr., *The Life and Letters of Edward Everett Hale* (1917); Jean Holloway, "Checklist," *Bulletin of Bibliography* (1954), and *Edward Everett Hale: a Biography* (1956). (JN. M. H.)

HALE, GEORGE ELLERY (1868–1938), U.S. astronomer, was known for his development of great astronomical instruments, including the zoo-in. Palomar telescope, and for his pioneering researches in solar physics, particularly his discovery of magnetic fields in sun spots. He was born at Chicago, Ill., on June 29, 1868. He graduated from Massachusetts Institute of Technology in 1890 and carried out research work at the Harvard College observatory (1889–90) and the University of Berlin (winter 1893–94). In 1888–91 he organized the Kenwood observatory in Chicago, where he invented and developed the spectroheliograph (*q.v.*), an instrument for photographing the sun in monochromatic light. In 1892, when he became associate professor of astrophysics (later professor) at The University of Chicago, he began the organization of the Yerkes observatory, of which he was director until 1904. Here he built the 40-in. refracting telescope which remains the largest of its type in the world. He established the *Astrophysical Journal*, an international review of spectroscopy and astronomical physics, in 1895. In 1904 he organized the Mt. Wilson observatory of the Carnegie Institution of Washington and was its director until 1923. Here he built solar apparatus of great power as well as the huge 60-in. and 100-in. stellar telescopes, both of the reflecting type. He organized the National Research council (1916). As foreign secretary of the National Academy of Sciences for many years he took an active part in international affairs. His plans and efforts led to the construction by the California Institute of Technology (with funds supplied by the Rockefeller foundation) of the zoo-in. reflecting telescope on Palomar mountain. His work was recognized by the awarding of many honors and by his election as a foreign member of most of the

world's leading academies of science.

He assisted in the organization of the Henry E. Huntington Library and Art gallery (San Marino, Calif.), of which he was a trustee, and in the improvement of the city of Pasadena as a member of the city planning commission. He took a leading part in the expansion and strengthening of the California Institute of Technology in Pasadena. He died at Pasadena on Feb. 21, 1938, after years of illness. He wrote *The Study of Stellar Evolution* (1908), *Ten Years' Work of a Mountain Observatory* (1911), *The New Heavens* (1922), *The Depths of the Universe* (1924), *Beyond the Milky Way* (1926), and *Signals From the Stars* (1931).

(P. W. M.)

HALE, JOHN PARKER (1806–1873), **U.S.** statesman, remembered chiefly for his long service in the U S, senate, of which he was a member from 1847 to 1853 and again from 1855 to 1865. Born at Rochester, N.H., on March 31, 1806, he graduated at Bowdoin college in 1827 and was admitted to the New Hampshire bar in 1830. In 1843–45 he was a Democratic member of the national house of representatives. In Jan. 1845, he refused in a public statement to obey a resolution of the state legislature directing him and his New Hampshire associates in congress to support the cause of the annexation of Texas, a Democratic measure which Hale regarded as being distinctively in the interest of slavery. The Democratic state convention was at once reassembled. Hale was denounced. and his renomination was withdrawn. Hale then set out to win over his state to the antislavery cause. The election resulted in the choice of a legislature controlled by the Whigs and the independent Democrats. He was one of the organizers of the Republican party, and during the Civil War was an eloquent supporter of the Union. He died at Dover, S.H., on Nov. 19. 1873.

HALE, SIR MATTHEW (1609–1676), lord chief justice of England under Charles II and one of the most learned and capable lawyers in English legal history, was born on Nov. 1, 1609. at Alderley, Gloucestershire. Left an orphan at the age of five, he was placed by his guardian under the care of the Puritan vicar of Wotton-under-Edge, with whom he remained until his 16th year, when he entered Magdalen Hall, Oxford. There, Hale studied with a view to taking holy orders, but, attracted by a company of strolling players, he threw aside his studies and plunged carelessly into gay society. For a time he considered entering the army of the prince of Orange in the Low Countries. He was drawn to the law, however, when in the course of settling his private legal affairs he met the celebrated Serjeant John Glanville (1586–1661), who recognized Hale's native ability and persuaded him to prepare for a career at the bar. He entered Lincoln's Inn, probably in 1628, and immediately devoted himself to legal studies with great intensity. His regimen included not only study of the conventional legal materials but broad reading in mathematics and the sciences.

He was called to the bar in 1637 and within a very few years mas at the head of his profession. He entered public life shortly before the onset of the Puritan revolution and in the confused and critical period that followed he conscientiously sought to steer a middle course. Hale was persuaded that a lawyer and a judge could best serve his country by holding aloof from partisanship and violent prejudices. He played a prominent role in the trials of political offenders that characterized the times. Some believe he was engaged as counsel for the earl of Strafford; it is certain that he acted for Archbishop Laud. Lord Maguire, Christopher Love, the duke of Hamilton and others. The assertion that Hale signed the Solemn League and Convenant. regarding the constitution of the Anglican church *(see* COVENANTERS), is not supported by satisfactory evidence. He did, however, take the engagement of loyalty to the Commonwealth required of all lawyers, and in 1653, already serjeant, he became a judge in the court of common pleas. Two years later he sat in Cromwell's parliament as one of the members for Gloucestershire. After the death of the protector he declined to act as a judge under Richard Cromwell, although he represented Oxford in Richard's parliament. At the Restoration in 1660 he was graciously received by Charles II, and in the same year he was appointed chief baron of the exchequer, and accepted. apparently with reluctance, the honor of knighthood. After holding the office of chief baron for 11 years he became chief justice of the king's bench in 1671. He resigned his office in 1676 and retired to his native Alderley, where he died on Dec. 25 of the same year.

As a judge Hale made a remarkable impression on his contemporaries for his probity. fairness, piety and moderation, traits that too often did not characterize those who then exercised judicial functions. It was these qualities that secured his position in the violent and shifting political life of the 17th century. The principal blot on his record involves the conviction of two women for witchcraft in 1661 or 1662. Hale presided at the trial and expressed "no doubt at all" of the existence of witches, a view already rejected by many educated men of the day.

Hale was a prolific writer, his works including discussions of theological and scientific matters as well as legal studies; most of them were left in manuscript and published posthumously. Perhaps his most important work is the *Historia placitorium coronae*, or *History of the Pleas of the Crown* (1685; 2 vol. 1736), one of the most influential treatises on the criminal law of England ever produced. Hale's other legal work of continuing importance is the *History of the Common Law of England* (1713). Among his numerous religious writings the *Contemplations, Moral and Divine* (1676–77) occupies the first place. One of his most popular works is the collection of *Letters of Advice to His Children and Grandchildren,* the first of which were published in 1762. He left a valuable collection of manuscripts and records to the library of Lincoln's Inn.

BIBLIOGRAPHY.—Hale's life has been written by G. Burnet (1682); by J. B. Williams (1835); by H. Roscoe, in *Lives of Eminent Lawyers* (1838); by Lord Campbell, in *Lives of the Chief Justices* (1849); and by E. Foss in *Lives of the Judges* (1848–70). (F. A. A.)

HALE, NATHAN (1755–1776), American Revolutionary officer and hero, was born at Coventry, Conn., on June 6, 1755. After he graduated from Yale in 1773, he became a school teacher. He joined a Connecticut regiment after war broke out, served in the siege of Boston and was commissioned a captain at the opening of 1776. When William Heath's brigade departed for New York he went with them. and the tradition is that he was one of a small and daring band who captured a provision sloop from under the very guns of a man-of-war. On Sept. 21, having volunteered to enter the British lines to obtain information concerning the enemy, he was captured in his disguise of a Dutch school teacher and was hanged the next day. The penalty was in accordance with military law, but young Hale's act was a brave one, and he has always been glorified as a martyr. Tradition attributes to him the saying (similar to a remark in Joseph Addison's play *Cato)* that he only regretted that he had but one life to lose for his country; and it is said that his request for a Bible and the services of a minister was refused by his captors.

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HALEBID, a village in Hassan district, Mysore, India, 15 mi. N.W. of Hassan. It is the site of the Hoysala dynastic capital, Dwarasamudra or Dorasamudra, plundered by Moslem invaders in 1310 and 1326. The Hoysalesvara (built 1141–82), one of its two surviving temples, is the most luxuriantly sculptured of all Hoysala shrines. The podium is covered nith order upon order of figures carved in the easily worked chloritic schist.

HALES, JOHN (1584–1656), English scholar, frequently referred to as "the ever memorable," was born at Bath on April 19, 1584. In 1618 he nent to Holland as chaplain to the English ambassador. Sir Dudley Carleton. In 1619 he returned to Eton, where he held a fellowship. His eirenical tract entitled *Schism and Schismaticks* (1636) fell into the hands of Archbishop Laud, and in 1639 Hales was made one of Laud's chaplains and also a canon of Windsor. In 1642 he was deprived of his canonry by the parliamentary committee, and two years later was obliged to hide in Eton with the college documents and keys. In 1649 he refused to take the "Engagement" and was ejected from his fellowship. He lived in poverty till his death on May 19, 16j6.

HALES, STEPHEN (1677–1761), English clergyman, physiologist, chemist and inventor, famous for his pioneering studies

in animal and plant physiology, was born at Bekesbourne, Kent, on Sept. 7, 1677. Educated at Corpus Christi college. Cambridge, he took holy orders at Cambridge and in 1709 was presented to the perpetual curacy of Teddington, Middlesex, where Alexander Pope was his neighbour and friend; there he spent his life. In 1718 he was elected fellow of the Royal society, which awarded him the Copley medal in 1739, and in 1753 he became foreign associate of the French Académie des Sciences. He died at Teddington on Jan. 4, 1761.

Hales is best known for his *Statical Essays.* The first volume, *Vegetable Staticks* (1727), describes experiments in plant physiology: transpiration, the rate of growth of shoots and leaves, variations in root force at different times of the day and the nourishment taken in by plants from the air. In his experiments he was able to collect gases over water in vessels separate from those in which they were generated, and thus used what was to all intents the pneumatic trough, later perfected by Joseph Priestley (*q.v.*). The second volume, *Haemastaticks* (1733), is the most important contribution to the physiology of the circulation after William Harvey *(see* MEDICINE. HISTORY OF: *Albrecht von Haller).* Hales made the first quantitative estimate of blood pressure, and his work led to the development of the instruments now in general use for that purpose. Like Robert Whytt, Hales showed the necessity of the spinal cord for reflex movements. He also devised a ventilator (a modified organ bellows) by which fresh air could be conveyed into jails, hospitals and ships' holds, and invented a sea gauge for sounding and processes for distilling fresh from sea water, for protecting corn from weevils by fumigation aith brimstone, for salting animals whole by passing brine into their arteries and for bottling chalybeate waters. His *A Friendly Admonition to the Drinkers of Brandy and Other Distilled Spirit* was published anonymously in 1734 and passed through six editions, and *A Description of Ventilators,* a pioneer work of great practical importance, appeared in 1743.

See A E. Clark-Kennedy, *Stephen Hales: an Eighteenth Century Biography* (1929); C. J. Singer *et al. (eds.), A History of Technology,* vol. iv (1958). (W. J. BP.; X.)

HALESOWEN, a municipal borough (1936) in the Oldbury and Halesowen parliamentary division of Worcestershire, Eng., 7 mi. W.S.W. of Birmingham. Pop. (1951) 39,903. Mentioned as Halas in Domesday, Halesowen had a Premonstratensian monastery, ruins of which exist, 1214–1539. William Caslon (1692–1766), inventor of the Caslon type face. was born at Cradley and William Shenstone, the poet, at Halesowen. There are a grammar school (1652) and a county technical school (1939).

HALEVI, JUDAH BEN SAMUEL (*c.* 1085–*c.* 1140), the greatest Hebrew poet of the middle ages, was born in Toledo, Spain, about 1085, and died in Palestine after 1140. He wrote a philosophical dialogue in five books, called the *Cuzari,* translated into English by H. Hirschfeld. This book, based on the historical fact that the Crimean Kingdom of the Khazars adopted Judaism, describes what Halevi conceived to be the steps by which the Khazar king satisfied himself as to the claims of Judaism. His real fame depends on his liturgical hymns. which are the finest written in Hebrew since the Psalter, and are extensively used in the Sephardic rite. He wrote some memorable odes to Zion, which have been commemorated by Heine.

HALÉVY, ÉLIE (1870–193j), French historian, the author of an important history of 19th-century England, mas born at Etretat (Seine-Inférieure), Sept. 6, 1870, a son of the playwright Ludovic Halévy. He was educated at the Lycée Condorcet and the École Normale Supérieure and became professor at the École Libre des Sciences Politiques in 1898. His *History of the English People in the Nineteenth Century,* which, though written in French, is better known in English translation. nas begun shortly before World War I. After three volumes dealing with the years 1815–41 (Paris, 1913–23), Halévy turned to the end of the century in his two-volume *Épilogue* covering 1895–1914 (Paris, 1926–32). He projected a further three volumes for the period 1841–95, but died, at Sucy-en-Brie (Seine-et-Oise), Aug. 21, 1937, before the work could be completed. A volume dealing mith the years 1841–52 mas later prepared from his notes (Paris, 1946). A translation was published as follows: *England in 1815* (1949); *The Liberal Awakening, 1815–1830* (1949); *The Triumph of Reform, 1830–1841* (1950); *Victorian Years, 1841–1895* (1951); *Imperialism and the Rise of Labour, 1895–1905* (1951); *The Rule of Democracy, 1905–1914* (1952).

Halévy's work remains the best detailed general account of English history in the 19th century and his introductory survey of England in 181j is particularly brilliant. As an informed foreign observer he was at an advantage when passing judgment on English history, especially where non-conformity, in which he was very interested, was concerned. He was the first to suggest that the absence of any revolt in England during the French revolutionary period might be due to the influence of Wesleyanism. Another service rendered by Halévy to English history was the revival of interest in Bentham, both in England and France, through his *La Formation du radicalisme philosophique,* 3 vol. (1901–04).

, HALÉVY, JACQUES FRANÇOIS FROMENTAL ÉLIE (1799–1862), French composer knoan for his romantic opera *La Juive.* Born, May 27, 1799, in Paris of a Jenish family originally named Lévy, he studied under Henri Berton and Cherubini. In 1819 he won the Prix de Rome with his cantata *Herminie.* He wrote more than 30 operas, from *L'Artisan* (1827) to *La Magicienne* (1858). Among the earlier operas *La Dilettante d'Avignon* (1829) was a satire on the poverty of contemporary Italian librettos. In 183j he wrote the five-act grand opera *La Juive* on a libretto by Eugène Scribe, based on episodes from *The Merchant of Venice* and *Ivanhoe.* Remarkable for its choral writing, psychological characterization and imaginative orchestration, *La Juive* was, mith Meyerbeer's *Les Huguenots,* the prototype of early French romantic opera. Equally successful was *L'Éclair* (1835) in which Halévy revived the 18th-century traditions of *opéra comique. La Tempesta,* based on *The Tempest,* was written in Italian for production in London (1850) and introduced the air by Thomas Arne, "Where the bee sucks." His last opera, *Noé,* was completed by his pupil Bizet who married Halévy's daughter, Geneviève, later portrayed as the Duchesse de Guermantes in Proust's *À la recherche du temps perdu.* Halévy was greatly influenced by Meyerbeer, and was in his day overshadowed by him, though some of Meyerbeer's more delicate orchestral effects were borrowed from *La Juive.* He published *Souvenirs et portraits* (1861) and *Derniers Souvenirs* (1863). He died at Nice, March 17, 1862.

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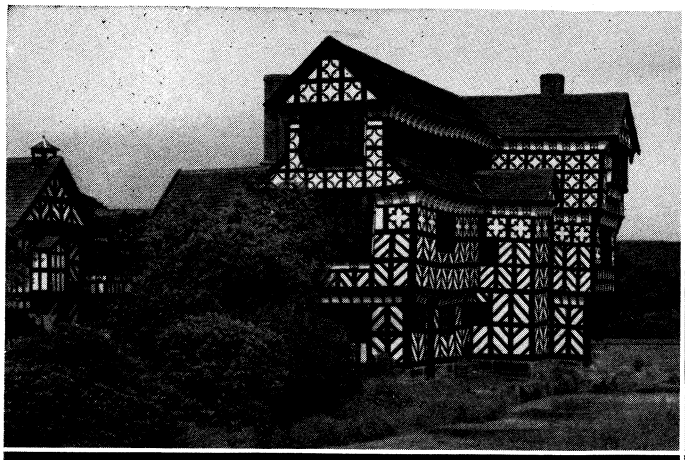
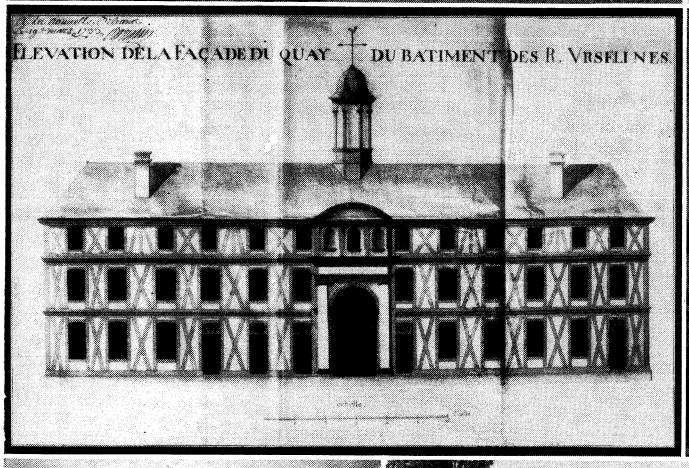
HALÉVY, LUDOVIC (1834–1908), French playwright and novelist, who in collaboration with Henri Meilhac wrote the librettos for the operettas of Oifenbach and satirical comedies about contemporary Parisian life. He was born in Paris, Jan. 1, 1834, the son of Léon Halévy, a versatile writer, and the nephew of the composer Fromental Halévy. While still a member of the civil service he began writing for the stage and collaborated anonymously in *Orphée aux enfers* (1858, music by Offenbach). In 1861 he entered into a partnership with Meilhac which was to last more than 20 years. While Halévy concentrated on the subject and its development and also directed the productions, the script was left to his partner. *La belle Hélène* (1864), a burlesque on the Homeric theme, opened a brilliant series of operettas with music by Offenbach. Among the best known of their plays are *Fanny* (1868) and the sentimental *Froufrou* (1869). They also wrote the libretto for *Carmen* (187j, music by Bizet).

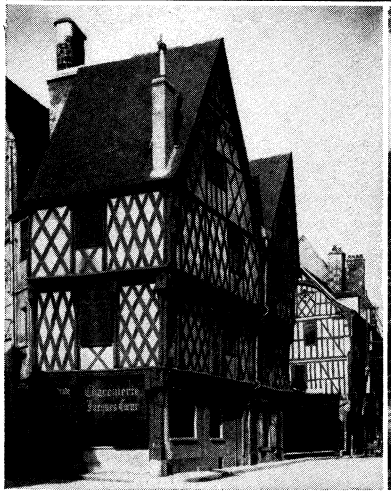
Halévy's own nondramatic works, which are of a high quality, include *L'Invasion* (1872)—impressions of the Franco-German War and the Commune; *Monsieur et Madame Cardinal* (1873)—amusing studies of the theatrical world; and short stories and novels, in particular *L'Abbé Constantin* (1882). After his election to the Académie Française in 1884, he almost ceased to write. He died in Paris, May 8. 1908. (D. Ks.)

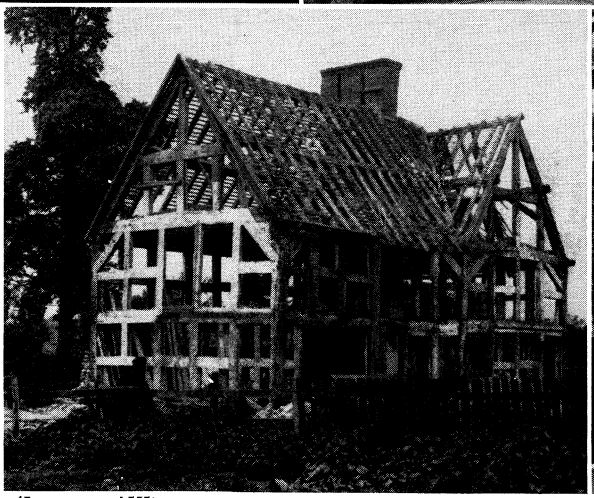
HALFBEAK, fishes belonging to the family Hemiramphidae, distinguished from the garfish or needlefish, which they closely resemble by the shortness of the upper jaw, whence they take their name. Many are small attractively coloured fish native to the coasts of tropical countries. The largest grow to about 18 in.;

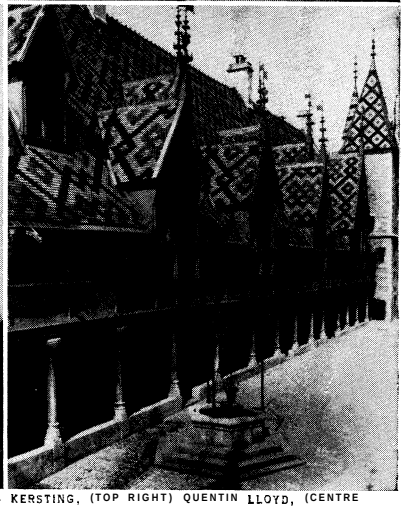
HALF-TIMBER WORK











BY COURTESY OF (CENTRE LEFT) SAMUEL WILSON, JR., (BOTTOM LEFT) TOURING CLUB OF FRANCE; PHOTOGRAPHS, (TOP LEFT) A. F. KERSTING, (TOP RIGHT) QUENTIN LLOYD, (CENTRE RIGHT) FROM MARTIN HURLIMANN SWITZERLAND " (BOTTOM CENTRE) FROM FRED CROSLEY'S, "TIMBER BUILDING IN ENGLAND" (1951), REPRODUCED BY PERMISSION OF BIRMINGHAM (ENG.) PUBLIC LIBRARIES, (BOTTOM RIGHT) JEAN ROUBIER

EXAMPLES OF HALF-TIMBER CONSTRUCTION IN ENGLAND, EUROPE AND THE U.S.

Top left: Little Moreton Hall, Cheshire, England: **1550-59**
Top right: Middle house, Mayfield, Sussex, England; about **1576**
Centre left: Drawing of the Ursuline convent, New Orleans, La.; **1733**
Centre right: Timbered house in Stammheim, Switzerland; **1731**
Bottom left: Butcher's shop, Bourges, France
Bottom centre: Half-timbered house of the midlands, England, in the course of demolition showing the structural framework
Bottom right: Courtyard of Les Hospices, Beaune, France; **1443-51**

the smaller to a foot or less. The North American halfbeak, *Hyporhamphus unifasciatus,* is found along the Atlantic coast.

HALFPENNY, WILLIAM (fl. 1752), English 18th-century architectural designer, was also known as Michael Hoare. He published about 20 books dealing almost entirely with domestic architecture and especially with country houses in the Gothic and Chinese fashions of his period. His most influential works were *New Designs for Chinese Temples* (1750–52); *Rural Architecture in the Gothic Taste* (1752); *Chinese and Gothic Architecture Properly Ornamented* (1752); and *Rural Architecture in the Chinese Taste* (1750–52). The first of these books disproves the statement that Thomas Chippendale and Sir Thomas Chambers introduced the Chinese taste into England. John Halfpenny, said to have been his son, was associated with William in the production of the above-mentioned works.

HALF-TIMBER WORK, in building, a method which exposes to view the heavy wood framing of the walls. Spaces between the structural members are filled with contrasting materials such as brick, plaster or wattle and daub. The strong cagelike skeleton is often stiffened with corner braces. Traditionally it is made of squared oak timbers joined by mortices, tenons and wooden pegs. The nature of the structure is expressed in rectangular buildings, the rhythmic spacing of posts and beams facilitating division into boxlike rooms. In the country, units of various sizes can be combined domino fashion to produce rambling plans and picturesque silhouettes, while in crowded towns narrow buildings with steep gables may rise six or seven stories. Although occasional structures are still built to take advantage of the strength and slow-burning properties of heavy timbers, the universal method today is to use light sills, studs, and joists only 2 in. thick nailed together to make "balloon frames" in place of the old pegged girts, beams and braces. Where the decorative effect of half-timber work is desired, boards are applied to the wall surface in a sham version of the old structural pattern. A more genuine, if unintentional, reflection is seen when the framing of concrete and steel buildings is made visible as part of the exterior effect.

Half-timber work is used where the climate is moderate, suitable wood is available, and there are craftsmen skilled in working with hand tools. It was common in China, and, in a refined form, in Japan, and was used for domestic architecture throughout northern Europe until the 17th century. At Pompeii there are remains of many houses whose upper floors were constructed in half-timber technique, and it is likely that Roman villas in wooded country were largely constructed in this way.

Extant medieval examples, from the 12th century, have projecting upper stories. The overhang, which probably originated in military construction, gains a small amount of space on the upper levels and gives some weather protection for walls and openings below. However, the main advantage is structural, since the cantilevers at the ends of the beams partially counterbalance the load carried by their spanning portions. The system permitted a series of open panels to serve as windows. Originally provided with shutters, louvres, or bars, in the 13th century these began to be fitted with leaded glass. The use of many studs set close together gives a pronounced vertical rhythm to the exteriors of this era. Along both coasts of the English channel this effect was retained even after the squarer panel forms of the Renaissance had been adopted elsewhere. The wooden frames of 13th- and 14th-century structures were elaborately ornamented, the moldings and carvings displaying the same forms used in Gothic artifacts and buildings of stone. Exposed ground floor posts, hewn from tree trunks and placed upside down, were often carved with the images of craftsman inhabitants or patron saints, while other framing elements were enriched with delicate running patterns. In France the latter emphasized the vertical elements, while in England the tendency was to stress the horizontals and the raking bargeboards which follow the edge of the roof. In the 15th and 16th centuries the decorative contrast between timber and filling was fully exploited. Panels were made of brick in herringbone patterns, of plaster molded or incised with floral forms or with inlays of slate, tile or marl. Carved ornament was lavish and fanciful, and showed classical motives. Many wooden members were added without structural necessity. These were often crisscrossed under windows, and, in England where more timber work was exposed, they were assembled in cusped shapes or chevrons to create the striking patterns of the "black and white" manor houses of Cheshire and Lancashire. In Germany a bolder and cruder effect was obtained by using fewer elements and emphasizing angle bracing. In the American colonies the English found it expedient to use an insulating layer of wood siding (clapboards or weatherboarding), and half-timbering was not visible from outside. In the French and German settlements, however, the buildings were faithful copies of the European models, an occasional one appearing as late as mid-19th century. *See* also **CARPENTRY.**

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HALFTONE: *see* PHOTO-ENGRAVING.

HALIBURTON, THOMAS CHANDLER (1796–1865), Canadian humourist and satirist, is best known as the creator of Sam Slick, the Yankee clock peddler and cracker-barrel philosopher. Born in Windsor, Nova Scotia on Dec. 17, 1796, he was educated at King's college, Windsor. In 1820 he was admitted to the bar and became in turn a justice of the court of common pleas (1829) and a judge of the supreme court (1841). But the formative development of his career was his election in 1826 to the provincial house of assembly and his subsequent involvement in the assembly's struggle against the misuse of powers by the ruling clique. For a time Haliburton led the popular movement for reform; but when, as it seemed to him, agitation for responsible government began to threaten the colony's ties with Great Britain and the crown, his Tory convictions reasserted themselves. Alienated from most of his contemporaries, he resigned his seat in the assembly and turned to writing as an outlet for his opinions. Of the 16 books he wrote, nearly all were rooted in his strongly conservative views on political and social questions.

Sam Slick made his first appearance in the *Novascotian* newspaper in 1835; and in the three series of *The Clockmaker* (1836, 1838, 1840), in *The Attache'; or, Sam Slick in England* (1843–44) and in *Sam Slick's Wise Saws and Modern Instances* (1853) Haliburton pressed home his attack against the political shiftlessness of the Nova Scotians, against the shortcomings of American "mobocracy" and indeed against the whole broad front (Britain not excepted) of the levelling tendencies of the age. In sum it is a remarkable body of writing — sometimes too blunt in its preachment or merely bad-tempered, but constantly quickened by the tremendous vitality of Sam Slick's colloquial speech and by his fund of anecdotes and tall tales. Artemus Ward is said to have called Haliburton "the father of the American school of humor," and Justin M'Carthy remembered the time when Sam Slick was as well known to English readers as Dickens' Sam Weller. Important volumes in similar vein, though without the central character of Mr. Slick, are *The Old Judge* (1849) and *The Season Ticket* (1860).

In 1856 Haliburton moved to England, where he represented Launceston in the house of commons for six years prior to his death in Middlesex, on Aug. 27, 1865. A son, Robert Grant Haliburton (1831–1901), was a prominent figure in literary circles at the time of Canadian confederation.

See V. L. O. Chittick, *Thomas Chandler Haliburton* (1924).

(R. L. McD.)

HALIBUT (*Hippoglossus hippoglossus*), the largest of the flat fishes, reaching a length of 10 feet. It is found in the north Atlantic and north Pacific, and extends into the Arctic ocean, but is not certainly circumpolar. The eyes are on the right side, and the mouth is large; the body is longer and less compressed than in other flat fishes. The halibut feeds on other fishes. It is a valued food fish, with very firm white flesh.

HALICARNASSUS (mod. *Budrum*), an ancient Greek city on the southwest coast of Caria, Asia Minor, on the Ceramic gulf or Gulf of Cos. It originally occupied only the small island of Zephyria close to the shore (which now has the great castle of St. Peter, built by the Knights of Rhodes in 1404), but in course of time this island was united to the mainland and the city extended so as to incorporate Salmacis, an older town of

the Leleges and Carians.

About the foundation of Halicarnassus various traditions were current; but they agree as to its being a Dorian colony, and the figures on its coins, such as the head of Medusa, Athena and Poseidon, or the trident, support the statement that the mother cities were Troezen and Argos. The inhabitants appear to have accepted Anthes as their legendary founder, and were proud of the title of Antheadae. At an early period Halicarnassus was a member of the Doric Hexapolis, which included Cos, Cnidus, Lindus, Camirus and Ialysus; but owing to the lapses of Agasicles, one of its citizens, the city was cut off from the league. In the early 5th century Halicarnassus was under the sway of Artemisia, who made herself famous at the battle of Salamis. Halicarnassus and other Dorian cities of Asia were afterwards to some extent absorbed by the Delian League, but the peace of Antalcidas in **387** made them subservient to Persia; and it was under Mausolus, a Persian satrap who assumed independent authority, that Halicarnassus attained its highest prosperity. Mausolus increased the population of Halicarnassus by the inhabitants of six towns of the Leleges. He was succeeded by Artemisia, whose magnificence has been perpetuated by the "Mausoleum," the monument she erected to her husband's memory. *(See* MAUSOLUS.) One of her successors, Pixodarus, tried to ally himself with the rising power of Macedon.

Alexander, as soon as he had reduced Ionia, summoned Halicarnassus, where Memnon, the paramount satrap of Asia Minor, had taken refuge with the Persian fleet, to surrender; and on its refusal took the city and devastated it, but not being able to reduce the citadel, was forced to leave it blockaded. He handed the government back to the family of Mausolus. Later the citizens received the present of a gymnasium from Ptolemy, and built in his honour a stoa or portico; but the city never recovered entirely from the siege, and Cicero describes it as almost deserted. The site is now occupied in part by the town of Budrum; but the ancient walls can still be traced round nearly all their circuit, and the position of several of the temples, the theatre, and other public buildings can be fixed with certainty.

Excavations of the Mausoleum show that the building consisted of five parts—a basement or podium, a pteron or enclosure of columns, a pyramid, a pedestal and a chariot group. The basement was built of greenstone and cased with marble. The pteron consisted (according to Pliny) of thirty-six columns of the Ionic order, enclosing a square *cella.* Between the columns probably stood single statues. From the portions that have been recovered, it appears that the principal frieze of the pteron represented combats of Greeks and Amazons. Above the pteron rose the pyramid. mounting by 24 steps to an apex or pedestal. On this apex stood the chariot with the figure of Mausolus himself and an attendant. The height of the statue of Mausolus in the British Museum is g ft. 9½ in. without the plinth.

See C. T. Newton and R. P. Pullan, *History of Discoveries at Halicarnassus* (1862–63); J. Fergusson, *The Mausoleum at Halicarnassus restored* (1862); E. Oldfield "The Mausoleum," in *Archaeologia* (1895); F. Adler, *Mausoleum zu Halikarnass* (1900); J. P. Six in *Journ. Hell. Studies* (1905); W. B. Dinsmoor, in *Amer. Journ. of Arch.* (1908); J. J. Stevenson, *A Restoration of the Mausoleum of Halicarnassus* (1909); J. B. K. Preedy, "The Chariot Group of the Mausoleum," in *Journ. Hell. Stud.,* 1910.

HALICZ (GALICH), a small town of the Ukrainian S.S.R., 70 mi. by rail S.S.E. of Lwow (Lemberg), on the Dniester. In the neighbourhood are the ruins of the old castle, the seat of the ruler of the former kingdom from which Galicia derived its name. Halicz, which is mentioned as early as 1113, was from 1141 to 1255 the residence of the Russian princes of that name. It probably suffered during the Mongol invasion of 1240. It has changed hands among Poland, Austria, Russia and Germany during its history; in World War II it was occupied in Sept. 1939 by the U.S.S.R., which surrendered it to German armies in the summer of 1941; it was ceded to the U.S.S.R. in 1945.

HALIDE EDIB ADIVAR (1883–), Turkish author, was a pioneer of the emancipation of women in Turkey. Born in Istanbul and educated by private tutors and at an American college there, she was soon actively engaged in literary, political and social movements. Her novel *Yeni Turan* (1912; German trans., *Das neue Turan,* 1916) portrays the nationalistic trends of the period. After educational work in Syria during World War I she and her husband, Adnan Adivar, joined the Nationalists and she served as a corporal in Anatolia. During 1925–38 she traveled extensively, lecturing in Paris, London, the United States and India. She became professor of English literature at Istanbul university (1939) and a member of parliament (1950–54). Her early novels. such as *Handan* (1912). written with passionate intensity, are studies in the problems of the educated women of her day. Later books, such as *Ateshten Gömlek* (1922) and *Zeyno nun Oglu* (1926), are concerned with war in Anatolia and renascent Turkey. Novels of her third phase, such as *Sinekli Bakkal* (1936; originally written in English as *The Clown and His Daughter)* and *Doner Ayna* (1953), are character studies and well-drawn portraits of Turkish society. Other books written in English include her *Memoirs* (1926) and *Conflict of East and West in Turkey* (1936). (F. I.)

HALIDON HILL, BATTLE OF. When the Scottish War was renewed after a four years' uneasy truce, this battle of July 19, 1333, proved the sequel to the unauthorized expedition and battle of Dupplin (*q.v.*) and confirmed the changed balance of fortune. Bruce was dead and the Scots neglected to fulfil his "testament" of guerrilla warfare. Compared with Bannockburn (*q.v.*) the strategical situation was also reversed, for in 1333 Edward III. was besieging Berwick and a great Scottish host marching to relieve it. With him were Baliol and Beaumont, the victors of Dupplin, and there is little doubt that his tactics were inspired by their advice and experience. His force was drawn up in three "battles,'.' composed of dismounted knights and men-at-arms, with archers on the wings. When the Scottish impetus failed and disorganization spread, Edward ordered his knights to mount and charge, until the Scottish host was a dissolved-rabble.

HALID ZIYA USHAKLIGIL (1865–1945), Turkish author, was the first true exponent in Turkey of the novel in its contemporary European form. Born in Istanbul of a western Anatolian family and educated at a French school in Izmir, he founded the newspaper *Hizmet* in which was serialized his early work: essays, translations from the French and several sentimental novels. Two of these, *Bir Ölünün dejteri* (1889) and *Ferdi ve Shürekasi* (1894), revealed his potentialities. The hero of his novel *Mai ve Siyah* (1897), published in the periodical *Servetifünun,* was the spokesman for the "new literature" movement. His masterpiece, *Ashk-i Memnu,* appeared in 1900 and was followed by many more novels and a series of short stories. His characters and situations, though mainly limited to westernized upper-class circles, are drawn from experience. In his short stories he depicts the everyday scenes of Turkish life. (F. I.)

HALIFAX, CHARLES MONTAGUE, EARL OF (1661–1715), English statesman and poet, fourth son of the Hon. George Montague, was born at Horton, Northamptonshire, on April 16, 1661. He was educated at Westminster school, where he was king's scholar in 1677 and at Trinity college, Cambridge, where he was one of the students who assisted Newton in forming the Philosophical Society of Cambridge. His clever panegyric on the death of Charles II. attracted the notice of the earl of Dorset, through whose patronage, he entered parliament in 1689 as member for Maldon. About this time he married the countess-dowager of Manchester, and after the coronation of William and Mary he purchased a clerkship to the council. His poetical *Epistle occasioned by his Majesty's Victory in Ireland* brought him a pension of £500 per annum. In 1692 he was made one of the commissioners of the treasury. His success as a politician was mainly due to his skill in finance. In 1692 he proposed to raise a million of money on annuities for 99 years. The Scotsman William Paterson (*q.v.*) had already submitted to the Government his plan of a national bank, and when in the spring of 1694 the prolonged contest with France had rendered another large loan absolutely necessary, Montague introduced the bill for the incorporation of the Bank of England. Immediately after the prorogation of parliament Montague was rewarded by the Chancellorship of the Exchequer.

In 1695 he was returned for Westminster to the new parliament, and pushed through the House his famous Recoinage Bill. Rapid restoration of public credit secured him a commanding influence; but although Godolphin resigned office in Oct. 1696, the king hesitated for some time between Montague and Sir Stephen Fox as his successor, and it was not till 1697 that Montague was appointed first lord. In 1698 and 1699 Montague acted as one of the council of regency during the king's absence from England. After the return of the king in 1699 he was compelled to resign his offices. He succeeded his brother in the auditorship of the Exchequer.

On the accession of the Tories to power he was raised to the peerage (1700) as Lord Halifax. In 1701 he was impeached for malpractices along with Lord Somers and the earls of Portland and Oxford, but all the charges were dismissed by the Lords; and in 1703 a second attempt to impeach him also failed. He was a member of the council of regency in 1714 pending the arrival of George I., and was first lord of the treasury in the new ministry. He was also created earl of Halifax and Viscount Sunbury. He died on May 19, 1715 and left no issue. He was buried in the vault of the Albemarle family in Westminster Abbey. Montague was a friend to many men of letters. He procured from Godolphin a commissionership for Addison, and enjoyed a life-long intimacy with Newton, for whom he obtained the mastership of the Mint. In administrative talent he surpassed all his contemporaries. and his only rival in parliamentary eloquence was Somers.

His *Miscellaneous Works* was published at London in 1704; his *Life and Miscellaneous Works* in 1715; and his *Poetical Works,* to which also his "Life" is attached, in 1716. His poems were reprinted in Johnson's *English Poets,* vol. ix.

HALIFAX, EDWARD FREDERICK LINDLEY WOOD, 1ST EARL OF (1881–1959), British statesman who was viceroy of India from 1925 to 1931 and foreign secretary in the period culminating in the outbreak of World War II, was born at Powderham castle, Devon, on April 16. 1881. He was the fourth son of the 2nd Viscount Halifax, a well-known churchman and a leader of the Anglo-Catholic movement! whose family had been established in Yorkshire for generations. He was educated at Eton and Christ Church, Oxford, being elected a fellow of All Souls college. Oxford, in 1903.

Wood entered parliament as Conservative member for Ripon, Yorkshire. in Jan. 1910, and for the next 30 years had a most successful career in politics. His grave manner and his air of aristocratic detachment counted in his favour, but some who knew him well regarded him as a very astute politician. During World War I he served for a time with the Yorkshire dragoons in France, but was assistant secretary to the ministry of national service from 1917 to 1918. Before 1925, when he was appointed viceroy of India and raised to the peerage as Baron Irwin. he was successively undersecretary of state for the colonies (1921–22), president of the board of education (1922–24) and minister of agriculture (1924–25). He was viceroy until 1931. On his return from India he again became president of the board of education (1932–35). He succeeded to his father's viscountcy in 1934. Thereafter he was lord privy seal (1935–37), leader of the house of lords (1935–38) and lord president of the council (1937–38), before being appointed foreign secretary on Feb. 25, 1938, on Anthony Eden's resignation from Neville Chamberlain's government.

Halifax had been close to Chamberlain long before he became foreign secretary, and when Chamberlain resigned in May 1940 he hoped Halifax would succeed him as prime minister. In fact. the issue was decided otherwise at a meeting between Chamberlain. Halifax and Churchill. Halifax remained foreign secretary for the first seven months of Churchill's ministry, but in Dec. 1940 he was named British ambassador to the U.S.

Halifax's career thus had three notable phases: as viceroy, as foreign secretary and as ambassador. His term of office in India coincided with a period of intense nationalist ferment among Hindus and Moslems alike, but his own deep concern with religious faith (like his father, he was a devout high churchman) enabled him to work on terms of understanding with Gandhi, the most powerful figure among Indian nationalists at that time. Halifax accelerated the processes of constitutional advance by using his great influence to that end both during his viceroyalty and after. His tenure of the foreign office was the most controversial period of his career! for by accepting this appointment he identified himself completely with Chamberlain's policy of "appeasement" toward Hitler. As lord privy seal he had visited Hitler and Goering in Nov. 1937, and he accompanied Chamberlain on a visit to Mussolini in Rome in Jan. 1939. As ambassador to the U.S. he gave great service to the Allied cause during World War II, in recognition of which he was created earl of Halifax in 1944. Named British delegate to the San Francisco conference in March 1945, he attended the first sessions of the United Nations. His resignation as ambassador became effective on May 1, 1946. In 1957 he published a volume of recollections *Fullness of Days.* He died at Garrowby hall, near Tork, on Dec. 23, 1959.

(J. F. B.)

HALIFAX, GEORGE MONTAGU DUNK, 2ND EARL OF (1716–1771), son of George Montagu, 1st earl of Halifax (of the second creationj, was born on Oct. j or 6, becoming earl of Halifax on his father's death in 1739. Educated at Eton and at Trinity college, Cambridge, he became in 1748 president of the board of trade. He helped to found Halifax, the capital of Nova Scotia, which was named after him, and in several ways he rendered good service to trade, especially with North America. In March 1761 Halifax was appointed lord lieutenant of Ireland, and was also for a time first lord of the admiralty. He was from 1762 to 1765 secretary of state for the northern department under Bute and under George Grenville. He signed the general warrant under which Wilkes was arrested in 1763, for which action he was mulcted in damages by the courts of law in 1769, and he was mainly responsible for the exclusion of the name of Augusta, princess of Wales, from the Regency bill of 1765. He returned to office in 1770 under his nephew, Lord North, but died on June 8, 1771.

HALIFAX, GEORGE SAVILE, 1ST MARQUESS OF (1633–1695). English statesman and political writer. was born at Thornhill. Yorkshire, on Nov. 11, 1633, and succeeded his father, Sir William, as 4th baronet on Jan. 24, 1644. Too young to take any part in the Great Rebellion, in which Sir William was prominent on the royalist side, he spent his early years partly in travel, with a private tutor, in France and Italy. and partly in retirement at Rufford abbey, Nottinghamshire, which he was to make the principal seat of his family. In the spring of 1660 he was returned as member for Pontefract to the convention which recalled the king, but there is nothing to suggest that he made any strong impression on contemporaries during this, his sole appearance in the house of commons. On Jan. 13, 1668. he was elevated to the peerage as Baron Savile of Eland and Viscount Halifax, and in the ensuing session of parliament took his seat in the house of lords.

For this promotion he was indebted partly to his extensive estates and connections with the great families of Talbot, Wentworth and Coventry, but partly also. it may be presumed. to the influence of the 2nd duke of Buckingham, then at the height of his power, with whose fortunes he and other young Yorkshiremen had chosen to associate themselves. To Buckingham he certainly owed his local offices of justice of the peace. deputy lieutenant and colonel in the militia. When, however. the duke embarked on the policy which ultimately led to the secret treaty of Dover, Halifax began to draw away from him. and although admitted to the privy council on April 17, 1672, and sent on a mission to Louis XIV in connection with the Anglo-French attack on the Dutch. he remained faithful to the principles of the triple alliance and therefore opposed t~ the existing government. On the other hand, when Charles II reversed his policy and gave the chief place in his counsels to the earl of Danby, Halifax proved equally unready to accept what seemed to him the extravagances of the new regime. He strenuously opposed Danby's non-resisting test bill, by which members of both houses of parliament. and all holding office under the crown. were to be required to subscribe a declaration that it was unlawful, upon any pretence whatsoever, to take up arms against the king. and to swear that they would not. at any time. endeavour the alteration of the government either in church or state; he denounced the court's attempt to control public opinion by sup-

pressing the coffeehouses; and he condemned the policy of continuing the Cavalier Parliament in existence long after it had ceased to be representative of national feeling. Thus early did he adopt that policy of "trimming." or balancing between opposing factions, with which his name came to be inseparably connected.

On Jan. 7, 1676. Halifax had been dismissed from the privy council for criticizing the government's measures against the coffee sellers. but on April 21. 1679, on the complete remodelling of the council associated with the name of Sir William Temple, he was again admitted. and for some time thereafter enjoyed a position of considerable power and dignity. On July 16, 1679, he was created earl of Halifax; on Aug. 22. 1682. marquess of Halifax; and on Oct. 27 of the same year lord privy seal. During these years his ambition was to secure the establishment of a truly national government on a moderate basis, and the chief dangers he had to provide against were the Catholic-despotic developments threatened by the probable succession of James. duke of York, on the one hand. and on the other the semirepublican designs of those who wished to exclude the dyke altogether from the throne. His greatest personal triumph was the defeat of the exclusion bill in the house of lords on Nov. 15. 1680; but he proved unable to devise any generally acceptable substitute for the policy of exclusion. and as the duke's influence increased after 1682 his own inevitably declined. Ton-ard the close of Charles's reign a reaction seemed to be developing which might have led to his restoration to power, but all prospect of this disappeared with the death of the king on Feb. 6. 168 j. Appointed lord president of the council by James. he was retained in office only to give an appearance of moderation to a government which was rapidly tending toward extremes. On Oct. 21, as a result of his refusal to support the repeal of the Test and Habeas Corpus acts, he was summarily dismissed.

For the next three years Halifax remained in retirement. criticizing James's designs, as they revealed themselves, in the political pamphlets on which his fame so largely rests. In his *Letter to* a *Dissenter,* published in 1687. he warned nonconformists of the danger of placing their trust in the king's promises of toleration; and in his *Anatomy of an Equivalent*, which appeared a year later, he demonstrated the absurdity of relying on any substitute for the safeguards of the established religion which already existed. Meanwhile he kept in touch with the more moderate among those who were contemplating resistance; but actual revolution he deprecated. The king's designs, he confidently maintained. were bound to fail of themselves, and all that was necessary was to wait.

When William of Orange landed in England and civil war seemed inevitable Halifax was thus in a strong position to mediate between the king and the prince, and exerted himself to the utmost. first to induce them to accept a reasonable accommodation. and then, after the flight of James, to set up a provisional government which might negotiate with either or both. Only when all such expedients had failed did he boldly take the side of William, and it was largely as a result of his efforts in the Convention Parliament of 1689 that William and Mary were accepted as king and queen. On him. as speaker of the lords. fell the duty of formally requesting the prince and princess to accept the crown.

To contemporaries it appeared that the reappointment of Halifax to his old office of lord privy seal and his acceptance as chief minister of the crown were natural consequences; but in actual fact the favour which Halifax enjoyed with William was due not so much to his services at this time as to the similarity of their political outlook. William was as anxious as Halifax for a reconciliation of parties based on a policy of "trimming," and hoped through Halifax to achieve that end. Only when it became apparent that in the heated atmosphere of the time such a policy was impracticable did his confidence in Halifax begin to waver, and even then it was Halifax who on Feb. 11, 1690, tendered his resignation. not William who required it. Thereafter Halifax was to be found mainly in opposition to the government of the moment. Toward the close of 1694 his health began to fail. and on April 5, 169 j. he died suddenly in his 62nd year. He was succeeded by his second and only surviving son William, with whose death on Aug. 31, 1700, the peerage became extinct.

The high reputation of Halifax among moderns is due to the fact that the political principles which guided his conduct and inspired his writings are such as mould now be generally approved; but in his own day these principles were regarded with little favour. The moderation which he consistently advocated mas denounced as treachery by every group of partisans who hoped to enlist his support, and not infrequently he had to withstand attacks from opposite sides at once. He lacked the practical capacity. and indeed the inclination, to organize a band of followers in support of his principles. and suffered from serious personal weaknesses which exposed him to the criticism of his numerous enemies. His passion for titles. leading to his rise from the dignity of baronet to that of marquess. seemed scarcely in accordance with his high professions of disinterestedness. His inordinate love of applause cast doubt on the sincerity of his most brilliant speeches. His tendency to see both sides of a question made him unready. even at a time of crisis. to take any resolute action. Few statesmen of comparable capacity have had less direct influence on the actual events of their time.

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HALIFAX, capital of Nova Scotia, Canada, and leading commercial, industrial and cultural city of the province. is on a rocky, boot-shaped peninsula. 4½ mi. long and 2 mi. wide. The harbour proper. on the east side of the peninsula. has extensive berthing facilities, while the inner harbour, Bedford basin. 6 mi. long and 4 mi. wide, is deep enough for the world's largest ships. Pop. (1961) city 92.511; metropolitan area 183.946. Included in the metropolitan area is the city of Dartmouth (*q.v.*), linked to Halifax by the mile-long Angus L. Macdonald suspension bridge completed in 1955.

The harbour of Halifax was noted by Champlain in 1605 but was not exploited until 1695 when the French established the fishing station, Chebucto. on McNab's Island. Plans were drawn up for a large fortress at Chebucto. but mainland Nova Scotia was lost to the English in 1713 and the French subsequently constructed a fortress (Louisbourg) on Cape Breton Island. Seeking a counterpoise to Louisbourg. Edward Cornwallis founded Halifax in 1749, naming it after the president of the Board of Trade and Plantations. For many years Halifax was little more than a military garrison. with forts and Martello towers (*q.v.*) strategically located throughout the area. Prince Edward. Queen Victoria's father. and others fortified Halifax until it had the strongest defenses outside of Europe. Halifax was an imperial army and naval base until 1906 when the defenses and dockyard were taken over by the Canadian government. Because of its strategic position it was Canada's largest and most important naval base during World Wars I and II.

Although the city has never been besieged, it has had more than its share of disaster during wartime. In 1917 the French steamship. "Mont Bianc," laden with TNT, explosive acid and benzine, collided in the Narrows with the Norwegian steamer, "Imo." The explosion that followed killed nearly 2,000 people and seriously injured an equal number. Windows were rattled 60 mi. away and an anchor shaft, weighing 1,000 lb., was hurled over 2 mi. from the scene. Much of the north side of the city was devastated, with property damage amounting to $35,000,000. A similar holocaust almost occurred in 1945, but the periodic explosions were not so great and they took place in Bedford basin well away from the populated areas.

Halifax is a leading Canadian port, particularly during the winter months, with fish: fish products, lumber and agricultural products being its major exports. It is the Atlantic terminus of the Canadian National railway and the Dominion Atlantic railway, the latter a part of the Canadian Pacific system. The area is served by two airports, one across the harbour at Eastern Passage, and an international airport at Kelly Lake, 20 mi. N.E. of Halifax.

Industries of Greater Halifax include foundries! oil refining. shipbuilding. fish processing. and the manufacture of candy and food products. rope and twine, paint and varnish, clothing,

electronic equipment and furniture. There are ship and aircraft overhauling facilities.

Among many prominent historic buildings are St. Paul's (Anglican) church, built in 1750, with many interesting memorial tablets and graves of celebrated Nova Scotians; Government house, erected in 1900, the residence of the lieutenant-governor; Province house, completed in 1819, the provincial legislative building; and the Old Clock, regarded as a Haligonian symbol, built on the side of Citadel Hill in 1803. Educational institutions include Dalhousie university (founded 1818), to which is affiliated the University of King's college (Anglican, founded 1789); St. Mary's university (Roman Catholic. founded 1811); Mount St. Vincent college, for women (Roman Catholic, chartered 1925); and Nova Scotia Technical college (founded 1909). Other interesting features are Citadel Hill, the Public Gardens, Point Pleasant park and Ft. Needham.

See T. Raddall, *Halifax, Warden of the North* (1948). (C. W. RD.)

HALIFAX, a municipal, county and parliamentary borough in the West Riding of Yorkshire, Eng., 191 mi. N.N.W. from London and 8 mi. S.W. from Bradford by road. Pop. (1961) 96,073. Area 22.0 sq.mi.

It lies in a hilly district on the Hebble, a tributary of the Calder which forms the southern boundary. The steep left bank of the Hebble restricts urban development: and Beacon.hill, rising sharply to 850 ft., overlooks the town. Road and railway bridges span the valley. the principal one being North bridge: opened in 1871. The main part of the town is situated on the slope of a long declivity facing east on the right bank of the stream. After World War II extensive suburban development took place on the northern side of the town, in the elevated district of Illingworth and at Mixenden in the Wheatley valley.

In Saxon times Halifax formed part of the extensive manor of Wakefield held by Edward the Confessor. After the Norman Conquest the manor of Halifax (Feslei in Domesday Book) was granted to William, earl of Warenne and Surrey. who made a gift of Yorkshire churches, including Halifax, to the Cluniac priory at Lenes in Sussex. The church was dedicated to St. John the Baptist. patron saint of wool weavers. The cloth trade has been plied in Halifax from an early date — the first record of a weaver being in 1275. In the alnagers' accounts for 1473–75 Halifax parish had the largest cloth production in the West Riding, a position it retained for three centuries. The late survival of the Halifax Gibbet law has been ascribed traditionally to the need for safeguarding the kerseys left on tenter frames in the open fields. The inhabitants retained the power to behead anyone found guilty of stealing goods "of the value of thirteen pence halfpenny." The gibbet, similar to the Scottish maiden and French guillotine. operated without human handling, a rope drawn by horse or sheep pulling out the pin to release the blade. The last of the executions. which took place on market days. was in 1650. The stone platform may still be seen at Gibbet hill. The blade is in the possession of the lord of the manor of Wakefield. During the Civil War Halifax was garrisoned by parliament although in 1643 royalist troops occupied it for six months.

Built largely in the 19th century. Halifax is a development of the industrial era. though some older buildings remain. The parish church is Perpendicular and two earlier churches are traceable — the first of Norman origin and the second of the Early English period. Features of the church are the western tower completed in 1482, unique Commonwealth windows of plain glass with beautifully designed leading and some fine woodwork. Among the public buildings are the town hall in the Palladian style. designed by Sir Charles Barry, opened in 1863; the central library and Bankfield museum housed in Victorian mansions: and Shibden hall. a 15th-century timbered house with the Halifax and West Riding Folk museum on its grounds. Heath grammar school was founded in 1585 with a royal charter. The Piece hall. u-here woollen piece goods were lodged and sold, was opened in 1779; is now scheduled as an ancient monument. Wainhouse tower. an octagonal tower with staircase and balconies, is a familiar landmark in the borough.

Halifax. an industrial town. is prosperous because of its manifold trades. It is a centre of the uoollen and worsted industries, other textile products being cotton, silk. rayon and moquette. The manufacture of carpets is important and further industries are iron and steel. wire drawing, breuing and confectionery; machine tools are a noted product and others include boilers, card clothing and cash registers Freestone and fire clay are abundant in the neighbourhood. The town is well equipped with gardens and parks, the most notable being Savile park, an expanse of 72 ac. of grassland. There are numerous charitable endowments, the earliest, the Waterhouse charity. dating from 1635 The town is the regimental depot of the duke of Wellington's regiment. which has been accorded the freedom of the borough. There are literary and artistic associations nith Sir Thomas Browne, Daniel Defoe, Laurence Sterne and the Brontes.

Halifax was first represented in parliament in 1654 but lost the seat aiter the Restoration. The Reform act of 1832 gave Halifax two members. It was a borough by prescription but was not incorporated until 1848; the county borough was created in 1888 and one member is returned to parliament. (F. C. P.)

HALITE, the mineralogic name for naturally occurring sodium chloride, common or rock salt. It occurs in well-formed cubic crystals. which occasionally exhibit hopper-shaped depressions. Halite also occurs commonly in granular masses. Although it is characteristically colourless. it may exhibit brownish. bluish, and other tints. The mineral is characterized by high solubility in water, distinctive salty taste, low specific gravity (2.16), and cubic cleavage.

Most halite occurs in bedded deposits formed by evaporation of bodies of salt water. Deposits range from a few feet to hundreds of feet in thickness and from a few tens of square feet to thousands of square miles in area. The deposits are characteristically associated with beds of limestone. dolomite. shale, and not uncommonly are interbedded with gypsum, anhydrite, and other soluble sodium. potassium, magnesium and calcium salts.

Such deposits are widely and abundantly distributed throughout the world, notably in the U.S.S.R., Germany, Poland, France, Spain and the U.S. In the U.S. very extensive deposits occur in New York, Ohio, Michigan and Pennsylvania and in Kansas, Colorado. Oklahoma. Texas and New Mexico. Halite also occurs along the Gulf of Mexico and the Mediterranean sea, in Rumania and in the U.S.S.R. in large pluglike bodies termed salt domes. Petroleum and sulfur are frequently associated with such domes.

Halite is an essential raw material for the preparation of soda ash, the production of sodium and chlorine compounds in the chemical industry. preservatives in the food-processing industry and for a host of other purposes. *See* also SALT: *Rock Salt;* SALT DOME. (D. M. H.)

HALL, ASAPH (1829–1907), U.S. astronomer and discoverer of the two satellites of Mars, was born on Oct. 15, 1829 at Goshen, Conn. In 1863 he was appointed professor in mathematics at the U.S. Naval observatory. Washington. D.C. This position he held until his retirement in 1891. From 1893 to 1901 he mas professor of astronomy at Harvard. At the naval observatory Hall had the 26-in. equatorial telescope under his charge from 1875 to 1891. His work with it was chiefly in three fields: planetary observations and the orbits of their satellites; observations of double-star orbits; determinations of the stellar parallax. In each of these fields Hall's extensive observations were of great value. His most spectacular achievement was the discovery in 1877 of the two satellites of Mars, whose orbits he calculated. He died at Annapolis, Md., on Nov. 22, 1907.

See G. W. Hill, *Biographical Memoir of Asaph Hall* (1908), which contains a full bibliography of Hall's scientific writings.

HALL, BASIL (1788–1844). British naval officer and traveler who increased geographical knowledge of the far east and of the west coast of South America, was born on Dec. 31, 1788, the son of the geologist Sir James Hall of Dunglass. Basil Hall entered the navy in 1802. He accompanied Lord Amherst's embassy to China in the sloop "Lyra" in 1816, and in that year was made a fellow of the Royal society. His *Account of a Voyage of Discovery to the West Coast of Corea and the Great Loo-Choo Island* appeared in 1818. After an interval for European travel. Hall

made his South American coastal expedition. described in *Extracts From a Journal Written on the Coasts of Chili, Peru, and Mexico, in the Years 1820–21–22* (2nd ed., 2 vol., 1824). Having left the navy. he traveled privately in North America, publishing in 1829 *Travels in North America in the Years 1827 and 1828* (3 vol.). His *Fragments of Voyages and Travels* (9 vol., 1831–33) give an interesting picture of the British navy of the early 19th century. Hall died in Haslar naval hospital near Portsmouth on Sept. 11, 1844.

HALL, CARL CHRISTIAN (1812–1888), Danish statesman, was born at Christianshavn on Feb. 2J, 1812, and was educated for the law. Returned to the *Rigsforsamling* of 1848 as member for the first district of Copenhagen, which he continued to represent in the *Folketing* till 1881, he displayed rare ability as a debater, while his extraordinary tact and temper disarmed opposition. Hall was not altogether satisfied with the fundamental law of June; but he accepted the existing constitution and sought to unite the best conservative elements of the nation in its defence. Failing to rally the landed aristocracy to the good cause, he determined to organize the middle class into a political party. Hence the "June Union," whose programme was progress and reform in the spirit of the constitution, and at the same time opposition to the *Bondevenner* or peasant party. The "Union" exercised an essential influence on the elections of 1852, and was, in fact, the beginning of the national Liberal party, which found its natural leader in Hall. During the years 1852–54 the burning question of the day was the connection between the various parts of the monarchy. Hall was "eiderdansk" by conviction. He saw in the closest possible union between the kingdom and a Slesvig freed from all risk of German interference the essential condition for Denmark's independence; but he did not think that Denmark was strong enough to carry such a policy through unsupported, and he was therefore inclined to promote it by diplomatic means and international combinations.

Hall first took office in the Bang administration (Dec. 12, 1854) as minister of public worship. In May 1857 he became president of the council after Andrae, Bang's successor, had retired, and in July 1858 he exchanged the ministry of public worship for the ministry of foreign affairs, while still retaining the premiership. Hall's programme, "den Konstitutionelle Helstat," *i.e.*, a single State with a common constitution, was difficult enough in a monarchy which included two nationalities, one of which, to a great extent, belonged to a foreign and hostile jurisdiction. But as this situation had been guaranteed by the Conventions of 1851–52, Hall sought to establish this "Helstat" by the Constitution of Nov. 13, 1863. For the failure of the attempt *see* DENMARK: *History*. Hall himself soon became aware of the impossibility of the "Helstat," and his whole policy aimed at making its absurdity patent to Europe, and substituting for it a constitutional Denmark to the Eider which would be in a position to come to terms with an independent Holstein. That this was the best thing possible for Denmark is indisputable, and "the diplomatic Seven Years' War," which Hall in the meantime conducted with all the powers interested in the question, is the most striking proof of his superior statesmanship.

After 1864 Hall's unconquerable faith in the future of his country made him, during those difficultyears, a power in the public life of Denmark. In 1870 he joined the Holstein-Holsteinborg ministry as minister of public worship; he passed many useful educational reforms, but on the fall of the administration, in 1873, he retired from public life. He died on Aug. 14, 1885.

See V. C. S. Topsoe, *Polit. Portraetstudier* (Copenhagen, 1878); S. P. V. Birkedal, *Personlige Oplevelser* (Copenhagen, 1890–91).

HALL, CHARLES FRANCIS (1821–1871), American arctic explorer, was born at Rochester, N.H. His enthusiasm for arctic exploration led him in 1859 to volunteer to the American Geographical Society to "go in search for the bones of Franklin." With the proceeds of a public subscription he was equipped for his expedition and sailed in May 1860 on board a whaling vessel. The whaler being ice-bound, Hall took up his abode in the regions to the north of Hudson bay, where he found relics of Frobisher's 16th century voyages. He published an account of his experiences under the title of *Arctic Researches and Life among the Esquimaux* (1864). Determined to learn more about the fate of the Franklin expedition he returned to the same regions in 1864, and passing five years among the Eskimo was successful in obtaining a number of Franklin relics, as well as information pointing to the exact fate of 76 of the crew, whilst also performing some geographical work of interest. In 1871 he was given command of the North Polar expedition fitted out by the U.S. Government in the "Polaris." Making a remarkably rapid passage up Smith sound at the head of Baffin bay, which was found to be ice-free, the "Polaris" reached on Aug. 30, the lat. of 82° 11′, at that time and until the English expedition of 1876 the highest north attained by vessel. He died suddenly on Nov. 8, 1871.

HALL, CHARLES MARTIN (1863–1914), American inventor, was born at Thompson, O., on Dec. 6, 1863, and graduated at Oberlin college in 1885. While still at college he became interested in the problem of devising a cheap process for the reduction of aluminium. Working with such apparatus as the Oberlin laboratory afforded, he invented, eight months after his graduation, the electrolytic process, which forms the basis for the present commercial production of the metal. The next three years were spent perfecting his process and interesting capitalists. In 1889 the Pittsburgh Reduction Company (later the Aluminum Company of America) began to manufacture aluminium and in 1890 Hall was made its vice-president. The invention made aluminium a common article of commerce, for which constantly increasing uses are being found. Hall's death occurred in Dayton& Fla., on Dec. 27, 1914. The fortune resulting from his invention was bequeathed chiefly to educational institutions, Oberlin receiving gifts totalling more than $3,000,000.

HALL, EDWARD (*c.* 1498–1547), English chronicler and lawyer, was a son of John Hall of Northall, Shropshire. Educated at Eton and King's college, Cambridge, he became common serjeant of the city of London and judge of the sheriff's court. He was also M.P. for Bridgnorth. Hall's great work, *The Union of the Noble and Illustre Famelies of Lancastre and York,* commonly called *Hall's Chronicle,* was first published in 1542, and continued by Richard Grafton (*q.v.*). The value of the *Chronicle* in its early stages is not great, but is very considerable for the reign of Henry VIII. To the student of literature it has the exceptional interest of being one of the prime sources of Shakespeare's historical plays.

HALL, GRANVILLE STANLEY (1844–1924), U.S. psychologist. one of the most influential of the pioneers in American psychology, was born at Ashfield, Mass., on Feb. 1, 1844. He did much to give the science of psychology a broad base, directing into the psychological currents of his time the ideas of Charles Darwin, Wilhelm Wundt. Sigmund Freud and others. Hall was the first president of Clark university (1888–1920) and at the same time professor of psychology there. At Clark he established the first institute of child psychology in the United States. Many of the studies issuing from this institute employed the questionnaire method: staunchly advocated by Hall as a psychological tool. One of the first psychological laboratories in the United States was founded by Hall in 1883 at Johns Hopkins university, where he served as lecturer and professor of psychology from 1881 to 1888. He was a leading spirit in the founding of the American Psychological association and its first president (1892). He launched four psychological journals—the *American Journal of Psychology* (1883), the *Pedagogical Seminary* (1891), the *Journal of Applied Psychology* (1915) and the *Journal of Religious Psychology and Education* (1902)—and published 489 works in nearly all the major areas of psychology. Among his most important published works are *Adolescence; senescence, the Last Half of Life; Youth; The Contents of Children's Minds on Entering School;* and *Founders of Modern Psychology.* A great teacher, Hall had many illustrious students. among them John Dewey, Joseph Jastrow, James McKeen Cattell, Henry Goddard, E. C. Sanford and Lewis Terman. He died at Worcester, Mass., on April 24, 1924.

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of Granville Stanley Hall," *Amer.* J. Psychol. (1925); Lorine Pruett, G. *Stanley Hall* (1926). (H. L. K.)

HALL, SIR JAMES (1761–1832), Scottish geologist and physicist, was born at Dunglass on Jan. 17, 1761. He made a series of experiments to demonstrate the views of James Hutton with regard to intrusive rocks, and was thus the founder of experimental geology. The results of his experiments were brought before the Royal Society of Edinburgh. He was M.P. for Michael, Cornwall, from 1807–12. He died on June 23, 1832, at Edinburgh. He left three sons, of whom the second, Basil (*q.v.*), was a well known writer of travel books.

HALL, JAMES (1793–1868), U.S. author, particularly successful in sketching life in the French settlements of the Illinois country and in interpreting such authentic figures as the backwoodsman, voyageur and Indian hater, was born in Philadelphia, Pa., Aug. 19, 1793. A versatile figure, he was a soldier in the War of 1812, a lawyer and circuit judge, a newspaper and magazine editor, state treasurer of Illinois (1827–1831), a banker in Cincinnati, O., and a writer of history and fiction. During his twelve years in Illinois (1820–1832) he lived at Shawneetown and Vandalia and played an important role in literary and cultural activities. In 1828 he compiled the first western literary annual, the *Western Souvenir,* and he edited the *Illinois Monthly Magazine* (1830–1832) which he continued at Cincinnati until 1836 as the *Western Monthly Magazine.* Much of the material in these periodicals he supplied himself although he consistently encouraged western contributors. He compiled statistical volumes on the steamboating and economic history of the Ohio valley. He died in Cincinnati on July 5, 1868.

Hall wrote an interesting travel book, *Letters from the West* (1828); one novel, *Harpe's Head* (1833); a readable survey of western exploration, *The Romance* of *Western History* (1857); and several volumes of short stories. Tales like "Pete Featherton" and "A Legend of Carondelet," which find a place in many anthologies, early established Hall as a short-story writer of distinction. His best stories appear in *Legends of the West* (1832) and *Tales* of *the Border* (1835).

See John *T.* Flanagan, *James Hall, Literary Pioneer of the Ohio Valley* (1941). (J. *T.* FN.)

HALL, **JAMES** (1811–1898), U.S. geologist and paleontologist, was born at Hingham, Mass., on Sept. 12, 1811. Extreme poverty was the lot of his family, and he acquired through his own efforts his early education, which was, however, sufficiently complete to prepare him for admission to the Rensselaer Polytechnic institute of Troy, N.Y. Even as a boy he was passionately interested in natural history, and at the time of Silliman's Lowell lectures he walked to Boston and back from Hingham in order to attend them. As a student he collected and determined more than 900 species of plants. He spent his summers and all of his limited finances doing field work. After his graduation from the Rensselaer institute in 1832 he became librarian at the institute, and later in the same year an assistant professor; subsequently he became professor of chemistry, natural science and geology. Stephen Van Rensselaer became interested in Hall and sent him to make geological explorations in the St. Lawrence valley.

In 1836 he was appointed one of four geologists on the geological survey of the state of New York which had been established just before that time. Although the youngest of the group, his is the only one of the four final reports which deals broadly with the problems of the science and has endured with authority as a classic of geological literature.

Eventually Hall became state geologist and director of the Museum of Natural History of Albany. Through various periods when state support was withdrawn from geological work, he carried it on at his own expense. At one time he sold 2,000 ac. of Ohio land in order to gain funds to pay obligations incurred through his work, receiving $15,000 for the land, which was valued at $200,000 ten years later. It was only through this sacrifice that the continued publication of the volume of the *Palaeontology of New York* (1847–94) was made possible. These volumes, the results of his chief work, contained descriptions of the invertebrate fossils of New York, in which he dealt with the graptolites, brachiopods, mollusca, trilobites, echini and crinoids of the palaeozoic formations. He was also at one time state geologist of Iowa and afterward of Wisconsin.

His publications, dating from 1836, include more than 260 scientific papers and 35 books, dealing with numerous phases of geology and paleontology of the different regions of the United States and Canada, including reports on the geology of Oregon and California (1845), of Utah (1852), Iowa (1859) and Wisconsin (1862). He received the Wollaston medal from the Geological society of London in 1858.

Hall was regarded as a great teacher as well as collector. In his 86th year he journeyed to St. Petersburg (Leningrad) to take part in the International Geological congress, and then joined the excursion to the Ural mountains. He died at Echo Hill, Bethlehem, N.H., on Aug. 7, 1898, and was buried at Albany, N.Y.

His most important publications were: *Palaeontology of New York,* vol. 1–8 (1847–88; vol. 8, in collaboration with J. M. Clarke, of especial importance); *Geology of New York,* part iv (comprising the survey of the fourth geological district, 1843); with J. M. Clarke, *An Introduction to the Study of the Brachiopoda,* part *I* (11th annual report of New York state geologist, 1892); and part II. (13th annual report, 1894). A complete bibliography of his work is given in the *Bulletin of the Geological Society of America,* vol. *X* pp. 436–451 (1898). *See* also "Life and Works of James Hall," by H. C. Hovey, *American Geol.,* XXIII, p. 137 (1899) (portraits); "Memoir of James Hall," by John J. Stevenson, *Bull. of Geol. Soc. of America,* vol. *X* pp. 425–435 (1898).

HALL, JOSEPH (1574–1656), English bishop, moralist, controversialist and satirist, a notable figure in literature in his own right and as the opponent of Milton and of some importance in the history of ideas both as a churchman and as a moral philosopher. He was born at a farm near Ashby-de-la-Zouch, Leicestershire, on July 1, 1574. Destined for the ministry, he was educated, under Puritan influences. at the Ashby school and in 1589 entered Emmanuel college, Cambridge, then a strongly Puritan college. He had a successful academic career; he was elected for two years running to the university lectureship in rhetoric; and he won a name by his two volumes of satires. But he felt called to the active ministry and accepted Sir Robert Drury's offer of the rectory of Hawstead, Suffolk, and took up his duties there on Dec. 2, 1601. Apart from a visit to Belgium (1605) his leisure at Hawstead was spent, he tells us, in "writing books to buy books." His writings brought him to the notice of Prince Henry and he was appointed a domestic chaplain to the prince and resigned Hawstead (1608) to take up the cure of Waltham Holy Cross, Essex. While absent as chaplain to an embassy to France (1616) he was made dean of Worcester, and on his return he accompanied King James on the visit to Scotland in 1617. He was one of the representatives of the king at the synod of Dort (1618). Consecrated bishop of Exeter on Dec. 23, 1627, he was repeatedly suspected of Puritan leanings by Archbishop Laud, but accepted Laud's suggestion to write *Episcopacy by Divine Right* (publ. 1640) against Puritan attacks on episcopacy. In 1641 he engaged in pamphlet controversy with Puritan opponents. On Nov. 15, 1641, he was translated to the bishopric of Norwich but was for four months imprisoned with the other bishops in the Tower of London before he went to his new see. Deprived of most of his episcopal revenues in 1643 he was finally ejected from his palace and retired to a small house at Higham, near Norwich, where he lived until his death on Sept. 8, 1656.

As a man of letters Hall is remarkable for his versatility and his innovations. The *Contemplations* (151 meditations on the moral and spiritual implications of biblical stories; 1612–26) are not perhaps especially original except for their "Senecan" prose—a clear, curt, pointed style of which Hall was one of the foremost English practitioners, though he could use a full, sonorous style on occasion. In other literary forms, however, he was a pioneer. Although he was not the first to write formal satire in English, his *Virgidemiarum. Six Books* ("six books of harvests of rods") are the first English volumes of satire successfully modeled on Latin satire. The first three books, of "toothless satires" (1597), deal with the defects of contemporary literature, abuses in the professions and ostentation in social life. The last three books, of "biting satires" (1598), deal with graver social, moral and economic evils. Although much of his material is derived from books,

Hall's work is lively and original. The satire is sharply and often wittily pointed; the couplets, often balanced and enclosed, anticipate the satiric heroic couplets of Dryden; and the pictures of Elizabethan life are vivid and striking. The satires were immediately popular and inaugurated a series of satirical books of which the most notable were John Marston's.

Hall was certainly the first to emulate Theophrastus in English when he published (1608) a volume of *Characters of Vertues and Vices* (pithy and witty delineations of such types as "The Flatterer" or "The Good Magistrate"), and he claimed to be an innovator with his volumes of *Epistles* imitating Seneca's *Moral Epistles*. Original and entertaining also, in spite of Milton's scorn for it, is Hall's Latin satire, *Mundus Alter et Idem (c.* 1605). An early example of the imaginary voyage, it is influenced by Rabelais, and itself influenced Swift's *Gulliver's Travels*. Finally, beginning with *Meditations and Vows Divine and Moral* (1605), Hall continued to write meditations for the rest of his life, and here too he showed the way to later writers, enriching the manner and extending the scope of the meditation.

His clash with Milton began in 1641, when, in reply to Hall's *Defence* against "Smectymnuus" (a name made up of the initials of the Puritan divines who had attacked his *Humble Remonstrance to the High Court of Parliament),* Milton wrote *Animadversions.* This provoked a writer on Hall's side (perhaps his son) to turn (in *A Modest Defence)* Milton's technique of unpleasant imputation upon Milton himself, thus stinging Milton into *An Apology* (1642), containing even worse invective, but also precious passages of autobiography. In this Anglican-Puritan conflict, Hall was a moderate, pleading for unity among fellow Christians and for a brotherly tolerance in place of embittered strife about nonessentials. He did not appreciate how strong in such Puritans as Milton was the passion for individual liberty of speech and religious thought, he was bewildered by their readiness to reject established authority and he did not share their confidence in the ability of the common man to govern a church or to extemporize prayer worthy of public worship; but he was prepared, in the interests of peace, to make compromises on church government and on liturgy.

As a moral philosopher Hall achieved a European reputation for his Christianization of Stoicism and became widely known as "the English Seneca" and "the Christian Seneca." In a series of works beginning with *Heaven upon Earth* (1606) he expounded a neo-Stoicism by which men might achieve "true Peace, and Tranquillity of mind." This, discarding the pagan elements of Stoicism, adds to the philosophy of Seneca the Christian doctrines of Grace and Redemption and the efficacy of Faith.

Hall's satires and *Contemplations* were read and appreciated throughout the 18th and 19th centuries; in the 20th century scholars took an increasing interest in his moral and meditative work and in his place in the development of English prose.

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HALL, MARSHALL (1790–1857), English physiologist, was born on Feb. 18, 1790, at Basford, near Nottingham, the son of a cotton manufacturer. He studied medicine at Edinburgh, and became resident house physician to the Royal infirmary. This appointment he resigned after two years to visit the medical schools of Paris, Berlin and Gottingen. He then settled at Nottingham, where he became physician to the General Hospital, and in 1826 removed to London. Hall's principal works are: *Diagnosis* (1817); *Mimoses* (1818), on the affections designated as bilious, nervous, etc.; *Observations on Blood-letting* (1830), and *Experimental Essay on the Circulation of the Blood in the Capillary Vessels* (1831) in which he showed that the blood channels intermediate between arteries and veins serve the office of bringing the fluid blood into contact with the material tissues of the system, previously discovered by M. Malpighi and A. van Leeuwenhoek. In 1832 he read before the Royal society a paper "On the inverse ratio which subsists between respiration and irritability in the animal kingdom." His most important work in physiology was concerned with the theory of reflex action, embodied in a paper "On the reflex function of the Medulla Oblongata and the Medulla Spinalis" (1832), supplemented in 1837 by another "On the true Spinal Marrow, and the Excito-motor System of Nerves." Hall thus became the authority on the multiform deranged states of health referable to an abnormal condition of the nervous system. His "ready method" for resuscitation in drowning and other forms of suspended respiration has saved innumerable lives. He died on Aug. 11, 1857.

A list of his works are given in his *Memoirs* by his widow (1861).

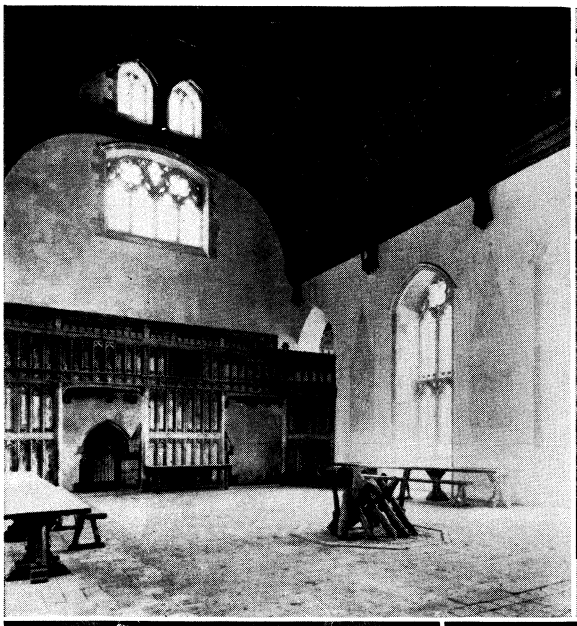
HALL, ROBERT (1764–1831), English Baptist divine, was born on May 2, 1764, at Arnesby near Leicester, where his father, Robert Hall (1728–91), was pastor of a Baptist congregation. Ending his studies at Aberdeen university he became classical tutor at the Bristol academy. In 1790 he became pastor of a church at Cambridge, where he remained for 15 years and made a great reputation as a preacher. He died on Feb. 21, 1831.

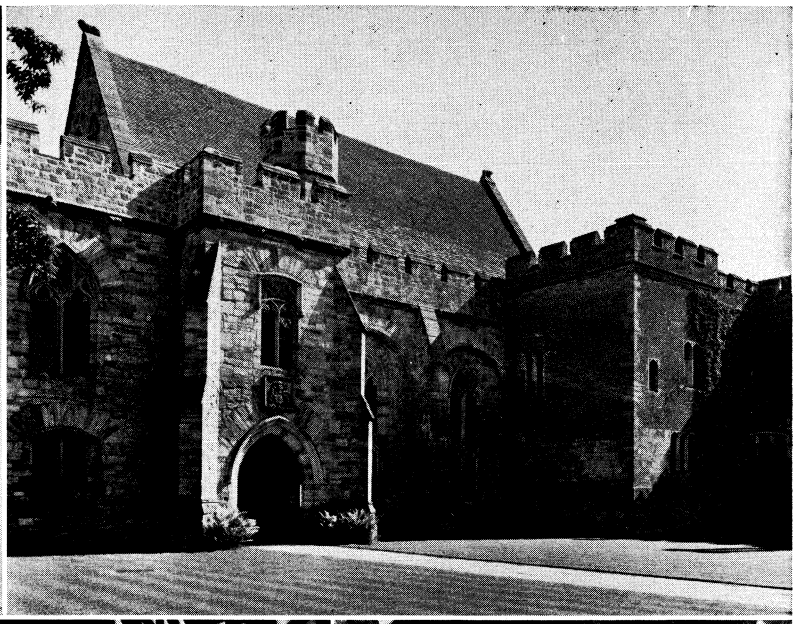
See *Works of Robert Hall, A.M., With a Brief Memoir of His Life, by Olinthus Gregory, LL.D., and Observations on his Character as Preacher by John Foster,* 6 vol. (1832).

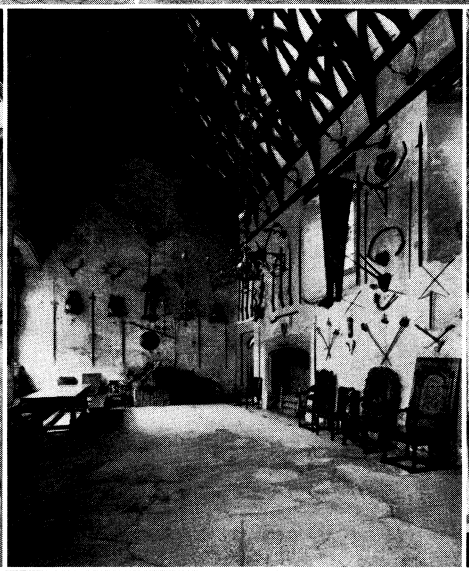
HALL, a meeting place, entry, or passageway, ranging in size from a large reception room in a public building to a corridor or vestibule of a house. For the feudal society of medieval Europe, the hall was the centre of all secular activities. Originally it was used for cooking and sleeping by large groups of people, as well as for the activities it still shelters when it is used as courtroom, banquet room, or place of entertainment. Beginning as a rectangular, barnlike structure, the hall probably evolved from the prehistoric wood framed tribal dwellings of northern Europe. Early examples had much in common with contemporary churches, employing a rhythmic structural system of three or more bays. The larger halls were divided by two rows of posts or stone columns into a nave and aisles. The rough stones of the fireplace were set near the centre of an earth floor strewn with an unsanitary layer of rushes to provide insulation. Smoke found its way out through the open roof framing at the gable ends or by means of a louver, near the centre of the ridgepole, protected by a wooden turret. The doors were opposite the end of the building reserved for the lord and his family. Eventually this area was distinguished by a low platform or dais, and a partial ceiling was brought forward the full width of the end wall behind it to form a canopy overhead. Dating from the 12th century, the remains of the bishop's palace at Hereford and the timber roof at Leicester castle are probably the oldest surviving fragments of gabled feudal halls.

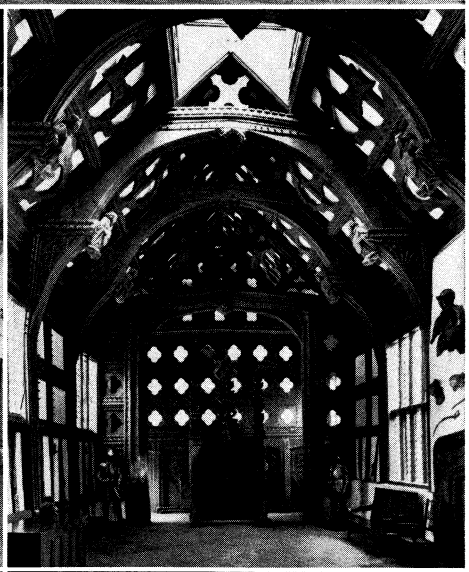
As a defense against marauders halls were placed to take advantage of terrain and were often protected by moats or palisades. In Norman castles and English border fortresses the hall was part of the principal stone tower, built over a vaulted storage room with wooden beams supporting rooms above. Until the 14th century the medieval town house consisted of an undivided all-purpose living room, or hall, over a street-level shop area. In the country the hall began to evolve into the manor house in the 13th century as smaller rooms were added at the ends of the great central space. A low structure was built against the end wall for cooking and storage of supplies. A centre door leading to the kitchen was flanked by the hatches or doors to the pantry and buttery. As the outside doors were placed opposite each other in the long walls at this end, a passageway was formed which was provided with porches and wooden screens to protect the rest of the hall from drafts. Behind the dais a two-story structure was annexed with a solar or private room over a storage basement accessible from it. The solar was entered from an outside ladder or stair and communicated with the hall by means of a window or

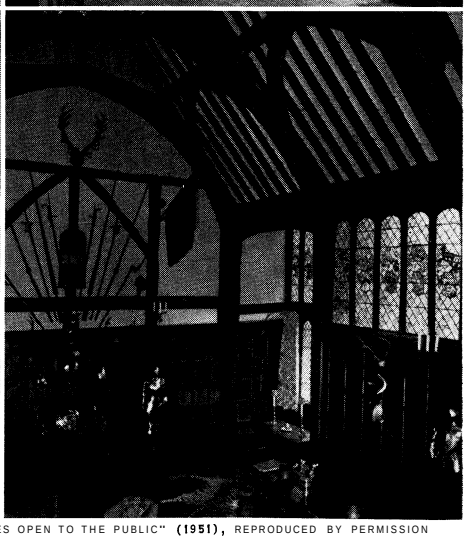
HALL











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ENGLISH HALLS

Top left and top right: Interior and exterior of Penshurst Place, Kent; 14th century. Notable for its hammerbeam roof. Interior view shows the central hearth of the great hall

Centre left: Great hall *of* Hampton Court palace, Middlesex; 16th century

Centre: Cotehele house, Cornwall; Tudor

Centre right: Rufford Old Hall, Lancashire; early Tudor

Bottom left: The south front of Hatfield House, Hertfordshire; early 17th century

Bottom right: Great hall of Ockwell Manor, Berkshire; 15th century

peepholes. Later, more secure conditions and the desire for privacy and for more easily heated rooms led to the development of living quarters on the lower floor, with entrances directly into the hall. As the end structures were extended they were linked with scattered service buildings and the gatehouse to form courts on one or both of the long sides of the hall.

From the 14th century halls were built with uninterrupted interiors spanned by great timber roofs. The aisled type was retained only in monastic hospitals where it was convenient to continue to place beds in the side bays. At Westminster hall the Norman interior supports were removed and a hammerbeam roof (*q.v.*) installed. A series of halls in northwestern England retained only the pair of columns nearest the doors to support a great wooden arch and light wooden screen walls blocking the aisles. A large freestanding screen like that at Rufford Old hall provided further protection from drafts. But the typical 15th- or 16th-century hall was entered through doors in a screen structure that terminated in the ornamented parapet of a musicians' gallery installed over the low passageway ceiling. The large fireplace and its chimney were built into a side wall. The dais was extended at one or both ends to provide a large bay which from the exterior appeared to balance the porch. It had full-length mullioned windows supplementing the traditional openings high in the side or end walls. With the development of the separate dining room and the decline of the old social order at the end of the middle ages began the descent of the hall in domestic architecture to its present status of entrance and passageway. However, towns. guilds. colleges, and other organizations built halls rivaling those of the barons. The names of many public buildings reflect the fact that a ceremonial reception room is their major feature.

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HALLAM, the name of a family of Anglo-U.S. actors and theatrical managers associated with the beginnings of the professional theatre in America. LEWIS HALLAM (1714–1756) was sent to the American colonies by his brother. WILLIAM HALLAM, manager of a London theatre. With Lewis Hallam were his wife. MRS. SARAH HALLAM, and their son, LEWIS HALLAM (1740–1808). Their first appearance in the new world was at Williamsburg, Va., where, on Sept. 15, 1752, they presented *The Merchant of Venice.* This production marked the first appearance of a professional acting company in the American colonies. The following year they built the first theatre in New York city. After six years in New York. Philadelphia and Jamaica, the elder Lewis Hallam died; and the company re-formed under David Douglass, whom Mrs. Hallam married. It was in this company that Lewis Hallam the younger first became a leading man. In 1775 the war forced them into temporary retirement in Jamaica. Ten years later the company returned under the leadership of Lewis Hallam, Mrs. Hallam having died and David Douglass having retired. For the next 25 years the younger Hallam managed and acted with various companies throughout the United States. He was an accomplished actor but was known as a quarrelsome manager. He died in Philadelphia in 1808.

ISABELLA HALLAM (1746–1826), a daughter of the elder Lewis Hallam, was, as Mrs. Mattocks, a well-known actress in England. (S. W. H.)

HALLAM, HENRY (1777–1859), English historian. was the only son of John Hallam, canon of Windsor and dean of Bristol. and was born on July 9. 1777. He was educated at Eton and Christ Church. Oxford. nhere he graduated in 1799. Called to the bar, he practised for some years on the Oxford circuit; but his tastes were literary, and nhen. on the death of his father in 1812. he inherited a small estate in Lincolnshire. he gave himself up wholly to the studies of his life. His Whig connections won for him a well-paid and easy post of commissioner of stamps. He supported the abolition of the slave trade; and he was throughout his life a sincere upholder of Whig principles General sympathy was felt for him when he lost his tno brilliant sons, Arthur Henry Hallam (d. 1833), the A.H.H. of Tennyson's *In Memoriam,* and Henry Fitzmaurice Hallam (d. 1850). Hallam was a fellow of the Royal Society and a trustee of the British Museum. He died on Jan. 21, 1859. His great reputation rests on three standard works: *The View of the State of Europe during the Middle Ages* (1818; supplementary note, 1848); *Constitutional History of England* (1827); and *Introduction to the Literature of Europe in the 15th, 16th and 17th Centuries* (1838–39).

The *Middle Ages* is made up of nine long chapters, each of which is a complete treatise. The history of France, of Italy, of Spain, of Germany and of the Greek and Saracenic empires, sketched in rapid and general terms, is the subject of five separate chapters. Others deal with the great institutional features of mediaeval society—the development of the feudal system, of the ecclesiastical system and of the free political system of England. The last chapter sketches the general state of society, the growth of commerce, manners and literature in the middle ages.

The *Constitutional History of England* takes up the subject at the point at which it had been dropped in the *View of the Middle Ages,* viz., the accession of Henry VII., and carries it down to the accession of George III. An unwillingness to excite the prejudices of modern politics, which withheld him from touching perhaps the most interesting period in the history of the Constitution, did not save him from a violent attack by Southey in the *Quarterly Review,* 1828; he was accused "of heaping obloquy on all who supported the established institutions of the country." His chief unfairness was in tacitly assuming the 19th-century theory of the Constitution to be the right theory in previous centuries, and that those who departed from it on one side or the other were in the wrong. But though his work is thus coloured by his opinions, this was not the outcome of a conscious purpose, and he was scrupulously conscientious in collecting and weighing his materials. In this he was helped by his legal training, and the *Constitutional History* remains a standard authority.

Like the *Constitutional History,* the *Introduction to the Literature of Europe* continues one of the branches of inquiry opened in the *View of* the *Middle Ages.* The great qualities displayed in this work have been universally acknowledged—conscientiousness, accuracy. judgment and enormous reading. In science and theology, mathematics and poetry. metaphysics and law. Hallam is a competent and always a fair if not a profound critic. The bent of his own mind is manifest in his treatment of pure literature and of political speculation—which seems to be inspired with stronger personal interest and a higher sense of power than other parts of his work display.

Hallam is generally described as a "philosophical historian." The description is worthy in that he fixed his attention on results rather than on persons. His conception of history embraced the whole movement of society. But sweeping theories of the government of society. and broad characterizations of particular periods of history had no attraction for him.

HALLAM, ROBERT (d. 1417), bishop of Salisbury and English representative at the council of Constance. was educated at Oxford. and was chancellor of the university from 1403 to 1405. In the latter year the pope nominated him to be archbishop of York. but the king objected. However. in 1407 he was consecrated by Gregory XII. at Siena as bishop of Salisbury. At the council of Pisa in 1409 he was one of the English representatives. On June 6, 1411, Pope John XXIII. made Hallam a cardinal, but there was some irregularity. and his title was not recognized. At the council of Constance (*q.v.*), nhich met in Nov. 1414, Hallam was the chief English envoy. In the discussions which led up to the deposition of John XXIII. on May 29. 1415, he had a leading share. With the trials of John Hus and Jerome of Prague he had less concern. Under Henry V.'s direction, he gave the emperor Sigismund vigorous support in the endeavour to secure a reform of the Church, before the council proceeded to the election of a new pope.

Hallam died suddenly, on Sept. 4, 1417.

HALLÉ, SIR CHARLES (originally KARL HALLE) (1819–1895), English pianist and conductor. German by nationality. was born at Hagen, Westphalia, on April 11, 1819. He studied under Rink at Darmstadt in 1835. and in 1836 nent to Paris. where for

12 years he mixed nith Cherubini, Chopin, Liszt, Alfred de Musset, George Sand and other celebrities. He had started a set of chamber concerts with Alard and Franchomme, when the revolution of 1848 drove him from Paris, and he settled, with his wife and two children, in London. His pianoforte recitals, given at first from 1850 in his own house, and from 1861 in St. James's Hall, were for many years an important feature of London musical life. At the Musical Union founded by John Ella, and at the Popular Concerts from their beginning, Hallé was a frequent performer, and from 1853 he was director of the Gentlemen's Concerts in Manchester, nhere, in 1857, he started the famous Hallé Concerts. In 1888 he married Madame Norman Neruda (1839–1911), a noted violinist. In the same year he was knighted. He died at Manchester Oct. 25, 1895.

HALLE (known as HALLEANDER SAALE to distinguish it from the small town of Halle in North Rhine-Westphalia), a city in the German Democratic Republic (east Germany), chief town of a district (*bezirk*) of the same name, lies 361 ft, above sea level in a sandy plain on the right bank of the Saale river, which there divides into several arms, 21 mi. N.W. from Leipzig. Pop. (1950) 289,119.

Halle is first mentioned as a fortress erected on the Saale in 806. In 968 Halle, with its valuable saltworks, was given by the emperor Otto I to the newly founded archdiocese of Magdeburg, and in 981 Otto II gave it a charter as a town. From the first there were separate jurisdictions for the *Halloren* (or "salt-workers") and the German settlers in the town. The conflict of interests and jurisdictions led to the usual internecine strife during the middle ages, and both groups resisted the pretensions of the archbishops. In the 13th and 14th centuries Halle was a member of the Hanseatic league (*q.v.*). Its liberty perished, however, as a result of the internal feud between the democratic guilds and the patrician owners of the saltpans. In 1478 a demagogue member of the town council, with his confederates, opened the gates to the soldiers of the archbishop. The townsmen were subdued, and to hold them in check the archbishop built the castle of Moritzburg. Notwithstanding the efforts of the archbishops of Mainz and Magdeburg, the Reformation found an entrance into the city in 1522. After the peace of Westphalia in 1648 the city was passed to the house of Brandenburg.

Its situation at the junction of railway lines from Berlin, Breslau, Leipzig, Frankfurt-on-Main, the Harz country and Hanover has developed the commercial and industrial importance of Halle. It consists of the old, inner town and two small towns, Glaucha in the south and Neumarkt in the north. The centre of the town is occupied by the market square, on which stand the medieval town hall (restored in 1883) and the Gothic Marienkirche, dating mainly from the 16th century, with two towers connected by a bridge. In the square is a bronze statue of Handel, the composer, a native of Halle. Among'the churches the St. Moritzkirche, dating from the 14th century, with fine wood carvings and sculptures, and the cathedral (belonging since 1689 to the Reformed or Calvinist church), built in the 16th century, are worthy of note. The castle of Moritzburg, formerly the residence of the archbishops of Magdeburg, was destroyed by fire in the Thirty Years' War, with the exception of one wing. The university was founded by the elector Frederick III of Brandenburg (afterward king of Prussia) in 1694, was closed by Napoleon in 1806 and again in 1813, but in 1815 was re-established and united with the University of Wittenberg. It has long been recognized as one of the principal seats of Protestant theology.

Among the industries of Halle are sugar refining, machine building, the manufacture of spirits, malt, rubber, cement, paper, chicory, lubricating and illuminating oil, wagon grease, printing, dyeing and coal mining (soft brown coal).

During World War II Halle was taken by U.S. forces on April 19, 1945, after four days of street fighting, during which it suffered much damage. It was included in the Soviet occupation zone, prior to the establishment of the German Democratic Republic in 1949.

HALLECK, FITZ-GREENE (1790–1867), U.S. poet, was a leading member of the Knicirerbocker group, and known both for his satirical and romantic verse. He was born at Guilford, Conn., July 8, 1790, and died there Nov. 19, 1867. He was an employee in various New York city banks, including that of John Jacob Astor. In collaboration with Joseph Rodman Drake he contributed the satirical "Croaker Papers" to the New *York* Evening *Post* in 1819, and on the death of his friend he wrote the moving tribute beginning "Green be the turf above thee." Fanny (1819), his longest poem, was a satire on social climbers. Other popular favourites were the feudal romance "Alnwick Castle" (1822), "Burns" (1822, publ. 1827), the often recited "Marco Bozzaris" (1823, publ. 182j), "Red Jacket" (1828) and "Young America" (1865). Strongly influenced by Scott and Byron, he was a poet of slight but genuine gift.

His *Life and Letters* by *J. G.* Wilson appeared in 1869. His *Poetical Writings* were edited by Wilson in the same year. *See* also N. *F.* Adkins, *Fitz-Greene Halleck* (1930).

HALLECK, HENRY WAGER (1815–1872), U.S. general and jurist, was born at Westernville, Oneida county, N.Y., in 1815. Upon graduation from West Point military academy in 1839 he was appointed to the engineers, and in 1844 he was sent by the government to visit the principal military establishments of Europe. After his return, Halleck delivered a course of lectures on the science of war, published in 1846 under the title Elements of Military *Art* and Science, a later edition of which was widely used as a textbook by volunteer officers during the Civil War. On the outbreak of the hlexican War in 1846. he served with the expedition to California and the Pacific coast, acting for several years in California as a staff officer, and as secretary of state under the military government, and in 1849 he helped to frame the state constitution of California. In 1854 Captain Halleck resigned his commission and took up the practice of law with great success. On the outbreak of the Civil War he returned to the army as a major general, and in Nov. 1861 he was charged with the supreme command in the western theatre of war.

There can be no doubt that his administrative skill was mainly instrumental in bringing order out of chaos in the hurried formation of large volunteer armies in 1861, but the strategical and tactical successes of the following spring were due rather to the skill and activity of his subordinate generals, Grant, Buell and Pope, than to the plans of the supreme commander. In July, however, he was called to Washington as general in chief of the armies. At headquarters his administrative powers were conspicuous, but he proved to be utterly wanting in any large grasp of the military problem; the successive reverses of McClellan, Pope, Burnside and Hooker in Virginia were not infrequently traceable to the defects of the general in chief. In March 1864 Grant was appointed to replace him, Halleck becoming chief of staff at Washington. This post he occupied with credit until the end of the war. Halleck's position as a soldier is easily defined by his uniform success as an administrative official, his equally uniform want of success as an officer at the head of large armies in the field, and the popularity of his theoretical writings on war. While his interference with the dispositions of the commanders in the field was often disastrous, his services in organizing and instructing Union forces were of high value. He died at Louisville, Ky., Jan. 9, 1872.

Besides *Military Art and Science*, Halleck wrote *Bitumen, Its Varieties, Properties and Uses* (1841); *The Mining Laws of Spain and Mexico* (1859); *International Law* (1861; new ed., 1908); and *Treatise on International Law and the Laws of War, Prepared for the Use of Schools and Colleges*, abridged from the larger work. He translated Jomini, *Vie politique et militaire de Napoléon* (1864), and De Fooz, *On the Law of Mines* (1860). The works on international law mentioned above entitle General Halleck to high rank among the jurists of the 19th century.

HALLEFLINTA (a Swedish word meaning "rock flint"), a white, gray, yellow, greenish or pink fine-grained rock found in Scandinavia consisting of an intimate mixture of quartz and feldspar. hlany examples are banded or striated; others contain porphyritic crystals of quartz which resemble those of the felsites and porphyries. Mica, iron oxides, apatite, zircon, epidote and hornblende may also be present in small amounts. The more micaceous varieties form transitions to granulite and gneiss. Halleflinta under the microscope is very finely crystalline, or even cryptocrystalline, resembling the felsitic matrix of many acid rocks. It is essentially metamorphic and occurs with gneisses, schists and gran-

ulites, especially in the Scandinavian peninsula, where it is regarded as being very characteristic of certain horizons. Of its original nature there is some doubt, but its chemical composition and the occasional presence of porphyritic crystals indicate that it has affinities to the fine-grained acid intrusive rocks. In this group there may also have been placed metamorphosed acid tuffs and a certain number of adinoles (shales, contact-altered by intrusions of dolerite). The assemblage is not a perfectly homogeneous one and includes both igneous and sedimentary rocks, but the former preponderate. Rocks very similar to the typical Swedish hälleflintas occur in the Tirol, Galicia and eastern Bohemia.

HALLEL, a Jewish liturgical term designating Ps. cxiii–cxviii, as read in synagogue services on festive occasions. The theme is faith in and gratitude for Divine Providence. These hymns or psalms were recited by the Levites in the services of the Jerusalem Temple, probably with the refrain "Hallelujah" ("Praise ye the Lord"). Later the term meant Ps. cxxxvi, used in the daily morning service. In modern times the Hallel is often recited in English antiphonally.

See S. Singer and I. Abrahams, *The Authorised Daily Prayer Book* (1922).

HALLER, ALBRECHT VON (1708–1777), Swiss anatomist and physiologist, notable for, among many other contributions, his conceptions of the nature of living substance and of the action of the nervous system, was born at Berne on Oct. 16, 1708. Prevented by ill-health from joining in sports, he developed an amazing precocity. He studied medicine at Tübingen under Camerarius. and then at Leiden under Boerhaave and Albinus. graduating in 1727 with a thesis that proved the so-called salivary duct to be merely a blood vessel. After visiting London, Oxford and Paris, in 1728 he went to Basel, where the awakening of his interest in botany led him to begin a collection of plants which was afterward the basis of his great work on Swiss vegetation. About the same time he wrote his poem "Die Alpen," included in the first edition of his *Gedichte* (1732).

In 1730 Haller began to practise as a physician in Berne, but the fame of his botanical and anatomical researches led to his appointment, in 1736, to the chair of medicine, anatomy, surgery and botany in the newly founded University of Gottingen. He held this post for 17 years, conducting at the same time a monthly journal (the *Gottingische gelehrte Anzeiger*), to which he is said to have contributed about 12,000 articles on almost every branch of knowledge. In 1753 Haller resigned his chair and returned to Berne, where he prepared his *Bibliotheca medica,* the botanical, surgical and anatomical parts of which he lived to complete; wrote three philosophical romances, *Usong* (1771), *Alfred* (1773) and *Fabius and Cato* (1774), expounding his views on various types of government; produced among other medical works, the justly famed *Elementa physiologiae corporis humani* (1757–66); and fulfilled various municipal and state duties. Haller died on Dec. 12, 1777.

Among Haller's most important contributions to medicine may be named his recognition of the mechanism of respiration and the automatism of the heart; his admission of the use of bile in the digestion of fat; his descriptions of the development of the embryo; his work on the anatomy of the organs of generation, of the brain, of the heart and of many imperfectly known arteries; and above all his classification of the bodily parts as sensible and insensible, irritable and nonirritable, together with his noteworthy demonstration that sensibility and irritability are independent, the former being a property of tissues endowed with nerves, the latter a peculiarity of all muscular tissue, independent of the nerves proceeding to it and surviving in severed parts.

Apart from the works mentioned above. Haller's chief writings are *Enumeratio methodica stirpium Helveticarum* (1742); *Icones anatomicae* (1743–54); *Disp. anatomicae Selectiores* (1746–52); *De respiratione experimenta anatomica* (1747); *Opuscula botanica* (1749); *Opuscula pathologica* (1754); an edition of Boerhaave's *Artis medicae principia* (1769); and *Disp. chirurg. collectio* (1777).

See J. G. Zimmermann, *Das Leben des Herrn von Haller* (1755); and the detailed biography in L. Hirzel's edition of the *Gedichte* (1882).

HALLEY, EDMUND (1656–1742), English astronomer who observed the comet of 1682 now called by his name, was born in London on Oct. 29, 1656, and was educated at St. Paul's school, London, and at Queen's college, Oxford. His first paper, concerning planetary orbits, was published in the *Philosophical Transactions* of the Royal society in 1676. He formed a friendship with John Flamsteed, who had been appointed astronomer royal in the preceding year, and was often in his company, helping him and Robert Hooke to design and construct the Greenwich observatory. Halley also assisted Flamsteed in his observations. Influenced by Flamsteed's great project of forming an accurate catalogue of northern stars, Halley proposed to do the same in the south, and obtaining an introduction, through Charles II, to the East India company, he left Oxford without a degree in Nov. 1676, and sailed to St. Helena in a ship of that company. At St. Helena he catalogued more than 300 stars, observed a transit of Mercury (Nov. 7, 1677) and made numerous pendulum observations. He also named a new constellation, Robur Carolinum, in honour of Charles II, but this is no longer recognized by celestial cartographers.

Upon his return to England in 1678 he was granted the degree of M. A. by the University of Oxford and began a friendship with Sir Isaac Newton, which resulted in his publication, at his own expense, of Newton's *Principia.* This work's debt to Halley was well expressed by Augustus De Morgan: ". . . but for him, in all human probability, that work would not have been thought of, nor when thought of written, nor when written printed." Halley calculated the orbit of the comet of 1682, and his correct prediction of its return in 1758 was the first application of Newton's laws of motion. His work on comets involved the calculation of orbits for all those for which sufficient observations existed, and, as well as making the important discovery that some comets are periodic, he noticed that their orbital planes are distributed at random, in sharp distinction to those of the planets. Under instructions from the admiralty he commanded the war sloop "Paramour Pink" from 1698 to 1700 on the first sea voyage undertaken for purely scientific purposes and again in 1701 during a survey of tides in the English channel. In 1703 Halley was appointed Savilian professor of geometry at Oxford and in 1720 he succeeded John Flamsteed as astronomer royal. Although then in his 64th year, he undertook to observe the moon through an entire revolution of its nodes (18 years), and actually carried out his purpose. Halley also detected the proper motions of the stars (1718), the acceleration of the moon's mean motion (1693) and the long inequality of Jupiter and Saturn. He indicated first in 1679 and again in 1716 a method extensively used in the 18th and 19th centuries for determining the solar parallax by means of the transits of Venus. He died at Greenwich on Jan. 14, 1742.

As an observational astronomer Halley was much inferior to Flamsteed and his astronomical observations remained largely unreduced and unpublished. His genius lay in discussing large bodies of data and reducing them to some kind of order. His *Breslau Table of Mortality,* published in 1693, is one of the first attempts to found tables of annuities on a basis of fact. He was the originator of graphical methods of representing on maps the geographical distribution of the physical features of the earth; the first meteorological chart appeared in 1688 and the first magnetic chart in 1701. The magnetic charts, constructed from all available observations augmented with many of his own made in England and on sea voyages, were of great practical value and were used for many years after his death.

Halley's principal works are *Catalogus stellarum Australium* (1679), the substance of which was embodied in the third volume of Flamsteed's *Historia coelestis* (1725); *Synopsis astronomiae cometicae* (Eng. trans., *A Synopsis of the Astronomy of Comets,* 1705); *Astronomical Tables* (1752); and 81 papers scattered through the *Philosophical Transactions* of the Royal society. To these should be added an edition of the *De sectione rationis* (1706) and the *Libri conicorum* of Apollonius of Perga (1710). Two books of the *De sectione rationis* and three of the *Libri conicorum* were known only in Arabic and Halley, after learning this language for the purpose and with some help from an Arabic scholar, produced a translation including a restitution of some passages in

which the Arabic text was corrupt. One lost book was restored from a summary given by Pappus and from references to it elsewhere in Apollonius. Halley also edited an unauthorized version of Flamsteed's *Historia coelestis* in 1712.

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HALLGRÍMSSON, JÓNAS (1807–1845), one of the greatest and most popular poets of Iceland, was born at Hraun in Öxnadalur in the north of the country. He began his education at the school of Bessastaðir, near Reykjavik, from which he graduated to the University of Copenhagen, Den., in 1829. He first of all studied law and afterward turned to science and literature. Hallgrimsson returned to Iceland in 1837 and engaged himself in scientific research in the island with the support of the Danish government until 1842. He then returned to Copenhagen, to remain in Denmark until his death in 1845.

Valuable as was Hallgrimsson's work as a scientist, he is remembered chiefly as a poet. His poetry is predominantly lyrical, and he excels in descriptions of Icelandic scenery. He greatly admired the romantic poets, especially Heinrich Heine, and adapted and translated much foreign poetry into Icelandic. Hallgrimsson's interest in romantic poetry led him to revolt against and criticize the *rimur*, narrative poems in traditional, artificial form, composed in stereotyped metres and phrases, which had long been popular in Iceland. He strove to puriiy and to simplify the language of poetry as Wordsworth did in England. Hallgrimsson's poetry is filled with patriotism and with a love of nature, and some of it was inspired by stories of ancient Icelandic heroes as well as by the Edda and other mediaeval poetry.

Much of Hallgrimsson's poetry was published in the periodical *Fjölnir*, which he, together with other Icelandic students, founded in Copenhagen in 1835. He was also the author of critical works and of short stories in prose, some of which were published in *Fjölnir* after his death.

See the complete works of Hallgrimsson, published under the title ***Rit***, 5 vol. (Reykjavik, 1929–36); also Richard Beck, History of Icelandic Poets, *1800–1940* (Ithaca, N.Y., Oxford, 1950). (G. T.-P.)

HALLMARK is a series of symbols stamped on an article of gold or silver to denote that it conforms to one of the legal standards. These standards define the maximum proportion of base metals which may be alloyed with pure gold or silver for hardening or other purposes. The presence of a hallmark on an article indicates that it has been sampled and tested at an authorized assay office. Most articles are required by law to be hallmarked before sale, although there are certain exemptions (*e.g.*, gold rings other than mourning or wedding rings).

Hallmarking in Great Britain dates from the reign of Edward I. A statute of 1300 provided that no gold or silver should be sold until tested by the "Gardiens of the Craft" and struck with the leopard's head. The London Guild of Goldsmiths (later the Worshipful Company of Goldsmiths) has since that date been responsible for the assay and marking of plate in London. The word hallmark means literally a mark applied at Goldsmiths' hall. There are now also assay offices at Birmingham, Chester, Sheffield, Edinburgh and Glasgow. (J. S. Fs.)

In the United States, there are no hallmarks on silver or gold objects, since there is no history of guild or government regulation comparable to that of Great Britain. Local regulatory practices were established in New York, Boston, Mass., Baltimore, Md., and elsewhere in the late 18th and early 19th centuries, but no consistent system of symbols was adopted. Maker's marks appear, usually consisting of the initials or name of the maker. Beginning in the early 19th century the words coin (900 parts fine silver to 100 parts alloy) and sterling (925 parts fine silver to 75 parts copper) were stamped on silver objects and in 1906 the use of the words became subject to federal regulation. The purity of gold is given in carats, pure gold being 24 carats; its marking is also subject to federal regulation. (X.)

MARKS ON SILVER

The history of the symbols making up a complete hallmark on modern silver (fig. 1) is as follows.

Town or Assay Office Mark.—The leopard's head, first known as the king's mark. indicated that a silver article was of sterling standard; *i.e.*, containing at least 92.5% fine silver. When the lion passant was introduced as the standard mark (see below), the leopard's head was retained as the London town mark. In 1478 a crown was added (see fig. 2); but since 1821 the head has remained uncrowned. Provincial offices, when subsequently recognized, had their own distinctive town marks (fig. 3).

Maker's Mark.—This was introduced by a statute of 1363. At first a device was used, examples being a fish, a key or a fleur-de-lis, often taken no doubt from the sign outside the goldsmith's shop. Gradually, it became the practice for the maker to use the initials of his Christian and surnames, either alone or in conjunction with a device.

In 1697, when the Britannia standard was introduced (see below), the adoption of the first two letters of the maker's surname was made compulsory. The previous form of mark was revived in 1720 when the sterling standard was restored. The new mark, however, was struck on articles made in the Britannia standard. In 1739 a statute ordered all silversmiths to substitute for their two existing forms of mark a single one with the initials of their Christian and surnames in new characters.

Manufacturers are obliged to register their marks at the assay officeto which they submit their wares. The original significance of the maker's mark has been lost to some extent by the occasional use of the registered mark of the subsequent retailer in place of that of the manufacturer.

Date Letter.—The assaying of plate was entrusted to one of the wardens of the London Goldsmiths' company, who held office for one year. It is probable that it was in order to identify the warden responsible for assaying a particular ware that an alphabetical date-letter system was introduced (fig. 4). Such a system is known to have existed as early as 1478. The letter was changed annually and, on completion of one alphabet, the character of the letters or the shape of the surrounding shield was altered. This practice has been adopted by all British assay offices. The London office uses the alphabet from A to U omitting the J and changes the date letter each May. At the Birmingham, Sheffield and Chester offices, the alphabets selected are of 25 letters; the change is made each July.

The date letter denotes the year of assay and marking, not necessarily that of manufacture, although in most cases these are the same. Occasionally an old ware which has not been previously submitted is sent to be marked so that it can be sold legally.

Standard Mark or Marks.—Sterling Standard.—The lion passant (fig. 5[A]) was introduced in 1544 and is used by all the English offices to denote that a silver article is of the sterling standard. At Edinburgh the sterling standard mark is a thistle and at Glasgow a thistle and a lion rampant (fig. 5[B]).

Britannia Standard.—In 1697 the standard of wrought plate was compulsorily raised to 95.84%. This step was taken to prevent silversmiths from melting coins for their raw material. The figure of Britannia and a lion's head erased replaced the lion passant and leopard's head respectively on silver of this standard which was known as Britannia or New Sterling. The higher silver content resulted in a softening of the alloy. Consequently, it proved to be not entirely suitable for domestic plate and in 1720 the old standard was restored together with the former marks. Articles which are made occasionally in the higher standard are struck with the Britannia marks (fig. 5[C]). For this standard the English provincial offices use their normal town marks in conjunction with the figure of Britannia. The Edinburgh and Glasgow offices include the lion's head erased with the figure of Britannia and their own town marks.

Additional Marks.—The following are sometimes found on silver.

Duty Mark.—From 1784 a duty imposed on plate was collected by the assay offices on behalf of the commissioners of customs and excise. To signify that the duty had been paid, a mark consisting of the sovereign's head in profile was struck in addition to the usual symbols. The duty was finally abolished in 1890 (in 1798 in respect of watchcases), the mark then becoming obsolete. Silver of this period therefore normally bears the head of one of the following: George III (fig. 6[A]), George IV, William IV, Victoria (fig. 6[B]).

Silver Jubilee Mark.—A special mark of the crowned heads of

FIG 1 — EXAMPLE OF A HALLMARK ON MODERN SILVER. (A) MAKER'S MARK. (B) TOWN MARK. (C) STANDARD MARK. (D) DATE LETTER

FIG 2 — LEOPARD'S HEAD LONDON

FIG. 4. — DATE LETTER (BIRMINGHAM. 1952-53)

FIG. 5. — (A) EARLY FORM OF LION PASSANT. (B) STERLING STANDARD MARKS (GLASGOW). (C) MODERN BRITANNIA MARKS (LONDON)

FIG. 6. — (A) DUTY MARK (GEORGE III). (B) DUTY MARK (VICTORIA). (C) SILVER JUBILEE MARK. (D) CORONATION MARK

ASSAY OFFICE	TOWN MARK
LONDON	LEOPARD S HEAD (ON STERLING SILVER)
	LION'S HEAD ERASED (ON BRITANNIA SILVER)
BIRMINGHAM	ANCHOR
CHESTER	THREE WHEAT SHEAVES AND A SWORD (CITY ARMS)
SHEFFIELD	CROWN
EDINBURGH	CASTLE
GLASGOW	TREE. BIRD. BELL, FISH AND RING (CITY ARMS)

FIG 3 — MODERN TOWN MARKS FOR SILVERWARE OF BRITISH MANUFACTURE

CARAT	PER CENT GOLD	STANDARD MARKS	ASSAY OFFICES
22	91.66	22	LONDON BIRMINGHAM CHESTER SHEFFIELD
		22	EDINBURGH
		22	GLASGOW
18	75.0	18	LONDON BIRMINGHAM CHESTER SHEFFIELD
		18	EDINBURGH
		18	GLASGOW
14	58.5	14 ·585	LONDON. BIRMINGHAM. CHESTER. SHEFFIELD. EDINBURGH. GLASGOW
9	37.5	9 ·375	

FIG. -/. — STANDARD MARKS FOR GOLD WARES IN GREAT BRITAIN

ASSAY OFFICE	TOWN MARK
LONDON	SIGN OF THE CONSTELLATION LEO
BIRMINGHAM	EQUILATERAL TRIANGLE
CHESTER	ACORN AND TWO LEAVES
SHEFFIELD	SIGN OF THE CONSTELLATION LIBRA
EDINBURGH	ST. ANDREW'S CROSS
GLASGOW	DOUBLE BLOCK LETTER F INVERTED

FIG. 8. — SPECIAL TOWN MARKS FOR FOREIGN WARES IMPORTED BY GREAT BRITAIN

EXAMPLES OF BRITISH HALLMARKS FOR GOLD AND SILVER WARES

King George V and Queen Mary was authorized in 1935 to commemorate their silver jubilee (fig. 6[C]). This was not a compulsory mark but was struck by the assay offices at the manufacturer's request on silverware made in 1933, 1934 and 1935.

Coronation Mark.—A special voluntary mark was authorized by Queen Elizabeth II to commemorate her coronation (fig. 6[D]). It represented the crowned head of the sovereign and was struck on wares bearing the date letter for 1952–53 or 1953–54.

MARKS ON GOLD

The fineness of gold alloys is usually expressed in carats, pure gold being 24 carats. The legal standards for gold plate prior to 1798 were as follows: 1300–1477, 19⅓ carats (80% gold); 1477–1575, 18 carats (75%); 1575–1798, 22 carats (91.66%). The hallmarks used were identical to those on silver. An act of 1798 authorized an additional standard of 18 carats which was marked with a crown and the figure 18. The lion passant continued to be struck on 22-carat gold until 1844 when a crown and the figure 22 were substituted. At Edinburgh a thistle and at Glasgow a thistle and a lion rampant take the place of the crown.

In 1854 lower standards of 15, 12 and 9 carats (62.5%, 50% and 37.5% gold) were permitted. The prescribed marks were the carat figure and its decimal equivalent. In 1932 the 15- and 12-carat standards were abolished in favour of one of 14 carats (58.5%). (*See* fig. 7.)

The maker's mark and town mark on gold wares are the same as for sterling silver except that a York rose replaces the crown at the Sheffield office. The date letter is frequently surrounded by a shield of a different design.

The duty and coronation marks are also to be found on gold.

PROVINCIAL, SCOTTISH AND IRISH MARKS

Provincial.— Under a statute of 1423, York, Newcastle, Lincoln, Norwich. Bristol. Salisbury and Coventry were allowed to assay and mark plate, although there is no evidence that this was ever carried out in the last two cities. Assay offices existed, however, at Chester, York, Exeter and Newcastle in the 18th and 19th centuries. Offices in Birmingham and Sheffield were opened in 1773, the responsible bodies being "The Guardians of the Standard of Wrought Plate in Birmingham" and "The Guardians of Wrought Plate within the Town of Sheffield."

Marks have been found on antique silver which have been ascribed to other provincial towns; *e.g.*, Barnstaple, Hill, Plymouth and Taunton. Although such pieces are sometimes of great interest, their marks were probably not applied by any recognized office.

Scottish.— An act of 1457 provided for the election in Edinburgh of a deacon to be responsible for controlling the standard. The marks of the maker and deacon were to be stamped on all gold and silver plate. The town mark for Edinburgh, a castle, was added in 1485. In 1681, after a date-letter system had been introduced, the deacon's mark was replaced by the initials of the assay master. This was discontinued in 1759 with the introduction of the thistle as the mark to denote the standard. Plate has been marked in Glasgow since the 17th century but it is improbable that an authorized assay office was established there before 1819. Marks occasionally found on Scottish silver have been attributed to Aberdeen, Arbroath, Dundee, Greenock. Wick, etc.

Irish.— At Dublin a charter of 1637 prescribed a crowned harp mark indicating the standard and a maker's mark. A date letter was also used. These marks became statutory in 1729. The date letter. however, is often missing on Dublin marked silver of the 18th century and an act of 1729 provided primarily for a duty on gold and silver. A further mark consisting of the figure of Hibernia was struck to denote that duty had been paid. In 1807, after the union with Great Britain, the mark of the sovereign's head was added. It was discontinued in 1890 when the plate duty was abolished. The figure of Hibernia has been retained.

The symbols used on gold are the figure of Hibernia. the date letter and the folloning standard marks: 22 carats, crowned harp; 20 carats, plume of feathers; 18 carats, unicorn's head; 14 carats, "14.585"; g carats, "9.375." Irish marks applied after 1922 are not recognized in the U.K.

MARKS ON IMPORTED WARES

Many countries outside the United Kingdom have a system of plate marks but these are not legally recognized in the U.K. Imported foreign wares were first required to be hallmarked by the Customs act, 1842. The importer's mark replaced the maker's mark. The same marks were in use until 1867 when a capital letter F was added. In 1904 distinctive marks were authorized for imported wares (fig. 8). The standard marks consist of the decimal equivalent in the case of silver and the carat figure followed by the decimal equivalent in the case of gold.

By the Hall-marking of Foreign Plate act, 1939, wares manufactured abroad more than 100 years before being imported or being sold in the U.K. are exempted from assay and marking.

HALLMARKING PRACTICE AND LAW

Assay Office Procedure.— Manufacturers normally send their wares to an assay office complete except for final polishing. Representative scrapings are taken from every article and accurately assayed by chemical methods. Articles which pass are stamped with the appropriate symbols of the hallmark, but any which are below the lowest standard are required by law to be broken before being returned to the manufacturer. An exception is made in the case of a substandard foreign ware. The importer or owner has the option of exporting such a ware within one month.

(See ASSAYING.)

Hallmarking Offenses.— Forgery of hallmarks is a felony. On conviction an offender is liable to a maximum penalty of 14 years' imprisonment. Transposition of hallmarks from one ware to another is likeuise a felony as is the sale, with guilty knowledge, of wares bearing forged or transposed marks.

Where an addition or alteration to a hallmarked article is intended the law requires that it shall be submitted again to an assay office. Additions of base metal are not allowed, nor is it permitted to add gold or silver of a lower standard than the original ware.

The sale or offering for sale or export of a ware that has not been hallmarked, unless it has been specifically exempted, is an offense, the penalty for which is a fine.

Foreign wares, if imported by a dealer, must be hallmarked at the time of entry into the country by arrangement with the customs authorities. The obligation is waived in the case of a private person who makes a statutory declaration that he does not intend to sell such wares.

See also SILVERSMITHS' AND GOLDSMITHS' WORK: SHEFFIELD PLATE.

(J. S. Fs.)

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HALL OF FAME. The Hall of Fame for Great Americans is a semicircular granite colonnade on the campus of New York university at New York city. It was established in 1900 from a gift of $100,000 (later $250,000) by Mrs. Finley J. Shepard, and was dedicated in 1901 when the first 29 inscriptions of outstanding Americans, including Washington, Lincoln, Webster, Franklin, Grant, Marshall and Jefferson, were unveiled. On the walls of the open colonnade are 150 panels destined to be filled with bronze inscriptions surmounted by busts of the persons elected. Selections are made each five years (1940, 1945, etc.) by a committee of 100 prominent electors representing each state in the union and appointed by the New York university senate. Nominations may be made by any citizen of the United States.

Eligible nominees must have been dead 25 years or more and must receive a vote of three-fifths of the electors. At first only native-born U.S. men were qualified for election, but the rules were later changed to permit the election of women and of distinguished foreign-born U.S. citizens.

HALLOWEEN (ALLHALLOWS EVEN) is the evening of Oct. 31. In its strictly religious aspect, this occasion is known as the vigil of Hallowmas or All Saints' day, Nov. 1, observed by the Roman Catholic and Anglican churches. Pope Gregory III (731–741) assigned this date for celebrating the feast when he consecrated a chapel in St. Peter's basilica to all the saints. Gregory IV extended the feast to the entire church in 834. The vigil of All Saints, which constitutes Halloween in the church calendar, is as old as the feast.

Students of folklore believe that the popular customs of Halloween exhibit traces of the Roman harvest festival of Pomona and of Druidism. These influences are inferred from the use of nuts and apples as traditional Halloween foods and from the figures of witches, black cats and skeletons commonly associated with the occasion.

In Latin countries the evening of Oct. 31 is observed only as a religious occasion, but in Great Britain, Ireland and the United States ancient Halloween folk customs persist alongside the ecclesiastical observance.

Evidence that Halloween reflects influences from the festival of

Pomona is scanty, but the occasion shows clear connections with the religion of the Druids in pre-Christian Ireland and Scotland. The Celtic year ended on Oct. 31, the eve of Samhain, and was celebrated with both religious and agrarian rites. For the Druids, Samhain was both the "end of summer" and a festival of the dead. The spirits of the departed were believed to visit their kinsmen in search of warmth and good cheer as winter approached. It was also the period for threshing and of food preparation for the winter season.

Divination and auguries for the new year mere practised at Samhain. These magical practices concerned such questions as who would die during the next year, the identity of future marriage partners and the chances of good fortune. It was also an occasion when fairies, witches and goblins terrified the populace. These agents of the supernatural were alleged to steal infants, destroy crops and kill farm animals. Ronfires were lighted on hilltops on the eve of Samhain. The fires may have been lighted to guide the spirits of the dead to the homes of their kinsmen or to kill and ward off witches. This Halloween fire ceremony persisted, particularly in Scotland, as late as the 19th century.

There is little doubt that the Christian church sought to eliminate or supplant the Druid festival of the dead by introducing the alternative observance of All Saints' day on Nov. 1. This feast was established to honour all saints, known or unknown, but it failed to displace the pagan celebration of Samhain. In 998 A.D. Odilo, abbot of Cluny, made another effort to Christianize the occasion by instituting in all Cluniac monasteries the feast of All Souls' day on Nov. 2. This celebration honoured all those who died in the faith and had some, though incomplete, success in neutralizing the ancient pagan rites.

As Christianity spread gradually over Europe and the British Isles, it attempted to displace or suppress pre-existing pagan cults devoted to the worship of such deities as Apollo, Diana or Ymir. Though the church mas able to destroy the temples and outward forms of worship of these heathen religions, it could not completely eradicate the faith and beliefs of their priests and worshippers. These found an outlet during the middle ages in witchcraft which was devoted to the worship of Satan. This cult included periodic meetings, known as witches' Sabbaths, which were given over to feasting and revelry. One of the most important Sabbaths was held on Halloween. Witches were alleged to fly to these meetings on broomsticks, accompanied by black cats who were their constant companions. Stories of these Sabbaths are the source of much folklore about Halloween.

By the end of the middle ages, the celebration of Allhallows Eve was an established part of the annual calendar of the Roman Catholic Church. However, after the Reformation, Protestants rejected this feast along with other important ones such as Christmas and Easter. Nevertheless, Halloween folk customs of pagan origin flourished in Ireland, Scotland, Wales, parts of England and in isolated localities such as the Orkney and Shetland Islands. In these places, the inhabitants lighted bonfires on hilltops on the evening of Oct. 31 and played Halloween games such as "bob apple." They also engaged in divination by such means as pulling kale, placing stones or nuts in the fire and throwing a shoe over the house. Some divination occurred even on the church porch, which was believed to be an especially reliable place to learn of future events.

Pranks and mischief were also common on Halloween in rural areas of Ireland and Great Britain. Wandering groups of celebrants blocked doors of houses with carts, carried away gates and plows, tapped on windows, threw vegetables at doors and covered chimneys with turf so that smoke could not escape. In some places, girls and boys dressed in clothing of the opposite sex and, wearing masks, visited neighbours to play tricks. These activities generally resembled the harmful and mischievous behaviour attributed to witches, fairies and goblins. The contemporary "trick or treat" custom resembles an ancient Irish practice associated with Allhallows Eve. Groups of peasants went from house to house demanding food and other gifts in preparation for the evening's festivities. Prosperity was assured for liberal donors and threats were made against stingy ones. These contributions were often demanded in the name of Muck Olla, an early Druid deity. or of St. Columb Cille, who worked in Ireland during the 6th century. In England some of the folk attributes of Halloween were assimilated by Guy Fawkes day, celebrated on Nov. 5. Consequently Halloween lost some of its importance there.

Immigrants from Great Britain and Ireland took secular Halloween customs to the U.S., but the festival did not become popular in that country until the latter part of the 19th century. This may have been because it had long been popular with the Irish, who migrated there in large numbers after 1840. In any event, a number of the traditional Halloween symbols and folk practices appeared in the U.S. during the late 1800s. Among these mere the figures of the witch, the black cat, the death's head cut from a pumpkin, candles, bobbing for apples, the "trick or treat" custom, masks, parties and pranks. Though some churches observed Halloween with religious services, most persons regarded it as a secular festival. This reflected the prevailing American Protestant attitude toward a great many church festivals and holy days.

During the latter decades oi the 19th century, Halloween pranks and mischief became common in the U.S. and often descended to vandalism. In rural areas, fences were built across roads, wagons placed on top of barns, gates removed, outbuildings overturned and farm animals hidden. In cities and towns, "spooks" placed porch furniture on top of telephone poles, overturned garbage cans, opened water faucets and soaped windows in houses and stores. In some cities overenthusiastic celebrants filled cloth sacks with flour and rubbed these against the clothing of passers-by.

In the course of the 20th century, the American public became less tolerant of Halloween pranks. This mas the result, in large part, of a different mode of life, brought about by increasing urbanization and the ubiquity of the automobile. These factors altered the material environment and lessened the vitality of folk beliefs and customs. In addition, Halloween mischief became very costly to property owners and was of serious concern to public officials.

Consequently, civic authorities and private citizens attempted to deal with this difficulty by both repressive and educational means. As early as 1908 some U.S. communities sponsored Halloween parties for the young in the hope of preventing injury to life or possessions. The police, local merchants or civic groups organized these festivities, and both parents and teachers cautioned children against vandalism. In some instances, merchants even invited the young to soap the windows of their stores on Halloween in the belief that this might lessen property damage. These efforts had only limited success.

The tendency to manipulate rather than to celebrate folk festivals such as Hallomeen is characteristic of the 20th century. It reflects the growing influence of a rational outlook on life and the loss of interest in imagination and fantasy. The secular character of contemporary culture is also reflected in public neglect of the religious significance of Halloween as well as in progressive loss of its folk vitality. Children are least affected by this disenchantment and consequently the more important folk occasions tend to be dominated by the young.

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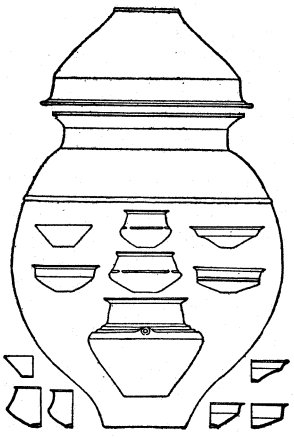
HALLSTATT. The first Iron Age of central and western Europe and the Balkans is known as the Hallstatt period after the place of that name in upper Austria. It is not the cradle of the earliest Iron Age culture, but the site where objects characteristic of it were first identified. There, between 1846 and 1899, more than 2,000 graves were found. The majority fall into two groups, an earlier (*c.* 900–700 B.C.) and a later (c. 700–400 B.C.). Hallstatt became an important settlement in the first Iron Age. Both cremation and inhumation were practised, the latter slightly preponderating. The cremation graves are on the whole the richer and, viewed in the mass, contain older objects than the inhumation burials, but this should not be pressed too strictly, for the two rites overlapped chronologically. Most of the types of grave furniture are found elsewhere in phase C and D burials (*see* below), but objects of a peculiar character occur as well. The pottery unearthed by the earlier excavators was practically all destroyed. Near by lies the prehistoric salt mine where salt was extensively obtained. A number of shafts were sunk, often to a considerable depth, sometimes at a steep angle. Thanks to the preservative nature of the salt, their implements, parts of their clothing and even (at Hallein as well as at Hallstatt) the bodies of the miners themselves have come to light.

Typology and Art.—Reinecke divides the Hallstatt period into four phases, A, B, C, D (*see* ARCHAEOLOGY: *Iron Age*). He equates the first of these with the period of the urn-field culture. Schumacher regards the latter as comprising the last phase of the Bronze and the first of the Iron Ages. Others hold that Hallstatt A and B are in reality the latest Bronze Age, and that the Iron Age did not begin until Hallstatt C. Others regard it as the last period of the Bronze Age. The fourfold division is adhered to in the following account.

Phase A.—Iron, though known, is rare, but Villanovan influences are already apparent. The rite is cremation in cemeteries of flat graves (or under very low mounds). The pottery in southwest Germany is thin walled of various forms, some betraying strong metallic influence. The large urns often contain a number of smaller vessels (fig. 1). Farther east (Stillfried, Mariarast, etc.) the Silesian influence (Lusatian B) is noticeable in much of the pottery. Among the metal objects are: Antennae, Ronzano (fig. 2) and other bronze swords; razors (fig. 3) and knives, compound fibulae and, in the east, harp and simple bow brooches, torques, pins,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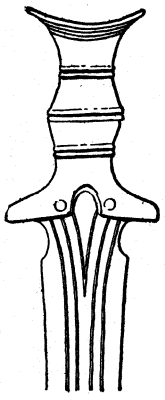
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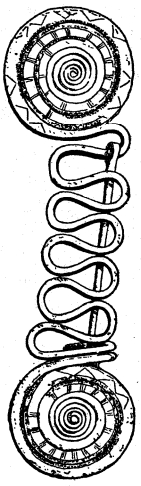
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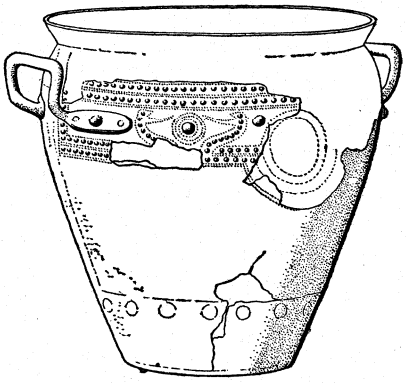
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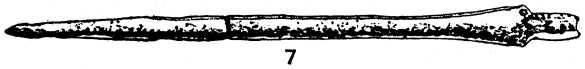
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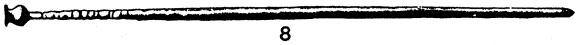
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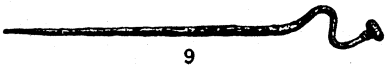
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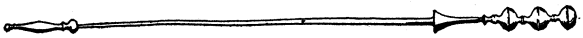
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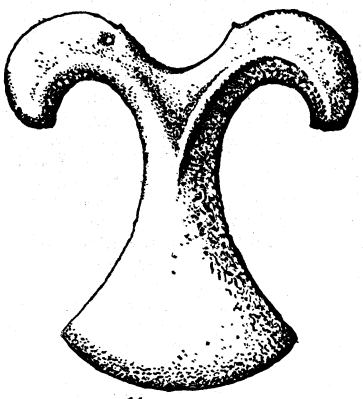
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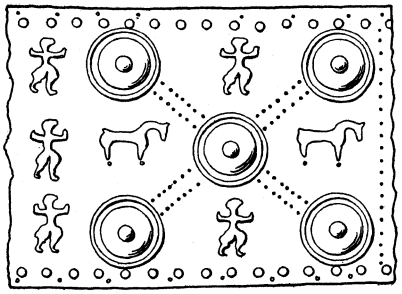
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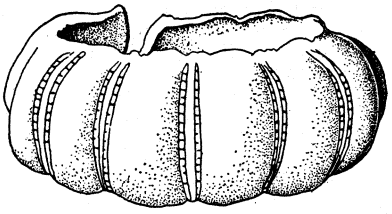
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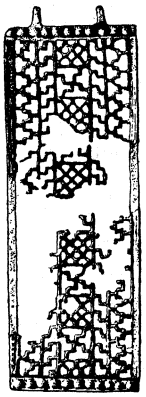
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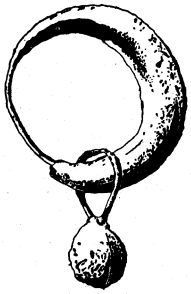
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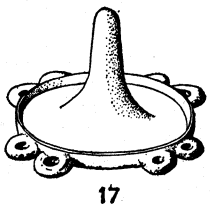
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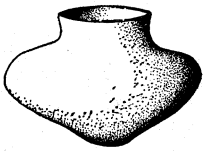
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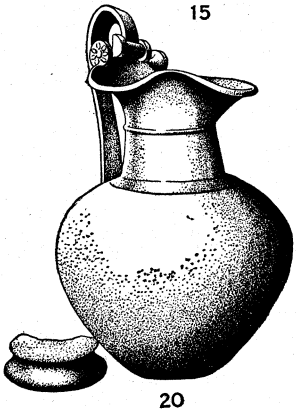
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FROM (1, 19)"PRAEHISTORISCHE ZEITSCHRIFT" BY PERMISSION OF THE ANTHROPOLOGISCHE GESELLSCHAFT; (2, 4, 5) "BRONZUT. SÜDDEUTSCHLANDS" (WILCKENS) BY COURTESY OF DR. BEHRENS; (3, 6, 7, 8, 9, 11, 12, 15, 16, 17, 18) LINDENSCHMIDT, "DIE ALTERTÜMER UNSERER HEIDNISCHEN VORZEIT" (ZABERN); (10, 13) VON SACKEN, "DAS GRABFELD VON HALLSTATT IN OBERÖSTERREICH UND DESSEN ALTERTÜMER" (BRAUMÜLLER); (14) "BAYERISCHE VORGESCHICHTSFREUND" (LEHMANN); (20) DÉCHELETTE, "MANUEL D'ARCHÉOLOGIE" (LIBRAIRIE ALPHONSE PICARD)

TYPES OF GRAVE FURNITURE OF THE HALLSTATT PERIOD

PHASE A; (1) Urn containing smaller vessels, (2) Ronzano bronze sword, (3) Metal razor, (4) Brooch, (5) Vessel with "sun boat and swans": PHASE B; (6) Globular urn, (7) Bronze sword with scrolled ohape, (8) Vase-headed bronze pin: PHASE C; (9 & 10) Bronze pins, (11) Winged Hallstatt axe, (12) Urn with conical neck, (13) Bronze girdle mount, (14) Onion-shaped urn, (17) Pointed tutulus: PHASE D; (15) Girdle mount, (16) Earring, (18) Cup brooch, (19) Urn, (20) Early archalo Greek vessel

the so-called "Old Italian" bronze vessels: cups, vessels with "sun boat and swans" (fig. 5), etc.

Phase B, if it can be said to have a general chronological significance, is marked by the reassertion of the old Bronze Age population of southwest Germany over the comparatively newly come urn-field peoples. It is confined to the more western regions. The tumulus again becomes common; cremation is the usual rite. The pottery (sometimes polychrome) is extremely well made and of various forms. The urns are often globular in body and with funnel-shaped necks (fig. 6) and influenced by Hallstatt A and older Bronze Age forms. The chief metal objects which have been found are the slender bronze Hallstatt sword with winged or slightly scrolled chapes (fig. 7) and the vase-headed pin (fig. 8).

Phase C.—Iron is first in general use. The rite is mixed; the tumulus prevails. The pottery is both polychrome and unpainted (often with polished graphite slip). In the west the urns are more onion shaped than in phase B (fig. 14); the Bronze Age chip carving (Kerbschnitt) reappears. In the east—Moravia, eastern Austria, etc.—where the culture of D is not represented, this phase probably lasted longer. The urns (graphite or polychrome) often have high conical necks (fig. 12); the so-called "moon idols," their horns often ending in beasts' heads, are very characteristic (fig. 13). Among the many metal types are: long, heavy iron and bronze swords with beautifully scrolled chapes; the winged Hallstatt axe (fig. 11); long bronze girdle mounts with *repoussé* ornamentation (fig. 13); various types of pins (fig. 9 and 10); fibulae, rare in the west (spiral spectacle and half-moon brooches), in the east, these and other types; bronze vessels (broadly ribbed bucket and other types); chariot-and-horse-harness—among the latter, the pointed tutulus (fig. 17), a type which occurs in the warrior's tomb at Corneto and gives a synchronism with Italy.

Phase D.—Not represented in eastern Austria, etc., but lasts until the appearance of the La Tène period (*q.v.*) in other areas. The tumulus prevails; the rite is mostly inhumation. The pottery, which is not common, degenerates; the urns are derived from C forms but are less crisp in profile (fig. 19). Among the metal objects are: the dagger-sword (sometimes one edged) with "horseshoe" or antennae hilt; pins are rare, brooches common (the drum, cup [fig. 18] and the later variants of the bow and serpentine fibulae); a variety of ring ornaments: ear- (fig. 16), neck-, arm- and footrings; girdle mounts, shorter than in C, sometimes in pierced work (fig. 15); bronze vessels, among them the narrowly ribbed bucket, and in upper Italy and the Veneto-Illyrian zone, situlae with figured motifs in friezes, stylized scenes from everyday life. Early archaic Greek vessels appear in the west, Pertuis (fig. 20), Grachwyl, etc. Amber occurs in C and D, gold mostly in D; ivory, lignite, jet and coral are not unknown, the last is found in D.

Hallstatt art, with the exception of the Veneto-Illyrian "situla style," is severely geometric in feeling; the advances made were on technical rather than aesthetic lines. It reveals indirect connections with the Greek Dipylon art, but developments of older Bronze Age elements are more prominent. There is a general tendency toward the extravagant, the baroque. The Greek orientalizing influence is hardly felt. Even the figural motifs are geometric in feeling as is shown by urns from Oedenburg and many of the girdle mounts; these are mainly confined to the Austrian area. The typical bird motif, probably derived from Italy, may perhaps be traced back to late Helladic times in Greece. Plant patterns are very rare and strongly stylized (Urmitz). Among the other motifs are lozenges, triangles, concentric circles, arcs, chevrons, "garlands," herringbone groups of parallel lines (sometimes grooved) and occasionally the swastika, triskele and maeander, etc. Contrasts in colour and the breaking up of smooth surfaces were in favour. The arrangement of figures in pairs is very characteristic. In H_3 pottery we find designs grouped in a circular field around a star or cross, or arranged in bands. Generally speaking, the arrangement consists in mechanical repetitions and a rigid regard for symmetry, rather than in the treatment of the design as an organic whole. Compared with the art of the northern Bronze Age or of the La Tène period, the Hallstatt style is lifeless and sterile.

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HALLUCINATION, a psychological term denoting a response the stimulus of which is within a person's phantasy but is mistakenly ascribed by the responding individual to sources outside it. Hallucination must be distinguished from illusion, which denotes the misinterpretation of verifiable receptor stimulation. The most common varieties of hallucination are the auditory, which include voices, mutterings, laughter, cries, bells, music and shots, and the visual, which may be of everyday persons, animals. objects and scenes, or of something strange, horrible or unearthly. Hallucinations of smell, taste and movement and of visceral and cutaneous sensitivity are not unusual. One, two or several varieties of hallucination may be present at the same time.

Hallucination occurs most commonly in ordinary dreaming; it may also develop during periods of deep preoccupation. In the person who is awake, hallucination is facilitated by profound emotional arousal or urgent need, and it is supported by delusional attitudes. Thus, under conditions of great excitement, fear, ecstasy or tense anticipation, many persons report seeing and hearing things which they would otherwise identify as their own phantasy. The hallucination of a person suffering from transient, chronic or progressive delusion is nearly always in keeping with his previously delusional convictions, and its character is in large part determined by his personality organization. *(See* ABNORMAL PSYCHOLOGY.)

See Norman Cameron, *The Psychology of Behavior Disorders* (Boston, London, 1947). (N. A. CN.)

HALLUIN, a frontier town of northern France, in the department of Nord, near the Lys, 14 mi. N. by E. of Lille by rail. Pop. (1946) 12,935. The family of Halluin, which became extinct in the 14th century, is mentioned in the 13th century. Halluin has a Gothic church. The manufactures comprise linen and cotton goods, chairs and rubber goods, and brewing and tanning are carried on; there is a board of trade arbitration.

HALM, CARL FELIX (1809–1882), German classical scholar and critic, was born at Munich on April 5, 1809, and died there on Oct. 5, 1882. He is known chiefly as the editor of Cicero. He also edited a number of other classical texts for the Teubner series, the most important of which are Tacitus (4th ed., 1883); *Rhetoves Latini minores* (1863); Quintilian (1865); Sulpicius Severus (1866); Minucius Felix together with Firmicus Maternus, De *errore* (1867); Salvianus (1877); and Victor Vitensis's *Historia persecutionis Africanae provinciae* (1878).

HALMAHERA ("great land"; also Djailolo), an island of Indonesia in the administrative district of Ternate, lying under the equator and about 128° E. It consists of four peninsulas enclosing three great bays: Kau (northeast). Buli (east) and Weda (southeast); and its total area is 6,500 sq.mi. The northern peninsula is connected, with the others by an isthmus, only 5 mi. wide, on the western side of which lies Dodinga bay. In the mouth of this bay are the two islands Ternate and Tidore, whose political importance exceeds that of the larger island *(see* these articles). Of the four peninsulas of Halmahera the northern and the southern are reckoned to the sultanate of Ternate, the northeastern and southeastern to that of Tidore; the former having 11, the latter 3 districts. The four peninsulas are traversed in the direction of their longitudinal axes by mountain chains 3,000 to 5,000 ft. high,

covered with forests rich in a great variety of trees. The mountain chains. from mhich spurs extend to the coast, are frequently interrupted by plains. The western and northern parts of the mountain chain of the northern peninsula are volcanic. the volcanoes continuing the line of those of Makian, Motir, Ternate and Tidore. Two volcanoes along this western coast are active and one. Gam Konora (5,364 ft.), is active on the north. Coral formations on heights in the interior would indicate oscillations of the land in several periods, but a detailed geology of the island is wanting. There are numerous small rivers and several lakes, and near Weda is a beautiful stalactite grotto. Halmahera is the largest island of the Ternate group of the Moluccas (*q.v.*).

The inhabitants are mostly of immigrant Malayan stock. In the northern peninsula, which is the most thickly populated, are found people akin to the Papuan-Malay type; and the members of a tribe around Galela resemble the Polynesians in physique and are possibly remnants. much mixed by subsequent crossings with the Papuan aborigines, of the Polynesian migration into the Pacific. Achille Raffray gave a description of them in *Tour du Monde* (1879): "They are as unlike the Malays as we are. excelling them in tallness of stature and elegance of shape. and being perfectly distinguished by their oval face, with a fairly high and open brow, their aquiline nose and their horizontally placed eyes. Their beards are sometimes thick; their limbs are muscular: the colour of their skins is cinnamon brown. Spears of ironwood, abundantly barbed, and small bows and bamboo arrows free from poison are their principal weapons." They are further described as having temples (*sabuas*) in which they suspend images of serpents and other monsters, as well as the trophies of war. They believe in a better life hereafter, but have no idea of a hell or a devil, their evil spirits only tormenting them in the present state. The people in the Tidore part of the island. as the result of keen propaganda of the sultans, are all Mohammedans, but in the Ternate division they are largely pagan. The people have crisp. wavy hair, a skin even lighter than that of the average Malay and are strongly built and well made. though the women are inclined to be thickset. They are true forest people, some nomads. living only in shelters. A loincloth, with headdress, is their only covering. They were headhunters in the past. and though generally orderly they are prone to violence from motives of revenge. Many indigenous dialects are spoken and on the coast Ternatan is largely used, but the official language is Indonesian (Bahasa Indonesia). The sago palm supplies their staple food, but they hunt. fish and cultivate the land in a simple style. growing chiefly rice and coconuts. They collect dammar gum (especially in Morotai), wild nutmegs and ironwood (*Mesua ferrea*) from the forests. In Ternate cacao and cloves are grown on the coconut plantations. The sea yields trepang and pearl shells.

The chief town is Gamsungi, with about 2,000 inhabitants in 1954, and other ports are Galela, Tobelo, Kau and Weda and Wayabula in Morotai. Galela is a considerable settlement, situated on a bay of the same name on the northeast coast, in a well-cultivated plain which extends southward and inland. In 1954 the population of Halmahera was about 55,000.

About 11 mi. N.E. of the northern peninsula is the considerable island of Morotai (635 sq.mi.), mhich is more than 50 mi. long and from 13 to 26 mi. wide, with mountains reaching 4,100 ft. (the Snbatai range) and several rivers. There are some Moslems and Christians among its population which numbered about 10.000 in 1954. During World War II Morotai was an important military base for the Japanese.

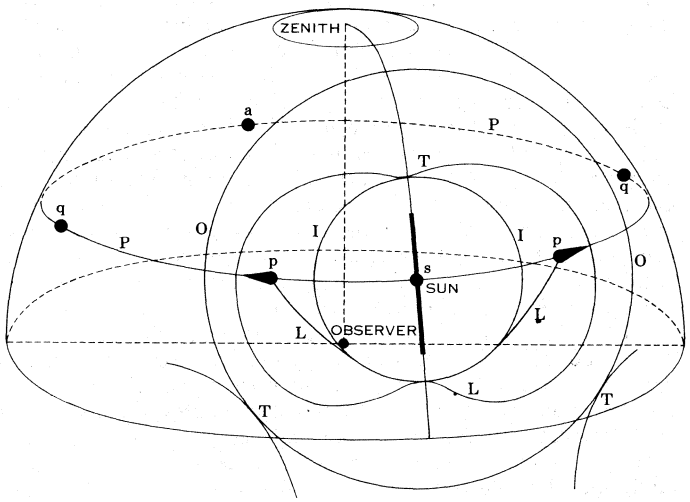
To the west of the southern peninsula lie the more important island of Batjan (*q.v.*) and other islands.

The Portuguese and Spaniards were better acquainted with Halmahera than with many other parts of the archipelago; they sometimes called it Batu Tjina, and sometimes Moro. It was circumnavigated by one of their vessels in 1525. The name (Djailolo) was really that of a native state, the sultan of which had the chief rank among the princes of the Moluccas before he was supplanted by the sultan of Ternate about 1380. His capital, Djailolo, lay on the west coast on the first bay to the north of that of Dodinga. The Dutch obtained a footing in Halmahera with the aid of their ally, the sultan of Ternate, and when they severed relations with this chief in 1683. the lands in Halmahera under the suzerainty of Ternate came under Dutch influence. By their treaty of 1660 with the sultan of Tidore, they had become overlords of all Tidorese fiefs and this had opened up to them that part of Halmahera under Tidorese influence. In 1876 Danu Hassan, a descendant of the sultans of Djailolo, raised an insurrection in the island against the authority of the sultans of Tidore and Ternate and would probably have been successful but for the intervention of the Dutch. The Moluccas were captured by the British in 1810, given back to the Dutch in 1814 who transferred sovereignty to the Indonesian republic in 1949. The Japanese occupied Halmahera in World War II.

HALMSTAD, a seaport of Sweden, chief town of the district (*län*) of Halland, on the east shore of the Cattegat, 76 mi. S.S.E. of Goteborg by the railway to Hälsingborg. Pop. (1960) 39,064. Mention of the church of Halmstad occurs as early as 1462, and the fortifications are mentioned first in 1225. The latter were demolished in 1734. There were formerly Dominican and Franciscan monasteries in the town. The oldest town privileges date from 1307 and Halmstad appears to have been frequently chosen as the meeting place of the rulers and delegates of the three northern kingdoms. Under the union of Kalmar it was appointed to be the place for the election of a new Scandinavian monarch whenever necessary. Until 1658, when it was ceded to Sweden, the *län* of Halland formed part of the territory of Denmark in Sweden. The town lies at the mouth of the Nissa river, having a harbour (20 ft. depth) and roads giving safe anchorage. In the neighbourhood there are quarries of granite, which is exported chiefly to Germany. Other industries are engineering, shipbuilding and brewing, and there are cloth, jute, hat, woodpulp and paper factories. The principal exports are granite, timber and matches, and butter through Halsingborg and Goteborg. The imports are coal, machinery, manures. jute and cloth. Potatoes are largely grown in the district, and the salmon fisheries are valuable. The castle is the residence of the governor of the province. There are both mineral and sea-water baths in the neighbourhood.

HALO, a luminous circle or a segment of a circle with the sun or moon in its centre caused by ice crystals in the atmosphere and is produced by the refraction or reflection of light rays striking or passing through the crystals. Halos of well-developed form are rare except in higher latitudes and in polar regions. where they attain great brilliance and considerable complexity, being accompanied by small coloured arcs or luminous columns or pillars. The similar phenomenon caused by difiraction by water or ice particles generally is referred to as a corona.

Parts of Halo.—The phenomenon of a halo as seen from the ground is represented schematically in the figure. The fundamental features of a halo are two circles surrounding the centre of illumination (S), the "inner" halo (I) and the "outer" halo (O),



FROM G. DIETZE EINFUHRUNG IN DIE OPTIK DER ATMOSPHARE

HALO AND RELATED PHENOMENA AS PROJECTED ON THE SKIES BY THE OBSERVER (IN THE CENTRE OF THE SPHERE). (AFTER G. DIETZE)

having radii of about 22° and 46°, respectively. Their inner contour is sharp and shows a distinct red tint. The spectral sequence of colours fades rapidly toward the outer. diffuse edge of the circle. Passing through the centre (S) and parallel to the horizon, a luminous white ring, the parhelic circle (P), can occasionally be seen with a number of bright coloured spots that are the images of the sun or moon (p). Of these images the most pronounced are situated at the intersections of the inner halo and the parhelic circle and are known as parhelia (mock suns or sun dogs) or as paraselenae (mock moons). They are quite brilliant when the sun is on the horizon. Their inner edges, directed toward the sun, are red, the outer edges are blue and they are extended into an arc For higher sun elevation they retain the same elevation as the sun, but their angular distances from the sun increase up to 45° for the sun elevation of 60°. Their angular width, as well as their brilliance, decreases with increasing sun elevation. The parhelia at the intersection of the outer halo and the parhelic circle are seen only on rare occasions. Other images on the parhelic circle are the paranthelia (q) and the anthelion (a). Paranthelia are situated 90°–140° from the sun on the parhelic circle while the anthelion is located at the antisolar point as a patch of white light often exceeding in size the apparent diameter of the sun.

Among other features occasionally observed are two different types of arcs. "Arcs of Lowitz" are two convex arcs (L in the figure) tangential to the inner halo, named after J. T. Lomitz. who first described these phenomena in 1794. Similar arcs can be seen as tangential to the visible upper and lower parts of inner and outer halos (T in the figure). On some occasions the arcs tangential to the inner halo seem to be prolonged and, for higher sun elevation, joined to give the appearance of a luminous closed curve.

Conditions of Formation. — The first step to a proper explanation of the halo and related phenomena was that of René Descartes who ascribed their formation to the effect of ice crystals. His explanation was pursued further by Henry Cavendish. Thomas Young, J. G. Galle and A. Bravais; Bravais demonstrated the general validity of the theory in his classical treatise about the halos published in the *Journal* de *l'École royale polytechnique* (1847).

The fundamental form of ice crystals in high level clouds (cirrostratus) or of those floating in lower levels in sub-zero weather is a hexagonal prism, either elongated as a needle or flattened like a thin plate. The rays of the sun or moon penetrate the crystals under three main refracting angles: 120° between two adjacent faces, 60° between tno alternate faces and go° between the prism face and the base. If a myriad of such crystals falls in any manner between the sun and observer, there will always be some prisms whose alternate faces are traversed by the sun's rays and these rays will be refracted. The deviation of the refracted rays from the incident direction depends on the angle of incidence. Among the large number of crystals occur crystal faces with all possible orientations and hence the refracted rays will fill up the range between the minimum and maximum deviation for 60° refracting angle. The rays will be crowded close to the minimum deviation and there mill be no refracted rays between the minimum deviation and the sun. Furthermore, the minimum deviation increases for shorter wave lengths, being smallest for the red light (22°). All the refracted rays will then form a circle, with sharp inner boundary of a red tint. In this way Edmé Mariotte, 17th-century physicist, explained the characteristic feature of the inner halo. Cavendish similarly explained the existence of the outer halo as the consequence of refraction under go° refracting angle; the minimum deviation in this case is 46°.

For the occurrence of these two halos no special arrangement of ice crystals is necessary. The circular shape of the halo indicates indeed all possible orientations of the symmetry axes of the prisms or plates. Nevertheless, certain arrangements of the ice crystals will predominate, for they will tend to fall with the axis so oriented as to offer the least resistance to their motion—a prolongated prism tending to keep its axis vertical, a plate-shaped crystal to keep its axis horizontal. If the axes of prolongated prisms are vertical and the sun is at the horizon, the refraction of the sun's rays by the alternate faces will produce the sun image at the same elevation as the sun, at an angular distance between the minimum and maximum deviation corresponding to the refracting angle of 60°. In this way the origin of parhelia and their characteristic features are explained. If the axes of the crystals deviate slightly from the vertical direction, the images of the sun will be moved from the parhelic circle, producing the arcs of Lowitz. When the sun's rays traverse the alternate faces of thin plates with their axes in a horizontal direction, a similar phenomenon will be produced, but above and below the sun. With all possible orientations of the horizontal axes of thin plates, a continuous series of parhelia will form the tangential arcs of the inner halo. The tangential arcs to the outer halo are due to the refraction through the faces inclined at go°; these arcs are more brilliant than those at the inner halo.

Some of the features described above and indicated in the figure can be explained as due to the reflection of the sun's rays either externally or internally from the faces or bases of the prism. Young explained the parhelic circle as caused by the reflection from the vertical faces of the long prisms and from the bases of the short ones. Reflections from the faces or bases slightly deviated from a horizontal position will produce a vertical pillar through the sun (see figure) observed on rare occasions. All features due to the reflection can be distinguished from those due to the refraction; they appear white, without the colouring always present with refraction. The paranthelia (q) and the anthelion (a) may be explained as being caused by two internal or two external reflections. The paranthelia will appear when the reflecting faces are inclined at 120°. Double internal reflection by an equilateral triangular prism would produce a single coloured image on the parhelic circle about 98° from the sun. The anthelion can be explained as being caused by two internal reflections of solar rays by a hexagonal prism of ice having its axis horizontal and one of the diagonals of its base vertical. The emerging rays are then parallel to their original direction and form a light spot on the parhelic circle opposite the sun. With the more complicated structure of the ice crystals other rare forms of halo may be produced.

Systematic observations of halos for 22 years (in the Netherlands) indicate the inner halo as the most frequent (in 209 days in a year at the average); the next are parhelia (71) and the tangential arcs to the inner halo (59). (Z. S.)

HALOGENS, a term applied to the chemical elements fluorine, chlorine, bromine and iodine because of the great similarity of their sodium salts to ordinary sea salt (Gr. *hals*, "salt," and *gen*, "to produce"). These four elements show a great resemblance to one another in their general chemical behaviour and in that of their compounds, while their physical properties show a gradual transition. Some of the properties of the halogens are tabulated below.

Some Properties of the Halogens

Name	Fluorine	Chlorine	Bromine	Iodine
Symbol	F	Cl	Br	I
Atomic number	9	17	35	53
Atomic weight	19.00	35.457	79.916	126.91
State at 70° F.	gas	gas	liquid	solid
Boiling point ° C.	—188	—34.7	58	183
Colour of gas	light yellow	green-yellow	red	violet
Electron affinity (Electron volts)	3.58	6.75	3.53	3.22

The halogens constitute main Group VII of the periodic system. Their atoms, having seven valence electrons, all readily combine with an additional electron to form a stable negative ion having a completed octet. The electron affinity given in the table is a measure, in electron volts, of the tendency for this reaction to occur with the atoms of the gaseous element. Fluorine is the most reactive (the best oxidizing agent) and iodine the least (see OXIDATION AND REDUCTION). Fluorides are formed with the greatest evolution of energy and are the most stable. Conversely. fluorine is prepared in the free state with the greatest difficulty and iodine with the least.

In the elementary state the halogens exist as diatomic molecules, the sharing of electrons by a pair of atoms satisfying in part their electron affinities. The binary compounds of the halogens,

except their oxides, are known as halides. The halides of the metals are solid saltlike substances and with a few exceptions, notably among the fluorides, soluble in water. The halide ions are colourless. The hydrogen halides are colourless gases, very soluble in water, forming strongly acid solutions. The halides of nonmetallic elements are volatile, reactive and generally decomposed by water.

In alkaline media the halogens, with the exception of fluorine, may be readily oxidized, the maximum state of oxidation being plus seven. While the oxygen-containing salts are fairly stable, the corresponding acids are not. The relative activity of the halogens in the oxidized state is reversed from that for the reduced state as halide ions. For example. chlorine will displace elementary iodine when added to potassium iodide solution, but iodine will displace chlorine from potassium chlorate, forming the more stable potassium iodate. That is, of the halide ions, iodide is the best reducing agent, and of the halogenates, chlorate is the best oxidizing agent.

A number of compounds have been made by direct combination of two halogens. Their formulas and melting points (° C.) are: IF_7 (5°), IF_5 (9.6°), ICl (two forms α 27.2°, β 13.9°), ICl_3 (101°), IBr (36°), BrF_5 (−61.3°), BrF_3 (9°), BrF (−33°), BrCl (−66°), ClF_3 (−83°) and ClF (−156°).

Element 85, or astatine (At), is a member of the halogen family but only short-lived radioactive isotopes are known. For additional information about astatine as well as other members of the halogen family see individual articles on each element.

(R. P. S.)

HALOPHYTES, a general name used in botany to denote plants growing in salt marshes and similar environments with a high salt content. Such plants often show adaptations for conservation of water. See PLANTS AND PLANT SCIENCE.

HALS, FRANS (c. 1580–1666), celebrated Dutch painter of portraits and groups, to whom, of all the Dutch school, only Rembrandt unquestionably and Vermeer more doubtfully may be considered superior by reason of their profounder spiritual or intellectual qualities. The originality of Hals rests largely in technique, and as a manipulator of oil paint he has few rivals in his own or any other age. Belonging to the first generation of the great era of Dutch art, he lived into the period when symptoms of decline were beginning to appear among the most literally "popular" painters in the form of glossy finish and laboured, imitative technique. Hals mas not a successful artist in the material sense, but he remained true to his instincts and, contrary to the nide current of Dutch painting, his style grew steadily looser, fresher and more spontaneous.

Hals's place of birth is credibly supposed to have been Antwerp, but the date is not certain. According to A. Houbraken, he was 85 or 86 when he died, which places his birth in 1580 or 1581; another early source states that he died aged "ninety, or not much less," while N. S. Trivas in the best modern monograph on the painter suggests that he was born "about 1585." The family moved to Haarlem while Frans was still a child, and it was in Haarlem that he lived and worked throughout his recorded life, but the question of where and under what masters he received his early training remains open. One tradition says that he studied in Haarlem under Karel van Mander, another that he was a pupil of Adam van Noort in Antwerp. Both may be true. His known work shows no trace of Van Mander, but it does show marks of Flemish style, in particular of the bravura of Rubens, whom he could conceivably have met in Van Noort's studio.

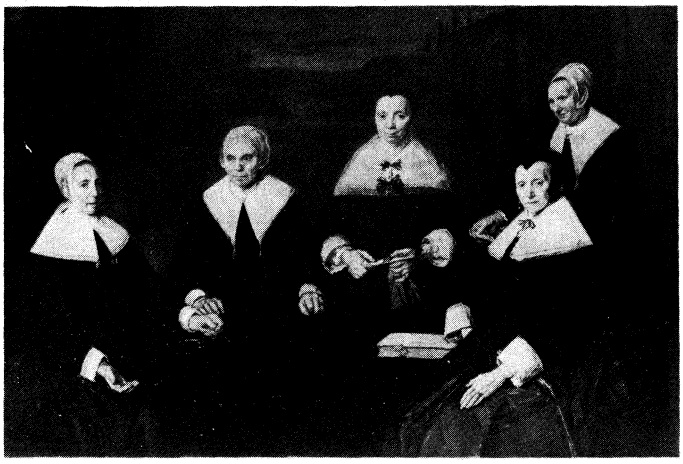
About 1608 Hals married Annetje Harmensdr, who died in 1615, and in 1617 he took as his second wife Lysbeth Reyniers, who outlived him. The number of his children varies in the accounts of different authorities, but it was certainly very large. Seven sons followed him in the career of painting, though not all of them are now knonn by identifiable works. The expense of supporting a huge family, aggravated by his own habits, uhich were irregular to say the least, can explain in part the poverty in which much of his long life was spent, but the fact remains that. in spite of occasional commissions for civic portraits, he was never a fashionable or highly paid artist, and his patronage was virtually confined to Haarlem. The records of his name in the city archives are mainly concerned with the succession of financial difficulties and disasters that beset him, and with measures taken to relieve or redeem his erring children. In 1662 he was granted a small pension, and in the winter of 1663/64 he was further provided by the city with three cartloads of fuel. He died on Aug. 29, 1666, and was buried in the Groote Kerk.

No work of Hals's youth has been identified. The earliest dated picture is the "Banquet of Officers of the St. Joris-Doelen" ("Civic Guard of St. George") of 1616, and on evidence of style a few portraits can be assigned to about the same date, such as "Nurse and Child" (Berlin) and "Man Holding a Skull" (Barber institute, Birmingham, Eng.). These are mature works, confident and crisp in handling, and in the "Banquet" Hals displays already his astonishing ability to give his heads the animation of fleeting yet characteristic expressions. His faces are never masks. By a swift collaboration of eye and hand he captures the momentary movements of expression about the eyes and mouth as his sitters smile or turn to speak to each other or to the spectator. Though his portraits seldom display the deep human understanding of Rembrandt, there are none that "live" more vividly on the canvas than his. There are no landscapes, still lifes, genre or historical subjects in Hals's work. His lifelong preoccupation was with living humanity. Burgher or beggar, his subject is set before us in the fullness of life, with no overtone of social or moral comment, no philosophy beyond the simple one that life is good. The painter's own zest for life is evident in the freedom and audacity of his brushwork, while the typical mood of his sitters ranges from confident good humour to downright merriment. Most of his pictures are single portraits of respectable Haarlem citizens, but there are also character studies of laughing children (his own) and of ragged but exuberant tavern society.

His most solid achievements are the eight large group portraits which hang in the Frans Halsmuseum, and no true idea of Hals's stature as a painter can be formed without seeing them. The first of these, the "Banquet" already referred to, shows understanding of contemporary baroque composition in its swinging diagonals through the rows of heads and the banner. Its colour is fresh and masterly, a harmony of black and white, enlivened by the red and orange of sashes and banner. Similar, but less interesting in design, is the "Banquet of Officers of the Cluveniers-Doelen" ("Civic Guard of St. Andrew") of 1623/24. In 1627 Hals painted a second "Banquet of Officers of the St. Joris-Doelen," in which one may admire an increasing freedom and vivacity of brushstroke while regretting an increasing carelessness in formal design. More thought is apparent in the composition of the "Meeting of Officers of the Cluveniers-Doelen" (1633), in which the open-air background was possibly painted by another hand.

The last and most formal of the civic guard groups is again of "Officers of the St. Joris-Doelen" (1639), and includes a self-portrait of Hals, who is to be seen second from the left in the rear rank. The fine seated group of "Governors of the St. Elisabeth Hospital" (1641) shows Hals at the height of his powers and is only excelled in its kind by Rembrandt's "Syndics," which it may have influenced. A gradual progression from bright colour to a more monochrome treatment can be traced in these pictures, culminating in the last two groups that Hals painted. These, both of 1664, are respectively of the "Men Governors" and the "Lady-Governors of the Old Men's Home at Haarlem." In both there is a moving quality in the presentation of character that the earlier pictures lacked, and the technique also attains a peak in which passion mingles with dexterity to move the spectator. The "Men Governors" suffers like many an earlier work from slipshod composition, but the "Lady-Governors" has no such fault. Firmly designed and marvelously handled, it is the crowning masterpiece of Hals's erratic career.

The single portraits show a parallel development toward more monochrome colouring and looser handling. Their quality becomes uneven in the later years, looseness sometimes degenerating into incoherence. Good examples are: the inaptly nicknamed "Laughing Cavalier" (1624, Wallace collection, London); "Portrait of a Man" (dated 1633, National gallery, London); "Man holding a



BY COURTESY OF FRANS HALSMUSEUM

"LADY-GOVERNORS OF THE OLD MEN'S HOME AT HAARLEM" BY FRANS HALS. IN THE FRANS HALSMUSEUM, HAARLEM. THE NETHERLANDS

Watch" (1643, Barnes foundation, Merion. Pa.); the portraits in Antwerp of "Stephanus Geraerdts" and his wife "Isabella Coymans" (about 1650/52); and the "Man in a Big Hat" (about 1661/64, Cassel). Of the character pieces, most of which belong to his earlier period, one may pick out "Malle Babbe, the Haarlem Witch" (Berlin) and the so-called "Gipsy Girl" (Louvre, Paris), both of about 1628.

Of Hals's pupils and followers in Haarlem the most talented was Judith Leyster, whose pictures are often confused with his.

DIRCK HALS (1591–1656), younger brother of Frans Hals the elder, was born in Haarlem. He was principally a painter of festive genre scenes, of which the earlier examples. such as "Cavaliers and Ladies at Table" (1626, National gallery), have the naive elegance seen also in W. Buytewech and W. C. Duyster. Some of the later ones aspire (less successfully) to the more polished grace of G. Terborch.

Of the sons of Frans Hals: HARMEN HALS (1611–1669) was a genre painter of the school of A. Brouwer and A. van Ostade; FRANS HALS, THE YOUNGER (c. 1620–1669), imitated his father and others with little subtlety (in "Malle Babbe and the Smoker," at Dresden, one figure is borrowed from Frans the elder, the other from Brouwer); REYNIER HALS (162 j?–1671) is represented by genre pictures of moderate quality in the Frans Halsmuseum; CLAES HALS (1628–1686) was a more varied artist, and his few known landscapes in the Ruisdael manner, such as "Village Street" (Ashmolean museum, Oxford), show considerable talent.

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(R. E. W. J.)

HALSBURY, HARDINGE STANLEY GIFFARD, 1ST EARL OF (1823–1921). English lord chancellor remarkable for his grasp of legal principles and for his mastery in applying them, was born in London on Sept. 3, 1823. Educated at Merton college, Oxford, he was called to the bar at the Inner Temple in 1850, subsequently working at the central criminal court and at the Middlesex sessions. He became queen's counsel and a bencher of the Inner Temple in 1865. Giffard had twice unsuccessfully contested Cardiff as a Conservative candidate for parliament when he was appointed solicitor general by Disraeli in 1875 and knighted. From 1877, however, he represented Launceston, until he was created Baron Halsbury and appointed lord chancellor in 188 j. Halsbury held this post continuously from 1886 to 1892, and again from 1895 to 1905. In 1898 he was created earl of Halsbury and Viscount Tiverton and became the leader of the group of Conservative "die-hard" peers who resisted to the end the abridgement of the powers of the house of lords embodied in the Parliament act of 1911. The digest famous as *Halsbury's* Lams of *England* was produced under his direction between 1905 and 1916. Halsbury died in London on Dec. 11, 1921. (W. T. Ws.)

HALSEY, SIR LIONEL (1872–1949), British admiral, was born on Feb. 26, 1872, son of Sir Frederick Halsey of Gaddesden. He was educated at Stubbington house, Fareham. He entered the navy, joining H.M.S. "Britannia" in 1885, and was one of those who served in the defense of Ladysmith (1899–1900). For his services in the defense he was promoted commander in 1901. He nas promoted captain (1905), and after the outbreak of World War I was in command of H.M.S. "New Zealand" in the actions in the Heligoland bight (1914) and at the Dogger Bank (1915). At the battle of Jutland he served in H.M.S. "Iron Duke." In 1917 he was promoted rear admiral and appointed third sea lord, and from 1918 to 1919 commanded the Royal Australian navy. He acted as chief of staff to the prince of wales during his tours in Canada (1919), Australia and New Zealand (1920) and India and Japan (1921–22), being promoted vice-admiral in 1921. He retired in 1922, and was given the rank of admiral in 1926. He was created knight grand cross of the Royal Victorian order (1920), knight commander of the Indian empire (1922) and knight grand cross of St. Michael and St. George (1925). He died Oct. 26, 1949, at Biggleswade, Beds.. Eng.

HALSEY, WILLIAM FREDERICK (1882–1959), U.S. naval officer and commander of the 3rd fleet, operating in the Pacific area, during World War II, was born in Elizabeth, N.J., Oct. 30, 1882, the son of a naval officer, and graduated from the United States Naval academy in 1904. He became a naval aviator May 1 j, 193 j, was promoted to rear admiral in 1938, to vice-admiral in 1940 and to admiral in 1942. After commanding aircraft of the Pacific fleet, Halsey became commander of the South Pacific force and the South Pacific area on Oct. 19, 1942. Naval task groups under his command defeated the Japanese in the battle of Santa Cruz Islands, Oct. 26, 1942; the naval battle of Guadalcanal, Nov. 12–1 j, 1942; and in a series of lesser fights. He became commander of the 3rd fleet on June 15, 1944, and led his carrier task forces in brilliant air strikes. In the battle for Leyte gulf his fleet sank four Japanese carriers and a battleship. He led the U.S. forces in the final naval operations of the war around Okinawa, from May 28 to the Japanese surrender on Sept. 2, 1945. Halsey was promoted to the rank of fleet admiral on Dec. 12, 1945, and retired in 1947. He died on Aug. 16, 1959. (J. B. HN.)

HALSTED, WILLIAM STEWART (1852–1922), U.S. surgeon, who developed original operations for hernia, carcinoma of breast, goitre, intestinal and gall bladder diseases and aneurysms, was born in New York city on Sept. 23, 1852. He studied at Andover and Yale and took his medical degree from the College of Physicians and Surgeons, New York, in 1877, later studying in the European clinics of E. T. Kocher, Theodor Billroth, Richard von Volkmann and Ernst von Bergmann. Halsted was visiting surgeon at Bellevue, Presbyterian, New York and Roosevelt hospitals from 1880 to 1886. During this period he discovered the anesthetic properties of injected cocaine, to which in the course of his investigations he became addicted, recovering after two years of treatment. From 1886 to 1889 he worked in the laboratory of William H. Welch, and in 1890 was appointed professor of surgery at Johns Hopkins university, which position he held until his death on Sept. j, 1922.

A surgical philosopher, Halsted established at Johns Hopkins the first school of surgery in the United States. He emphasized the concepts of complete hemostasis, absolute asepsis, gentleness in the handling of tissues, and accurate reapproximation of divided tissues. concepts that are accepted as fundamental in all techniques of surgery. In 1890 he introduced the wearing of rubber gloves by all members of the surgical team during an operation. He was author of numerous surgical papers and of several monographs, published in two volumes in 1924 and reprinted in 1951.

(EE. F. H.)

HALTEMPRICE, an urban–district (1935) and parliamentary division of the East Riding of Yorkshire, Eng., on the Humber immediately west of Hull, for which it is a residential district. Pop. (1931) 16,757; (1951) 35,654. Area 14.1 sq.mi. It includes the old villages of Hessle, Anlaby, Cottingham, Kirk Ella, Willerby—all mentioned in Domesday—West Ella and Dunswell. A small Elizabethan manor house in Cottingham was built on the site of Baynard castle. Among the industries are horticulture

under glass. agricultural products, shipbuilding at Hessle, precision engineering, mink farming and the making of trailers, carpets and essences.

HAM (in the Douai version of the Bible, CHAM) is the name of Noah's second son. (Though he appears in Gen. ix, 24 as the youngest of Noah's three sons, close examination of this story makes it clear that the name Ham has replaced an original Canaan.) The table of nations in Gen. x represents Ham as the ancestor of Cush (= Ethiopia), Egypt, Put and Canaan; that is, of the original inhabitants of Palestine and the peoples to the southwest. Ham appears also as a place name in Gen. xiv, 5, and as the designation of a people or place in I Chron. iv, 40; both references are obscure.

HAM, a small town of northern France, in the *département* of Somme, 36 mi. E.S.E. of Amiens on the Northern railway between that city and Laon. Pop. (1954) 3,545. It stands on the Somme, dominated by a ruined 10th-century castle. The castle of Ham has frequently been used as a state prison both in ancient and modern times, and the list of prisoners includes Joan of Arc, Louis of Bourbon, the ministers of Charles X, Louis Napoleon and Gen. L. E. Cavaignac and Gen. C. L. L. J. de Lamoricière.

During 1870–71 Ham was several times captured and recaptured by the belligerents. From the 9th century onward it was the seat of a lordship which, after the extinction of its hereditary line, passed in succession to the houses of Coucy, Enghien, Luxembourg, Rohan. Vendôme and Navarre, and was finally united to the French crown on the accession of Henry IV. The church, damaged during World War I, includes 12th-century effigies of the lords of Ham in its ancient crypt. Ham is at an important position on the Somme and suffered greatly during the campaigns on the western front in 1914–18. It was in this vicinity that tanks were first used.

HAM. The term ham is commonly applied to the fresh or cured thigh of the hog, or, in some parts of the world to the thigh and hind leg, or gammon. The somewhat similar but rather less choice shoulder portions of the carcass are produced, processed, marketed and in part consumed in a fashion so similar to ham that considerable mingling may occur in the statistics and no little fuzziness results in the mind of the public and the consumer. This confusion is increased by the term picnic ham employed in trade and commerce for that portion of the shoulder from which the butt and plate portions have been trimmed. Henceforth in this article ham refers to the thigh ham.

Processing. — After the carcass has been butchered and chilled it is cut up. Each pork carcass yields two thighs, or hams. A long ham is cut off just behind the rise in the pelvic arch; the more popular short ham is obtained by cutting through the second vertebra behind the rise. They are carefully trimmed, not only to shape them but to remove blood spots and excess fat. Some fat is left as protection on the inside or face of the ham. Ham may of course be consumed promptly, or kept in frozen storage for three or four months, but most hams are cured.

Before refrigeration became common curing the hams was the only way of preserving them. In practice, curing has many variations but basically consists in a race between the multiplication of spoilage bacteria in the ham and the penetration of the preserving and drying salt. Salt may be used alone or with sugar to improve flavour and texture of the meat. Saltpetre may be included to fix the bright red colour of the lean meat. These chemicals may be rubbed on the hams periodically as a dry-sugar cure or made into a brine in which the hams are immersed, or cold brine may be forced into the joints and arteries of the ham under pressure, called pumping.

A standard brine for 100 lb. of ham includes 8 lb. of salt, 2 lb. of sugar, 2 oz. of saltpetre and 4½ to 6 gal. of water. Temperatures during curing of 36° to 38° F. are safest, but much farm curing is done at temperatures even up to 50° F. The curing time depends on the weight of the ham and the temperature and length of time the ham is to be kept after curing. Some mildly salty commercial products cured by pumping cold brine into them may require only 5 to 21 days, but are almost as perishable as fresh pork and are stored under refrigeration. Hams to be safely stored in the country smokehouse over summer without refrigeration require about 4 days in the cure per pound of ham (*i.e.*, a 15-lb. ham requires 60 days), with one or more turnings and repacking to assure uniform penetration.

After curing, the scrubbed hams are hung and smoked for 1 to 15 days at temperatures ranging from 70° to 175° F. depending on the type of ham produced and the amount of smoky flavour desired. Normal smoking temperatures are 100° to 120° F. and the time two or more days. Hardwoods, especially hickory and apple, provide a smoke which yields a desirable flavour. After cooling, the ham may be peppered, partly for flavour, wrapped in grease-resistant paper, bagged and hung in dark, dry, well-ventilated storage. Some special types may be aged and mellowed for 50 to 70 days in heated storage (105° to 110° F.). Some hams are canned. Prepared in a variety of ways, they may be partly skinned, completely skinned and glazed, fully cooked, "ready to eat." They may be sold by half, or by butt end, shank end and centre slices.

Marketing and Trade. — Fresh, cured or canned, name-branded and attractively wrapped or unnamed and unwrapped, standardized or specialty types, government-inspected or country-killed and cured. Irish ham, Polish ham, Canadian ham, Smithfield or Virginia ham. U.S. western ham—a wide variety of kinds and types and cures is available on the market.

Uses and Food Value. — Flavour, palatability, versatility and convenience, storability, comparative economy and nutritional characteristics give ham high rank as a meat food. Its use is widespread and popular except among peoples who are forbidden by their religious lams to eat it. Ham is not eaten raw because of its being a possible carrier of trichinae, but its cookery includes variations of broiling, frying and baking. It is a nonbulky source of high-grade animal protein, comparing favourably in this respect with good beef. (*See* Table I.) Available energy ranges from 1,200 to 2,600 cal. per pound, depending on the degree of fatness. It is an outstanding source of thiamine (B_1) and perhaps of some of the less well-explored vitamins.

TABLE I. — Ham and Beefsteak Compared as to Food Values

	Composition, 100 g, edible portion, cooked	
	Ham, cured and smoked (Medium fat)	Beefsteak, round (Medium fat)
Water, percent	39	50
Food energy, cal.	397	233
Protein, g.	23	27
Fat, g.	33	13
Ash, g.	5.4	1.3
Calcium, mg.	10	11
Phosphorus, mg.	166	224
Iron, mg.	2.9	3.4
Thiamine, (B_1), mi.	.54	.08
Riboflavin, mg.	.21	.22
Niacin, mg.	4.2	5.5

Source: U.S. Department of Agriculture, *Composition of Foods—Raw, Processed, Prepared,* miscellaneous publication 572 (1950).

Production. — The geography of ham production is closely associated with swine distribution. World hog numbers in the late 1950s were estimated at nearly 375,000,000. Concentrations occurred in some midlatitude areas of temperate climate and favourable food supply, such as the corn belt of the United States, some potato and grain areas of Europe and in China. Some of the warmer areas of the world also were rather well represented. China (with perhaps 75,000,000 head), the United States (60,000,000), the U.S.S.R. (50,000,000), Brazil (35,000,000), and western Germany (15,000,000) were the major producing countries.

Many hogs are slaughtered under one year of age, and it is estimated that the annual pork harvest approaches the number in the swine population, or 375,000,000. If so, and the hogs average 200 lb. each, of which the usual 13% is ham, the total annual world ham harvest

TABLE II. — Estimated Ham Production for Some Leading Producing Countries
(in 000,000 lb.)

Country	1934–38 (average)	1946–50 (average)	1955
United States	1,342	1,929	2,024
Western Germany	526	280	601
France	273	247	343
United Kingdom	154	92	289
Denmark	124	95	206
Canada	114	174	186
Brazil	89	94	104

is nearly 5,000,000 short tons. The estimated ham production, as computed from pork carcass production reported by the U.S. department of agriculture, is shown for some leading countries in Table II.

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(J. K. R.)

HAMA, a city in northern Syria, on the river Orontes (Asi), capital of Hama province, population (1960) 110.809. Formerly an important military station, the town is dominated by the citadel hill. partly artificial. about 130 ft. high, although the citadel itself disappeared early in the Ottoman period. Peculiar to Hama are the nine. vast water wheels (*na'ura*) which raise water from the river to irrigate fields and gardens at a higher level. In the 14th century there were more than 30 of these wheels. Hama is connected by rail through Aleppo with the Istanbul-Baghdad railway and through Homs with Beirut and Damascus.

History.— Hama was an early Hittite settlement and is the southernmost place in which Hittite inscriptions have been found. After the fall of the Hittite empire it became the seat of a local dynasty, which eventually succumbed to the Assyrians after successive occupations and campaigns by Assur-nasir-pal and Shalmaneser III in the 9th century B.C. and by Adad-nirari III, Tiglath-Pileser III and Sargon II in the 8th. According to II Kings xvii. 24, a portion of its inhabitants was transported to Samaria.

In the Seleucid period Hama received the name Epiphania in honour of Antiochus IT' Epiphanes. It was occupied by the Moslem Arabs, and in 637 its Christian basilica was transformed into the Great mosque. In 1180 Saladin gave it to his nephew Taki ud-Din Omar, whose descendants held it as an independent principality until 1299. In 1310 the Mameluke sultan al-Nasir restored it to a cousin of the last prince. the famous historian Abu'l-Fida (d. 1331), with the personal rank of sultan. After the death of his son (1341) Hama was reincorporated in the Mameluke structure of Syria. After the Ottoman conquest in 1516 it sank in importance and population. In the 18th century it became tributary to the Bedouin tribes on its borders. (E. Ro.; X.)

HAMADAN, a General Governorship and a city in west central Iran. A high mountain range on the west supplies the plains with water. making possible extensive grain production. The population of the General Governorship was 11956) 693.690; area 7,567 sq.mi. Hamadan, the chief city of the General Governorship, is about 180 mi. W.S.W. of Tehran, on the Kazvin-Kermanshah motor road. at an elevation of over 6,000 ft., near the foot of the Mount Alvand, whose granite peak has an altitude of 11.641 ft. It is one of the principal trade and distributing centres of Iran. The main east-west highway passes through Hamadan and lesser roads connect with the principal towns east and south. The population was (1956) 100,029, of whom about one-fourth were Turks or of Turkish origin, the remainder being Iranians, Jews (about 5,000), with a sprinkling of Armenians. The bazaars are extensive and well stocked, the narrow and somewhat tortuous streets are intersected by broad tree-lined avenues that meet in a parklike plaza.

Hamadan is the seat of the leather, shellac and gallnut trade of Iran and it is one of the principal as well as one of the oldest centres of rug production. The climate is delightful and has made Hamadan a much favoured summer resort, not only for Iran but for Iraq as well. The winters are long and severe with heavy falls of snow.

The city has had a long and eventful history. It is first mentioned by Tiglath-Pileser I (c. 1100 B.C.) when it bore the significant name, Amadana, which means "place of meeting of many ways." According to tradition, Semiramis built herself a palace there in 800 B.C. as a refuge from the intolerable summer heat of the Mesopotamian plain.

Hamadan became the capital of the Medes in the late 7th and early 6th century B.C. It is the Ecbatana (*q.v.*) of the classical authors and the Bible (Ezra vi 2). Herodotus, recounting an ancient Medean legend, describes the city as enclosed in "seven round walls of increasing height with battlements painted in white, black, purple, lapis blue, orange; the last two plated with gold." But the number of colours and the metals which signify the planets are really Babylonian conceptions. He is specific that each successive wall out-topped the preceding by the height of its battlement and at the centre was the royal treasury, which had been the repository of the plunder from Nineveh in 612 B.C., and housed the wealth of Croesus after his defeat by Cyrus in 550 B.C. It is reputed to have had 1,000 treasure chambers and eight double iron doors, each nearly 30 ft. high.

Under the Achaemenids (550 to 330 B.C.) it became one of the capitals, and great temples and palaces, which have not yet been located or excavated, were built. Polybius, the historian, was quite dumfounded by the power and splendour of the structures on which had been lavished incredible wealth. The beams of the ceilings and the columns of the arcade were covered with plates of silver and gold.

Antiochus was able to coin over 6,000,000 dollars out of the gold and silver tiles of the temple of Anahit.

According to tradition Darius rebuilt the city which had long lain in ruins in order to have a safe asylum for his family and treasures during the war with Alexander. Whether the later citadel of Hamadan actually dated back to such early times must remain uncertain.

A famous relic of ancient times is the colossal, badly battered figure of a lion which once guarded a gate that was destroyed in A.D. 931.

According to Curzon this lion, ancient symbol of the sun, is still regarded as a potent talisman against hunger and cold.

As a centre of a well populated district, at vital crossroads, Hamadan developed at a very early period, and in early Islamic times was said to have extended nearly 15 mi. Jews have been established in Hamadan since the 4th century, attracted by the favourable conditions of trade and more recently also by the alleged tombs of Mordecai and Esther, in a small domed building in the middle of the town, to which Jews from other countries make a pilgrimage.

There also is the tomb of the celebrated philosopher, physician and scientist, Avicenna (*q.v.*), who died there in 1037, and a beautiful 12th century tomb tower, the Alaviyan, decorated with magnificent carved stucco. Hamadan served as capital for both the Parthians and Sassanians.

See Herodotus, i, 8, 9; Polybius, X. 27–6; G. N. Curzon, *Persia and the Persian Question* (1892); Brugsch, *Reise nach Persien* (1862–63); J. De Morgan, *Expedition Scientifique* etc., iv; Le Strange, *Lands of the Eastern Caliphate; A. V. W.* Jackson, *Persia Past and Present* (1906); *M.* H. Donohoe, *With the Persian Expedition* (1919); A. Poidebard, *Au Carrefour des Routes de Perse* (1923); Henry Filmer, *The Pageant of Persia* (1936); *Encyclopedia of Islam,* Vol. II, p. 241; Streck, *Zeit. fur Assyr.,* XV, p. 367; Ernst Herzfeld, *Archaeological History of Iran* (1935) p. 20 ff.

HAMADHANI, AL- (ABU AL-FADL AHMAD IBN AL-HUSAIN AL-HAMADHANI) (967–1007), Arab poet and writer known as Badi'-al-Zaman ("the wonder of the age") whose reputation is based on his letters and *maqamat* (romances and anecdotes) in rhymed prose. He was born and educated at Hamadan in west Persia in 967. He traveled, after 990, in Khorasan and Sijistan. finally settling in Herat (northwest Afghanistan) under the protection of the vizier of Mahmud. the Ghaznevid sultan. He was renowned for a remarkable memory and for fluency of speech, as well as for the purity of his language, and was one of the first to use rhymed prose in letters, *maqamat* and dialogues (of which he claimed to have composed 400), as well as in theological discussions, sermons and poetical puzzles.

His letters were edited by Ibrahim al-Ahdab (1890). The *maqamat* were edited by Mohammed 'Abduh (and ed. 1908) and translated into English by W. J. Prendergast (1915).

See Zaki Mubarak, *La Prose Arabe* (1931); C. Brockelmann, *Geschichte der arabischen Litteratur,* vol. i (1898) and Suppl., vol. i (1937).

HAMAMATSU, Japanese city (1960 pop. 333,009), is located on the Pacific coast of Honshu in Shizuoka prefecture, midway between Tōkyō and Kyoto. A leading industrial centre with strong Nagoya ties, it is noted for cotton weaving and dyeing, high qual-

ity musical instruments (pianos, violins, harmonicas and organs), hats, cellophane and other consumer goods. Hamamatsu is the regional marketing centre for western Shizuoka, serving the Lake Hamana and lower Tenryū river areas. Long a transportation hub, it is served by the Tōkaidō railway line and the Shinano and Tōkaidō highways. (J. D. Ee.)

HAMANN, JOHANN GEORG (1730–1788), German philosopher known as the "Magus of the North" because of his cryptic and paradoxical style of utterance, was born at Königsberg in Prussia on Aug. 27, 1730. After miscellaneous studies he worked intermittently as a tutor at Riga and in Courland from 1752 to 1759 (apart from a journey to London with a merchant in 1757–58) and then returned to Konigsberg. Having secured a post in the excise office in 1767, he was appointed administrator of the customshouse in 1777 but fell into financial difficulties in 1784 and was pensioned off. Thereafter he lived mainly with friends, in particular with F. H. Jacobi at Pempelfort and with F. K. Buchholtz at Wellbergen near Miinster. He died in Miinster on June 21, 1788.

Hamann's principal works were Biblische *Betrachtungen* eines Christen (1758); Sokratische Denkwiirdigkeiten (1759); *Kreuzzüge eines* Philologen (1762), in which he makes the much-quoted remark that poetry is the mother-tongue of mankind; Golgatha und *Scheblimini* (1784), against Moses Mendelssohn; and *Metakritik über* den *Purismus* der *Vernunft* (written 1780; published 1800). Temperamentally rather unstable, Hamann was radically opposed both to the rationalism of the Enlightenment and to the systematic idealism of Kant (with whom he nevertheless maintained friendly relations). He contended that truth was a matter of subjective belief, which the individual must attain for himself through experience or intuition. Against the prevalent tendency toward abstraction and distinction he upheld Giordano Bruno's doctrine of the identity of opposites. Everything, moreover, is a revelation of God and serves to convince us of His benevolence.

Hailed as a seer by the writers of the *Sturm und* Dvang movement in German Literature, Hamann was despised for his irrationalism by the academic philosophers of the 19th century but came to command more respect with the development of Christian existentialism.

The best edition of Hamann's works is by J. Nadler (1949–). *See* J Nadler, *Johann* Georg *Hamann* (1949).

HAMASAH, the name of a famous Arabic anthology compiled by Habib ibn Aws, surnamed Abu Tammam (*q.v.*). The collection is so called from the title of its first book, containing poems descriptive of constancy and valour in battle, patient endurance of calamity, steadfastness in seeking vengeance, and under reproach and in temptation, all which qualities make up the attribute called by the Arabs *hamasah* and best rendered into English by the word "fortitude."

The Hanzasah consists of ten books or parts, containing in all 884 poems or fragments of poems, and named respectively—(I) *al-Hamasah*, 261 pieces; (2) *al-Marathi,* "Dirges," 169 pieces; (3) *al-Adab,* "Manners," 54 pieces; (4) al-Nasib, "The Beauty and Love of Women." 139 pieces; (5) *al-Hija,* "Satires," 80 pieces; (6) al-Adyaf *wa-l-Madih*, "Hospitality and Panegyric," 143 pieces; (7) al-Sifat, "Miscellaneous Descriptions," 3 pieces; (8) *al-Sair wa-l-Nu'as,* "Journeying and Drowsiness," 9 pieces; (9) *al-Mulah,* "Pleasantries," 38 pieces; and (10) *Madhammat al-nisa,* "Dispraise of Women," 18 pieces. The poems are for the most part fragments selected from longer compositions. They are taken from the works of Arab poets of all periods down to that of Abu Tammam himself (the latest ascertainable date being A.D 832), but chiefly of the pre-Islamic period (*Jahiliyyun*), of the early days of Islam (*Mukhadrimun*) and of the reigns of the Umayyad caliphs. A D 660–750 (*Islamiyyun*) Perhaps the oldest pieces in the collection are those relating to the mar of Basus, nhich ended nith the peace of Dhu-al-Majaz, about A.D. 534.

Most of the poeins belong to the class of extempore or occasional utterances, as distinguished from qasidahs, or elaborately finished odes. While the *qasidahs* abound nith comparisons and long descriptions, the poems of the Hanzasah are short. direct and for the most part free from comparisons. Abu Tammam in compiling his collection chose hardly anything from the works of the most famous poets of antiquity. Not a single piece from Imru'-al-Qays occurs in the *Hamasah*, nor are there any from 'Alqamah, Zuhayr or A'sha; Nabighah is represented only by two pieces of four and three verses respectively; 'Antarah by two pieces; Tarafah by one piece; Labid by one piece; and 'Amr ibn Kulthum by one piece.

The book entitled al-Nasib is, however, an important exception, and contains verses relating to women and love. In the classical age of Arabic poetry it was the established rule that all qasidahs must begin with the mention of women and their charms, in order that the hearts of the hearers might be softened. These fragments are therefore generally taken from the opening verses of *qasidahs;* where this is not the case, they are chiefly compositions of the early Islamic period.

About A.D. 935 Abu Tammam, the compiler, visited Khurasan, then ruled by 'Abdallah ibn Tahir, whom he praised and by whom he was rewarded; on his journey home to Iraq he passed through Hamadhan, and was there detained as a guest of Abu al-Wafa, son of Salama. During his stay at Hamadhan, Abu Tammam is said to have compiled or composed five poetical works, of which one was the *Hamasah.* This collection remained as a precious heirloom in the family of Abu al-Wafa until it fell into the hands of Abu l-'Awadhil, who carried it to Isfahan and made it known to the learned of that city.

The worth of the Hanzasah as a storehouse of ancient legend can hardly be exaggerated. The high level of excellence which is found in its selections caused it to be said that Abu Tammam displayed higher qualities in his choice of extracts than in his own compositions. The class of poetry of which the *Hamasah* is a specimen is remarkable for the evident firsthand experience which the poets possessed of all about which they wrote. For historical purposes the value of the collection is considerable; but most of all there shines forth from it a complete picture of the strenuous life of passion and battle, which marked the valiant stock who bore Islam abroad over the outworn civilizations of Persia, Egypt and Byzantium.

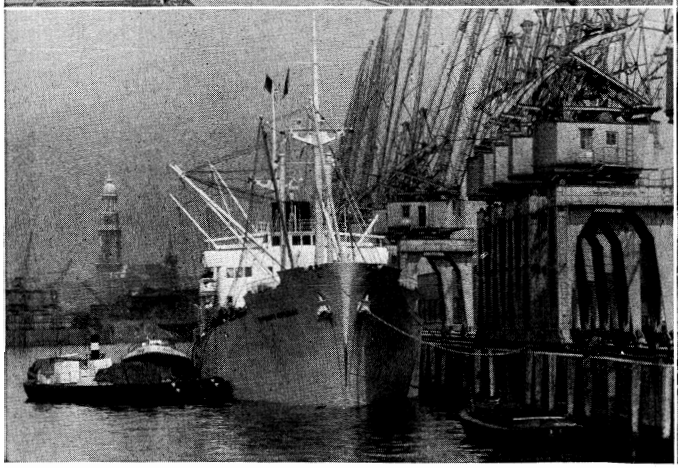
The importance of the *Hamasah* in the history of Arabic literature is indicated by the fact that no fewer than 20 commentaries on it by medieval Arab scholars are enumerated by Hajji Khalfah, the historian and bibliographer. Of these the most famous are those of Abu Riyash, Xbu al-Fath ibn al-Jinni, Shihab-al-Din Ahmad al-Marzuqi of Isfahan and Abu Zakariya Yahya al-Tibrizi (1030–1109). This last is a mine of information regarding the classical age of Arabic literature.

When the *Hamasah* is spoken of, that of Abu Tammam, as the first and most famous of the name, is meant; but several collections of a similar kind, also called Hanzasah, exist. The best-known and earliest of these is the *Hamasah* of Buhturi (*q.v.*). Four other works of the same name, formed on the model of Abu Tammam's compilation, are mentioned by Hajji Khalfah. Besides these, a work entitled *Hamasat* al-Rah ("the Hamasah of wine") was composed by Abu-al-'Ala al-Ma'arri.

Bibliography.—Editions of the *Hamasah* include those by G. W. Freytag, with Latin trans. and al-Tibrizi's commentary (1828–1851); and by Mohammed Sa'id al-Rafi'i, with notes from al-Tibrizi's commentary, 2nd ed. (1913). The text was published by A. Amin and A. S. Harun with al-Marzuqi's commentary (1951). There is a German verse trans, by F. Ruckert (1846) and an English trans. of some excerpts by Sir Charles Lyall (1885). See also the bibliography to Arabic Literature. (C. J. L.; X.)

HAMBURG, a city-state, is a Land of Germany; situated on the Elbe, 7 j mi. from its mouth of Cuxhaven. It is the largest seaport on the continent of Europe and has an area of 288 sq.mi. Pop. (1950) 1,605,606. The city proper lies on both sides of the little Alster river; which, dammed up a short distance from its mouth, forms a lake, of which the southern portion within the line of the former fortifications bears the name of the Inner Alster (Binnen Alster), and the other and larger portion, that of the Outer Alster (Aussen Alster). The oldest portion of the city lies to the east of the Alster.

To the west lies the new town (Neustadt), incorporated in 1678; beyond this is St. Pauli, incorporated in 1876, and toward the northeast St. Georg, which arose in the 13th century but was not



PHOTOGRAPHS, (CENTRE LEFT, RIGHT, BOTTOM LEFT) STAATLICHE LANDESBILDSTELLE HAMBURG, (TOP) HANS HARTZ, HAMBURG

THE CITY AND HARBOUR OF HAMBURG

Top: General view of the city toward the Alster-basins. The building in the centre is the city hall, one of the few public buildings of the city not destroyed in World War II

Centre *left:* Modern apartment buildings in a residential section

Right: Commercial district in the heart of the city

Bottom left: View from the harbour with St. Michael's church in the background

incorporated till 1868. During the following centuries numerous rural communities were incorporated. On April 1. 1938, the former Prussian towns of Altona. Harburg and Wandsbek as well as several rural communities were united with Hamburg (Gross-Hamburg). Among the communities which Hamburg had to relinquish in return was the town of Cuxhaven at the mouth of the Elbe.

The old town lies low, and it is traversed by a great number of narrow canals or "fleets" (*Fleeten*) which serve as convenient channels for transport of goods. As they are subject to the ebb and flow of the Elbe, at certain times they run almost dry. The Binnen and Aussen Alster are separated by the Lombardsbrücke (a second bridge over the Alster was completed in 1953) and surrounded by newer buildings. Shallow-draught screw steamers provide means of communication between the business centre of the city and the outlying suburbs. The largest of the public squares in Hamburg is the Hopfenmarkt, which contains the church of St. Nicholas (~Nikolaikirche). Others of importance are the Rathausmarkt, the Gänsemarkt, the Zeughnusmarkt and the Grossneumarkt. The St. Petrikirche, St. Nikolaikirche. St. Katharinenkirche, St. Jakobikirche and St. Michaeliskirche give their names to the five old city parishes. The old Nikolaikirche was destroyed in the great fire of 1842, which destroyed a great part of the Altstadt, and the new building. designed by Sir George Gilbert Scott in 13th-century Gothic, was opened in 1863. Except for the steeple, it was destroyed in World War II. The Michaeliskirche, on the highest point in the city, is remarkable for its bold construction, there being no pillars. The St. Petrikirche, originally consecrated in the 12th century and rebuilt in the.14th, was the oldest church in Hamburg; it was burned in 1842 and rebuilt in its old form in 1844–49. It has the granite columns from the old cathedral. The St. Katharinenkirche and the St. Jakobikirche are the only surviving medieval churches. Both were seriously damaged by bombs during World War II.

The nen- Rathaus, a German Renaissance building, constructed of sandstone in 1886–97, contains the city archives. Immediately adjoining it and connected with it is the exchange, erected in 1839–41 on the site of the convent of St. Mary Magdalen. Along the line of the former town wall are the criminal law courts (1879–82, enlarged 1893), the civil law courts (finished in 1901) and the Oberlandesgericht (finished in 1912). Facing the botanical gardens a new central post office in the Renaissance style was built in 1887. The picture gallery contains works by modern masters, and the museum for art and industry, founded in 1874–76, is one of the most important institutions of the kind in Germany. Nearby are Hagenbeck's zoological gardens. schools of music, arts and navigation and schools of engineering and commerce. In 1900 a high school for shipbuilding was founded, and in 1901 an institute for seamen's and tropical diseases, with a laboratory for their physiological study, was opened.

History. — Hamburg probably had its origin in a fortress erected by Charlemagne, on an elevation between the Elbe and Alster, as a defense against the Slavs. and called Hammaburg because of the surrounding forest (*Hamme*). In 811 Charlemagne founded a church there. perhaps on the site of a Saxon place of sacrifice, and this became a great centre for the evangelization of the north of Europe, missionaries from Hamburg introducing Christianity into Jutland and the Danish islands and even into Sweden and Norway. In 834 Hamburg became an archbishopric, St. Ansgar, a monk of Corbie and known as the apostle of the north, being the first metropolitan. In 84j church, monastery and town were burned down by the Norsemen, and two years later the see of Hamburg was united with that of Bremen (*q.v.*) and its seat transferred to the latter city. The town, rebuilt after this disaster, was again more than once devastated by invading Danes and Slavs. In 1110 Hamburg, with Holstein, passed into the hands of Adolph I. count of Schauenburg, and it is with the building of the Neustadt (the present parish of St. Kicholas) by his grandson, Adolph III of Holstein (1188), that the history of the commercial city actually begins. In return for a contribution to the costs of a crusade, he obtained from the emperor Frederick I in 1189 a charter granting Hamburg considerable franchises, including exemption from tolls, a separate court and jurisdiction and the rights of fishery on the Elbe from the city to the sea. The city council (Rat), first mentioned in 1190, had jurisdiction over both the episcopal and the new town. Craft guilds were already in existence, but these had no share in the government. The defensive alliance of the city with Lübeck in 1241, extended for other purposes by the treaty of 12j5, practically laid the foundations of the Hanseatic league (*q.v.*), of which Hamburg continued to be one of the principal members. The internal organization of the city, too. was rendered more stable by the new constitution of 1270 and the recognition in 1292 of the complete internal autonomy of the city by the count of Schauenburg. The exclusion of the craftsmen from the Rat led, early in the 1 jth century, to a rising of the craft guilds against the patrician merchants; and in 1410 they forced the latter to recognize the authority of a committee of 48 burghers, which concluded with the senate the so-called First Recess; there were. however, fresh outbursts in 1458 and 1483, which were settled by further compromises. During the 16th century Hamburg became a free imperial city.

In 1529 the Reformation was definitively established in Hamburg by the Great Recess of Feb. 19. which at the same time vested the government of the city in the *Rat*, together with the three colleges of the *Oberalten*, the Forty-eight (increased to 60 in 1685) and the Hundred and Forty-four (increased to 180). The ordinary burgesses consisted of the freeholders and the master workmen of the guilds.

The 17th and 18th *Centuries.*—The 17th century saw notable developments. Hamburg had established. as early as the 16th century. a regular postal service with certain cities in the interior of Germany, *e.g.*, Leipzig and Breslau; in 1615 it was included in the postal system of Turn and Taxis. In 1603 Hamburg received a code of laws regulating exchange, and in 1619 the bank was established. In 1515 the Neustadt was included within the city walls. During the Thirty Years' War the city received no direct harm. but the ruin of Germany reacted upon its prosperity, and the misery of the lower orders led to an agitation against the Rat, culminating in 1708 in the victory of the democratic factions. The imperial government, hon-ever, intervened. and in 1712 the Great Recess established durable good relations between the Kut and the commonalty.

The trade of Hamburg received its first great impulse in 1783, when the Cnited States. by the treaty of Paris. became an independent power. From this time dates its first direct maritime communication with America. Its commerce was further extended and developed by the French occupation of Holland in 1795, when the Dutch trade was largely directed to its port. The French Revolution and the later occupation of the city by Napoleon (1811–14), however, exercised a depressing and retarding effect. Under the long peace which followed the close of the Kapoleonic Wars, its trade gradually revived. fostered by the introduction of steam navigation and the declarations of independence of South and Central America, with both of which it opened close commercial relations. In 1866 Hamburg joined the North German confederation, and in 1871 became a constituent state of the German empire, retaining its own constitution which had become liberalized after 1848. In 1921 a democratic *bürgerschaft* (parliament) was set up; this was dissolved in 1933.

The jurisdiction of the free port was, on Jan. 1, 1882, restricted to the city and port by the extension of the *Zollverein* to the lower Elbe, and in 1888 the whole of the state of Hamburg, with the exception of the so-called free harbour (comprising the port proper and some large warehouses. set apart for goods in bond), was taken into the *Zollverein.*

Before 1937 *Land* Hamburg had an area of 16j sq.mi. and consisted of the city of' Hamburg, several islands in the Elbe, the ton-11s of Cuxhaven. Bergedorf and Geesthacht and several small districts (enclaves) wholly enclosed in the territory of the neighbouring Prussian provinces of Schleswig-Holstein and Hanover. In 1937, by a rearrangement of boundaries between the *Länder* of Hamburg and Prussia to do away with the inconvenience of having outlying enclaves. the new *Reichsland* of the "Hanseatic city of Hamburg" (*Hansestadt*) was extended to include an area of 288

sq.mi. with a population in 1939 of 1,712,011. What existed till 1937 as the *Land* of Hamburg. a separate and autonomous state, became a new incorporated German territory *(Reichsland)*. with something like the status of Alsace-Lorraine after 1871. Most of its administration was placed under the minister of the interior at Berlin. who exercised his authority through the local nazi district leader (gauleiter) and federal governor *(Reichsstatthalter)*. Karl Kaufmann. The new Hanseatic city of Hamburg retained, however. corporative autonomy for some local matters. with a burgomaster who was assisted by 45 assessors *(Ratsherren)*. But the burgomaster had to be the same person as the *Reichsstatthalter,* who thus served in a double capacity—as agent for the reich minister of the interior and as local governor. This was a step in Hitler's process of securing greater unity and centralization of administration in the third reich.

The *Land* of Hamburg was re-established by the constitution of 1952. Its parliament consists of 120 deputies elected for four years who in their turn elect a senate of 1j from which the first and second *Bürgermeister* are chosen.

Effects of World Wars I and II.—Hamburg's commercial prosperity was seriously affected by World Wars I and II. In Nov. 1918 the Council of Workmen and Soldiers assumed political power in the city. and endeavoured to form a state of Great Hamburg; but in the following February. after a conflict with the soldiers of the German reich. the movement was suppressed. *(See* H. Ströbel, *The German Revolution and After;* Eng. trans., 1923.) In Oct. 1923 serious Communist riots again broke out. The rising was not put down until a cruiser and three torpedo boats had entered the harbour and marines had been landed to assist the police.

During World War II. Hamburg was of vital importance because of its large trade. great railway yards and warehouses, numerous industries and especially its shipyards. where large naval vessels were built and repaired and submarines were fitted out. It was therefore subjected to severe bombing; seven big air raids during July and Aug. 1943 killed more than 50,000 persons and destroyed 53% of Hamburg's dwellings, 60% of the port installations and much of its business and industrial premises.

Education.— Hamburg university was founded in 1919 as a development of the Colonial institute (1908); it has faculties of law, medicine, philosophy, natural science and Protestant theology. Special facilities exist for the study of phonetics and of the history and culture of India. China. Japan, Africa and the South seas. In 19jj there were 8,000 students.

Between World Wars I and II Hamburg became known for its experimental attitude to education and in 1949 a law was passed combining the older types of school into a comprehensive system. All children were to attend the primary school for six years; they then went on to one of three types of secondary school. In 1954 some modifications were made.

Religion.— From the Reformation to the French occupation, in the beginning of the 19th century, Hamburg was a purely Lutheran state; according to the Recess of 1529, re-enacted in 1603, non-Lutherans were subject to punishment and expulsion from the country. Exceptions were gradually made in favour of foreign residents. but it was not till 1785 that regular inhabitants were allowed some religious freedom. In 1860 full religious liberty was guaranteed. and the identification of church and state abolished. After 188; a church rate was levied on the Evangelical-Lutheran communities, and after 1904 upon the Roman Catholics also. Civil marriages were permissible after 1866.

The religious divisions of the population in 195j were as follows: Evangelical Church of Germany 77.82%; Free churches 13.56%; Catholics 6.66% (Roman Catholics 6.51%); Free Evangelical communities 1.01%; non-Christian religions 0.08% (Jewish 0.06%); freethinkers 0.87%.

Trade, Shipping and Industry.— Hamburg, the "gateway to the world" and an important traffic centre, is one of the largest trade and shipping places of the European continent and the most important industrial town of the Federal Republic of Germany. A dense network of shipping lines with 500 monthly sailings connects the port with all parts of the world. A lively inland traffic by rail and road, waterways and canals! passes through Hamburg, which is about 75 mi. from the estuary of the Elbe. The division of Germany after World War II, however. caused heavy loss to Hamburg by separating it from its hinterland in central and eastern Germany and by thus reducing east-west traffic. These effects of German division were so serious that they could not even be compensated by increased industrialization.

The port is the centre of Hamburg's economy. To a large extent commerce and industry receive their impetus from shipping. Shipbuilding and its manifold auxiliary industries, factories manufacturing import and export goods and consumer-goods industries for the city's own population have settled there. About 180.000 of 650,000 employed persons living in Hamburg work in the town's industries. In 1954 the shipyards built 55 seagoing vessels with a total of 223,000 tons gross. about one quarter of the output of the whole of the Federal Republic. Nearly half of these ships were built for foreign customers.

Hamburg is the port of registry of j5% of the merchant marine of the Federal Republic. which comprises about 2,500,000 tons gross. In 19j5 it was expected that seagoing vessels would be able to occupy 50 km. of berths at the quays and in midstream, as against 74 km. in 1938. More than 300,000.000 marks (RM./DM.) were spent during the first ten years after World War II for the reconstruction of the port, As much as 80% of copper production, 40% of oil extraction, 35% each of shipbuilding and mineral-oil refining. 32% of fish.curing and processing and 25% each of the margarine and cigarette industries of the Federal Republic were by 19jj established in Hamburg. Many of the goods coming in by sea, such as mineral oil, coal. iron ore. copper. wheat, feeding stuffs, fruit and tropical fruits. coffee, tea, cocoa, fish, meat, oilseeds, animal and vegetable oils and fats, timber and wood manufactures. wool, cotton and skins and hides, are processed in Hamburg. Most of its exports consist of the finished products of west German industries. such as machinery and industrial equipment, metal goods, glass and glassware, vehicles. timber and wooden articles, and also cement, mineral-oil derivatives. fertilizers: sugar and coal. In 1954 the number of ships entering the port was 15,775, with a tonnage of 19,296,000 (1936: 16,268 ships, with a tonnage of 18,922,000). Considering the serious destruction of port facilities during World War II and the interruption of commercial connections. this was a visible sign that Hamburg had begun to play its former role in German and European trade. Hamburg had also become important for its airport. Fuhlsbüttel. In 1954 there were 23 air lines with about 30.000 take-offs and landings; 170,000 passengers were carried within Germany, and 126,000 to and from foreign countries. Air freight was transported to all parts of the world.

Hamburg's leading position in foreign trade was also shown by the fact that most of the consular representations in the Federal Republic and many foreign trade banks had established themselves there. The federal post office had installed the largest number of its telautograph lines in Hamburg and most of the telephone calls to foreign countries were put through from there.

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HAMDANI (ABU MOHAMMED AL-HASAN IBN AHMAD IBN YA'KUB AL-HAMDANI (d. 945), Arabian geographer, belonged to a family of Yemen. He was held in repute as a grammarian and poet. He compiled astronomical tables, studied the history and geography of Arabia and died in prison at Sana in 945.

His *Geography of the Arabian Peninsula (Kitab Jazirat ul-'Arab),* by far the most important work on the subject, was edited by D. H. Müller (Leyden. 1884). His other important work is the *Iklil* ("Crown"), concerning the genealogies of the Himyarites and the wars of their kings, in ten volumes. Of the surviving parts of this work, vol. 1, 2, 8 and 10 were published, and vol. 8 was trans-

lated into English by N. A. Faris as The Antiquities of South Arabia.

See the introduction to *The Antiquities of South Arabia,* trans. *by N.* A. Faris (Princeton and Oxford, 1938); also C. Brockelmann, *Geschichte der arabischen Litteratur,* 1st supplementary volume, p. 409 (Leyden, 1937).

HAMDI BEY, OSMAN (1842-I~IO), Turkish statesman and art expert, son of Hilmi Pasha, one of the last of the grand viziers of the old regime, was born at Istanbul. Hamdi Bey's great service to his country was the assertion of the right of Istanbul to receive the finds made by various archaeological enterprises in the Turkish empire. He founded the museum of antiquities at Istanbul and became its director in 1881; it owes much to his enlightened taste and to his energy.

Hamdi Bey secured for Turkey the famous Greek sarcophagi found in Sidon in 1887, which are among the treasures of the museum of antiquities. These are not only magnificent examples of Greek art of the jth and 4th centuries B.C., but are in perfect preservation, and the magnificent "Alexander" sarcophagus even retains traces of its original colouring (see SIDON). In 1888 Hamdi Bey founded the School (later, Academy) of Fine Arts in Istanbul. He died on Feb. 23, 1910.

His brother, HALIL EDHEM BEY (b. 1860), was also a distinguished archaeologist. He held various ministerial posts, and eventually became director of the Turkish museums in Istanbul.

HAMEG (or HAMAG), a name shared by the Kanembu of the Lake Chad area and the Negroid subjects of the Fung to the south of Sennar (*q.v.*) in the Anglo-Egyptian Sudan. It implies a servile position.

In the Sudan the Hameg are the descendants of the aboriginal inhabitants of the southern Gezira before the coming of the Fung, who probably gave them the name of Hameg. At mid-20th century they were particularly centred on Jebel Guli (between Renk and Roseires) and Keili, farther south on the borders of Beni Shangul.

About the middle of the 18th century. Mohammed Abu el Kaylak or Abulikeilik, a famous Hameg (really the son of a Ja'ali by a Hameg mother), became commander of the Fung army and governor of Kordofan; from that date the real power belonged to him and his descendants rather than to the Fung kings. On the Egyptian occupation, his grandson Idris Adlan retired to Guli and was recognized as chief of all the area south, including Sillok, Kurmuk, Ulu, the Burun and Fadasi. His descendant was still nazir of Dar Fung in modern times, although he would resent being called a Hameg, because of the servile association of the name.

See J. W. Robertson, "Fung Origins," *Sudan Notes and Records,* xvii, 260–265 (Khartoum, 1934). (A. J. AL.)

HAMELIN, FERDINAND ALPHONSE (1796–1864), French naval officer. an early advocate of armour for naval vessels, was born at Pont l'Évêque on Sept. 2. 1796. He took part in the expedition to Spain in 1823 and distinguished himself in the action at Algiers in 1830. In the later years of Louis Philippe's monarchy he held a command in the Pacific. Having become vice-admiral in 1848, he led the Black sea squadron in the Crimean War, collaborating with the English admiral J. W. D. Dundas in the bombardment of Sevastopol. He became an admiral in 1854 and was minister of marine from 1855 to 1860.

When Napoleon III made his first concession to the Liberal opposition. Admiral Hamelin was among the first ministers to be dismissed. He held no further command, and died in Paris on Jan. 10. 1864.

Hamelin was an able administrator and took a notable part in developing the use of armour; the "Gloire," launched in 1859, set the model for seagoing ironclads.

HAMELN, GLÜCKEL VON (1646–1724), German author of memoirs of the early period of European capitalism. was born in Hamburg. Ger.. in 1646, the daughter of Lob Pinkerle. She married a businessman, Chajim Hameln. in 1659, and headed his extensive enterprises after his death in 1689. In 1690 she began her memoirs. The seven books describe the everyday life of a German Jewish matriarch, the mother of 14 children. and also vividly cover her relations with the ruling families and the business practices of early capitalism in western Europe. In 1700 Glückel was married to a banker, Cerf Lévy of Metz, who died a few years later. Gliickel died in Metz in 1724.

Her memoirs were published in 1896, and thereafter were widely used as a source for early capitalism, especially by the German economist Werner Sombart (1863–1941) (*q.v.*).

In 1932 an abridged English translation of her memoirs was published by Marvin Lowenthal.

The poet Heinrich Heine (1797–1856) was a descendant of Gliickel von Hameln.

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HAMELN, a town in Lower Saxony, Ger., at the confluence of the Weser and Hamel, 33 mi. S.W. of Hanover, on the line to Altenbeken. Pop. (1950) 48,122. The older name of Hameln was Hameloa or Hamelowe. and the town owes its origin to an abbey. It existed as a town in the 11th century. Hameln fell into French hands, and in 1806 it was incorporated in the kingdom of Westphalia. In 1814 it again became Hanoverian, but in 1866 fell with that kingdom to Prussia. The chief public buildings are the minster, dedicated to St. Boniface and restored in 1870–7j; the town hall; the so-called Rattenfangerhaus (rat-catcher's house) with mural frescoes illustrating the legend (see below); and the Hochzeitshaus (wedding house) with beautiful gables. The principal industries are the manufacture of paper, leather, chemicals and tobacco, sugar refining and shipbuilding. There is communication with Karlshafen and Minden by steamboats on the Weser. In order to avoid the dangerous part of the river near the town, a channel was cut in 1734 and deepened in 1873.

Hameln is famed for its legend. In 1284 it was infested by a plague of rats, when there appeared a piper who offered for money to charm the vermin into the Weser. His conditions were agreed to, but after he had fulfilled his promise the inhabitants, saying he was a sorcerer, broke their bargain, whereupon he reappeared and played a tune which drew all the children. He led them out to the Koppelberg hill, in which a door opened. He entered and the children after him, all but one who was lame. Some trace the origin of the legend to the children's crusade of 1212, others to an abduction of children, though not on quite so large a scale.

HAMERLING, ROBERT (1830–1889), Austrian poet, was born at Kirchenberg-am-Walde, Lower Austria, on March 24, 1830, of humble parentage. In the revolutionary year of 1848 he joined the student's legion and in 1849 shared in the defense of Vienna against the imperialist troops of Prince Windischgrätz. From 1855 to 1866 he was master of the gymnasium at Trieste. After his retirement he lived quietly at his villa in Stiftingstal near Graz, where he died on July 13. 1889. Hamerling's most popular poem is *Ahasver in Rom* (1866), of which the emperor Nero is the central figure. Among his other works are *Venus im Exil* (1858); Der Konig von Sion (1869). generally regarded as his masterpiece; Die sieben *Todsünden* (1872); *Blätter im Winde* (1887); *Homunculus* (1888): *Amor* und *Psyche* (1882). He also wrote a novel, *Aspasia* (1876), and a tragedy, *Danton und* Robespierre (1870).

A popular edition of Hamerling's works in four volumes was published by M. M. Rabenlechner (Hamburg, 1900). For the poet's life, *see* his autobiographical writings, *Stationen meiner Lebenspilgerschaft* (1889) and *Lehrjahre der Liebe* (1890); also *M.* M. Rabenlechner, *Hnmerling, sein Leben und seine Werke,* i (Hamburg, 1896); a short biography by M. M. Rabenlechner (Dresden, 1901); R. H. Kleinert, *R. Hanzerling, ein Dichter der Schönheit* (Hamburg, 1889); A. Polzer, *Hamerling, sein Wesen und Wirken* (Hamburg, 1890).

HAMHŬNG (Japanese KANKŌ), a city of Korea. about 115 mi. N.E. of Pyongyang, was the commercial and governmental centre of northeastern Korea during the Yi dynasty (1392–1910) and was further developed by the Japanese (1910–45). Even greater transformation took place in Hungnam, a nearby fishing village which became a major industrial centre and port. Chemical and other industries depended largely upon the large scale hydroelectric

power projects developed inland from Hamhŭng.

During the Korean war, UN troops captured Hamhŭng and the reservoir areas, but were forced to retreat by massive numbers of Chinese Communist troops. The hydroelectric power facilities and many industrial plants in the Hungnam area were destroyed. The population of the Hamhŭng-Hungnam area in 1958 was estimated at 400,000. (S. McC.)

HAMI (QOMUL) an oasis in Chinese Turkestan (Sinkiang) in lat. 42° 48′ N. and long. 93° 28′ E. Hami is situated in the northeast of the Tarim basin, on the southern slopes of the eastern spurs of the Thian Shan Mts., and on the western verge of the Gobi desert. It lies at an elevation of 3,150 ft. Its position as a fertile tract at the point of convergence of the two main routes north and south of the Thian Shan connecting China with the West has given it importance since the westward expansion of the Chinese Empire under the Han dynasty in the first century A.D. It is first mentioned in Chinese history under the name of I-Wu-lu. Whenever China was strong enough to assert her claims to the control of central Asia, it was Hami which served as the main rendezvous and supply base for Chinese forces sent to overcome the hostile nomadic tribes in the north. Its commercial importance was equally great since the Pei-shan desert would have been a far more formidable obstacle if Hami had not been available as a place where caravans could re-victual and where animals could be rested. One serious drawback, however, in early times was the constant liability to raids from the nomadic tribes of the good grazing lands on the northern slopes of the eastern Thian Shan. When the Chinese lost their hold on eastern Turkestan, Hami fell into the hands of the Uighurs, who made it their chief town and held it for several centuries. It continued to be an important Buddhist centre long after Islam was dominant in the west of the Tarim Basin. In the early part of the 17th century, however, Hami was ruled by the Mohammedan khan of Kashgar. It was recovered for the Chinese in 1720 during the period of vigorous expansion under the early Manchus, lost for a short time during the great Mohammedan rebellion of 1865 and again recovered in 1873 as part of the successful reconquest of Sinkiang. Hami is now a small town of about 6,000 inhabitants and is still a busy trading centre. Its population consists in part of descendants of the Uighurs and in part of Mohammedan immigrants from Kashgar, Bukhara and Samarkand.

HAMILCAR BARCA or BARCAS, Carthaginian general and statesman, father of Hannibal, was born c. 270 B.C. During the First Punic War in 247, he took over the chief command in Sicily, which at this time was almost entirely in the hands of the Romans, and seizing Mt. Ercte (Monte Pellegrino, near Palermo), carried his raids as far as the coast of south Italy. By the peace of 241 Hamilcar's unbeaten force was allowed to depart from Sicily without any token of submission. On returning to Africa his troops broke out into open mutiny when their rewards were withheld by Hamilcar's opponents among the governing aristocracy. The serious danger into which Carthage was brought was averted by Hamilcar, whom the government reinstated. After crushing the revolt (237), Hamilcar enjoyed a virtual dictatorship. On his own responsibility he led an expedition into Spain to gain a new empire to compensate Carthage for the loss of Sicily and Sardinia. In eight years by force of arms and diplomacy he secured an extensive territory, but his premature death in battle (228) prevented him from completing the conquest.

This Hamilcar has been confused with another general who succeeded to the command of the Carthaginians in the First Punic War, and after successes at Therma and Drepanum was defeated at Ecnomus (256 B.C.). Apart from subsequent unskillful operations against Regulus, nothing is certainly known of him. For others of the name see CARTHAGE, SICILY, Smith's Classical *Dictionary*.

See Polybius i.–iii.; Cornelius Nepos, *Vita Hamilcaris;* **Appian,** *Res Hispanicae,* chs. 4, 5; Diodorus, *Excerpta,* xxiv., xxv.; O. Meltzer, *Geschichte der Knrthager* (1877), ii., also PUNIC WARS.

HAMILTON, the name of a famous Scottish family. The first authentic ancestor of the Hamiltons is one Walter FitzGilbert, one of the witnesses (Jan. 10, 1295) to a charter by James, the high steward of Scotland, to the monks of Paisley; in 1296 his name appears in the Homage Roll as Walter FitzGilbert of "Hameldone." He joined the English party, but after Bannockburn went over to Bruce, was knighted and subsequently received the barony of Cadzow. His younger son John was father of Alexander Hamilton who acquired the lands of Innerwick by marriage, and from him descended a certain Thomas Hamilton, who acquired the lands of Priestfield early in the 16th century. Another Thomas, grandson of this last, who had with others of his house followed Queen Mary and with them had been restored to royal favour, became a lord of session as Lord Priestfield. His eldest son, Thomas, was made an ordinary lord of session as early as 1592 and was eventually created earl of Haddington (*q.v.*). The 5th earl of Haddington by his marriage with Lady Margaret Leslie brought for a time the earldom of Rothes to the Hamiltons to be added to their already numerous titles.

Sir "David FitzWalter FitzGilbert," who carried on the main line of the Hamiltons, was taken prisoner at Neville's Cross (1346); in 1371 and 1373 he was one of the barons in the parliament. His son David succeeded in the representation of the family, Sir John Hamilton of Fingaltoun was ancestor of the Hamiltons of Preston, and Walter is stated to have been progenitor of the Hamiltons of Cambuskeith and Sanquhar in Ayrshire. David Hamilton, the first apparently to describe himself as lord of Cadzow, died before 1392, leaving four or five sons, from whom descended the Hamiltons of Bathgate and of Bardowie, and perhaps also of Udstown, to which last belong the lords Belhaven. Sir John Hamilton of Cadzow, his eldest son, was twice a prisoner in England. John Hamilton's two younger sons are stated to have been founders of the houses of Dalserf and Raploch. His eldest son, James Hamilton of Cadzow, like his father and great-grandfather, visited England as a prisoner, being one of the hostages for the king's ransom. From him the Hamiltons of Silvertonhill and the lords Hamilton of Dalzell claim descent, among the more distinguished members of the former branch being General Sir Ian Hamilton, K.C.B.

James Hamilton was succeeded by his eldest son Sir James Hamilton of Cadzow, an hereditary lord (1445) of parliament. He married (1474) as his second wife, Mary, sister of James III. and widow of Thomas Boyd, earl of Arran. Their son, James, second lord Hamilton, was created (1503) earl of Arran. Of his many illegitimate children Sir James Hamilton of Finnart, beheaded in 1540, was ancestor of the Hamiltons of Gilkerscleugh; and John, archbishop of St. Andrews, hanged by his Protestant enemies, was ancestor of the Hamiltons of Blair, and is said also to have been ancestor of Hamilton of London, baronet. James, second earl of Arran (*q.v.*) son of the first earl by his second wife Janet Beaton, was chosen governor to the little Queen Mary, being nearest of kin to the throne through his grandmother, though the question of the validity of his mother's marriage was by no means settled. He received (1549) the duchy of Châtellerault in France. He was succeeded in the title in 1579 by his eldest son James, who became insane, his brother John, afterwards first marquess of Hamilton, administering the estates. From the third son, Claud, created a lord of parliament as Baron Paisley (1587), descends the duke of Abercorn, heir male of the house of Hamilton.

The first marquess of Hamilton had a natural son, Sir John Hamilton of Lettrick, who was legitimated in 1600 and was ancestor of the lords Bargany. His two legitimate sons were James, 3rd marquess and first duke of Hamilton, and William, who succeeded his brother as 2nd duke and was in turn succeeded under the special remainder contained in the patent of dukedom, by his niece Anne, duchess of Hamilton, who was married in 1656 to William Douglas, earl of Selkirk. The history of the descendants of this marriage belongs to the great house of Douglas, the 7th duke of Hamilton becoming the male representative and chief of the house of Douglas, earls of Angus. Claud Hamilton, Baron Paisley, had five sons, of whom three settled in Ireland, Sir Claud being ancestor of the Hamiltons of Beltrim and Sir Frederick, distinguished in early life in the Swedish wars, being ancestor of the viscounts Boyne.

James, eldest son of Lord Paisley, was created in 1603 lord of

Abercorn, and in 1606 earl of Abercorn and lord of Paisley, Hamilton, Mountcastell and Kilpatrick. His eldest son James, 2nd earl of Abercorn, eventually heir male of the house of Hamilton and successor to the dukedom of Châtellerault, was created in his father's lifetime lord of Strabane in Ireland, but resigned this title in 1633 in favour of his brother Claud, whose grandson, Claud, 5th Lord Strabane, succeeded eventually as 4th earl of Abercorn. The 8th earl of Abercorn, who was summoned to the Irish house of peers in his father's lifetime as Lord Mountcastle, was created a peer of Great Britain in 1786 as Viscount Hamilton of Hamilton in Leicestershire, and renewed the family's connection with Scotland by repurchasing the barony of Duddingston and later the lordship of Paisley. His nephew and successor was created marquess of Abercorn in 1790, and was father of James, 1st duke of Abercorn.

See the article HAMILTON, MARQUESSES AND DUKES OF, and other articles on the different branches of the family (*e.g.*, ABERCORN, HADDINGTON and BELHAVEN) in Sir J. B. Paul's edition of Sir R. Douglas's Peerage of Scotland; and also G. Marshall, Guide to Heraldry and Genealogy.

HAMILTON, MARQUESSES AND DUKES OF. The holders of these titles descended from Sir James Hamilton of Cadzow (see HAMILTON).

JOHN, 1st marquess of Hamilton (c. 1542–1604), third son of James Hamilton, 2nd earl of Arran (*q.v.*) and duke of Châtellerault, was given the abbey of Arbroath in 1551. In politics he was largely under the influence of his unscrupulous younger brother Claud, afterwards Baron Paisley (see HAMILTON). At first hostile to Mary, they later became her devoted partisans. Claud met Mary on her escape from Lochleven and escorted her to Hamilton palace. John appears to have been in France in 1568 when the battle of Langside was fought, and it was probably Claud who commanded Mary's vanguard in the battle. With others of the queen's party they were forfeited by the parliament and sought their revenge on the regent Murray. Although the Hamiltons disavowed all connection with Murray's murderer, James Hamilton of Bothwellhaugh, he had been provided with horse and weapons by the abbot of Arbroath, and it was at Hamilton that he sought refuge after the deed. Their uncle, Archbishop Hamilton, was hanged at Stirling in 1571 for alleged complicity in the murder of Darnley, and is said to have admitted that he was a party to the murder of Murray. At the pacification of Perth in 1573 the Hamiltons abandoned Mary's cause. On the uncertain evidence extracted from the assassin by torture, the Hamiltons had been credited with a share in the murder of the regent Lennox in 1571. In 1579 proceedings against them for these two crimes were resumed, and when they escaped to England their lands and titles were seized by their enemies. James Stewart becoming earl of Arran. John Hamilton presently dissociated himself from the policy of his brother Claud, who continued to plot for Spanish intervention on behalf of Mary. With other Scottish exiles he crossed the border in 1585 and marched on Stirling; he was admitted on Nov 4, and formally reconciled with James VI., with whom he was thenceforward on the friendliest terms. He was created marquess of Hamilton and Lord Evan in 1599, and died on April 6, 1604.

His eldest surviving son JAMES, and marquess of Hamilton (c. 1589–1625), was created baron of Innerdale and earl of Cambridge in the peerage of England in 1619, and these honours descended to his son James, who in 1643 was created duke of Hamilton (*q.v.*). William, 2nd duke of Hamilton (1616–1651), succeeded to the dukedom on his brother's execution in 1649. He was created earl of Lanark in 1639, and in the next year became secretary of state in Scotland. Arrested at Oxford by the king's orders in 1643 for "concurrence" with Hamilton. he escaped, and was temporarily reconciled with the Presbyterian party. Sent by the Scottish committee of estates to treat with Charles I. at Newcastle in 1646, he sought in vain to persuade the king to consent to the establishment of Presbyterianism in England On Sept 26, 1647 he signed on behalf of the Scots the treaty with Charles known as the "Engagement" at Carisbrooke Castle, and helped to organize the second Civil War. In 1648 he fled to Holland; he returned to Scotland with Prince Charles in 1650, and joined in the Scottish invasion of England. He died on Sept. 12, 1651 from wounds received at Worcester. He left no male heirs, and the title devolved on the 1st duke's eldest surviving daughter Anne, duchess of Hamilton in her own right.

Anne married in 1656 William Douglas, earl of Selkirk (1635–1694), who was created duke of Hamilton in 1660 on his wife's petition, receiving also several of the other Hamilton peerages, but for his life only. He resisted Lauderdale's measures in Scotland, and was dismissed from the privy council in 1676. He presided over the convention of Edinburgh which offered the Scottish crown to William and Mary in March 1689. He died at Holyrood on April 18, 1694. His wife survived until 1716.

JAMES DOUGLAS (1658–1712), 4th duke of Hamilton and duke of Brandon (cr. 1711), eldest son of the preceding and of Duchess Anne, succeeded his mother, who resigned the dukedom to him in 1698. On Nov. 15, 1712 he fought the duel with Charles, Lord Mohun, narrated in Thackeray's Esmond, in which both the principals were killed.

The title of Lord Hamilton and that of Viscount Hamilton, in the peerage of Great Britain, conferred on the 8th earl of Abercorn in 1786, are borne by the dukes of Abercorn, whose eldest son is usually styled by courtesy marquess of Hamilton, a title which was added to the other family honours when the 2nd marquess of Abercorn was raised to the dukedom in 1868.

See John Anderson, The House of Hamilton (1825); Hamilton Papers, ed. J. Bain (2 vols., Edinburgh, 1890–92); Gilbert Burnet, Lives of lames and *William. dukes* of Hamilton (1677); The Hamilton Papers relative to *1638–1650*, ed. S. R. Gardiner for the Camden Society (1880); G. E. C[okayne], Complete Peerage (1887–98); an article by the Rev. J. Anderson in Sir J. B. Paul's edition of the Scots Peerage, vol. iv. (1907).

HAMILTON, ALEXANDER (1755–1804), American statesman, was born a British subject, on the island of Nevis in the West Indies, on Jan. 11, 175j. He came of good family on both sides. His father was James Hamilton, a Scottish merchant of St. Christopher. His mother, Rachael Fawcett (Faucette, of French Huguenot descent), married a Danish proprietor of St. Croix with whom she lived unhappily and whom she soon left, subsequently living with James Hamilton; her husband procured a divorce in 1759 and the court forbade her remarriage. Whatever the fault or the excuse of the parents, the anxiety bestowed upon these facts by the son's biographers seems exaggerated. Business misfortunes having caused his father's bankruptcy, and his mother dying in 1768, young Hamilton was thrown upon the care of maternal relatives in St. Croix, where, in his 12th year, he entered the counting-house of Nicholas Cruger. Shortly afterward Cruger, going abroad, left the boy in charge of the business. The extraordinary specimens we possess of his letters, mercantile and friendly, written at this time, attest an astonishing poise and maturity of mind. His opportunities for regular schooling must have been very scant; but he early formed the habits of wide reading and industrious study that were to persist through his life. An accomplishment later of great service to Hamilton, common enough in the Antilles but very rare in the English continental colonies, was a familiar command of French. In 1772 some friends, impressed by his talents, made it possible for him to complete his education in the colonies of the mainland. He prepared for college at Elizabethtown. NJ., and in 1774 entered King's college (now Columbia university) in New York city. His studies, however, were interrupted by the Revolutionary War. A visit to Boston confirmed him in an opinion that he should cast his fortunes with the colonists. Into their cause he threw himself with ardour. In 1774–75 he wrote two influential anonymous pamphlets (entitled "A Full Vindication of the Measures of the Congress from the Calumnies of their Enemies," and "The Farmer Refuted") which were attributed to John Jay; they show remarkable maturity and controversial ability, and rank high among the political arguments of the time Concerning them George Ticknor Curtis (Constitutional History of the *United* States, vol. i. p. 274) has said, "There are displayed in these papers a power of reasoning and sarcasm, a knowledge of the principles of government and of the English constitution, and a grasp of the merits of the whole controversy, that would have

done honour to any man at any age." He then organized an artillery company, was awarded its captaincy on examination, won the interest of Nathanael Greene and Washington by the proficiency and bravery he displayed in the campaign of 1776 around New York city, joined Washington's staff in March 1777 with the rank of lieutenant-colonel, and during four years served as his private secretary and confidential aide. The duties with which he was entrusted — including constant correspondence with Congress, and some very important military missions — attest a complete confidence in his abilities and character. But Hamilton was ambitious for military glory — it was an ambition he never lost; he became impatient of detention in what he regarded as a position of unpleasant dependence, and seized a slight reprimand administered by Washington as an excuse for abandoning his staff position (Feb. 1781; see his Works, vol. ix., p. 232); the incident, however, involved no break in their good relations. Later he secured, through Washington, a field command and won laurels at Yorktown, where he led the American column that captured the first redoubt of the British works.

Meanwhile, in 1780, he had married Elizabeth, daughter of Gen. Philip Schuyler, and thus became allied with one of the most distinguished families in New York. Also, he had begun the political efforts upon which his fame principally rests. In letters of 1779–80 he correctly diagnosed the ills of the Confederation, and suggested with admirable prescience the necessity of centralization in its governmental powers. After a year's service in Congress in 1782–83, in which he experienced the futility of endeavouring to attain through that decrepit body the ends he sought, he settled down to legal practice in New York. The call for the Annapolis Convention (1786), however, presented an opportunity which he immediately improved. A delegate from New York, he supported Madison in inducing the Convention to exceed its delegated powers and summon the Federal Convention of 1787 at Philadelphia (himself drafting the call); secured a place on the New York delegation thereto; and, after his anti-Federal colleagues withdrew from the Convention, signed the constitution for his State. So long as his colleagues were present his own vote was useless, and he absented himself for some time from the debates after making one remarkable speech (June 18, 1787). In this he held up the British Government as the best model in the world. It is worth while noting that it was the monarchy of George III. that Hamilton defended and admired. Both parties, as Sir Henry Maine pointed out (Popular Government, 1886, pp. 212–13), had in mind "monarchy" as practised by George III. It is with this in mind that the quarrel of Hamiltonians and Jeffersonians is to be judged. Hamilton favoured an elective executive of life tenure, holding an absolute veto on national legislation, and with power to appoint the State governors who should hold a similar veto on State legislation; an upper house chosen for life on a property basis; a lower house (this, doubtless, a sop to democrats!) chosen by manhood suffrage; and control by the Federal Government of all militia. Complete extinction of the States he deemed desirable but impracticable. (See Works, vol. i., p. 347; and cp. x., pp. 446, 431, 329.)

Hamilton certainly realized that such proposals could serve no purpose except to focus conservative aims. Though fully conscious that monarchy in America was impossible, he wished to obtain the next best solution in an aristocratic, strongly centralized, coercive, but representative union, with devices to give weight to the influence of class and property. Aside from his one elaborate argument, and membership (undoubtedly, with his aamirer Madison as chairman, no fruitless membership) of the committee on style that gave final form to the constitution, he played an inconspicuous part in the Convention. "No man's ideas," he wrote when the work was done, "are more remote from the plan than my own are known to be; but is it possible to deliberate between anarchy and convulsion on one side and the chance of good to be expected on the other?" Unable to secure all that he desired he used his talents and utmost endeavours to secure what was attainable.

To this struggle was due the greatest of his writings, and the greatest individual contribution to the adoption of the new Government, The *Federalist*, a series of essays that appeared in the New York journals between Oct. 1787 and April 1788. Its inception and much more than half its contents were Hamilton's; the rest, Madison's and Jay's (see Amer. *Hist.* Review, vol. ii., pp. 443–60, 675–80). It remains a classic commentary, not merely on American constitutional law but on the principles of Government generally. Guizot said of it that "in its application of elementary principles of government to practical administration" it was the greatest work he knew; and Chancellor Kent declared it--quite justly — to be "equally admirable in the depth of its wisdom, the comprehensiveness of its views, the sagacity of its reflections, and the fearlessness, patriotism, candour, simplicity and elegance with which its truths are uttered and recommended." Sheer will and reasoning could hardly be more brilliantly and effectively exhibited than they were by Hamilton in the New York convention of 1788, whose vote he won, against the greatest odds, for ratification.

When the new Government was inaugurated he became secretary of the treasury in Washington's cabinet. Congress immediately referred to him a press of queries and problems, and there came from his pen a succession of papers that have left the strongest imprint on the administrative organization of the national Government — two reports on public credit (1790), upholding an ideal of national honour higher than the prevalent popular principles; a report on manufactures (1791), advocating their encouragement (*e.g.*, by bounties paid from surplus revenues amassed by tariff duties) — a famous report, one of the first notable revolts against the doctrines of Adam Smith, which has served ever since as a storehouse of arguments for American protective policy, and served also as an inspiration for Friedrich List; a report favouring the establishment of a national bank (1790), the argument being based on the doctrine of "implied powers" in the Constitution, and on the application that Congress may do anything that can be made, through the medium of money, to subserve the "general welfare" of the United States — doctrines that, through judicial interpretation, have revolutionized the Constitution; and, finally, a vast mass of detailed work by which order and efficiency were given to the national finances. In 1793 he put to confusion his opponents who had brought about a congressional investigation of his official accounts. The success of his financial measures was immediate and remarkable. They did not, as is often but loosely said, create economic prosperity; but they propped it, in an all-important field, with order and confidence. His ultimate purpose was always the strengthening of the Union; but before particularizing his political theories, and the political import of his financial measures, the remaining events of his life may be traced.

His activity in the cabinet was by no means' confined to the finances. He apparently regarded himself as premier, and sometimes overstepped the limits of his office in interfering with other departments. The heterogeneous character of the duties placed upon his department by Congress seemed in fact to reflect the English idea of its primacy. It is often said that Hamilton's counsels were predominant with Washington. In domestic affairs this is, on the whole, true; partly because their views were naturally sympathetic, and partly because Hamilton's advice was naturally accepted in the field of his special competence where Washington really needed guidance — finance. With regard to foreign relations, common sense and better judgment usually supported Jefferson's counsels — but where those qualities were involved Washington needed no counsel. Neutrality and isolation were American policies (to be found in the letters of every public man) before any occasion arose for their official promulgation. There was here no real difference between Hamilton and Jefferson: one sympathized with England, the other with France, but both desired neutrality. On domestic policy their differences were vital and in their conflicts over Hamilton's financial measures they organized, on the basis of varying tenets and ideals which have never ceased to conflict in American politics, the parties of Federalists and Republicans. In Jan. 1795 Hamilton resigned and returned to the practice of law in New York, leaving it for public service only in 1798–1800, when he was the active head, under Washington (who insisted that Hamilton should be second only to him-

self), of the army organized for war against France. But though in private life he remained the continual and chief adviser of Washington, notably in the serious crisis of the Jay Treaty, of which Hamilton approved, Washington's "Farewell Address" can not fairly be said to have been "written" by Hamilton; for Washington had worked upon it for years, and Madison had contributed to it. But though Washington supplied what he called the "body" to Hamilton, the latter apparently largely redressed it; and in particular he added what he described as "such reflections and sentiments as will wear well, progress in approbation with time, and redound to future reputation"—which can hardly be other than the passages which, to-day, give to the address its life.

After Washington's death the Federalist leadership of John Adams, who had the prestige of a varied and great career and greater strength than any other Federalist with the people, was disputed by Hamilton, who controlled practically all the leaders of lesser rank. Hamilton's faults were glaringly displayed in this connection. He sacrificed his influence and his future in political intrigues. Twice, when Adams had been nominated for the presidency he sought to bar him from that office by manipulations of the electoral college; after Adams became president, and so the official head of the party, Hamilton directed the members of the cabinet, and colluded with Federalist senators, in an endeavour to control the president's policy; and finally, on the eve of the crucial election of 1800, he wrote a bitter personal attack on the president (containing much confidential cabinet information) which he only privately circulated, but which was secured and published by the Democrats.

Had he been prosecuted for this under the Sedition Act passed by his Party, as was threatened by a political opponent, it would have been only a just rebuke to him and to his Party. The result of his efforts against Adams was that his agents were dismissed from the Cabinet, that the president turned to southern Federalists, and that he made peace (in 1799) with France; thereby ending such influence as Hamilton enjoyed, and such ambitions as he may have cherished, as head of the army. Similarly, when in Washington's cabinet, he had carried on for five years behind the back of the secretary of State confidential communications with the British minister, which—aside from the ill effects (discernible in the Jay Treaty) of the false ideas that they conveyed of American sentiment—in substance amounted to intrigue. Again, after Aaron Burr outgeneralled Hamilton in the New York campaign of 1799, carrying the State for the Democrats, Hamilton proposed to Gov. John Jay to call together the out-going Federalist legislature in order to choose Federalist presidential electors, a suggestion which Jay simply endorsed. "Proposing a measure for party purposes which it would not become me to adopt" (Works, vol. x., p. 371). Indeed, his opposition to Burr for a decade was conducted very largely by indirection, innuendo and whisper, in letters and conversation.

In short, as a political manager Hamilton, though ready in intrigue, was unsuccessful in it. He was a fighter through and through, and his courage was superb; but he was indiscreet in utterance, impolitic in management, opinionated, self-confident and uncompromising in nature and methods. To considerations of what was politic or practical he could not yield, and yet he could not leave politics alone and devote himself to law. With the establishment of democratic power in 1801 he lost all influence upon national affairs. His courage, and his high ideal of public rectitude were displayed in publishing the details of his *amour* with Mrs. Reynolds, that the favours shown to her complacent husband might permit no suspicion of impropriety in his conduct of the Treasury.

To his antipathy against Adams he sacrificed much prestige; to that against Burr, his life. No matter what may be the final judgment on Burr's character and schemes, doubtless Hamilton judged it a patriotic duty to thwart him in his ambitions; defeating his hopes successively of a foreign mission, the presidency, and the governorship of New York. Unfortunately, personal rivalry was also clearly involved, and personal dislike, and his methods of attack certainly, under the customs of that day, gave abundant cause for the duel in which he died. If his unsparing denunciations were known to Burr they were ignored by him until his last defeat. After that he forced a quarrel on a trivial bit of hearsay (that Hamilton had said he had a "despicable" opinion of Burr); and Hamilton, believing as he explained in a letter he left before going to his death that a compliance with the duelling prejudices of the time was inseparable from the ability to be in the future useful in public affairs, accepted a challenge from him. The duel was fought at the same spot where his eldest son, a boy of 20, had fallen in a duel in 1801. He was mortally wounded, and died on the following day, July 12, 1804. The tragic close of his career appeased for the moment the fierce hatreds of politics, and his death was very generally deplored as a national calamity.

No emphasis, however strong, upon the mere events of Hamilton's life suffices to show his importance in American history. In his earliest pamphlets he started out with the ordinary pre-Revolutionary Whig doctrines of natural rights and liberty; but the first experience of semi-anarchic States'-rights and individualism released by the Revolution ended his fervour for ideas so essentially alien to his mind, and they have no place in his later writings. The loose and barren rule of the Confederation, its feeble inadequacy of conception, infirmity of power, disintegrating particularism, and vicious finance were realized by many; but none other saw so clearly the concrete nationalistic remedies for these concrete ills, or pursued remedial ends so constantly and so ably. An immigrant, Hamilton had no particularistic ties; he was by instinct a "continentalist" or Federalist. Liberty, he remarked in the New York convention in 1788, was too exclusively considered, but there was another thing equally important: "a principle of strength and stability in the organization . . . and of vigour in its operation." He wanted a strong union and energetic Government that should "rest as much as possible on the shoulders of the people and as little as possible on those of the State legislatures"; that should have the support of wealth and class; that should curb the States to such an "entire subordination" as nowise to be hindered by those bodies; that should overbear all local and sectional prejudices and influences, and control the people. At these ends he aimed with extraordinary skill in all his financial measures—though of course he also regarded them as merely justice to creditors. As early as 1776 he urged the direct collection of Federal taxes by Federal agents. From 1779 onward we trace the idea of supporting Government by the interest of the propertied classes; from 1781 onward the idea that a not-excessive public debt would be a blessing in giving cohesiveness to the union: hence his device by which the Federal Government, assuming the war debts of the States, secured greater resources, based itself on a high ideal of nationalism, strengthened its hold on the individual citizen, and gained the support of property. From 1784 onward he seems to have been clear in his desire for judicial review of all legislation. In his report on manufactures his chief avowed motive was to strengthen the union. To the same end he conceived the constitutional doctrines of liberal construction, "implied powers," and the "general welfare," which were later embodied in the decisions of John Marshall. The idea of nationalism pervaded and quickened all his life and works.

The adoption of the constitution was less the end than the beginning of the struggle between its supporters and its opponents. The issue was not merely one of political abstractions; the literature of the Confederation epoch is full of discussions of class rights and economic interests; The Federalist, as Beard says, is "the finest study in the economic interpretation of politics which exists in any language" The constitution's "champions as well as its opponents knew that its real character was to be determined by the measures of law and administration to be established under it. . . . It did not go into effect until the economic measures which its adoption implied were put upon the statute books and carried into execution" (Economic Interpretation of the Constitution, pp. 10, 153, 189; *Economic* Origins *of Jeffersonian* Democracy, pp. 3, 85–86). Here was Hamilton's contribution. He believed with Hume that men are moved only by force and by interest, and in The Federalist he remarked: "Every institution will grow and flourish in proportion to the quantity and extent of the means concentrated towards its formation and support." This explains all

his financial measures. Madison and Hamilton reasoned alike, but they parted, as the former stated years later, "upon its plainly becoming his (Hamilton's) purpose to administration the government into something totally different from that which he and I perfectly knew the convention when it framed that government intended, and from what the people intended in adopting that framework." With one great exception, the dictum of Guizot is hardly an exaggeration, that "there is not in the Constitution of the United States an element of order, of force, of duration, which he did not powerfully contribute to introduce into it and to cause to predominate."

The exception, as history has shown—though Hamilton, of course, would have held it an element merely of disorder and dissolution—was American democracy. It is a commonplace today that colonial experience shaped the Constitution. It was Hamilton's weakness—and misfortune—that he did not share that experience, and lacked feeling for its lessons. It is a weakness everywhere apparent in his calculations, but especially apparent in his total failure to understand the democracy created by two centuries of frontier life. It explains, also, his total lack of understanding of the West, When scores of thousands of settlers were yearly pouring over the Alleghanies, north and south of the Ohio, he was opposed to the wide distribution of public land; and was so fatuous as to encourage the British minister to believe that his country would share with Great Britain the navigation of the Mississippi. Only a few lesser contemporaries were so lacking in judgment of their own time and place. This misunderstanding of American society, and exaltation of administration over the ends of government, condemned him to increasing isolation and impotence; confidence in the integrity, the self-control, and the good judgment of the people, which was the content of Jefferson's political faith, had almost no place in his theories. "Men," said he, "are reasoning rather than reasonable animals"; "opinion is as much influenced by appearances as by realities"; "I have an indifferent opinion of the honesty of the country." It is easy to understand why he received but twice an office at the hands of the people, and none after 1788. The charge that he laboured to introduce monarchy by intrigue was a gross underestimate of his good sense. The idea, he wrote to Washington, was "one of those visionary things none but madmen could undertake, and that no wise man will believe" (1792). We may accept as just, and applicable to his entire career, the statement made by himself in 1803 of his principles in 1787: "(1) That the political powers of the people of this continent would endure nothing but a representative form of government. (2) That, in the actual situation of the country, it was itself right and proper that the representative system should have a full and fair trial. (3) That to such a trial it was essential that the government should be so constructed as to give it all the energy and the stability reconcilable with the principles of that theory."

Throughout life, however, he held to his preference for such a government as he proposed in the convention of 1787; and though its inconsistency with American tendencies was yearly more apparent, he never ceased to avow on all occasions his aristocratic-monarchical partialities. Since Jefferson's assertions, alike as regards Hamilton's talk and the intent and tendency of his political measures, were, to the extent of the underlying basic fact—but discounting Jefferson's somewhat intemperate interpretations—unquestionably true,[1] it cannot be accounted strange that Hamilton's Democratic opponents mistook his theoretic predilections for positive designs. Nor would it be a strained inference from much that he said, to believe that he hoped and expected that in the "crisis" he foresaw—and in which he evidently hoped to play a military rôle—when democracy should have caused the ruin of the country, a new government might be formed that should approximate to his own ideals. No Jeffersonian obsession regarding "monocrats" is more fantastic than this counter obsession of his great opponent.

After the Democratic victory of 1800, his letters are but rarely relieved in their sombre pessimism by flashes of hope and courage. "Every day," he wrote, "proves to me more and more that this American world was not made for me." His last letter on politics, written two days before his death, illustrates the two sides of his thinking already emphasized: in this letter he warns his New England friends against dismemberment of the Union as "a clear sacrifice of great positive advantages, without any counterbalancing good; administering no relief to our real disease, which is democracy, the poison of which, by a subdivision, will only be more concentrated in each part, and consequently the more virulent." To the end he never appreciated the value of his own labours, never lost his fear of the States, nor gained faith in the future of the country. He laboured still, in mingled hope and apprehension, "to prop the frail and worthless fabric," but for its spiritual content of democracy he had no understanding, and even in its nationalism he had little hope. (See his Works, vol. x., pp. 363, 425, 434, 440, 445.) Yet to no other men, except to Washington and Marshall, does American nationalism owe so much.

In the development of the United States the influence of Hamiltonian nationalism and Jeffersonian democracy has been a reactive union; but changed conditions since Hamilton's time, and particularly since the Civil War, have created misconceptions as to Hamilton's position in his own day. Great constructive statesman as he was, he was also in that day essentially a reactionary. He was in sympathy with the dominant forces of public life only while they took, during the war, the predominant impress of an imperfect nationalism. Jeffersonian democracy came into power in 1800 in direct line with colonial development; Hamiltonian Federalism had been a break in that development; and this alone can explain the ouster of the Federalists despite their brilliant success in constructing the Government. Hamilton stigmatized his great opponent as a political fanatic; but actualist as he claimed to be, himself, he could not see, or would not concede, the predominating forces in American life, and would uncompromisingly have minimized the two great political conquests of the colonial period—local self-government and democracy.

Few Americans have received higher tributes from foreign authorities. Talleyrand, personally impressed when in America with Hamilton's brilliant qualities, declared him greater than Fox and Napoleon. Of the judgments rendered by his countrymen, Washington's confidence in his ability and integrity is perhaps the most significant. Chancellor James Kent, and others only less competent, paid remarkable testimony to his legal abilities. Chief-justice Marshall ranked him second to Washington alone. No appraisal is more justly measured than Madison's (1831): "That he possessed intellectual powers of the first order, and the moral qualities of integrity and honour in a captivating degree, has been awarded him by a suffrage now universal If his theory of government deviated from the republican standard he had the candour to avow it, and the greater merit of co-operating faithfully in maturing and supporting a system which was not his choice."

In person Hamilton was rather short (5 ft. 7 in.) and slender; in carriage, erect, dignified and graceful. Deep-set dark eyes vivified his features, and set off his light hair and very fair and rosy complexion. His head in the famous Trumbull portrait is boldly poised and striking. The charm of his manners and conversation is attested by all who knew him, and in familiar life he was artlessly simple. Friends he won readily, and held in devoted attachment by a frank, ardent, generous, warm-hearted and high-minded character. As Lodge says, "the roll of his followers is enough of itself to establish his position in American history." It is therefore the more notable that reciprocal confidence and respect took the place, between Washington and Hamilton, of personal attachment—at least as regards Hamilton. This may be under-

[1] *Cf.* Gouverneur Morris, *Diary and Letters,* vol. ii., pp. 455, 526, 531 and even Lodge's judgments, *Life,* pp. 90–92, 115–116, 122, 130, 140. When he says (p. 140) that "In Hamilton's successful policy there were certainly germs of an aristocratic republic, there were certainly limitations and possibly dangers to pure democracy," this is practically Jefferson's assertion (1792) that "His system flowed from principles adverse to liberty"; but Jefferson went on to add: "and was calculated to undermine and demolish the reoublic." Jefferson merely had exaggerated fears of a moneyed political engine, and seeing that Hamilton's measures of funding and assumption did make the national debt politically useful to the Federalists in the beginning he concluded that they would seek to fasten the debt on the country forever.

stood, considering their extremely different temperaments. It is more difficult to understand why Hamilton—although on the score of personal and Federalist indebtedness he left explicit recognition—never really appreciated Washington's great qualities: Jefferson differed equally from him in temperament and vastly more in opinions, yet fully recognized his greatness. A firm will, tireless energy, courage and bold self-confidence were other leading qualities of Hamilton's nature. Amiability and enthusiastic aggressiveness seem to have been equally characteristic. In his mind, clarity and penetration were matched with logical solidity. Its remarkable quality lay in a combination of acute analysis and grasp of detail with great comprehensiveness of thought. So far as his writings show he was almost wholly lacking in humour. and in imagination little less so. In public speaking, however. he often combined a rhetorical effectiveness and emotional intensity that might take the place of imagination. and enabled him, on the coldest theme. to move the feelings of his auditors.

He died insolvent, leaving a widow and seven children, none of whom revealed the brilliance of their father.

BIBLIOGRAPHY.—Hamilton's Works have been edited by H. C. Lodge (New York, 9 vols., 1885–86, and 12 vols., 1904); all references above are to the latter edition. There are various editions of *The Federalist,* notably those of H. B. Dawson (1863), H. C. Lodge (1888), and—the most scholarly—P. L. Ford (1898); cf. *American Historical Review,* vol. ii., pp. 413, 675. Among modern biographies *see* A. M. Hamilton, *The Intimate Life of Alexander Hanzilton* (1910), very valuable for its materials but both biased and naïve in judgments; H. J. Ford, *Alexander Hamilton* (1920), carefully reasoned; James Schouler, *Alexander Hamilton* (1901), a slender but very judicious study; J. T. Morse, *Life of dlexander Hamilton* (1876), and *H.* C. Lodge, *Alexander Hutnilton* (1882), both partisan; and G. Shea's two books, his *Historical Study* (1877) and *Life and Epoch* (1879). W. *G.* Sumner's *Alexander Hamilton* (1890) is important for its criticism from the point of view of an American free-trader; *see* also, on Hamilton's finance and economic views, C. F. Dunbar, *Quarterly Journal of Economics,* vol. iii. (1889), p. 32; E. G. Bourne in *ibid.,* vol. x. (1894), p. 328; E. C. Lunt in *Journal of Political Economy,* vol. iii. (1895), p. 289; W. C. Culbertson, *Alexander Hanzilton: an Essay* (New Haven, 1911); and the two indispensable books by C. Beard cited in the text. F. S. Oliver's *Alexander Hamilton: An Essay on American Cnion* (1906), an English study, which uses its subject to illustrate the necessity of British imperial federation, has been criticized as being too partisan. *See* also James Bryce, "Predictions of Hamilton and de Tocqueville," in *Johns Hopkins University Studies,* vol. v. (Baltimore, 1887); and the capital essay of Anson D. Morse in the *Political Science Quarterly,* vol. v. (1890), pp. 1–23. The unfinished *Life of Alexander Hamilton,* by his son, J. C. Hamilton, going only to 1787 (New York, 1834–40), was superseded by the same author's valuable, but partisan and uncritical *History of the Republic . . . as traced in the Writings of Alexander Hamilton* (New York, 1857–64; Boston, 1879). New materials and viewpoints have rendered somewhat antiquated the earlier biographies mentioned. (F. S. P.)

HAMILTON, ALLAN McLANE (1848–1919), U.S. physician. was born in Brooklyn. N.Y., on Oct. 6. 1848. He graduated from the College of Physicians and Surgeons (Columbia universityj in 1870.

In 1879 for an essay on "Diseases of the Lateral Columns of the Spinal Cord" Hamilton won the first prize given by the American Medical association. Later he took up more specifically the work of an alienist and medico-legal practitioner. He was present in an advisory capacity at more than 100 murder trials where insanity was the issue, notably at the trials of the assassins of Presidents Garfield and McKinley and in the Thaw case and was influential in the reform of court methods in dealing with criminals of this type. He was professor of mental diseases at Cornell Medical college.

He died at Great Barrington. Mass., on Nov. 23, 1919.

See "Allan McLane Hamilton, 1870–1919," *J.A.M.A.,* 73:1714 (Nov. 29, 1919); Allan McLane Hamilton, *Recollections of an Alienist* (New York. 1916).

HAMILTON, ANTHONY (1646–1720), French author, was probably born in Tyrone or Tipperary. His grandfather, earl of Aberdare, settled in Ireland in the Plantation of Ulster. The family moved to France in 1651 and returned at the Restoration to a house near Whitehall.

Anthony's sister Elizabeth, *la belle Hamilton,* married the comte de Gramont (*q.v.*). Anthony probably went to France in 166; with his brother George, after the expulsion of the Roman Catholics from the army. In any case. he served in the *régiment d'Hamilton,* was wounded in the Palatinate in 1674 and at intervals went over to Ireland for recruits. The regiment was not a success after George's death, and Anthony seems to have left France for Ireland in 1678.

King James II gave him command of an Irish regiment in 1687. After the siege of Limerick. Anthony joined the court of James at Saint Germain, where he shared the general poverty and died on April 21, 1720.

The *Mémoires du conzte de Gramont* were written, theoretically at Gramont's dictation, at the château of the duchesse du Maine at Sceaux, and published, probably much against the author's will, under the rubric of Cologne, but really in Holland. in 1713. The memoirs are after the manner of Bussy-Rabutin. halfway between English memoirs and the French *roman prétendu historique.* The prose is typically early 18th-century, well-bred and conversational. They are generally accurate in substance, though weak in chronology. and are especially valuable for their pictures of the English court.

Of Hamilton's other works, *Le Bélier* is a parody on the followers of Charles Perrault, and the *Contes des fées, Fleur d'épine, Zénéyde* and *Les quatre facardins* satirize the romantic tales popularized by Galland's *Arabian Nights.* He also wrote some light verse and corresponded with Lady Mary Wortley Montague. His *Oeuvres diverses* were collected in 1731.

The *Mémoires* were first translated into English by Abel Boyer in 1714. *See* Kuth Clark, *Anthony Hamilton* (London and New York, 1921); E. Legouis and L. Cazamian, *Histoire de la littérature anglaise* (Paris, 1924).

HAMILTON, ELIZABETH (1758–1816), British author, born in Belfast: of Scottish extraction, spent the greater part of her life in Scotland and at Bath.

Her most famous works are *Letters on Education* (1801–02); *The Cottagers of Glenburnie* (1808), a picture of Scottish rural life which aimed to shake country-dwellers out of their complacency and general backwardness; and the popular song "My Ain Fireside." Her *Hints addressed to the Patrons and Directors of Schools* (1815) recommended the "natural" methods of teaching used by J. H. Pestalozzi. She died at Harrogate on July 23, 1816.

See E. O. Benger, *Memoirs of Mrs. Elizabeth Hamilton,* 2 vol., 2nd ed. (London, 1819).

HAMILTON, EMMA, LADY (*c.* 1765–1815), wife of Sir William Hamilton (*q.v.*), the British envoy at Naples, and famous as the mistress of, Nelson, was the daughter of Henry Lyon, a blacksmith of Great Neston, Cheshire: where she mas christened on May 12, 1765. When she went to live with Charles Greville in 1781 she called herself Emily Hart. Under the protection of Greville, whose means were narrowed by debt, she was taught to sing, dance and act with professional skill. In 1782 he introduced her to his friend Romney, whose portraits of her may have somewhat idealized her apparently robust and brilliantly coloured beauty, but her vivacity and powers of fascination cannot be doubted. She seems to have been sincerely attached to Greville. In 1784 his uncle, Sir William Hamilton, saw—and admired—her. Two years later she was sent on a visit to him at Naples, as the result of an understanding between Hamilton and Greville—the uncle paying his nephew's debts and the nephew ceding his mistress. Emma at first resented the exchange, but submitted. Her beauty, her artistic capacity, and her high spirits made her a great favourite in Neapolitan society, and Queen Maria Carolina became closely attached to her. She became famous for her "attitudes," a series of *poses plastiques* in which she represented classical and other figures. On Sept. 6, 1791, during a visit to England, Hamilton married her, in order to justify her public reception at the court of Naples, where she was the channel of communication between the queen and the British minister—sometimes in opposition to the policy of the king. It was claimed that she secured valuable information in 1796, and was of essential service to the British fleet in 1798 during the Nile campaign, by enabling it to obtain stores and water in Sicily. When Nelson returned from the Nile in Sept. 1798 Lady Hamilton subjugated him, and drew him into a most unhappy participation in the domestic troubles of Naples, and when Sir W. Hamilton was recalled in 1800 she travelled with him and Nelson across Europe. In England Lady

Hamilton paraded her hold over Nelson. Their child, Horatia Nelson Thompson, was born on Jan. 30, 1801. On her husband's death in 1803 she received by his will a liferent of £800, and the furniture of his house in Piccadilly. She then lived with Nelson at his house at Merton. On his death she received Merton, and an annuity of £500, as well as the control of the interest of the £4,000 he left to his daughter. But gambling and extravagance kept her poor, and in 1813 she was put in prison for debt and remained there for a year. She died at Calais in distress if not in want on Jan. 15, 1815.

See *The Memoirs* of *Lady Hamilton* (anon., 1815); and Walter Sichel, Emma, Lady *Hamilton* (1905); J. Turquan and J. d'Auriac, *Une aventurière de haut vol.: Lady Hamilton et la Révolution de Naples 1763–1815* (1913). *See* also the references *s.v.* NELSON.

HAMILTON, LORD GEORGE (1845–1927), English statesman, was born on Dec. 17, 1845, son of the first duke of Abercorn. He was educated at Harrow school and entered the house of commons in 1868 as member for Middlesex. After 1885 he sat for the Ealing division until his retirement in 1906. Lord George took a keen interest in education throughout his life. He was vice-president of the committee of council on education from 1878 to 1880, and chairman of the London School Board from 1894 to 1895. He was a well-known economist and statistician, and rendered signal service to social science as chairman of the Poor Law commission, 1904–09. But his most famous achievements were in two departments of state, the India office and the admiralty. Disraeli made him under-secretary at the India office in 1874, and he spent four years there. He returned to the office as secretary of state in 1895 and held office until 1903. This important period in Indian affairs covered the vice-royalties of Lord Elgin and Lord Curzon. At the outset he laid down a moderate frontier policy which secured the Indian government from much fruitless border warfare. His other and perhaps greatest work was done as first lord of the admiralty (1885–1886 and 1886–1892). He carried through the Naval Defence act of 1889, which formed the framework for the development of the navy up to the beginning of World War I. He secured the transfer of the control of naval ordnance from the war office to the admiralty, created the naval intelligence department and "discovered" Lord Fisher. His long service with unionist governments ended in 1903, when he and Ritchie resigned on the fiscal question. His last public service was as chairman of the Mesopotamia commission (1916–17). He died in London on Sept. 22, 1927.

Lord George married in 1871 Lady Maud Lascelles, daughter of the third Earl Harewood. He wrote *Parliamentary Reminiscences and Reflections* (1917).

HAMILTON, SIR IAN STANDISH MONTEITH (1853–1947), British soldier, was born at Corfu on Jan. 16, 1853. Educated at Wellington college and in Germany, he joined the army in 1872. He served with the 92nd Highlanders in the Afghan War and the Boer War of 1881, and was severely wounded on Majuba hill, one arm being permanently disabled. He was then for several years intermittently on the staff of Sir F. (Lord) Roberts. He served in the Nile Expedition of 1884–85, in Burma in 1886–87, and on the staff of the Chitral Relief Force in 1895. He commanded a brigade on the North-West Frontier in 1897, and afterwards the School of Musketry, Hythe. In the South African War he commanded a mounted infantry division during the advance from Bloemfontein to Pretoria and into the eastern Transvaal. He returned home early in 1901 to become military secretary at the War Office, but towards the end of the year went back to South Africa nominally as chief of the staff to Lord Kitchener, although in reality he was employed chiefly as the commander-in-chief's deputy to control particular groups of operations from time to time during the closing stages of the struggle.

He was afterwards again military secretary and then quartermaster-general at the War Office, and in 1904 he went out to the Far East to accompany the Japanese armies in the field. His impressions under the title *A Staff Officer's Scrap Book* (2 vol., 1906–07), by reason of the interest of its subject, the charm of the author's style, and the combination of war experience and of imagination which inspired his judgments and criticisms; at once took rank in Europe as a modern military classic. His literary ability, though a token of unusual imagination and clearness of thought, rather prejudiced him throughout his career in the eyes of old-fashioned soldiers. On his return he had charge of the Southern Command until 1909, and was afterwards adjutant-general at the War Office for a year. He took a prominent part on behalf of the voluntary service system during the campaign in favour of compulsory service led by Lord Roberts, and in the course of this controversy he published a book *Compulsory Service* (1910), which he wrote at the request of Lord Haldane. In 1910 he was appointed commander-in-chief in the Mediterranean and inspector-general of the Overseas Forces.

On the outbreak of World War I in 1914 Hamilton served for some months as commander in chief of the Home Defence army in England. Then in March 1915, he was selected to take charge of the Mediterranean expeditionary force *(see* DARDANELLES CAMPAIGN). The naval effort to force the Dardanelles having failed, he found himself obliged to undertake operations in the Gallipoli peninsula, and although his army was ill-equipped for the task, he succeeded in landing it in the face of the enemy, but was brought to a standstill. Having, after considerable delay, received substantial reinforcements, he made a great effort in August to improve his position, but partly through the inertia of some of the local commanders, sent out without consulting him, the operations miscarried, and a situation of stalemate arose. The government consulted him in October as to the expediency and feasibility of withdrawing from the peninsula, and on his pronouncing himself strongly opposed to such a policy he was replaced by Sir C. Monro and returned home. In 1920, after the issue of the *Report* of the Dardanelles commission, he published his own story of the campaign under the title of *Gallipoli Diary* (2 vols., 1920), and in 1921 *The Soul and Body of an Army*. Hamilton was the recipient of many honours, including the G.C.M.G. (1919) and the D.S.O. (1891). He died Oct. 12, 1947, at London. (B. H. L. H.)

HAMILTON, JAMES HAMILTON, 1ST DUKE OF (1606–1649), Scottish nobleman, son of James, 2nd marquess of Hamilton, and of the Lady Anne Cunningham, daughter of the earl of Glencairn, was born on June 19, 1606. As the descendant and representative of James Hamilton, 1st earl of Arran, whose mother was a daughter of James II. of Scotland, he was the heir to the throne of Scotland after the descendants of James VI. He married in his fourteenth year May Feilding, aged seven, daughter of Lord Feilding, afterwards 1st earl of Denbigh, and was educated at Exeter College, Oxford, where he matriculated on Dec. 14, 1621. He succeeded to his father's titles on the latter's death in 1625. In 1628 he was made master of the horse, gentleman of the bedchamber and a privy councillor. In 1631 Hamilton took over a force of 6,000 men to assist Gustavus Adolphus in Germany. He guarded the fortresses on the Oder while Gustavus fought Tilly at Breitenfeld, and afterwards occupied Magdeburg, but his army was destroyed by disease and starvation, and after the complete failure of the expedition Hamilton returned to England in September 1634. He now became Charles I.'s chief adviser in Scottish affairs. In 1638, after the outbreak of the revolt against the English Prayer Book, he was appointed commissioner for Scotland to appease the discontents. He was easily intimidated by the covenanting leaders and accomplished nothing. Charles offered an assembly and a parliament, and eventually revoked the prayer book. On Nov. 21, Hamilton presided over the first meeting of the assembly in Glasgow cathedral, but dissolved it on the 28th on its declaring the bishops responsible to its authority. The assembly, however, continued to sit notwithstanding, and Hamilton returned to England leaving the enemy triumphant and in possession. War was now decided upon, and Hamilton was chosen to command an expedition to the Forth to menace the rear of the Scots. He failed, and in July 1639 resigned his commissionership.

Hamilton supported Strafford's proposal to call the Short Parliament, but otherwise opposed him as the chief adversary of the Scots. In Feb. 1641 he persuaded Charles to admit some of the

parliamentary leaders to the council. Hamilton was now confronted by a new antagonist in Montrose, who detested both his character and policy and repudiated his supremacy in Scotland. On Aug. 10, 1641, he accompanied Charles on his last visit to Scotland.

As no reconciliation proved possible between Charles and Argyll, Hamilton sided with Argyll at Edinburgh. In consequence he received a challenge from Lord Ker, of which he gave the king information, and obtained from Ker an apology. Montrose wrote to Charles declaring he could prove Hamilton to be a traitor. Shortly afterwards the plot—known as the "Incident"—to seize Argyll, Hamilton and the latter's brother, the earl of Lanark, was discovered, and on Oct. 12 they fled from Edinburgh.

In July 1642 Hamilton, who, in spite of his intrigues, retained Charles's confidence, went to Scotland on a hopeless mission to prevent the intervention of the Scots in the war, and a breach then took place between him and Argyll. When in February 1643 proposals of mediation between Charles and the parliament came from Scotland, Hamilton instigated the "cross petition" which demanded from Charles the surrender of the annuities of tithes in order to embarrass Loudoun, the chief promoter of the project, to whom they had already been granted. This failing, he promoted a scheme for outvoting Argyll in the Scottish parliament by sending to Scotland all the Scottish peers then with the king, while Charles was to guarantee the establishment of Presbyterianism in Scotland only. Montrose was eager to strike and anticipate the plans of the Covenanters. Hamilton, however, gained over the queen for his project, and in September was made a duke, while Montrose was condemned to inaction. Hamilton's scheme completely failed. On refusing to take the Covenant, he and Lanark were obliged to leave Scotland. They arrived at Oxford on Dec. 16. Hamilton's conduct had at last incurred Charles's resentment and he was sent, in Jan. 1644, a prisoner to Pendennis Castle, in 1645 being removed to St. Michael's Mount, where he was liberated by Fairfax's troops on April 23, 1646.

Hamilton showed great activity in the futile negotiations between the Scots and Charles at Newcastle. In 1648 he obtained a temporary influence and authority in the Scottish parliament over Argyll, and led a large force into England in support of the king on July 8. He showed complete incapacity in military command; mas kept in check for some time by Lambert; and though outnumbering the enemy by 24,000 to about 9,000 men, allowed his troops to disperse over the country and to be defeated in detail by Cromwell, during the three days Aug. 17-19, at the so-called battle of Preston, being himself taken prisoner on the 25th. He was tried on Feb. 6, 1649, condemned to death on March 6 and executed on the 9th.

For his successors *see* HAMILTON, MARQUESSES AND DUKES OF.

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HAMILTON, JAMES (1769–1831), English educationist, and author of the Hamiltonian system of teaching languages, was born in 1769. He went in 1814 to America, intending to become a farmer and manufacturer of potash; but, changing his plan before he reached his "location," he started as a teacher in New York. There, and in other cities, he mas very successful, using a method of teaching languages which he had learned in Harnburg from a French émigré, General d'Angelis. He returned to England in 1823, and taught in various centres. The two master principles of his method were that the language should be presented to the scholar as a living organism, and that its laws should be learned from observation and not by rules. As textbooks for his pupils Hamilton printed interlinear translations of the Gospel of John, of an *Epitome historiae sacrae*, of Aesop's *Fables*, Eutropius, Aurelius Victor, Phaedrus, etc., and many books were issued as Hamiltonian with which he had nothing personally to do. He died on Oct. 31, 1831.

HAMILTON, JOHN (*c.* 1511–1571), Scottish prelate and politician, natural son oi James Hamilton, 1st earl of Arran, became a monk and abbot of Paisley. After studying in Paris he returned to Scotland. where. under his half-brother, the regent Arran. he was made keeper of the privy seal (1543), bishop of Dunkeld (1546). archbishop of St. Andrews (1546) and finally became treasurer of the kingdom. He was imprisoned, owing to Protestant hostility, in 1563. After his release he was an active partisan of Mary, queen of Scots; he baptized the infant James, afterward King James VI, and pronounced the divorce of the queen irom Bothwell. After the battle of Langside he took reiuge in Dumbarton castle. There he was seized, and on the charge oi complicity in the murders of Lord Darnley and the regent Murray he was tried, and hanged on April 6, 1571.

HAMILTON, PATRICK (1504–1528), Scottish protomartyr of the Reiormation, second son of Sir Patrick Hamilton and of Catherine Stewart. daughter of Alexander. duke of Albany, second son of James II of Scotland. In 1517 he was appointed titular abbot of Ferne. Ross-shire. He graduated in Paris in 1520, and then went to Louvain, attracted probably by the fame of Erasmus. On returning to Scotland he became a member of the University of St. Andrews where he conducted, as precentor, a musical mass of his own composition in the cathedral. Early in 1527 the attention of James Beaton. archbishop of St. Andrews, was directed to the heretical preaching of the young priest. Hamilton fled to Germany, first visiting Luther at Wittenberg and afterward enrolling as a student in the new University of Marburg. He returned to Scotland, bold in the conviction of the truth of his Protestant principles. He accepted Beaton's invitation to a conierence at St. Andrews, and for nearly a month was permitted to preach and dispute. At length he was summoned before a council of bishops and clergy presided over by the archbishop; there were 13 charges, seven of which were based on the doctrines affirmed in his Loci *communes*. The council convicted him, after a sham disputation with Friar Campbell, and handed him over to the secular power. The sentence of burning at the stake was carried out on the same day (Feb. 29, 1528) lest he should be rescued by his friends. His courageous bearing greatly helped to spread the Reformation in Scotland. The "reek of Patrick Hamilton infected all it blew on." He represented in Scotland the Lutheran stage oi the Reformation. The *Loci communes*, known as "Patrick's Places." set forth the doctrine of justification by faith and the contrast between the Gospel and the law in a series of clear-cut propositions. It was translated into English by John Frith (1528), and is to be found in Fox's *Acts and Monuments*.

See Lorimer, *Patrick Hanzilton, the First Preacher and Martyr of the Scottish Reforn:zation* (1857).

HAMILTON, SIR WILLIAM (1730–1803), British diplomat and archaeologist, son of Lord Archibald Hamilton, governor of Greennich hospital and of Jamaica, nas born in Scotland on Dec. 13. 1730 and served in the 3rd regiment of foot guards from 1747 to 1758. He left the army after his marriage with a Welsh heiress. and inherited an estate in Snansea upon her death in 1782. From 1764 until his recall in 1800 he was British envoy to the court of Naples. Hamilton made or caused to be made, at Vesuvius and Etna, a series of observations on the action of volcanoes, and published several treatises on earthquakes and volcanoes betneen 1776 and 1783. He was a notable collector and many of his treasures nent to enrich the British museum. In 1791 he married Emma Lyon. The outbreak of the French Revolution and the rapid extension of the revolutionary movement in western Europe soon overwhelmed Naples a situation with which he was incapable of dealing.

See, for the rest of his career, the articles HAMILTON, EMMA, and NELSON, HORATIO. He died on April 6, 1803.

HAMILTON, SIR WILLIAM, BART. (1788–1856), Scottish metaphysician, who as a teacher exerted a remarkable influence over the thought of the younger generation in Scotland, was born in Glasgow on March 8. 1788, the son of William Hamilton, professor of anatomy and botany there. Educated at Glasgow, Edinburgh and Balliol college. Oxford, he took his B.X. in 1811 and became a member of the Scottish bar two years later. Hamil-

ton was an unsuccessful candidate for the chair of moral philosophy at Edinburgh university in 1820 but was appointed professor of civil history there in 1821. His essay in the *Edinburgh Review*, on the "Philosophy of the Unconditioned" (1829), a critique of Victor Cousin's *Cours de philosophie*, led to a long and friendly correspondence between him and Cousin. His subsequent articles on German philosophy (he had taken up the study of the German language as a result of visits to Germany in 1817 and in 1820) established his reputation as a philosopher; and in 1836 he was elected to the chair of logic and metaphysics at Edinburgh. His knowledge embraced anatomy, physiology, literature and theological lore as well as his professed subjects.

Hamilton published a pamphlet on Presbyterian church affairs, *Be Not Schismatics, Be Not Martyrs by Mistake*, in 1843. In the following year he was stricken with paralysis. His edition of Thomas Reid's works appeared in incomplete form in 1846. Later publications were *A Letter to Augustus De Morgan* (1847). part of a controversy on the principles of logic; *Discussions on Philosophy, Literature and Education* (1852), a collection of articles reprinted from the *Edinburgh Review;* and 9 vol. (1854–56) of an edition of the works of Dugald Stewart. He died in Edinburgh on May 6, 1856.

Hamilton was not a great originator, and his attempt to combine the Scottish ,"philosophy of common sense" with elements of Kantianism was not successful. He was. however. influential both in stimulating a taste for metaphysics in his students and in introducing some of Kant's ideas to the British public. At the lowest estimate. he made British philosophy less narrow and one-sided than it was. In the history of logic he has a place for his doctrine of the "quantification of the predicate" (an attempt to elaborate the traditional classification of propositions by expanding "All *A* is *B*" into the two forms "All *A* is all *B*" and "All *A* is some B"; and so on) ; but its radical implications in leading to an extensional conception of logic were not perceived by him. In the field of education Hamilton's *Edinburgh Review* articles on "The State of the English Universities" (1831) and "The Right of Dissenters to Admission Into the English Universities" (1834) were among the factors which led to the royal commission of 1850 and the subsequent reforms.

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HAMILTON, WILLIAM, OF GILBERTFIELD (*c.* 166*j*–17j1). Scottish poet whose vernacular poetry (*e.g.,* "The Last Dying Words of Bonnie Heck." printed in James Watson's *Choice Collection,* 1706) is among the earliest in the 18th-century revival. He was born at Ladyland, Ayrshire. He exchanged with Allan Ramsay "Familiar Epistles" in verse, which are usually included in editions of Ramsay; and his modernized version of Blind Harry's *Wallace* (1722) influenced Burns. He died at Latrick, Lanarkshire, May 24, 1751. (E. *G.* M.)

HAMILTON, WILLIAM GERARD (1729–1796), English statesman, popularly known as "Single Speech Hamilton," was born in London on Jan. 28, 1729, and educated at Winchester and at Oriel college. Oxford. His maiden speech in the house of commons. delivered on Nov. 13, 1755, during the debate on the address. which excited Walpole's admiration. was. in fact, not the only one which he made in the house. Hamilton was one of the commissioners for trade and plantations (1756), chief secretary to Lord Halifax, the lord lieutenant of Ireland (1761), chancellor of the exchequer in Ireland (1763) and filled other offices.

HAMILTON, SIR WILLIAM ROWAN (1805–1865), Irish mathematician, whose works were of great value in mathematical physics, was born in Dublin on Aug. 4, 1805. His great mathematical intelligence was awakened by the reading of Newton's *Arithmetica universalis* when he was 12 years old. He went on to the *Principia,* and when he was 1; attacked Laplace's *Mécanique céleste.* In this he detected an error which was communicated to John Brinkley, then royal astronomer in Ireland. who at once recognized one of the first mathematical minds of the age. Hamilton had a brilliant career at Trinity college. Dublin, but before it was completed he was appointed, at the age of 22, to the Andrews chair of astronomy in succession to Brinkley. The rest of his life was spent at the observatory at Dunsink, near Dublin. in the close study of mathematics. He was knighted in 183j. At the time of his death, Sept. 2, 1865, Hamilton was working on his *Elements of Quaternions,* on which the last six years of his life had been spent.

His earliest papers were the "Theory of Systems of Rays" (*Trans. Roy. Irish Acad.,* 1828–32); in the last of these, by the aid of mathematics. he predicted conical refraction. These were followed by papers on "The Principle of Varying Action" and in 1834 and 183j by two memoirs "On a General Method in Dynamics." The latter papers made a great addition to the methods of inquiry in dynamics, being of great value particularly in the quantum theory.

Hamilton's *Lectures on Quaternions* were published in 1853 and his great book. *The Elements of Quaternions,* posthumously in 1866. In the preface to the *Lectures* he describes the steps by which he reached his important conclusions which form the germ of the later basic theories of hypercomplex numbers.

The discoveries, papers and treatises mentioned might well have formed the whole work of a long and laborious life. But he left an enormous collection of manuscript books, full of original in-i-estigations, that were handed over to Trinity college. His paper on *Fluctuating Functions* and his extremely ingenious invention of the hodograph must be mentioned. Only a few items of his investigations into the solution (especially by numerical approximationj of certain classes of differential equations were published in the *Philosophical Magazine.* Hamilton was a neat, precise and fastidious writer; this may be the reason that he published so little compared with the extent of his investigations.

See R. *P.* Graves, *Life of Sir W. R. Hamilton* (1882–89) ; Royal Irish Academy, *Mathematical Papers of Sir W. R. Hamilton,* 2 vol. (1931–40). (O. OE.)

HAMILTON, a city in southwestern Victoria, Austr. Pop. 1 j 8,507. It lies 613 ft. above sea level on Grangeburn river! south of the Grampians, the most western of the plateaus forming the Great Divide and a sheep and agricultural district. Hamilton has saleyards and abattoirs. and its manufactures include butter, leather. knitted goods and tools. There is a mechanics' institute with a large library and also a botanic garden. Hamilton was proclaimed a borough in 1863, a town in 1928 and a city in 1949.

HAMILTON, the capital of the British colony of Bermuda, is situated on the main island along the sloping northern shore of a deepwater, landlocked harbour. Pop. (1960) 2.763. Rectangular in shape, its streets are parallel and cross at right angles. An imposing neo-Gothic cathedral is centrally situated on Church street at the highest point in the city, which it dominates. Near the cathedral is the handsome Sessions house, accommodating the house of assembly, the supreme court and judicial offices. It is surrounded by government departments, including the Public building, containing the colonial secretariat and the council chamber, in which the executive and legislative councils meet and the colonial parliament is convened and prorogued. The city possesses the Bermuda historical museum and a public library. which stands in the Par la Ville gardens. In the northwest is Victoria park. Hamilton was founded in 1790. incorporated in 1793, succeeded historic St. George as capital in 1815 and was raised to city status in 1897. In 1956 it was made a free port to encourage business and employment. Cars were not permitted in the city until 1946 when a 15 m.p.h. speed limit was imposed. External communications are maintained by sea, and by air from the terminal which is 11 mi. S.E. of the city. The principal industry is the thriving tourist trade.

HAMILTON, one of the chief cities of Canada, the capital of Wentworth county, Ont., occupies a site upon the shore of a large landlocked harbour, Hamilton bay, at the western extremity of Lake Ontario. It covers a plain stretching between the water front and an escarpment called "the mountain," over 250 ft. high.

La Salle landed on the shore of Hamilton bay in Aug. 1669. but European settlement did not begin until 1778 with the arrival of Robert Land and Richard Beasley, United Empire loyalists. The actual founder of the city was George Hamilton who bought a farm between James and Wellington streets and between the mountain and King street. In 1813 he laid out a town. naming the first streets after members of his family. Incorporated in 1816. the village became a town in 1833 and a city in 1846.

During the first decades. Hamilton was overshadowed by nearby Dundas which had important industries. was an early focal point for roads and in 1837 gained access to the bay with the opening of the Desjardins canal. Hamilton. however. was more important in trade and finance. It benefited from the opening in 1830 of the Burlington canal. which linked the bay with Lake Ontario. After 1850 Hamilton became a railway centre and the real growth of the city began.

Railway repair shops, bridge building and a variety of other metal-working industries were established. The basic iron and steel industry began in 1893. In its wake a large variety of metal-using industries followed: transportation equipment. structural steel shapes, building equipment. bolts, screws, wire. farm machinery. etc.

Called the "Pittsburgh of Canada." Hamilton is a leading industrial centre producing over 50% of the steel made in the country. The heavy industries are mainly concentrated on the water front. and the port handles over 8.000.000 tons of freight annually. including direct overseas trade. The harbour covers about 10 sq.mi. and is separated from Lake Ontario by a four-mile-long sand and gravel bar which carries a railway and highway. The approach to the harbour was greatly improved with the completion of a high-level bridge for the highway in 1958. The business district is centred around King and James streets as are the civic buildings such as the library. the city hall and the courthouse.

Hamilton is the centre of one of the finest fruit-growing districts on the continent. and behind the city hall is Canada's largest open air market. held three days a week with fresh displays of fruits. vegetables and flowers. The better residential districts are toward the foot of the mountain, and residential development has spread to the top of the escarpment.

McMaster university, founded in Toronto in 1887 and moved to Hamilton in 1930. and its affiliate Hamilton college are on the western edge of the city. The university is known for nuclear research, having Canada's first privately owned nuclear reactor. Nearby is Hamilton's art gallery. The city has four high schools (one Roman Catholic) and several other educational institutions. four hospitals. a tuberculosis sanatorium and a mental hospital.

On the western fringes are the Royal Botanical gardens of 1.900 ac.. established in 1941 by provincial legislation and including the famous rock gardens, an outstanding horticultural attraction. Well-known is the monument in the park at Stoney Creek. 5 mi. E. of the city. marking the site where in 1813 a British force of 700 men defeated an invading force of 2,000 Americans in a decisive battle of the War of 1812.

The population of Hamilton is largely of British. Polish. Italian and Hungarian descent. The leading religious denominations are Anglican. United Church of Canada, Roman Catholic. Presbyterian and Baptist. Pop. (1961) 273,991; greater Hamilton. 395.189.

(JB. S.)

HAMILTON, a large burgh of Lanarkshire, Scot., situated about 1 mi. from the junction of the Xvon water with the Clyde and 11 mi. S.E. of Glasgow by road over Bothwell bridge. Pop. (1961) 41.928. Hamilton. which is crossed by many winding burns, is flanked on the east side by the Hamilton Low parks and by alluvial haughs. The area has been settled since prehistoric days, the original capital of the parish being Cadzow castle, now about 2 mi. S.E. on a precipitous rock, 200 ft. in height. washed by the Avon. After a charter of 1145 it was renamed after the 1st Lord Hamilton, and became a burgh of barony in 1456 and a royal burgh in 1548, this last dignity being surrendered in 1670 when it was made the chief burgh of the regality and dukedom of Hamilton.

The disco\-ery of coal caused great expansion of the town, and later iron foundries and engineering works n-ere established, but by 1947 all the pits had closed down. Now mainly a residential and shopping town. its industries include the making of metal castings and goods, electrical equipment, radio sets. carpets. knitwear and ioodstufis. In the district are orchards, market gardens and dairy farms.

The Mote hill in the Hamilton Low parks is the site of the original village of Ketherton whose 10th-century cross now stands in front of the parish church. In the churchyard is a monument to a group of Covenanters executed at Edinburgh in 1600. The dukes of Hamilton had a palace on the part of their estate called the Low parks: the building was begun in 1591 and added to through the centuries: but because of subsidences caused by mining it was demolished in 1927. In the town is a domed mausoleum. 120 ft. high. erected by the 10th duke of Hamilton (d. 1852). and bought by the burgh in 1922. Near the mausoleum stood the tolbooth. built in 1642 and demolished in 1951. except for the clock steeple. The 16th-century grammar school. called the Academy, is housed in buildings dating from 1913. The municipal buildings were opened in 1914.

At Barncluith, 1 mi. S.E of the town, are the Dutch gardens laid down in 1583 on the Avon terraces. Two mi. S.E. of Hamilton, near the ruined Cadzow castle, is the chase with its ancient oaks — remains of the great Caledonian forest; there is a herd of wild, white cattle in this estate of the High parks.

HAMILTON, a city of southwestern Ohio, U.S., the seat of Butler county, is located on the Great Miami river. 23 mi. N. of Cincinnati. The population in 1960 was 72,354; the population of the Hamilton-Middletown standard metropolitan statistical area (defined by the federal census as comprising all of Butler county, was 199.076. Fort Hamilton, the first of a chain of forts on the Miami and Maumee rivers, was built there in 1791 by Gen. Arthur St. Clair. A town called Fairfield was laid out adjoining the fort in 1794. The fort was abandoned in 1796 and about that time Fairfield was renamed Hamilton. for Alexander Hamilton. When Butler county was organized in 1803, Hamilton became the county seat. It was incorporated as a village in 1810 and as a city in 1857. Across the river was Rossville, a lusty rival until it united with Hamilton (1854).

Hamilton had the advantages of being in a fertile agricultural district, at the centre of many turnpikes, on a useful river. on the Miami and Erie canal (from 1827 to 1913), and on the Baltimore and Ohio and the Pennsylvania railways. .Abundant water power encouraged early industrial development, including the manufacture of farm machinery, paper, textiles and tools. Manufactures include paper. paper-mill felts, safes, vaults, automobile bodies; machinery, diesel engines, woolen blankets. machine tools, prefabricated houses and hydraulic and mechanical presses. The city has several parks and public buildings, and owns its public utilities (water since 1884; electricity since 1895). (W. E. SH.)

HAMILTON RIVER (GRAND or ASHUANIPI), is the principal river of Labrador. in northeastern Canada. It rises on the central plateau of Labrador-Ungava in a chain of lakes 1.750 ft. above sea level; and wanders aimlessly for 208 mi. until it falls precipitously into the Bowdoin canyon at Grand falls, 250 mi. from its mouth. The falls are 302 ft. high, and the river drops more than 800 ft. in 10 mi. Grand falls have a hydroelectric power potential in excess of an estimated 4,000,000 h.p.; a program to harness them was begun in 1956. The upper stream, at the outfall from Menihek Lakes. was developed in 1953 to provide power for Schefferville. Below Grand falls the river flows in a deeply cut valley about 800 ft. below the plateau level, opening out only in the final six miles before discharging into Lake Melville and thence into the Atlantic ocean. Dense spruce forests vegetate the lower sections of the valley. Grand falls were discovered in 1839 by John McLean. Hudson's Bay company. (J. D. I.)

HAMIRPUR, a municipality, tehsil (subdivision) and district in the Jhansi division of Uttar Pradesh. India. The town stands near the confluence of the Betwa and the Jumna, 110 mi. N.W. of Allahabad. Pop. (1951) 8,469. It was founded, according to tradition, in the 11th century by Hamir Deo, a Karchuli Rajput expelled from Alwar by the Mohammedans.

HAMIRPUR TEHSIL (416 sq.mi.) had a population in 1951 of 109,316.

HAMIRPUR DISTRICT has an area of 2,776 sq.mi. and forms part of the great plain of Bundelkhand, which stretches from the Jumna to the central Vindhyan plateau and contains the famous artificial lakes of Mahoba. These magnificent reservoirs were constructed by the Chandel rajahs before the Mohammedan conquest, for irrigation and as sheets of ornamental water. Many of them enclose craggy islets or peninsulas, crowned by the ruins of granite temples, exquisitely carved and decorated. From the base of this hill and lake country the plain spreads northward, arid and treeless, toward the rivers. Of these the principal are the Betwa and its tributary the Dhasan.

The deep black soil of Bundelkhand, known as *mar,* retains the moisture under a dried and rifted surface, making the district fertile, but the rainfall is precarious and droughts are frequent. The staple products are grains of various sorts, the most important being gram. Cotton is also a valuable crop. Agriculture suffers much from the *kans* grass, a noxious weed which overruns the fields and is almost ineradicable wherever it has obtained a footing. In 1951 the population was 665,429. Exports are chiefly agricultural produce and cotton cloth. Rath (pop. 13,852) is the principal commercial centre! and other important towns are Mahoba (19,244) and Charkhari (11,631).

From the 9th to the 10th century this district was the centre of the Chandel kingdom, with its capital at Mahoba. The rajahs adorned the town with many splendid edifices, remains of which still exist. At the end of the 12th century Mahoba fell into the hands of the Mohammedans. In 1680 the district was conquered by Chhatar Sal, the hero of the Bundelas, who assigned at his death one-third of his dominions to his ally the Maratha peshwa. Until Bundelkhand became British territory in 1802 there was constant warfare between the Bundela princes and the Maratha chieftains.

HAMITIC LANGUAGES: *see* AFRICAN LANGUAGES: *The Hamito-Semitic (Afro-Asiatic) Languages.*

HAMITIC RACES. The term Hamitic as applied to race is not only extremely vague but has been much abused by anthropological writers. Sergi and Meinhof have both made classifications. Sergi includes the Hamites, racially, as a branch of his Mediterranean Race and distinguishes an eastern branch including the Nubians, Bejas, Abyssinians, Gallas, Somalis, Masais, etc., and a northern branch including the Berbers, Fulani, etc. Meinhof's classification is on broad lines essentially the same but he would include the Hottentots, on very unsatisfactory grounds, mainly linguistic. The southern Abyssinians have certainly absorbed Galla blood but the majority are Semitic or Semito-Negroid. There is still some support for the contention that only Sergi's eastern branch should be called definitely Hamitic and that the northern should take the name Libyan.

The definition of the term Hamitic as an anthropological description is still a type of brown people with frizzy hair, of lean and sinewy physique, with slender but muscular limbs, a thin, straight or even aquiline nose with delicate nostrils, thin lips and utter absence of prognathism. There is still much confusion in the use of the term from linguistic and ethnologic viewpoints. *See* G. Sergi, *Africa Anthropologia della stirpe camitica* (1897), and *The Mediterranean Race* (1901); C. Meinhof. *Die Hamitensprachen (Hamburg Kolonials-Institute).*

BY COURTESY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

MASAI WARRIORS, OF BRITISH EAST AFRICA

Masai men live in military kraals for several years during their youth, and then settle down as cattle-breeders

HAMLET, the hero of Shakespeare's tragedy, a striking figure in Scandinavian romance. Saxo Grammaticus devotes parts of the third and fourth books of his *Historia Danica,* written at the beginning of the 13th century, to the story of Hamlet. Amleth or Amloði, which is supposed to have been contained in the lost Skjöldunga saga. The close parallels between the tale of Hamlet and the English romances of Havelok, Horn and Bevis of Hampton make it conceivable that Hamlet is of British rather than of Scandinavian origin. His name does in fact occur in the Irish *Annals of the Four Masters* (ed. O'Donovan 1851).

Late in the 10th century there is evidence of the existence of an Icelandic saga of Amloði or Amleth in a passage from the poet Snaebjorn in the second part of the prose *Edda:* "'Tis said that far out, off yonder ness, the Nine Maids of the Island Mill stir amain the host—cruel skerry-quern—they who in ages past ground Hamlet's meal." This passage may be compared with one of Hamlet's sayings quoted by Saxo: "As they passed the sand-hills, and bade him look at the meal, meaning the sand, he replied that it had been ground small by the hoary tempests of the ocean." According to Saxo (Books iii. and iv., chaps. 86–106), Hamlet's history is briefly as follows. In the days of Rorik, king of Denmark, Gervendill was governor of Jutland, and was succeeded by his sons Horvendill and Feng. Horvendill married Gerutha, Rorik's daughter, who bore him a son Amleth. But Feng, out of jealousy, murdered Horvendill, and persuaded Gerutha to become his wife, on the plea that he had avenged her of a husband by whom she had been hated. Amleth, afraid of sharing his father's fate, pretended to be imbecile, but the suspicion of Feng put him to various tests. Among other things they sought to entangle him with a young girl, his foster-sister, but his cunning saved him. When, however, Amleth slew the eaves-dropper hidden, like Polonius, in his mother's room, Feng despatched him to England in company with two attendants, who bore a letter enjoining the king of the country to put him to death. Amleth secretly altered the message on their wooden tables to the effect that the king should put the attendants to death and give Amleth his daughter in marriage. After marrying the princess, Amleth returned to Denmark, taking with him certain hollow sticks filled with gold. He arrived in time for a *funeral feast,* held to celebrate his supposed death. At the feast he plied the courtiers with wine, and during their drunken sleep fastened down over them the woollen hangings of the hall with pegs he had sharpened during his feigned madness, and then set fire to the palace. Having slain Feng with his own sword, he was proclaimed king. Returning to England for his wife he found that his father-in-law and Feng had been pledged each to avenge the other's death. The English king, unwilling personally to carry out his pledge, sent Amleth as proxy wooer for the hand of a terrible Scottish queen Hermuthruda, who had put all former wooers to death, but fell in love with Amleth. On his return to England his first wife, whose love proved stronger than her resentment, told him of her father's intended revenge. In the battle which followed Amleth won the day by setting up the dead men of the day before with stakes and thus terrifying the enemy. He then returned with his two wives to Jutland, where he was slain in a battle against Wiglek, Rorik's successor.

The other Scandinavian versions of the tale are: the *Hrolfs-saga Kraba;* the modem Icelandic *Ambales Saga,* a romantic tale the earliest manuscript of which dates from the 17th century; and the folk tale of Brjám which was put in writing in 1707. Saxo Grammaticus was certainly familiar with the Latin historians, and it is most probable that, recognizing the similarity between the northern Hamlet legend and the classical tale of Lucius Junius Brutus, he deliberately added circumstances from the classical story. 0. L. Jiriczek first pointed out the striking similarities existing between the story of Amleth and that of Kei Chosro in the *Shāhnāma* ("The Book of the Kings") of the Persian poet Firdousi, and *R.* Zenker *(Boeve Amlethus,* pp. 207–268, Berlin and Leipzig, 1904) even concluded that the northern saga rested on an earlier version of Firdousi's story. Further resemblances exist in the *Ambales Saga* to the tales of Bellerophon, of Hercules and of Servius Tullius. In *The Classical Tradition in Poetry* Gilbert Murray has drawn an interesting parallel between the story of Hamlet and the story of Orestes. The tale of Hamlet's adven-

tures in Britain forms an episode so distinct that it was at one time referred to a separate hero.

The story of Hamlet uas known to the Elizabethans in François de Belleforest's *Histoires tragiques* (1559), and as early as 1587 or 1589 Hamlet had appeared on the English stage, as is shown by Thomas Nashe's preface to Robert Greene's *Menaphon:* "He will afford you whole Hamlets, I should say, handfulls of tragical speeches." The Shakespearian Hamlet owes, however, little but the outline of his story to Saxo. *See* also SHAKESPEARE.

See an appendix to O. Elton's translation of Saxo Grammaticus (1894); I. Gollancz, *Hamlet in Iceland* (1898); *H.* L Ward, *Catalogue of Romances,* under "Havelok," vol. i, pp 423 *seq ; English Historical Review, x* (1895); *F.* Detter, "Die Hamletsage," *Zeitschr f. deut. Alter.,* vol. xxxvi (1892); O. L. Jiriczek, "Die Amlethsage auf Island," in *Germanistische Abhandlungen,* vol. xii (Breslau), and "Hamlet in Iran," in *Zeitschr. des Vereins für Volkskunde,* x (1900); A. Olrik, *Kilderne til Sakses Oldhistorie,* 2 vol. (1892–94).

HAMLEY, SIR EDWARD BRUCE (1824–1893), British general and military writer, was born on Aprii 27, 1824, at Bodmin, Cornwall, and entered the Royal Artillery in 1843. He served in the Crimean War, and in 1859 became professor of military history at the staff college at Sandhurst. In 1866 he weni to the council of military education, returning in 1870 to the staff college as commandant. From 1879 to 1881 he was British commissioner successively for the delimitation of the frontiers of Turkey and Bulgaria, Turkey in Asia and Russia, and Turkey and Greece. He commanded the 2nd division of the expedition to Egypt under Lord Wolseley. From 1885 he represented Birkenhead in parliament as a Conservative He died in London on Aug. 12, 1893.

HAMLIN, HANNIBAL (1809–1891), vice-president of the United States (1861–65), was born at Paris, Me., on Aug 27, 1809. After studying in Hebron academy, he conducted his father's farm for a time, became schoolmaster and later managed a weekly newspaper at Paris. He then studied law, was admitted to the bar in 1833 and rapidly acquired a reputation as an able lawyer and a good public speaker. Entering politics as an anti-slavery Democrat, he was a member of the state house of representatives in 1836–40, serving as its presiding officer. He was a representative in congress from 1843–47, and was a member of the U.S senate, 1848–56. From the very beginning of his service in congress he was prominent as an opponent of the extension of slavery; he was a conspicuous supporter of the Wilmot proviso, spoke against the compromise measures of 1850 and in 1856, chiefly because of his party's endorsement of the passage in 1854 of the Kansas-Nebraska bill, which repealed the Missouri compromise, he withdrew from the Democrats and joined the newly organized Republican party. The Republicans of Maine nominated him for governor in the same year, and having carried the election by a large majority he was inaugurated in this office on Jan. 8. 1857. In February, however, he resigned the governorship, and was again a member of the senate, 1857–61. From 1861 to 1865, during the Civil War, he was vice-president of the United States. While in this office he was one of the chief advisers of Pres Abraham Lincoln, and urged both the Emancipation proclamation, and the arming of the Negroes. After the war he again served in the senate (1869–81), was minister to Spain (1881–83) and then retired from public life. He died at Bangor, Me., on July 4, 1891.

See *Life and Times of Hannibal Hamlin* by C. E Hamlin, his grandson (1899).

HAMM, a town in the province of North Rhine-Westphalia, Ger., on the Lippe, 19 mi. by rail N.E. from Dortmund on the main line Cologne-Hanover Pop. (1960) 68 775. The town possesses very extensive wire factories and machine works breweries and manufactories of brushes, baskets, leather, starch, varnish and oil Nearby are some thermal baths and coal mines Because of its factories and very extensive railway yards and connections Hamm was one of the German cities most heavily bombed by British and U S planes during World War II

HAMMAD AL-RAWIYAH (ABU AL-QASIM HAMMAD IBN ABI LAILA SABUR) (*c.* 694–*c.* 772) Arab scholar, famous for his knowledge of pre-Islamic and early Islamic poetry and credited nith the collecting of the early odes known as the *Mu'allaqat* (q *v.*). He was born in Kufa, probably in 694, of the tribe of Dailam Reputed to be the most learned man of his time in regard to the "days of the Arabs" (*i.e*, their chief battles). their stories, poems. genealogies and dialects, he is said to have boasted that he could recite 100 long *qasidas* (odes) for each letter of the alphabet (*i.e.,* rhyming in each letter) and these chiefly from pre-Islamic times. Hence his name *al-Rasiyak* ("the reciter of verses from memory"). A favourite of the caliphs Yazid II and Hisham, he came to live in Damascus, where he died c. 772.

See Ibn Khallikan's biographical dictionary in French trans. by M'G. de Slane, vol i (1842).

HAMMANN, OTTO (1852–1028) German journalist, who as director of the press section of the German foreign office from 1894 to 1916 exercised considerable influence, was born at Blankenhain, Jan. 23, 1852. He studied law and in the 1880s moved to Berlin where he became a journalist. He was appointed leader of the foreign office press section by the imperial chancellor, Count Leo von Caprivi, and played a leading part in Caprivi's defensive campaign against Bismarck's followers. Hammann maintained friendly relations with Caprivi's successor Prince Hohenlohe, and under the chancellorship of Prince von Bülow, who fully recognized the importance of the press, his influence increased, arousing, however, much hostility. Among his tasks was the preparation of the important declarations of policy which the chancellor made before the *Reichstag.* His works include *Der neue Kurs* (1918), *Zur Vorgeschichte des Weltkriegs* (1918) and *Um den Kaiser, Errinerungen . . .* 1906–09 (1919). He died in Berlin, June 18, 1928.

See *Deutsches Biographisches Jahrbuch,* vol. x, 1928 (1931).

HAMMARSKJÖLD, DAG (HJALMAR AGNE CARL) (1905-1961), Swedish statesman, economist and United Nations official who was posthumously awarded the 1961 Nobel peace prize, was born at Jönköping, Swed . on July 29, 1905 Son of a former Swedish prime minister, Hjalmar Hammarskjold, he studied law and economics at the universities of Uppsala and Stockholm At Stockholm he became an assistant professor of political economy in 1933. He joined the civil service in 1936 as permanent undersecretary in the ministry of finance He was also for several years president of the board of the Bank of Sweden.

In 1947 Hammarskjöld was appointed to the ministry of foreign affairs and was made responsible for all international financial and economic questions He served for two years as permanent secretary-general of that ministry and entered the cabinet in 1951 as minister of state with the functions of deputy foreign minister. In April 1953, he was elected secretary-general of the U S and was re-elected unanimously for another term of five years in Sept 1957. In 1956-57 Hammarskjöld was deeply involved in the Suez canal crisis Thereafter the middle east continued to occupy his attention, and he went there several times to confer with Israeli and Arab leaders. On March 27. 1959, he visited Soviet Premier N S Rhrushchev at Sochi, U.S S R

Civil strife broke out in the Belgian Congo after it gained independence in 1960 and Hammarskjdld dispatched UN troops to the area in an effort to reunite—by force if necessary—the warring factions This action was denounced by the U S S R , which demanded that Hammarskjold resign and that a three-man board replace the office of secretary-general. The members of this *troika* (a Russian word meaning a three-horse team). one each from the western, neutralist and Communist nations, would exercise veto power over the other two and thus over the actions of the secretariat. Hammarskjold refused to resign. but while on a peace mission to the Congo he was killed in a plane crash near Ndola, Northern Rhodesia. on Sept 18. 1961, just one day before the scheduled opening of the 16th session of the UN general assembly. A month after his death Hammarskjöld was awarded the 1961 Nobel peace prize.

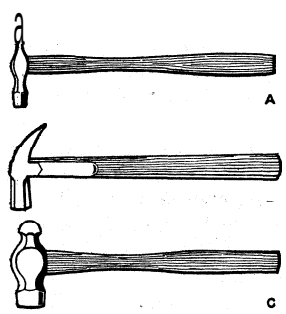
HAMMARSKJOLD, HJALMAR (1862–1953), Swedish statesman. was horn at Tuna on Feb. 4, 1862. He studied at Uppsala, where in 1891 he was appointed professor of civil law. He became minister of justice in the Van Otter cabinet, holding this post from 1901–02, when he was appointed president of the Göta high court. In 1905 he was minister of education in the

Lundeburg cabinet and also a delegate to the conference with Norway at Karlstad at the time of the dissolution of the union. He was Swedish minister in Copenhagen from 1905–07 when he became governor (*landshörding*) of the province (Ian) of Uppsala.

He had been Swedish delegate at The Hague conferences in regard to private international law in 1900 and 1904, and from 1904 was Swedish member of The Hague international board of arbitration. In 1907 he was Sweden's leading delegate to The Hague Peace conference and in 1909 acted as president of the Franco-German board of arbitration in regard to the Casablanca affair. He presided in 1913 over the Franco-Italian arbitration court regarding the seizure of vessels during the Tripoli war. In Feb 1914 he succeeded Karl Staaff as prime minister, retaining this post during World War I until 1917 (*see* SWEDEN). Hammarskjold became a curator of the Académie de Droit International at The Hague. He was president of the Institut de Droit International (1924–38) and chairman of the Nobel Prize foundation (1929–47).

Hammarskjold died in Stockholm on Oct. 12, 1953.

HAMMER, an implement consisting of a shaft or handle with head fixed transversely to it. The head, usually of metal, has one flat face. the other may be shaped to serve various purposes, *e.g.*, with a claw, a pick. etc. The implement is used for breaking, beating, driving nails, rivets, etc., and the aord is applied to heavy masses of metal moved by machinery, and used for similar purposes. (*See* TOOL.) The word is also applied to many objects resembling a hammer in shape or function. Thus the "striker" in a clock, or in a bell. when it is sounded by an independent lever and not by the swinging of the tongue is called a hammer; similarly. in the action of a pianoforte the word is used of a wooden shank with felt-covered head attached to a key, the striking of which throws the hammer against the strings.



SPECIMENS OF HAMMERS
A, cross-peen pin hammer. B, claw hammer. C, ball-peen engineer's hammer

In the-mechanism of a firearm the hammer is that part which by its impact on the cap or primer explodes the charge. (*See* SMALL ARMS, MILITARY.)

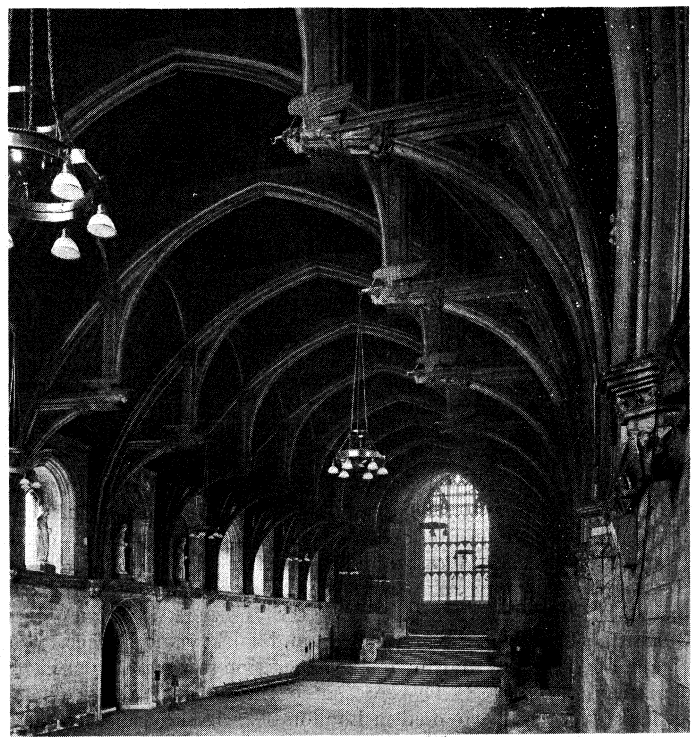
The hammer. more usually known by its French name of *martel de fer,* was a medieval hand weapon. With a long shaft it was used bv infantrv, especially when acting against mounted troops. With a short handle and usually made altogether of metal it was also used by horse-soldiers.

HAMMERBEAM ROOF, in architecture, a term for a type of truss used in an open timber roof In this construction, the ordinary tie beam, *i.e.,* the horizontal beam in a roof nhich ties together the feet of the rafters, is cut through, leaving a horizontal portion, the hammerbeam, which projects from the wall. The cutting of the tie beam allows a higher open space in the centre of the building.

The hammerbeam is supported by curved braces springing from wall posts which rest on corbels. A post usually rises vertically from the end of the hammerbeam to the intersection of the rafter and the cross tie. For greater strength a large arched piece of timber, rising from the wall post or from the hammerbeam, is often carried across the hall. The hammerbeam ends usually terminate in carved figures and all other parts are richly decorated with moldings. Two rows of hammerbeams are occasionally used, and the hammerbeam is also found in conjunction with other forms of trusses.

Although this principle of trussing was known in the 13th century. it received its most characteristic development in 14th-century England. The earliest extant example is the Great Hall, Palace of Westminster, London, begun 1394. Other important examples exist over the halls of the palaces of Hampton Court and Eltham, and many examples are to be found, especially in East Anglia, in parish churches of the 15th and 16th centuries.

(E. B. MACD.)



A f KERSTING

HAMMERBEAM ROOF IN **WESTMINSTER** HALL, LONDON

HAMMERFEST, the most northerly town in Europe. Pop. 11959 est) 5.131. It is situated on an island (Kvaloy) off the northwest cosst of Norway, in Finmark county. in 70° 40' 11″ N., the latitude being that of the extreme north of Alaska. In spite of this, its average January temperature is little below freezing point. owing to the influence of the warm westerly winds and North Atlantic drift. and the harbour is ice-free. The district around is barren and naturally treeless. but a "forest" of birches has been successfully planted. Hammerfest is 674 mi. by sea S.E. of Trondheim, and 78 mi. S.W. from the North cape. The narrow strait Strommen separates Kvaloy from the larger Seiland, whose snow-covered hills with several glaciers rise above 3,500 ft., while an insular rampart of mountains, Soro, protects the strait and harbour from the open sea. The town is timber-built and modern; much of it having been rebuilt after fire in 1890. The sun does not set at Hammerfest from May 13 to July 29. Vessels set out to the fisheries, as far as Spitsbergen and the Kara sea; and trade before World War II was brisk, not only Norwegian and Danish but British, German and Russian vessels engaged in it.

Cod-liver oil, train oil and salted fish are exported with some reindeerskins, foxskins and eiderdown; and coal and salt for curing are imported. In the spring the great herds of tame reindeer are driven out to swim Strommen and graze in the summer pastures of Seiland; toward winter they are called home again. From Nov. 18 to Jan. 23 the sun is not seen, and the enforced quiet of winter prevails. Electric light was introduced in the town in 1891.

HAMMERHEAD SHARK. Any of several species of ovoviviparous sharks of the genus *Sphyrna,* characterized by the unique configuration of the head, the anterior portion of which resembles a hammer. They are formidable and ferocious and occur in all tropical and subtropical seas. particularly in the Indian ocean. The common hammerhead shark (*S. zygaena*), which attains a length of 16 ft., occurs on the milder coasts of Europe and ranges northnard along American shores to Massachusetts and California *See* SHARK; CHONDRICHTHYES.

HAMMERKOP or HAMMERHEAD (*Scopus umbretta*), an African wading bird related to the storks and herons (*qq.v.*) and constituting the family Scopidae in the order Ciconiiformes. It is found over Africa south of the Sahara, as well as Madagascar and southwest Arabia. It is nearly uniform umber or

earthy-brown, whence the name umbrette, has a large head with a horizontal crest and a heavy. compressed. hook-tipped bill. black like the shortish legs. It sits beside a stream. head pulled down. or wades slowly stirring the mud with one foot and then the other, feeding on mollusks, frogs, small fishes and water beetles. Though only about 2 ft. long, it builds an enormous nest of sticks. 6 ft. across and 3 to 4 ft. high, on rocky ledges or trees in which it lays 3 to 6 chalky white eggs. The dome-shaped nest has an entrance on the side and a narrow tunnel leading to a central chamber lined with mud. (G. F. Ss.)

HAMMER-PURGSTALL, JOSEPH, FREIHERR VON (1774–1856), Austrian diplomat and author. the pioneer of Islamic studies in Germany, mas born at Graz. June 9. 1774. In 1799 he was appointed to a post in the Austrian embassy in Constantinople and subsequently took part in an English campaign against the French in the eastern Mediterranean. He returned to Austria in 1807, and on inheriting estates in Syria in 1835. he was ennobled and retired from the diplomatic service. He died in Vienna, Nov. 23, 1856.

Hammer-Purgstall's services to oriental studies in Germany resembled those of Sir William Jones in England and Silvestre de Sacy in France. For jo years he wrote incessantly on many subjects, but more important than his scholarly works were his texts and translations of Arabic. Persian and Turkish authors. which made their work known to a public outside narrow academic circles and opened the way for later studies. His principal historical work is his *Geschichte des Osmanischen Reiches,* 10 vol. (1827–35). He also wrote poems, plays and novels, now forgotten. He was largely responsible for the foundation of the Akademie der Wissenschaften at Vienna.

Despite faults. Hammer-Purgstall did more for oriental studies than those who criticized his inaccuracies.

For a full list of Hammer-Purgstall's works, see *Comptes rendus* of the Xcademie des Inscriptions et des Belles Lettres (1857). *See* also **C.** Schlottmann, *Joseph von Hammer-Purgstall* (1857).

HAMMERSMITH, a western metropolitan borough (1899) of London. Eng., bounded east by Kensington and south by Fulham and the Thames river, and extending north and west to the boundary of the county of London. Pop. (1951) 119.36;. Area 3.6 sq.mi. Hammersmith is mentioned with Fulham as a camp of Danish invaders in 879. when they occupied the island of Hame, identified with Chiswick Eyot. Hammersmith. though retaining little of its early rural charm, is a residential area with many large industrial concerns. chiefly in the north, in the part called Shepherd's Bush. Industry is mainly electrical and light engineering and food and drink manufacture. Old Hammersmith bridge, designed by W. Tierney Clark (1824), was the earliest suspension bridge erected near London. It was replaced in 1884–87 by another suspension bridge by Sir Joseph Bazalgette.

Until 1834 Hammersmith formed part of Fulham parish. Its church of St. Paul was built as a chapel of ease to Fulham and consecrated by William Laud in 1631. The modern building dates from 1890. St. Paul's school was founded in or about 1509 by John Colet, dean of St. Paul's, under the shadow of the cathedral church. But it appears that Colet actually refounded and reorganized a school which had been attached to the cathedral from at least the early 12th century. The school was moved to its site in Hammersmith road in 1883. The number of foundation scholars was set at 153, according to the number of fishes taken in the miraculous draught (John xxi. 11). The school governors are appointed by the Mercers' company (by n-hich body the new site was acquired) and the universities of Oxford. Cambridge and London. There are also the Latymer Upper school for boys (1624); the Godolphin school, founded in the 16th century and remodelled as a grammar school in 1861; St. Paul's school for girls, in Brook Green; Nazareth House of Little Sisters of the Poor; and other institutions. By the large Shepherd's Bush green is the White City stadium. first occupied by the Franco-British exhibition of 1908. By it is a television centre. The new town hall (1939) faces Furnivall gardens which are crossed by the Cromwell road extension to the west completed in 1956 to relieve congestion in King street. Other buildings include the Olympia, an exhibition centre, built in 1884 and refaced in 1930, and Wormwood Scrubs prison, built in 1874 by convicts. In the neighbourhood of the Mall, bordering the river, are the Dove inn, where James Thomson is said to have written part of "The Seasons." and Kelmscott house, residence successively of Sir Francis Ronalds, who there invented a telegraph in 1816, George Macdonald and William Morris. Hammersmith returns two members to parliament. for North Hammersmith and, with part of Fulham, for Baron's Court.

HAMMER THROWING is the name given the 16-lb. weight-throwing event of the Olympic games track-and-field program that was developed into a sport centuries ago in Ireland, Scotland and England.

The earliest authentic date for a hammer-throwing contest outside the British Isles was Sept. 4, 1838, at Hoboken, N.J. On Sept. 11, 1839, there was a similar competition near Toronto. Ont. In 1900 the event was placed on the Olympic games program. It was made popular in the United States by a group of Ireland-born U.S. citizens, who raised the world record to 189 ft. 63 in. in 1913—an increase in distance of 111 ft. 1½ in. over the winning performance at the first English amateur championships, March 23. 1866. (For hammer throwing in the Olympic Games, *see* OLYMPIC GAMES.)

The principal reason for the increase in record distances was the improvement in equipment and technique. In the early years of the sport, which goes back at least to 1154, a blacksmith's sledge hammer with a stiff wooden handle was used, and it was from the employment of that implement that the event originally derived its name.

The modern implement bears little resemblance to that used by the early Irish. Scottish and English hammer throwers. In its specifications of the implement to be used in its hammer-throwing event, the Amateur Athletic Union of the United States stated that the head should be of lead or a brass shell filled with lead or cast gray iron and spherical in shape. The handle must be a single unbroken and straight length of spring steel wire not less than ⅛ in. (3.175 mm.) in diameter. or no. 36 piano wire .102 in. (2.591 mm.) in diameter. The handle may be looped at one or both ends as a means of attachment. The grip may be either of single or double loop construction, but must be rigid and without hinging joints of any kind. The handle must be connected to the head by means of a swivel which may be either plain or ball bearing. The grip must be connected to the handle by means of a loop. A swivel may not be used. The weight must be not less than 16 lb. (7.257 kg.) complete as thrown. The length must not be more than 4 ft. (1.219 m.) complete as thrown.

There was also a diversity of rules governing the event prior to 1900. In Ireland: the thrower was permitted to make one or more turns before releasing the hammer. In Scotland, the thro was made from a stand. A go-ft. circle was used in Oxford and Cambridge university competition from 1866 to 1881. The English Amateur Athletic association used a seven-foot circle from 1866 to 1887, changed that year to a nine-foot circle and a few years later returned to the seven-foot circle, which became the standard in Olympic games competition. In the United States; from 1876 to 1886, rules of the national championship specified that the throw was to be made from a stand without follow. After 1887. turns were permitted in national A.A.U. competitions. The throw is made from a seven-foot circle, the thrower must not touch the circle or the area outside the circle. and the hammer must fall within a go° sector marked on the ground. These also became the rules governing the event in Olympic games competition.

Method **of** Throwing. — All successful hammer throwers use the same basic technique. The effort is begun at the rear of the circle with the thrower's back toward the intended direction of flight. The athlete swings the hammer several times about his head and then begins the first of three full turns of the body. Upon the completion of the third turn the hammer is released. It is important that each turn be faster than the preceding one. The first half of each turn is usually made on the heel of the left foot and completed on the ball of the left foot. During the course of the throw, the left foot should always maintain contact with the ground.

Hammer throwing performance depends upon the efficiency with which centrifugal force is developed. Thus, the orbit of the hammer must be circular until its release. An athlete best develops centrifugal force by twisting his body from right to left about a perpendicular axis. In this way the body is twisted from a position of nonalignment to and past a position of alignment. The fundamental principle employed in hammer throwing is similar to that used in swinging a bat or golf club. However, the use of body turns permits repetitions of the twisting motions with a consequent increase in centrifugal force. In the 1950s there was remarkable improvement in hammer throwing performance throughout the world. In 1952 at Oslo. Nor , Sverre Strandli first threw a 16-lb. hammer more than 200 ft. officially, the distance being 200 ft. 11⅜ in. Throws of better than 200 ft. became common, and in the 1960s throws of more than 230 ft. were recorded Advances in the style of throwing did not involve a new principle of centrifugal force development, instead, changes were designed to obtain a fuller and faster twisting movement of the body.

See Jacob Weber and Frank Rasky, *Training Olympic Champions in Track and Field* (1951). (H. AR. RX.; F. J. RN.)

HAMMERTOE, a painful condition in which a toe, commonly the second toe, is rigidly bent due to pressure from short shoes. The salient angle on its upper aspect is constantly irritated by the shoe and develops a corn (*q.v.*). It is treated surgically, by the simple excision of the small digital joint causing the toe to lie flat.

HAMMETT, (SAMUEL) DASHIELL (1894–1961), U.S writer whose works may be considered the first and best attempt to depict realistically the world of American crime, was born in St. Mary's county, Md., on May 27. 1894. His writings stem from his eight years' experience, as a young man. with Pinkerton's Detective agency. Hammett's countless short stories and novelettes in the magazine *Black Mask,* starting in 1923, and his first tno novels—Red *Harvest* (1929) and *The Dain Curse* (1929)—are about the Continental Op, an anonymous agency operative modeled on Jimmy Wright of Pinkerton's Baltimore office. *The Maltese Falcon* (1930) introduces the more complex Sam Spade, in a work which many critics rank not only as a great detective story but as an important American novel. *The Glass Key* (1931) is a subtle study in loyalties. *The Thzn Man* (1934) is his least typical book—a poor detective story but a bright comedy, ieaturing Nick and Nora Charles. After 1934 Hammett stopped writing for publication. In only a decade of creative activity, he exerted an influence on the American detective story greater than that of any other author since Poe, and no small influence upon the American novel. His gifts of characterization and dialogue have been compared, notably by André Gide, to those of Ernest Hemingway. Hammett died in New York city Jan. 10, 1961. (AY. B.)

HAMMOND, EDMUND HAMMOND, 1ST BARON (1802–1890), British civil servant, nho, as head of the foreign office for nearly 20 years, exercised considerable influence behind the scenes on late 19th-century diplomacy. He was a son of George Hammond (1763–1853), the first British minister to the Cnited States (1791–95) and permanent undersecretary for foreign affairs (1795–1806 and 1807–09). Edmund Hammond was born in London on June 25, 1802, and was educated at Eton, Harrow and Cniversity college, Oxford. He began his official career in the privy council office in Oct. 1823, but was transferred to the diplomatic service early in 1824. Apart from four special missions abroad, he passed the rest of his working life in the foreign office. Lord Palmerston made him head of the Turkish department. In 1854 Hammond was permanent head of the office as undersecretary for foreign affairs, a post he retained until 1873. He was distinguished by an exceptional capacity for work. coupled with an exceptional grasp of detail; though always subordinate. he often influenced foreign secretaries. He inexpediently assured Lord Granville. then foreign secretary, on July 5, 1870, ten days before the Franco-German War began, that he had never known "so great a lull in foreign affairs," an opinion also expressed by a French prime minister five days earlier. On retirement, Hammond was raised to a barony Feb 22, 1874. almost an unprecedented honour for a civil servant. He died at Menton, France, on April 29, 1890; as he had no male heir the peerage became extinct. (M. R. D. F.)

HAMMOND, JOHN HAYS (1855–1936), U.S. mining engineer, was born in San Francisco. Calif.. on March 31, 1855. He studied at the Sheffield scientific school. Yale university, until 1876, and later at the Royal School of Mines, Freiburg, Saxony. In 1880 he was engaged in the U.S. geological survey of the California gold fields; afterward as consulting engineer, he visited most of the countries of North and South America. In 1893 he became associated with Barnato Bros. and Cecil Rhodes in South Africa. acting as consulting engineer for the Consolidated Gold Fields Company of South Africa. the British South Africa company and the Randfontein Estates Gold Mining company. As a leader of the Rand faction, he was, in Jan. 1896, after the Jameson raid, arrested and condemned to death. but was released on payment of a $125,000 fine. In 1900 he became interested in mining properties and irrigation projects in the United States and Mexico. He was chairman of the World Court commission, 1914–15; and chairman of the U.S. coal commission, 1922–23. In 1903 he became general manager and consulting engineer of the Guggenheim Exploration company. In 1911 he was special U.S. ambassador at the coronation of King George V.

He died at Gloucester. Mass., on June 8, 1936.

His son. JOHN HAYS HAMMOND, JR. (1888–), was in 1959 anarded the Edward Cresson medal by the Franklin institute for inventions and developments in radio and electronics, particularly for remote radio control of marine and submarine vehicles. (S. C. HR.)

HAMMOND, JOHN LAWRENCE LE BRETON (1872–1949), British author and journalist, was educated at Bradford grammar school and St. John's college, Oxford. He was editor of the *Speaker* from 1899 to 1906, when he joined the staffof the *Tribune* as leader (editorial) writer. In 1907 he was appointed secretary to the civil service commission. He served in World War I with the Lowland division (Sept. 1915 to Aug. 1916), and on his discharge obtained a post in the ministry of reconstruction.

Hammond was the historian of the Industrial Revolution in England; in his works on this subject, which are indispensable to the student, he had the assistance of his wife, Barbara Hammond. His chief journalistic work was done on the *Manchester Guardian.* His publications include: *Charles James Fox* (1903); *The Village Labourer, 1760–1832* (1911, and later editions); *The Town Labourer, 1760–1832* (1917); *The* Skilled *Labourer, 1760–1832* (1919); *Lord Shaftesbury* (1923); *The Rise of Modern Industry* (1925); *The Age of the Chartists* (1930). He mas one of the authors of *Liberalism and tlze Empire* (1900). He died April 7, 1949, near Hemel Hempstead, Hertfordshire, Eng.

HAMMOND, an industrial city of Lake county, Ind., U.S., adjacent to Chicago and Calumet City, Ill., a part of the Gary-East Chicago-Hammond standard metropolitan statistical area. The city had its beginning in 1869 when George H. Hammond, a Detroit butcher and pioneer in shipping refrigerated beef hy rail, established with Marcus M. Towle the State Line Slaughter house, ultimately the G. H. Hammond company, on the Grand Calumet river. This site mas selected because the ice used for refrigeration could be readily obtained irom the river and inland lakes, and it was far more economical to ship dressed beef than live cattle fronn the Chicago stockyards to distant markets.

Until it was destroyed by fire in 1901. the packing house, which at that time employed 1,500 workers, was Hammond's largest industry.

It was originally called Hohman's Inn, then State Line because of,its location on the Illinois-Indiana boundary. The name was changed in 1873 to Harnmond, in honour of the meat packer. The city was incorporated in 1883. It was heavily populated by Germans in the earlier years, manifested by the many streets that bear German names. In 1910 the census showed that almost 30% of its people were born in Germany and Austria or their parents were natives of those countries.

While Hammond was served by numerous railroads and had a frontage on Lake Michigan, heavy industrial development was initially handicapped by the lack of a harbour. Consequently, it

failed to Secure the heavier basic industries such as steel mills and oil refineries as did its neighbours, East Chicago, Whiting and Gary. The city attracted smaller industries which included iron and brass foundries, steel fabricators, and those manufacturing railroad equipment, surgical instruments and metal toys; other products include soaps, corn products, chemicals, gasoline and motor oils, clothing and stock feeds. There is also a large printing works.

Hammond is the site of a Purdue University extension centre which includes a technical institute for the advanced training of industrial employees. The Calumet centre of Indiana university presents a regular schedule of classes.

The population increased from 5,428 in 1890 to 20,925 in 1910 and soared to 55,378 in 1920. It was 87,594 in 1950 and 111,698 in 1960.

For comparative population figures *see* table in INDIANA: *Population.* (P. *ME.*)

HAMMURABI, 6th king of the Amoritic or West Semitic dynasty of Babylonia, reigned 43 years, 2067–2025 B.C. and is one of the most illustrious figures of ancient history. The so-called 1st Babylonian dynasty was founded by Sumuabi in 2169 B.C. at Babylon, which thus was raised from an unimportant town on the eastern bank of the Euphrates to the dignity of a capital, and a rival of the far more ancient and greater city, Kish, 8 m. to the east. The invasion of Babylonia by the Canaanitic race of the west had already resulted in the founding of a West Semitic dynasty at Isin in 2301 B.C., a city in southern Sumer, which, until the rise of the Canaanitic kingdom of Babylon, shared with Ellasar the control of Sumer and Accad. At first, the kingdom founded at Babylon by this ancestor of the famous line of 11 kings at Babylon had control of only a small region north and south of the capital, and under the first two kings there was even a rival kingdom at Kish, only 8 m. away. During the reigns of Hammurabi's five predecessors the kingdoms of Isin and Ellasar successfully maintained control of the whole southern area of Babylonia; and Sinmuballit, predecessor of Hammurabi, conquered and put an end to the kingdom of Isin with the aid of Rim-Sin of Ellasar, in 2076, or only nine years before Hammurabi came to the throne, only to lose it again to Rim-Sin, the powerful king of Ellasar, seven years later, and Hammurabi himself did not gain control of the whole of Babylonia and put an end to the kingdom of Rim-Sin until his 30th year (2038).

Although his father, Sinmuballit, had largely succeeded in bequeathing to his illustrious son the united control of Sumer and Accad, the military and political achievement of Hammurabi in finally establishing a central and efficient Government at Babylon, which included not only Sumer and Accad, but extended northward to the central provinces of the Tigris and Euphrates, must be regarded as one of the most far-reaching events in ancient history. Henceforth Babylon was to be the political and intellectual centre of West Asiatic history right down to the Christian era. His name is particularly associated with the great law code promulgated for the use of the courts throughout the empire. The only fairly complete text of this Semitic code was found at Susa, inscribed on a diorite stela 8 ft. high, which had been taken to Elam as plunder by invaders during the later period of Babylon's decline, probably in the period of the Pashe dynasty (12th–11th centuries). The text is inscribed in 21 horizontal columns on the obverse beneath a bas relief of the king, who stands in attitude of prayer before the seated sun god (Shamash), who delivers to Hammurabi the laws of the kingdom, a *motif* undoubtedly connected with the legend of Moses and the revelation of the Decalogue from Yahweh on Mt. Sinai. The last five or six columns of the obverse have been defaced by the Elamitic invader, who probably intended to inscribe here a relation of his conquest of Babylon. The reverse is complete and carries 28 horizontal columns. The first four columns and top of column five of the obverse, contain the prologue, which is the principal source for Hammurabi's extensive restorations of the temples and cults of Babylonia and Assyria. The last five columns of the reverse contain the epilogue, a glorification of the mighty works of peace executed by Hammurabi. Sixty-five laws are contained on the obverse, and about 40 laws are defaced at the bottom; the reverse contains 183 laws. Fragments of the code as redacted on a series of tablets for use at Nippur in the same period have been excavated there, and fragments of an Assyrian copy of the 7th century were found at Nineveh. These partially restore the great gap in the Susa stela.

Hammurabi is generally identified with Amraphel, king of Shinar, who with Arioch of Ellasar, Cheodorla'omar of Elam and Tidal, king of Goiim, invaded Canaan in the days of Abraham. Since Hammurabi apparently enjoyed peaceful relations with the powerful Elamitic king, Rim-Sin of Ellasar, and his father, Kudurmabug, *ad-da* of Emutbal and of Amurru, the biblical records appear to harmonize with these facts and the identification has never been successfully disproved.

Although no great literary or historical documents from his reign have survived, a great number of administrative documents and letters from it are known and are constantly increasing. There is little doubt but that the theological reconstruction of the Sumerian pantheon, by which the priests of Babylon raised Marduk, the local deity, to the rank of a great god, began at this time. To his and the succeeding reigns of Samsuiluna, Abi-eshu', Ammiditana and Ammizaduga, may certainly be ascribed the gradual completion of the Accadian version of the Epic of Creation in six books or tablets, in which Marduk is made to displace the older Ninurta of the Surnerian legend of Creation. Hammurabi regularly employs *Sumerian* as the language of his records of temple and cult restorations and of other dedicatory inscriptions, as did all his successors.

The derivation of his name is disputed; the element *ḫammu, ʿammu, ammu, ammi* is clearly the West Semitic word *ʿam,* "family, relative," Arabic *"uncle,"* and it is characteristic of West Semitic religion to describe a deity as "father, brother, uncle." A grammatical gloss explains *ḫammu* by *kimtu,* "family." The element *rabi* is usually explained as meaning "great," "the uncle is great." There is another king by this name of the Canaanitish kingdom of Hana, whose capital Tirga is the modern Ashârah on the middle Euphrates, near the mouth of the Ḫabur. This name is spelled Ammurabi, and Ḫammurapiḫ; the Ḫana kingdom is contemporary with the Cassite dynasty of Babylonia. Since the name of the famous king of Babylon is once written *Ammurapi* it has been argued that the name should be pronounced *Hammurapi, Ammurapi,* with the meaning "the uncle is exalted, high," but this suggestion is not generally accepted.

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HAMPDEN, HENRY BOUVERIE WILLIAM BRAND, 1ST VISCOUNT (1814–92), 23rd Baron Dacre, was speaker of the house of commons and, earlier, a prominent member of the English Liberal party. Born on Dec. 24, 1814, Brand was elected to parliament for Lewes in 1852 and retained the seat until 1868, sitting for Cambridgeshire from 1868 to 1884. He was parliamentary secretary to the treasury between 1859 and 1866 and was chief whip during the last ministries of Lord Palmerston and Lord (John) Russell. Brand was speaker of the house of commons from 1872 until 1884, when he retired and was raised to

the peerage. He died at Pau. France. on March 14, 1892.

Brand was a greatly respected political manager in a difficult period for the Liberal party and laid the foundations of the party's later organization. His success as whip led to criticism of his election as speaker. However. Brand proved an excellent choice. His tenure of the chair was memorable for the part he played in reforming parliamentary prvcedure in 1882, having taken the initiative in meeting Irish obstruction in 1881; and for his dignified conduct during the disputes caused by Charles Bradlaugh's election to the commons. (A. F. T.)

HAMPDEN, JOHN (*c.* 1595–1643), English statesman. the eldest son of William Hampden. of Great Hampden in Buckinghamshire. and of Elizabeth. second daughter of Sir Henry Cromwell and aunt of Oliver, the future protector. was educated at the grammar school at Thame and at Magdalen college. Oxford. In 1613 he was admitted a student of the Inner Temple. He first sat in parliament for the borough of Grampound in 1621. representing later Wendover in the first three parliaments of Charles I. Buckinghamshire in the Short Parliament of 1640 and again in the Long Parliament. In his early parliamentary career he was content to be overshadowed by Sir John Eliot. as later he n-as content to be overshadowed by Pym and to be commanded by Essex.

In 1626 Hampden helped prepare the charges against Buckingham. In Jan. 1627 he was bound over to answer at the council board for his refusal to pay the forced loan. Later in the year he was committed to the gatehouse. and then sent into confinement in Hampshire, from which he was liberated just before the meeting of the third parliament of the reign. in n-hich he once more rendered useful but unobtrusive assistance to his leaders. After Eliot's imprisonment he often consulted Hampden on national and family matters. It was not till 1637, however, that Hampden's resistance to the payment of ship money gained for his name the lustre which it has never since lost. (*See* SHIP MONEY.) Seven out of the 12 judges sided against him. but the connection betrreen the rights of property and the parliamentary system was firmly established in the popular mind. The tax had been justified, says Clarendon. who expresses his admiration at Hampden's "rare temper and modesty" at this crisis. "upon such grounds and reasons as every stander-by was able to swear was not law." In the Short Parliament of 1640 Hampden led the opposition (May 4) to the grant of 12 subsidies in return for the surrender of ship money. Parliament was dissolved the next day, and on the 6th an unsuccessful search was made among the papers of Hampden and of other chiefs of the party to discover incriminating correspondence with the Scots. In the Long Parliament, though Hampden was by no means a frequent speaker, it is possible to discern that his power consisted in his personal influence and as a debater rather than as an orator. Unwearied in attendance upon committees, he was always at hand to second Pym. whom he plainly regarded as his leader. Hampden was one of the eight managers of Strafford's prosecution. Like Pym, he was in favour of procedure by impeachment rather than by attainder. and his influence secured a compromise under which Strafiord's counsel were heard as in the case of an impeachment, and thus a serious breach between the two houses was averted.

Hampden was among the opponents of episcopacy. It is not that he was a theoretical presbyterian. but he distrusted the bishops as he distrusted the monarchy. He was not tempted by the offers of advancement made him and his friends by Charles who would gladly have given them office if they had been ready to desert their principles. Every day Hampden's conviction grew stronger that Charles would never abandon the position which he had taken up. In Xug. 1641 Hampden was one of the four commissioners who attended Charles in Scotland. He was a warm supporter of the Grand Remonstrance and. when opposing members were at sword's point on the motion to print it. his intervention prevented a free fight. He was one of the five impeached members whose attempted arrest on Jan. 4, 1642, brought at last the opposing parties into open collision (see HOLLES. DENZIL HOLLES: LENTHALL, WILLIAM; PYM, JOHN; STRODE. WILLIAM). After the attempted impeachment Hampden laid down the two conditions under which resistance to the king became the duty of a good subject. Those conditions were an attack upon religion and an attack upon the fundamental laws. There can he no doubt that Hampden fully believed that both those conditions n-ere fulfilled at the opening of 1642.

When the Civil War began Hampden was appointed a member of the committee for safety, levied a regiment of Buckingharnshire men for the parliamentary cause and in his capacity of deputy lieutenant carried out the parliamentary militia ordinance in the county. He took no actual part in the battle of Edge Hill. His troops in the rear. however. arrested Rupert's charge at Kineton, and he urged Essex to renew the attack there. and also after the disaster at Brentford. In 1643 he was present at the siege and capture of Reading, though he had argued that the greater importance of Oxford made it a fitter objective. But it is not on his skill as a regimental officer that Hampden's fame rests. In war as in peace his distinction lay in his power of disentangling the essential part from the nonessential. In the constitutional struggle he had seen that the one thing necessary was to establish the supremacy of the house of commons. In the military struggle which follon-ed he saw, as Cromwell saw afterward, that the one thing necessary was to beat the enemy. He protested at once against Essex' hesitations and compromises. In the formation of the confederacy of the five associated counties. which was to supply a basis for Cromwell's operations. he took an active part. His influence was felt alike in parliament and in the field. But he was not in supreme command, and he had none of that impatience which often leads able men to fail in the execution of orders of which they disapprove. On June 18, 1643. he joined the parliamentary horse that u-as trying to intercept Rupert's cavalry returning to Oxford after a successful raid on Essex' outposts. At Chalgrove field he was fatally wounded and died at Thame on the 24th. He was buried in the church of Great Hampden. His loss was felt by his party "as if their n-hole army had been defeated or cut off."

Hampden married (1) in 1619 Elizabeth. daughter of Edmund Synieon of Pyrton. Oxfordshire, and (2) Letitia. daughter of Sir Francis Knollys and widow of Sir Thomas Vachell. By his first wife he had nine children, one of whom, Richard (1631–95), was chancellor of the exchequer in William III's reign; from two of his daughters are descended the families of Trevor-Hampden and Hobart-Hampden. the descent in the male line becoming apparently extinct in 1; 54 in the person of his grandson John Hampden.

See S. R. Gardiner, *History of England* (London, 1883–84) and the *Gveat Civil War* (London, 1893); the article on Hampden in the *Dictionary of National Biography*, by C. H. Firth, with authorities there collected; Clarendon, *History of the Rebellion* (Oxford, 1888); Lord Nugent, *Memorials of John Hampden* (London, 1831); Macaulay's review is in *Essays*, ed. by F. C. Montague (London, 1903). The printed pamphlet announcing his capture of Reading in Dec. 1642 is shown by Firth to be spurious, and the account in *Mercurius Aulicus* (Jan. 27 and 25, 1643) of Hampden commanding an attack at Brill to be also false. n-hile the published speech supposed to have been spoken by Hampden on Jan. 4, 1642, and reproduced by Forster in the *Arrest of the Five Members* (London, 1860) has been proved by Gardiner to be a forgery (*History of England*, x, 135). Firth has also shown, in The *Academy* (Nov. 2 and 9, 1889), that "the belief that we possess the words of Hampden's last prayer must be abandoned." (G. Ds.)

HAMPDEN, JOHN (1653–1696), English politician. was the second son oi Richard Hampden (1631–95). An intimate of Lord William Russell and Algernon Sidney. he was arrested with them in 1683 for alleged complicity in the Rye House plot. As he could not pay the fine of £40.000 imposed upon him he remained in prison. In 1685, after the failure of the duke of Monmouth's rising. Hampden was again brought to trial and, pleading guilty, was condemned to death on a charge of high treason. But the sentence was not carried out and having paid £6.000 he was set at liberty. In the Convention Parliament of 1689 he was an extreme Whig and because of his violent opposition to the government he was not elected to the parliament of 1690. Disappointed again in 1696. he died by his own hand on Dec. 12, 1696.

HAMPDEN, WALTER (WALTER HAMPDEN DOUGHERTY) (1879–1955), U.S. actor, was born in Brooklyn. N.Y.. June 30, 1879. After a year at Harvard. he graduated from Brooklyn Polytechnic institute. Following a year's study of singing, dancing,

speech and the cello in France, he joined Sir Frank Benson's company in England, where he played over 70 classical roles in three years. In 1905 he married Mabel Moore. an actress in the troop, and the following year he played Hamlet in London to great applause. After his return to the U S in 1907 he appeared in several modern dramas with Nazimova. but his *Hamlet* was so successful that when he formed his own repertory company that play became its foundation. In 1923 Hampden revived Edmond Rostand's *Cyrano* dc *Bergerac,* a play that will forever be associated with his name. He opened his own theatre (1925), with Ethel Barrymore as his leading lady, and among his outstanding performances in the ensuing years were *Hamlet* and *The Merchant* of *Venice* (1925–26), *The Immortal Thief* and *Caponsacchi* (1926–27) and *An Enemy of the People* (1927–28). In 1939 Hampden appeared in his first motion picture, *The Hunchback of Notre Dame,* and later played the part of an aging actor in *All About Eve.* He made his television debut as Macbeth in 1949. Hampden was the fourth president of the Players' club, succeeding John Drew, Edwin Booth and Joseph Jefferson. He died in Los Angeles, Calif., June 11, 1955. (S. W. H.)

HAMPSHIRE (abbr. HANTS) is a county of southern England bounded W. by Dorsetshire and Wiltshire, N. by Berkshire. E. by Surrey and Sussex, S. by the English channel. Area (1951) 1.650. j sq.mi., including the Isle of Wight (147.1 sq.mi.), which formed part of ancient Hampshire but became a separate administrative county in 1890 *(see* WIGHT, ISLE OF). Hampshire was styled the County of Southampton for legal purposes until April 1, 1959, when its name was officially changed to Hampshire.

Geology.—The county falls physiographically into four areas. A broad belt of rolling chalk downland, at times more than 800 ft. high, runs across the middle from west to east. To the north and south lie mixed Tertiary clays, sands and gravels, often covered by heath and woodland. In the east the western extremity of the Weald. with its typical scarps and vales, crosses the county border. The oldest rocks occur in this Wealden area—the Lower Greensand (Hythe. Sandgate and Folkstone Beds) and the Gault and Upper Greensand. The Upper Cretaceous beds are. for the most part, flint-bearing Upper Chalk. although the Middle and Lower Chalk strata are exposed toward the Surrey-Sussex border. Scattered over the chalk are small Tertiary outliers. The Tertiary rocks of the north, about Aldershot. Farnborough and Kingsclere, comprise the Reading Beds and London Clay, often covered by the more sandy Bagshot Beds. The Tertiaries, south of the chalk boundary by Romsey and Bishops Waltham to Havant. include the Eocene Reading Beds, London Clay and Bagshot, Bracklesham and Barton Beds and, at Brockenhurst, Hordle and Lyndhurst, the Oligocene Headon Beds. The Barton and Headon strata are rich in fossils.

The narrow strait called the Solent and known at its eastern end as Spithead. which divides the Isle of Wight from the mainland, marks the lower course of the ancient Frome or Solent river. Submergence, further evidence of which can be seen in the drowned valleys and estuaries of the Hampshire coast line, converted it into an arm of the sea, and rivers which were formerly tributaries in that greater system are now independent streams. These streams, flowing southward, drain nearly the whole of the chalk and southern Tertiary areas. The Avon, in the southwest, rises in Wiltshire and is joined by the Dorset Stour near its mouth at Christchurch. The Test, with its tributary the Anton, and the Itchen rise in the chalk downs near Ashe and Hinton Ampner respectively and flow into the head of Southampton water. The Lymington or Boldre, the Beaulieu, Hamble, Meon and Wallington also drain southward. The Wey, Loddon and Blackwater, rising in the northeastern part of the county, flow northward into the Thames basin. The clear, swift chalk streams, especially the Test and Avon, are famous for their trout and salmon fishing.

History and Antiquities— There is considerable evidence of prehistoric settlement in Hampshire, particularly on the chalk downs and heathlands. Palaeolithic tools have been found in the river gravels and Mesolithic implements near Petersfield and elsewhere, and there are Neolithic long barrows, *e.g.,* near Bournemouth, Danebury, Meonstoke and Rockbourne. Bronze Age settlement is represented by round barrows of different types and by the remains of small farmsteads. as at Quarley. Most notahle among Iron Age remains are the hill forts, *e.g.,* Danebury. Hengistbury. Ladle. Old Winchester. Quarley and St. Catherine's.

Hampshire was conquered within a fen. years of the Roman invasion in A.D. 43. During the occupation. urban settlements developed at Silchester (Calleva Atrebaturn) and Winchester (Venta Belgarum), the focal points of the Roman road system in the area. There was a small settlement at Southampton (Clausentum). Villa sites are especially numerous in the northwest of the county. There were potteries in the New forest and an imperial weaving works at Winchester. The most substantial Roman remains are the town walls of Silchester (*q.v.*) and the outer wall at Portchester castle which formed part of the defenses of what was probably the most westerly of the forts of the Saxon shore. Reading museum houses a large collection of objects from Silchester.

The progress of the early English settlement of Hampshire is obscure and the contributions of the Jutes, along the coast and in the Hamble and Meon valleys, the followers of Cerdic and Cynric, the Genisse and the peoples moving in from the northeast. are uncertain. The county. first mentioned by name in the Anglo-Saxon Chronicle in 755, became the cradle of Wessex and the English kingdom. with Winchester the capital. It suffered severely from the attacks of the Norsemen. During the middle ages, apart from coastal raids during the Hundred Years' War. the county enjoyed a comparatively peaceful existence and the influence of the church and such men as William of Wykeham was of major importance. Few castles were built and only at Christchurch, Odiham, Portchester and Winchester are there substantial remains. At Winchester and, more especially. Southampton, town walls and gates still survive. Later 16th-century coastal defenses exist in Calshot and Hurst castles. During the Civil War, battles were fought at Alton (1643) and Cheriton (1644), Portsmouth and Basing house suffered notable sieges. and Charles I stayed at Hurst castle and Titchfield. Some postmediaeval fortifications can be seen in and near Portsmouth. During World War II Portsmouth and Southampton were heavily damaged by enemy air raids.

The conversion of Hampshire to Christianity was begun by Birinus (634) and Wilfrid (687). At first the county formed part of the West Saxon bishopric of Dorchester-on-Thames. but on the transference of the episcopal seat in 676 it was included in the diocese of Winchester. The whole of the county remained in this diocese until the creation of the see of Portsmouth in 1927. Mediaeval Hampshire had many religious houses. There were pre-Conquest Benedictine foundations at Romsey and Wherwell besides three in Winchester—St. Swithun's. New Minster and St. Mary's. After the Conquest, houses of Augustinian canons were established at Breamore. Christchurch. Mottisfont. Portchester (later moved to Southwick), Selborne and Southampton (St. Denys); of Cistercians at Beaulieu. Hartley Wintney and Netley; and of Premonstratensians at Titchfield. Alien priories existed at Andover. Andwell. Ellingham, Hamble. Hayling and Monk Sherborne. There were houses of Franciscan friars at Southampton and Winchester, and of Austins, Carmelites and Dominicans at the latter. Substantial monastic remains can still be seen at Beaulieu and Netley, in the great churches of Christchurch and Romsey and in the cathedral at Winchester. Although not renowned for its parish churches. Hampshire can show interesting Saxon work. *e.g.,* at Boarhunt, Breamore, Corhampton and Headbourne Worthy; Norman work, *e.g.,* at East Meon, Hambledon and Portchester; and early English, *e.g.,* at Cheriton, Grateley. Hound and Sopley. Decorated and Perpendicular work are represented in a number of places. but only by details. Eighteenth-century churches can be seen at Avington. Wolverton and St. George's, Portsmouth and good examples of 19th-century Gothic at St. Michael's and St. Peter's, Bournemouth and St. Mary's, Portsea.

Interesting domestic architecture includes Norman houses at Southampton, and Christchurch, the mediaeval palace at Bishops Waltham, 16th-century and later work in the Vyne at Sherborne St. John, the Jacobean Bramshill. the work of Henry Holland at Broadlands and Charles Barry's 19th-century restoration of High-

clere. The homes of Jane Austen at Chawton and of Gilbert White at Selborne are museums.

Hampshire has always been essentially agricultural, but its history shows some evidence of industrial activity. Woollen manufactures mere formerly widespread throughout the county, *e.g.,* in the Xlresford. Andover, Romsey and Winchester areas. and survived in some places until the early 19th century. Iron was smelted at Sowley in the New forest and near Bramshott until the 18th century. Salt manufacture was carried on at a number of places along the coast, particularly at Lymington, where the last saltworks disappeared as late as 1865. Among the many ships built in Hampshire yards, the men-of-war launched at Bucklers Hard in the late 18th and early 19th centuries are perhaps the most famous. Other industries practised at different times include malting, brewing and tanning, and silk weaving and papermaking which were introduced into the county by Huguenot refugees. Winchester (St. Giles) and Weyhill were nationally important fairs. Southampton, since the Conquest. has been preeminent in overseas and coastal trade. There the mediaeval wine and wool trade and the business with northern Italian merchants in rich Levantine commodities were followed by a period of decline until the railway and dock development of the mid-19th century. From early in the 18th century, Portsmouth grew rapidly as a naval dockyard town. The earliest turnpike road in Hampshire was a section of the London to Portsmouth road (1710), and the earliest railway, the London to Southampton (1840).

In 1832 the county was represented in parliament by no less than 26 members, the majority from pocket and corrupt boroughs.

Famous figures connected with Hampshire include Tane Austen. William Cobbett Charles Dickens, John Keble, Charles Kingsley, George Meredith Mary Mitford. Florence Nightingale, Isaac Watts, Gilbert White and Charlotte M Tonge

The National trust in the mid-1950s owned more than 3.000 ac and protected 30 ac

Agriculture, Industries and **Communications.**—In 1954 the following acreage was under crops and grass: tillage and fallow 296,000, temporary grass 112,000. permanent pasture 147,000, rough grazing 35,000, with an additional 9,000 ac. of agricultural holdings of which 3,000 ac. were devoted to horticulture. Great changes took place in Hampshire farming after 1939. The old system of folded sheep and barley on the chalkland. the extensive water meadows and much formerly semi-derelict farmland disappeared. In the main. Hampshire agriculture is almost equally concerned with corn production and dairying. This revolution has been facilitated by the large farms, found especially in the chalk country, rapid mechanization, the supply of piped water and the replacement of the old root rotations by grass leas and kale. thus making possible the combination of corn growing and dairying on individual farms. Relatively few sheep are now reared in the county and breeds of the Clun type have mostly replaced the old folded Hampshire Downs sheep. On the Tertiaries. particularly in the south, farms are generally smaller, and between Southampton and Portsmouth market gardening, with strawberries and potatoes, is an especially large industry. In the greensand area, in addition to corn and dairy produce, hops are grown near Xlton. There is still a high proportion of woodland in the county. In the New forest (*q.v.*), once a royal hunting ground. the rights of the Forestry commission. commoners and general public are carefully defined by the New Forest act (1949).

There has been a marked increase recently in cattle rearing and milk production in this area. Around Aldershot, Blackmoor and Bordon large tracts of wasteland are used by the army for military training.

Portsmouth and Gosport form one of the principal naval centres of Great Britain. The great port of Southampton is especially concerned with passenger traffic. Eastleigh has important railway works. Two modern industries which are of particular importance are petroleum refining at Fawley on the western side of Southampton water, and aircraft engineering at Christchurch, Farnborough and near Southampton. The holiday industry affords much employment. particularly at Bournemouth, which has grown since the beginning of the 19th century from a few scattered houses to a town of nearly 150,000 people. and at Southsea. Smaller resorts along the coast include Highcliffe. Barton. Milford, Lee-on-the-Solent and Hayling Island. Bursledon, Christchurch, Hamble and Lymington are well-known yachting centres. Shipyards of varying size and character are to be found at a number of places. Most market towns have light industries; engineering, *e.g.,* at Andover, Basingstoke. Lymingron and Ringwood, and brewing, *e.g.,* at Alton and Romsey, are two of the major ones.

The county is served by three main lines of the Southern region of British railways which also own the docks at Southampton. A main route from London to the southwest crosses the county from Farnborough to Xndover. From it the Southampton-Bournemouth line branches south at Basingstoke. Portsmouth is linked with London via Petersfield. Some of the secondary lines were closed after World War II. There are civil airports at Blackbushe. Hurn. Portsmouth and Southampton.

Population and Administration.— In 1951 the population of Hampshire, excluding the Isle of \\Tight (95,625), was 1,197,170, which represents a growth of 18% since 1931. The 1951 populations of the county boroughs of Bournemouth, Portsmouth and Southampton were 144,845, 233,545 and 178,343 respectively, leaving a total of 630,437 in the administrative county area. Bournemouth and Southampton each return two members to parliament and Portsmouth returns three. The county is divided into seven parliamentary divisions: Aldershot, Basingstoke, Eastleigh, Gosport and Fareham. New Forest, Petersfield and Winchester, each of which returns one member. There are 9 municipal boroughs, 6 urban and 11 rural districts.

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HAMPSTEAD, a metropolitan (1900) and parliamentary borough of northwest London, Eng., about 4 mi. N.N.W. of Hyde Park corner by road. Pop. (1951) 95,131. Area 3.j sq.mi. It is built up the steep southern slopes of a hill from the top of which the Spaniards road leads across the heath to Highgate, the other prominent hill of north London. From between the rather sterile Bagshot Sands of Hampstead heath and the London Clay flowed chalyheate springs, one of which in the early 18th century caused a fashionable spa to grow up by Well walk near the heart of the old village—still a complexity of streets, alleys, tenements, flats, mansions and cottages. Down the hill are the late-19th-century residential accretions of Belsize Park, Chalk Farm. Swiss Cottage, the Finchley road area and Kilburn near the Edgware road. The borough, almost entirely residential, has long been the home of lawyers, artists. writers and politicians; the few industries include the making of Christmas cards. In the borough are two colleges of London university, several big schools, hospitals and medical research centres. Samuel Johnson, Sir Richard Steele, Sir Rowland Hill! Kate Greenatvay. John Galsworthy and four prime ministers are among the well-known people once resident there. Hampstead ("farm site") was settled in Anglo-Saxon times; a Roman burial and a barrow on Parliament hill are the only antiquities. The manor, which included Kilburn priory, belonged to Westminster abbey until the Reformation. In St. John's parish church (rebuilt 1744–47) and its churchyards lie buried many famous men including John Constable, George du Maurier and Sir Herbert Beerbohm Tree. Old houses include Fenton house (c. 1693), George Romney's house (1797) and the Keats Memorial house. The Spaniards, Jack Straw's Castle and the Bull and Bush near Pitt house, home of the first earl of Chatham, are well-known local inns. At Wyldes farm, near North End, William Blake was a frequent guest of John Linnell. Kenwood, reconstructed about 1767 by Robert Adam and with gardens by H. Repton, was presented. with its paintings and other works of art, to the nation in 1927 by Lord Iveagh.

The heath, consisting of 793 ac., rising to 443 ft., of woods, grassland and ponds includes Golders Hill park, Parliament hill

and Ken wood, all largely outside the borough; foxes and badgers, owls, woodpeckers and other country birds have been seen there. On bank holidays two fun fairs are held. The last 74 ac. were acquired for the public in 1927, thus completing negotiations begun nearly 100 years before. The heath is administered by the London County council.

HAMPTON, WADE *(1818–1902)*, U.S. statesman and Confederate general during the Xmerican Civil War, was born on >larch *28. 1818,* at Charleston, S.C. He was the son of Wade Hampton (1791–1858), planter and politician, and grandson of Wade Hampton (1754–1835), who served as a colonel in the American Revolution and as a brigadier general in the War of *1812.* He graduated from South Carolina college in *1836* and inherited vast estates. As a South Carolina legislator he opposed secession but nevertheless raised "Hampton's Legion" for Confederate service when war came. He was an infantry colonel at the first battle oi Bull Run and a brigadier general at the battle oi Seven Pines. Transferring to Gen. J. E. B. Stuart's cavalry oi the army of Northern Virginia in *1862,* he won praise and promotion and was wounded five times. After Stuart's death Hampton became a lieutenant general and served as chief of General Lee's cavalry during the defense of Petersburg. In *1865* he assisted Gen. Joseph E. Johnston's effort to oppose Gen. W. T. Sherman's march through the Carolinas and attempted to save Pres. Jefferson Davis from capture after Johnston's surrender.

During the reconstruction period Hampton worked for conciliation and the restoration of southern home rule. He was governor of South Carolina, 1877–79, U.S. Senator. *1879–91,* and U.S. commissioner of Pacific railways. *1893–97.* He died at Columbia. S.C., on April 11, *1902.* (M. W. We.)

HAMPTON COURT, a palace in Twickenham *(q.v.)*, Middlesex. Eng.. on the Thames *1 j* mi. S.W. of St. Paul's cathedral, London. It was built by Cardinal Wolsey who in 1526 presented it to Henry VIII whose favourite residence it became. George II was the last reigning sovereign to occupy it and Queen Victoria threw the state rooms open to the public. Later, nearly 1.000 rooms were assigned by the sovereign as "grace and favour" apartments for the widows or children of distinguished servants of the crown.

Henry VIII enlarged the palace. building wings on either side of the Great gatehouse behind which is the Base court and Anne Boleyn's gateway leading to the Clock court. This contains Henry VIII's Great hall and the colonnade and King's staircase built by Sir Christopher Wren. Over the gateway is the clock made by N. Oursian for the king in 1540; the George II gateway opposite leads to Fountain court rebuilt by Wren for William III n-ith the state apartments on the south side. Beyond are the Broad n-alk and the Great Fountain garden.

The Chapel, Royal, built by Wolsey, was embellished by Henry VIII. and by Grinling Gibbons according to designs by Wren for Queen Anne. Charles II filled in the moat which was dug out again in 1910 when Henry VIII's bridge was uncovered. The tennis court. built for Henry VIII. is the oldest in the world where the game is still played.

The gardens. laid out in the Dutch style for William III. contain a vine planted in 1768. two orangeries along the south side of the palace, a wilderness and a maze.

See G. H. Chettle, *Hampton* Court Palace, reprinted (H.M.S.O., 1954).

HAMPTON INSTITUTE, a coeducational college located in Hampton, Va. Founded in *1868.* Hampton attained distinction under the principalship of Samuel Chapman Armstrong as an agricultural. normal and industrial school for Negroes. Xrmstrong's most noted student was Booker T. Washington, who founded Tuskegee institute in Tuskegee Institute, Ala.; and gave international stature through Tuskegee to the principles of industrial education and advocacy of racial harmony learned from Armstrong at Hampton institute. (H. M. Bd.)

HAMPTON ROADS, a natural roadstead or harbour of Virginia, U.S.. formed by the confluence of the James. Nansemond and Elizabeth rivers. It lies to the west of Chesapeake bay. with which it is connected by Thimble Shoal channel *(1.000* ft. wide, *40* ft. deep and *11* mi. long); two deepwater channels branch out from the harbour. The southern channel is linked with the sounds of North Carolina through the Intracoastal waterway. The port of Hampton Roads, administered by a state port authority, includes the port cities of Norfolk. Newport News *(qq.v.)* and South Norfolk, which connect with nine trunk railroads and which have a combined water frontage of about *50* mi. The Hampton Roads tunnel bridge (4½ mi.) spans the James river between Norfolk and Newport News.

An important naval base since colonial days, Hampton Roads embraces the most significant concentration of naval establishments in the U.S., including the headquarters of the Atlantic fleet (at Norfolk) and the Norfolk naval shipyard (at Portsmouth). Army and air force installations are also located in the vicinity. The Civil War naval engagement between the "Monitor" and "Virginia" ("Merrimack") was fought in Hampton Roads (*see* "Monitor" and "Merrimack." Battle of). The abortive peace conference between President Lincoln and Confederate representatives was held there aboard the "River Queen!" Feb. *3. 1865.*

In the second half of the 20th century waterborne commerce exceeded *80.000.000* tons annually. Foreign commerce (mainly exports, comprising about 75% of total tonnage) increased considerably after World War II. Coal is the principal export, but tobacco, grain, scrap metal. fertilizer and cotton are also important. Crude-oil residues, oils, ores and crude gypsum are leading imports. (G. M. Be.)

HAMSTER, a mammal of the order Rodentia, belonging to the mouse group, Muroidea. in which it typifies the family Cricetidae. Hamsters are short-tailed nocturnal rodents with large cheek pouches and thick soft fur. There are many species representing several genera, of which three are well known. *Cricetus,* the European genus, ranges throughout Europe and into Asia: *Cricetulus,* commonly known as the Chinese hamster. is a larger genus and its distribution extends throughout Asia and into southern parts of Europe; *Mesocricetus,* the Syrian hamster. is limited to Asia Minor and the Balkans. The European hamsters are the largest in size. n-ith a body length of more than 200 mm. The most common species. *Cricetus cricetus,* is light brown above and mainly black underneath. The Chinese hamsters are small and gray, and one species (*Cricetulus barabensis*) has a middorsal black stripe. *Mesocricetus auratus,* the most common species of the Syrian genus, is medium in size with reddish brown above and gray underneath, and is commonly known as the golden hamster.

Species of these three genera have been introduced into the laboratory for research purposes. but the most successful in captivity by far is *Mesocricetus auratus.* It has been extensively used since 1930, when one litter was captured in Aleppo, Syr., and brought to the laboratory at the Hebrew university. Israel (then Palestine). All golden hamsters in laboratories in Europe and America derive from this original litter raised in captivity. The golden hamster is very easily tamed and has become a popular pet. It is a clean and attractive small creature which requires little care and can be fed very common foodstuffs.

Cricetus cricetus inhabits cultivated lands of central Europe. where it constitutes a pest to agriculture because of the enormous quantities of grain and vegetables which it ransacks from the field. It digs elaborate burrows consisting of galleries and chambers: in the summer these are short and shallow with one central chamber for grain. while in the winter they are one or two yards deep with several storage places. Provisions are stored in great quantities for the winter, and the animals. having fattened themselves during the previous season, retire to their burrows to spend the cold months in a state of inactivity. They are very prolific, the female producing several litters in one year. At birth the young are blind and naked. but they mature fast and by three weeks set forth to build their own burrows.

Hamsters are usually pugnacious and attack other rodents. lizards and small birds. which they consume as part of their diet. although their chief food consists of fruits. vegetables and grain. They are preyed upon by carnivores and killed by man hut nevertheless remain abundant. The skin of the hamster is of some value. and its flesh is used for food. (E. O.)

HAMSUN, KNUT (1859–1952), Norwegian author, was born on Aug. 4. 1859. at Lom in the Gudbrandsdal valley. of poor parents. He started to write at the age of 19 when he was a shoemaker's apprentice at Bodö in north Norway, and for the next ten years earned his livelihood in various ways; *e.g.*, as coal trimmer and country schoolmaster. He eventually went to the U.S., where he became a streetcar conductor in Chicago and a farm labourer on the prairies. In 1888 he published, in a Danish magazine, the fragment of a novel. *Sult*, later translated into English as *Hunger*. He is chiefly known to the English-speaking world by three novels. *Hunger, Growth of the Soil* and *The Woman at the Well*. The influence of Nietzsche and Strindberg (*qq.v.*) was apparent in Hamsun's impatience with contemporary emphasis on man's social problems; his talents were long centred more directly on the psychological analysis of the individual at grips with a simpler reality (hunger. physical labour, etc.). In 1920 he mas awarded the Nobel prize for literature. After World War II he was charged with treasonable hehaviour during the German occupation, but charges were dropped in view of his advanced age. He died near Grimstad. Nor., on Feb. 19, 1952.

HAMTRAMCK, a city of Wayne county, Mich., U.S., is completely surrounded by Detroit. Named for Col. John F. Hamtramck, the first American commander at Detroit (1796), the area was originally settled by French and later by German farmers. After 1910, stimulated by the growth of the automobile industry, a great migration of Poles to this area began. In this decade Hamtramck's population increased from about 3.500 to more than 45,500. After World War II the city was a haven for refugees from central Europe and the Balkans. The Hamtramck public school code. fostered by Maurice R. Keyworth in the 1920s, was a notable plan for educating children of foreign-born parents for American democracy, and its principles were widely adopted by educators in other cities. Hamtramck was incorporated as a village in 1901 and as a city in 1922. The automobile industry is the most important; other industrial products include paints, varnishes, automobile radiators. wire, electrical supplies, dishes and metal products. For comparative population figures *see* table in MICHIGAN: *Population.* (P. P. M.)

HANAU, a town in the *Land* of Hesse, Ger., on the right bank of the Main, 14 mi. E. of Frankfurt. Pop. (1950) 30.702. From the number of finds near Hanau, it would appear that it owes its origin to a Roman settlement. It received municipal rights in 1393, and in 1528 it mas fortified and the castle rebuilt. At the end of the 16th century its prosperity received considerable impulse from the accession of the Walloons and Netherlanders. Early in the 15th century Hanau became the capital of a principality of the empire, and in 1785 the province was united to Hesse-Cassel. In 1803 it again became an independent principality. In 1815 it reverted to Hesse-Cassel, and in 1866 it was joined to Prussia.

The streets of the old town are narrow and irregular. but the new, founded at the end of the 16th century by fugitive Walloons and Netherlanders, is built in the form of a pentagon with broad streets crossing at right angles. Among the principal buildings are the ancient castle, formerly the residence of the counts of Hanau, who are buried in the old church of St. Mary; the church of St. John, dating from the 17th century. with a handsome tower; and the church in the new town, built by the Walloons in the beginning of the 17th century in the form of two intersecting circles. Hanau is the birthplace of the brothers Grimm, to whom a monument was erected there in 1896. In the neighbourhood of the town are the palace of Philippsruhe and the spa of Wilhelmsbad. Hanau manufactures ornaments of various kinds; cigars; leather; paper; gold, silver and platina wares; chocolate; soap; hats; gloves; machinery; chemicals; and lamps. Diamond cutting is carried on and the town has also foundries and breweries. It carries on trade in wood, wine and corn.

HANCOCK, JOHN (1737–1793), American revolutionary statesman, was born in that part of Braintree. Mass., now known as Quincy. on Jan. 23, 1737. After graduating at Harvard in 1754, he entered the mercantile house of his uncle, Thomas Hancock of Boston, who had adopted him, and on whose death, in 1764, he fell heir to a large fortune and a prosperous business. In 1765 he became a selectman of Boston. and from 1766 to 1772 was a member of the Massachusetts general court. An event which is thought to have greatly influenced Hancock's subsequent career was the seizure of the sloop "Liberty" in 1768 by the customs officers for discharging, without paying the duties, a cargo of Madeira wine consigned to Hancock. Many suits were thereupon entered against Hancock. which, if successful. would have caused the confiscation of his estate, but which undoubtedly enhanced his popularity with the Whig element and increased his resentment against the British government. He was a member of the committee appointed in a Boston town meeting immediately after the "Boston massacre" in 1770 to demand the removal of British troops from the town. In 1774 and 1775 he was president of the first and second provincial congresses respectively, and he shared with Samuel Adams the leadership of the Massachusetts Whigs in all the irregular measures preceding the American Revolution. The famous expedition sent by Gen. Thomas Gage of Massachusetts to Lexington and Concord on April 18–19, 1775, had for its object, besides the destruction of materials of war at Concord. the capture of Hancock and Adams. who ivere temporarily staying at Lexington, and these two leaders were expressly excepted in the proclamation of pardon issued on June 12 by Gage. their offenses: it was said. being "of too flagitious a nature to admit of any other consideration than that of condign punishment." Hancock was a member of the Continental Congress from 1775 to 1780, was president of it from May 1775 to Oct. 1777, being the first to sign the Declaration of Independence, and was a member of the Confederation Congress in 1785–86. In 1778 he commanded, as major general of militia, the Massachusetts troops who participated in the Rhode Island expedition. He was a member of the Massachusetts constitutional convention of 1779–80, became the first governor of the state and served from 1780 to 1785 and again from 1787 until his death. Although at first unfriendly to the federal constitution as drafted by the convention at Philadelphia. he was finally won over to its support, and in 1788 he presided over the Jlassachusetts convention which ratified the instrument. Hancock was not by nature a leader, but he wielded great influence on account of his wealth and social position, and. was liberal. public-spirited and. as his repeated election—the elections were annual—to the governorship attests, exceedingly popular. He died at Quincy. Mass., on Oct. 8, 1793.

HANCOCK, WINFIELD SCOTT (1824–1886), U.S. general. was born on Feb. 14. 1824. in Jfontgomery county. Pa. He graduated in 1844 from the Military academy and was breveted first lieutenant for "gallant and meritorious conduct" in the Mexican War. After serving in the west, in Florida and elsewhere he married in 1850 Miss Almira Russell of St. Louis; became first lieutenant in 1853 and assistant quartermaster with the rank of captain in 1855. At the outbreak of the Civil War he was ordered east at his own request and on Sept. 23, 1861, was made brigadier general of volunteers and assigned to command a brigade in the army of the Potomac. He took part in the Peninsula campaign: and the handling of his troops in the engagement at Williamsburg on May 5, 1862, was such that McClellan reported "Hancock was superb." an epithet always afterward applied to him. At the battle of Antietam he was placed in command of the 1st division of the 2nd corps. and in November he mas made major general of volunteers, and about the same time was promoted major in the regular army. In the battle of Fredericksburg (*q.v.*) Hancock's division was among the troops that were ordered to storm Marye's heights. Out of the 5,006 men in his division 2,013 fell. At Chancellorsville his division received the brunt of the attack of Lee's main army. Soon after the battle he was appointed commander of the 2nd corps.

In the battle of Gettysburg (*q.v.*), after the defeat of the left wing of the army of the Potomac and the death of General Reynolds, Hancock arrived on the field with orders from Meade to assume command and to decide whether to continue the fight there or to fall back. He decided to stay, and held Cemetery hill and ridge until the arrival of the main body of the Federal army. During the second day's battle he commanded the left centre of the

Union army and, after General Sickles had been wounded, the whole of the left wing. In the third day's battle he commanded the left centre, upon which iell the full brunt of Pickett's charge, one of the most famous incidents of the war. As the guns of the Confederate army opened the attack Hancock rode along the front of his line to show his soldiers that he shared the dangers of the cannonade with them. His corps lost in the battle 4,350 out of less than 10,000 fighting men; but it captured 27 Confederate battle flags and as many prisoners as it had men when the fighting ceased. Hancock himself was struck in the groin by a bullet, but continued in command until the repulse of the attack. Six months passed before he resumed command. In the battles of the year 1864 Hancock commanded at the Wilderness. during the second day's fighting: half of the Union army; at Spottsylvania he had charge of the successful attack on the "salient"; at Cold Harbor his corps formed the left wing in the unsuccessful assault on the Confederate lines. In August he was promoted to brigadier general in the regular army. His old wound troubling him, he obtained a short leave of absence, expecting to return to his corps. He was, however, detailed to raise a new corps. and later was placed in charge of the "middle division." Before he could take the held Richmond had fallen and Lee had surrendered. After the assassination of Lincoln. Hancock was placed in charge of Washington, and it was under his command that Booth's accomplices were tried and executed. In July 1866 he was appointed major general in the regular army. A little later he was placed in command of the department of the Missouri, and the year following assumed command of the jth military division, comprising Louisiana and Texas. His policy, however, of discountenancing military trials and conciliating the conquered did not meet with approval at Washington, and he was at his own request transferred.

His war record and personal popularity caused Hancock's name to be considered as a candidate ior the presidency; and in 1880 he was nominated by the Democrats, but was defeated by his Republican opponent, General Garfield. He died at Governor's Island, near New York city, on Feb. 9. 1886. Grant said of him, "Hancock stands the most conspicuous figure of all the general officers who did not exercise a separate command. He commanded a corps longer than any other, and his name was never mentioned as having committed in battle a blunder for which he was responsible." (F. H. H.)

HAND, (BILLINGS) LEARNED (1872–1961), **U.S.** jurist, whose more than 2,000 opinions ranged virtually through all fields of law, was born in Albany, N.Y., on Jan. a7, 1872. Both his grandfather, Xugustus Hand (1803–78), and his father, Samuel Hand (1833–86), were judges; the former, justice of the New York supreme court and the latter, judge of the New York court of appeals. New Tork's highest state bench. With his cousin and boyhood companion, Augustus Noble Hand (1869–1954), also an outstanding U.S. judge in New York, Learned Hand attended Harvard. where he studied philosophy under William James: Josiah Royce and George Santayana, graduating in 1893. He received an M.A. degree (1894) and an LL.B. (1896) from Harvard. For 12 years he practised law in Albany and New York city.

In 1909 he was appointed United States district judge in New York. In 1913 he ran unsuccessfully on the Progressive ticket for chief judge of the New York state court of appeals. In 1924 he was elevated to the federal court of appeals ior the second circuit (New York. Connecticut and Vermont). where he became chief judge in 1939 through seniority. Augustus N. Hand reached the same bench in 1927.

His notable cases included the celebrated antitrust suit against the Aluminum Company of America (1945) in which his court acted for the supreme court where a quorum, because of disqualifications. was impossible. Summarizing his view of 40,000 pages of testimony, taken over four years. Hand said in characteristic epigram: "Congress did not condone 'good trusts' and condemn 'bad ones'; it forbade all." He upheld in 1gjo the conviction of the top 11 Communist party members on Smith-act charges of conspiracy to teach and advocate overthrow of the government. His opinion (183 Fed.. 2nd 201) was adopted by Chief Justice Frederick M. Vinson in 1951 when the supreme court also sustained the convictions (*Dennis* v. *U.S.*, 341 U.S. 494). But in 1957, under Chief Justice Earl Warren and with other changes in the justices, the supreme court substantially altered the application of the Smith act and with it the Hand and Vinson decisions. "Advocacy or teaching of abstract doctrine." the court said (Yntes v. *U.S.*, 354 U.S. 298), was not punishable "even though uttered with the hope that it may ultimately lead to violent revolution."

In delivering the Holmes lectures at Harvard in 1958, Hand cautioned strongly against judge-made law by "a third legislative chamber." with the result that his views were claimed as support for the Jenner-Butler bill (then before Congress) to limit severely the supreme court's jurisdiction. Asked to clarify this. Hand wrote to Sen. Thomas C. Hennings, Jr.. that he believed enactment of the bill "would be detrimental to the best interests of the United States" inasmuch as the supreme court "should have the last word on the questions of the character involved." Describing the highest tribunal as "the least contentious organ of government generally." he said that n-hile he did not think it always right, "some final authority is better than unsettled conflict."

Hand's Harvard lectures appeared as *The* ***Bill*** of *Rights* (1958). A collection of his papers and addresses, *The* ***Spirit*** of Liberty (1952; reissued with new material, 1959), appeared in his 81st year. The combination of faith and skepticism that distinguishes his thought was movingly presented in his "I Am an American" day address in New Work city, May 21, 1944. This brief definition of the spirit of a free people had an impact so immediate and profound that it was likened to Lincoln's Gettysburg address. Hand retired officially in 1951, hut continued to sit in many cases.

On April 10, 1959, Judge Hand. then 87 years old, set a record of 50 years of service in the United States judiciary, an occasion marked by a special session of his court at which Chief Justice Warren led the national bench and bar in paying him warm and admiring tribute. He died in New York city on Aug. 18, 1961.

See citations in *The Spirit of Liberty: Papers and Addresses of Learned Hand,* collected and with an introduction and notes by Irving Dilliard (1952–59). (I. Dd.)

HAND. That man has a hand, rather than a paw, hoof, fin or wing, has set him above all other animals and has enabled him to develop a culture based on toolmaking and tool using. It is quite possible that the emergence of a culture in turn accelerated the pace of hominid evolution to hasten the appearance of modern man, Homo *sapiens* (see MAN, EVOLUTION OF). It is thought that the hand has evolved from the five-rayed forepaw of early vertebrates. Occasionally, however, a child is born with an extra rudimentary thumb (prepollex) and an extra rudimentary little finger (postminimi) which has led some to speculate that the hand was originally seven-rayed.

In the human hand there are 8 small bones (carpals), 5 longer tubular bones (metacarpals) and 14 shorter tubular bones (phalanges). The phalanges compose what are called fingers; the thumb contains two phalanges, the other four fingers. three each.

Scientifically the thumb is numbered finger I; index finger, II; middle. III; ring. IV; and little finger, V.

The thumb is the outstanding part of the human hand. Although the anthropoid apes can flex and extend their thumb (bend it, straighten it) and can abduct it and adduct it (move it away from and return it to the midline), only man has true opposability (*i.e.,* he can rotate it inwardly so that very precise pincerlike movements are possible).

From anthropoid to man the thumb has increased in relative and absolute length. For example. the pollicial index (total phalangeal length of finger I × 100/total phalangeal length of finger III) may be noted: gibbon 35.2%, orangutan 30.2%, chimpanzee 35.4%, gorilla 37.3%, man 56.9%. In man the total absolute finger length is, in descending order, most often III, IV, II, V, I, though frequently IV equals II.

Anthropoids tend to be ambidextrous. But man is predominantly right-handed; only about 8% favour their left hand. (See HANDEDNESS.) A man-made flint implement possibly 1,000,000 years old appears to have been beveled to be held between the right thumb and forefinger. In prehistoric Europe a cave painting shows a man throwing a spear with his right hand.

The hand is very important in the study of the growth and development of the child. In carpals, metacarpals and phalanges centres of ossification appear in a time-sequence that (via the X-ray film) gives a biological growth-age of the child.

As an important cultural symbol the hand is used in gestures which impart meaning; the hand is important also medico-legally; *i.e.*, fingerprints (*q.v.*) serve to identify; and other marks, calluses, worn areas, etc., give clues to the possesser's occupation.

For a discussion of the anatomy of the hand see SKELETON, VERTEBRATE: *Appendicular* Skeleton; MUSCLE AND MUSCULAR SYSTEM; NERVOUS SYSTEM. See also HAND, DISEASES AND DISABILITIES OF.

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HAND, DISEASES AND DISABILITIES OF. The hand is composed of skin, fatty tissue, tendons, nerves, muscles, bones and joints. Disease may affect each tissue separately or the whole hand.

Abnormality of the hand may occur as an anomaly of development. Two or more fingers may be conjoined (syndactyly). A finger or thumb may be duplicated, presenting a hand with six or more digits. Conversely, the hand may be formed with absence of part of a finger or an entire finger or fingers. One such deformity is seen in the hand that has only a thumb and little finger and resembles a lobster claw; although unsightly, such hands may be very agile. A less severe but commoner developmental abnormality is the thumb that cannot be completely straightened due to constriction of a tendon by adjacent tissues, a condition known as a trigger thumb.

The hand is subject to frequent and severe injuries. Lacerations of the skin of the hand are more serious than such lacerations in most other parts of the body, because in the hand there it little fatty tissue protecting the vital nerves and tendons. Should a nerve be severed the finger will lose sensation and therefore most of its function. A severed tendon leaves the finger as useless as a marionette without strings. Fingertips are prone to crushing injuries in doors and under ill-aimed tools. Should such an injury result in loss of the tip of the finger, the tip is frequently replaced by tender scar, greatly reducing the effectiveness of the digit. Tendons may be severed without an exterior wound, as when a baseball is caught on the end of an outstretched finger; the tendon near the base of the nail is pulled loose and the end of the finger cannot be straightened. Drummers may wear out the tendon that straightens the thumb on the left hand. Other tendons break spontaneously in arthritic hands. Fractures of the bones of the hand result from direct blows or when the hand is used as a striking instrument, as in boxing. Most fractures in these bones heal readily. Serious injuries may occur to the hands when they are caught in machines, as washing-machine wringers.

Diseases affecting other parts of the body may show evidence in the fingers. Swelling of finger joints may indicate arthritis (rheumatoid), and enlarging prominences near joints may indicate osteoarthritis or gout.

Infections may occur as a result of minor cuts and scratches, "hangnails" (causing infection in the base of the nail called run-around), pin pricks into finger tips (abscess in the pulp). The most serious infections of the hand are those occurring in the tendons and deep in the palm.

Function of the hand is of paramount importance, and this is most severely impaired when one of the three major nerves to the hand is damaged. Such damage may take place as a result of fractures of the arm, birth injury to the neck, lacerations of the wrist or poliomyelitis. Should the nerve to the small muscles of the thumb be destroyed, almost 80% of the function of the hand is lost. Damage to one of the major nerves results in loss of sensation to the skin, and this impairs the ability of the hand to feel objects.

Tumours (*q.v.*) may be found in all the composite tissues of the hand. Within the bones occur benign tumours of cartilage; along the tendons occur tumours of fatty tissue; tumours of a gelatinous substance occur in joints.

Disability of the hand arises from a loss of one or both of its functions, feeling and grasping. Feeling is lost when a nerve is severed. Grasp is lost when motor power in the muscles is lost or when stiffness of the fingers robs them of their flexibility. Such stiffness may be due to arthritis, too long immobilization for treatment of a fractured finger, swelling of the hand due to injury of the arm, infection in the tendons or scarring of the skin and fatty tissue after an extensive burn.

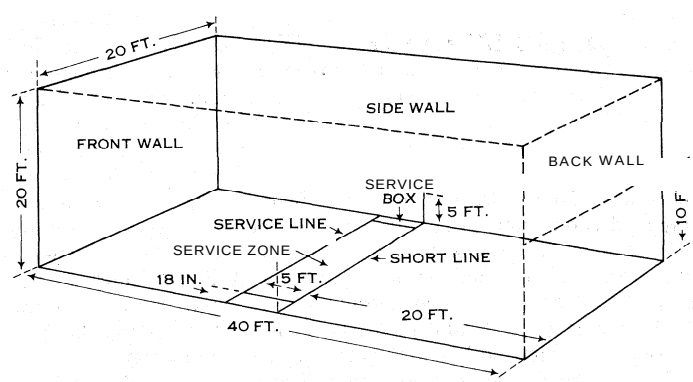
For the anatomy of the hand, *see* SKELETON, VERTEBRATE; MUSCLE AND MUSCULAR SYSTEM; NERVE. (T. D. B.)

HANDBALL, an active game that is popular in the United States, Canada and in various forms in other countries, is played mith a small rubber ball that is struck with a gloved hand against a wall or walls. (For English versions of the game, see FIVES.) Two or four persons play at a time. When two play, the game is called singles and when four play, doubles. The object is to strike the ball in such a manner that the opponent or opposing team has difficulty in returning it or is unable legally to keep the ball in play.

The game is played on a court, either indoors or outdoors. The court usually has one wall or four walls (see below for variations). Three organizations in the United States formerly issued playing rules; co-operation among the three—the Amateur Athletic union (A.A.U.), National Jewish Welfare board (N.J.W.B.), the United States Handball association (U.S.H.A.) and the Young Men's Christian association (Y.M.C.A.)—resulted in the publication in 1959 of one set of official unified handball rules.

The game involves strenuous physical activity, and persons of all ages and both sexes enjoy it. It helps develop speed, skill and endurance, and has been used by athletes as a conditioner for other sports.

History.—The Irish hard handball is often considered one of the national games of Ireland (see below). In the late 19th century, the game was introduced to the United States, and thereafter it grew rapidly in popularity There were more players in



FOUR-WALL HANDBALL COURT ACCORDING TO OFFICIAL UNIFIED RULES

the United States, it was believed, than in any other country of the world in the second half of the 20th century.

The first international match was the Lawlor-Casey series played in 1887 with a prize of $1,000 for the best of 21 games, 10 to be played in Cork, Ire., and 11 in the U.S. John Lawlor won six games to four in Cork; Phil Casey, the U.S. champion, won seven straight in New York city, winning the match. Casey, who retained his title against all challengers until he retired in 1900, was spoken of as "the father of handball in the U.S." Bernard McQuade, Drew Cashman and Michael Eagan were other outstanding stars of former days.

After 1900 handball developed into three separate games (covered separately below): a four-wall game called soft handball; the one-mall game; and the Irish four-wall, hard-ball game. National hard-ball championships were discontinued in the U.S. after 1938.

In the Cnited States national A.A.U. championships were started in 1919 and national Y.N.C.A. championships in 1925, and the United States Handball association began conducting national championships in the early 1950s. The three organizations sponsored one combined national tournament 'in 19j8. In ,1959, the Y.M.C.A. and the A.A.U. again conducted a combined national tournament, but the C.S.H.A. sponsored a separate tournament.

When the first Helms Hall of Fame handball selections were made in 1954, Joe Platak, who died in that year, was chosen along with Al Banuet. Banuet was the leading player ior three years, 1929–31, but was disqualified as an amateur after a brief professional boxing career. Platak dominated singles championship play from 1935 to 1941 and returned in 1943 and 1945 to bring his total to nine national championships. Victor Hershkowitz of Brooklyn, N.Y., dominated modern tournament play. He had captured more than 20 national championships in one-wall, three-wall and four-wall play when he won another title in the national Y.M.C.A. championships in 19j7. Other outstanding players included Robert Brady of San Francisco, Calif.: Philip Collins of Chicago, Ill., and John Sloan (Chicago), the "over-all 19j8 champion."

Four-Wall Game.—This is the most popular version of the game in the Cnited States. The approved court should measure 20 ft. wide, 40 ft. long and 20 ft. high with the back wall 10 ft. high. under official unified handball rules (see diagram).

A game consists of 21 points. A match is the best two out of three games.

The ball is made of black rubber; it is $1\frac{7}{8}$ in. in diameter with not more than $\frac{1}{32}$ in. variation; it should weigh 2.3 oz. with not more than .2 oz. variation; when dropped from a height of 70 in. the ball must rebound not less than 42 nor more than 48 in. at a room-and-ball temperature of 68" F. Only one hand may be used in striking the ball; no other part of the body may be used. When attempting to return the ball, the player cannot strike it more than once. Gloves made of soft cloth or leather must be worn during all matches (to prevent moisture from the hands making the ball wet and slippery).

A service zone five feet wide is marked across the court; the back edge (called the short line) is exactly in the middle of the court (*e.g.*, in a court 20 ft. wide and 40 ft. long, the 20 ft. back edge of the zone, the short line, is parallel with and 20 ft. from the front wall; the front edge of the service zone, called the service line, is parallel with and 1j ft. from the front wall. To put the ball in play the server stands anywhere he chooses within the service zone, drops the ball to the floor and on the rebound strikes it with one hand so it travels directly to the front wall and rebounds in such a manner that it travels beyond the short line beiore striking the floor. A legally served ball that fails to rebound beyond the short line before it touches the floor, or one that hits two side walls beiore touching the floor is called a short serve. Two short serves retire the server. If the server steps outside the service zone, while in the act of serving, this is called a foot fault and is considered the same as a short service. Two foot faults retire the server.

After the ball is served the server's opponent (or one of the opponents in a doubles game) known as the receiver, must play the ball before it touches the floor twice, hitting it in such a manner that it travels from the striker's hand to the front wall without touching the floor. First the receiver then the server play the ball in alternate fashion until one or the other makes an error. If the receiver fails to return the ball legally a point is scored for the server. If the server makes an error, no point is scored, but he is "out" and the receiver comes "in" and has his opportunity to serve and while doing so may score points. A server continues to serve as long as he makes points.

In singles the receiver stations himself anywhere in the back court (but at least five feet behind the short line), where he waits for the service. In doubles the two receivers may stand anyn-here in the back court (at least five feet behind the short line), but the server's partner must stand in the service box with his back to the side wall, both feet on the floor, and remain there until the ball passes the short line. If a served ball strikes the server's partner while he is in the back-to-wall position, it is called a dead ball (the ball is out of play) and the serve is made over. If the server's partner leaves the service box position before the served ball crosses the short line, this is a short service and must be repeated.

BY COURTESY OF UNITED STATES HANDBALL ASSOCIATION

GLASS-WALLED HANDBALL COURT

Court has full side walls of giass with a large glass insert in the back wall

Because of the many angle shots (side wall to front wall, ceiling to iront wall, recoveries from the back wall, and so on) many players and spectators consider the four-wall game more scientific and interesting than the one-wall game. The one-wall game supporters say their game requires more speed, stamina and control. It is generally conceded that a person who learns the one-wall game and then chahges to the four-wall game adapts more quickly than does a four-wall starter who goes to the one-wall game.

One-Wall Game.—The one-wall game is played in several sections of the Cnited States! but it achieved its greatest popularity in the New York city area. where an estimated 2,500 one-wall courts were built in parks and playgrounds. at beaches and elsewhere. The one-wall game is played with the ball described above for the four-wall game and is scored the same as the four-\?all game. The court dimensions differ; as specified by the Amateur Athletic union: they are length. 34 ft.; width, 20 ft.; and iront wall, 16 ft. high. The short line is 16 ft. from and parallel to the front wall. A "receiver restraining" line called the service line is indicated 9 ft. behind the short line (25 ft. from and parallel to the iront wall). In doubles the server's partner steps outside the court but in the space represented by a slight extension of the serving zone beyond the side line of the court.

Definitions.—A hinder is an accidental interference with or obstruction of flight of the ball: no penalty is involved. Fault refers to an infraction of the rules which involves a penalty. A ball returned to the front wall in such manner that it rebounds so close to the floor that it is impossible to get has been "killed." An ace is a service which completely eludes the receiver.

Other Versions.—Standard versions of the game in the United States have been described, but various adaptations have been introduced. Instead of two or four players. for example, three participants may engage in "cut-throat" handball. One player, while serving. engages the other two. He continues to serve as long as he makes points. When he is put "out." a move clockwise is made, the server pairs off with another, and a new server comes "in." The person scoring 21 points first is the game winner.

Sometimes a one-n-all court laid out on a gymnasium floor where the back line of the court is parallel to and near a gymnasium wall can be adapted for two-wall play. By agreement players are allowed to play legal balls off the wall, thus keeping in play balls that would not otherwise be returnable.

Some one-\+-allcourts are laid out in the corner of a gymnasium,

permitting corner shots and play on a side wall as well as the front wall. There are also courts with two folding triangular "wings" that swing out from the front wall of a one-wall court and fit into place on the side lines. The wings thus provide two front corners for angle corner shots. A further modification of this idea is a three-wall court (front, side and back wall), with one side open to accommodate a large group of spectators when contest matches are played. Two such courts were built by the New York department of parks and opened in Nov. 1959 with special exhibition matches. One is in Lincoln Terrace park, Brooklyn; the other is at Forrest park playground in Queens.

Glass-wall handball courts permit as many as 200 or 300 spectators to see tournament matches, but problems of materials, lighting. glare, variation in bounce and expense delayed development of such courts. The St. Louis Downtown Branch Y.M.C.A. built one of the first partial glass-mall courts. In 1958 the principal and final contests of the combined national four-wall handball tournament were played in a glass-enclosed court at the Y.M.C.A. in Aurora, Ill.

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Irish Handball. — The game of Irish handball originated about 1,000 years ago and was played on a hard clay floor, with one wall, of stone, at the front of the court, against which the ball was struck. In the modern form of the game the court dimensions and rules are almost identical with those laid down in the 1880s, when the first Irish championships were played; the ball and the system of scoring go back to the 18th century, when handball was a popular pastime in many parts of Ireland.

The standard ball court is a four-wall structure, with concrete walls and floor. The playing floor is 60 ft. long and 30 ft. wide; the front wall is 30 ft. high and the back wall, 9 ft. high. The side walls are higher at the front than the back. The walls must be perpendicular and smooth. The short line, from which the ball is tossed (served). is drawn at or near halfway down the court. In the toss the ball must be hit against the front wall on the first bounce and must come out beyond the short line to be accepted. Returns count. as in all ball games; the game proceeds with return and counterreturn—the ball is "up" when it hits the front wall direct. The ball may be punched or hit with the open palm or kicked. Ambidexterity is most important in Irish handball. Players toss a coin for inside position which is held until the tosser (server) is beaten in the rally. A good tosser can score a considerable number of aces direct from service. The game is 21 aces and the rubber of games varies from five to seven or more games. Both single- and double-handed games are general.

The Irish ball has a cork or greenhart centre covered by woolen thread and thin pieces of cork or rubber. The outer cover is of thin sheepskin. This ball is called an alley cracker or hard ball. Some tournaments or championships are played with a soft, rubber ball, but the Irish ball is the recognized championship medium. The standard ball is $1\frac{7}{8}$ in. in diameter and weighs $1\frac{1}{2}$ to $1\frac{3}{4}$ oz.

For many years challenge and championship games for high wagers were common. Side bets amounting to £1,000 were not unusual. Many matches for big wagers were played between Ireland and the United States between 1895 and 1910. Then the Gaelic Athletic association took handball under its wing; wager matches were abolished in 1924 and handball became a truly amateur game in Ireland. Separate boards of handball control were subsidized by the Gaelic Athletic association, and regular county. provincial and all-Ireland championships were organized. There are many standard courts throughout Ireland and innumerable ball alleys, and every secondary school and college has its first-class handball court. The soft ball is generally used in schools.

(P. D. M.)

HANDCUFFS AND FETTERS are instruments for securing the hands and feet of prisoners under arrest, or as a means of punishment. The old names were manacles, shackbolts or shackles, gyves and swivels. Until modern times handcuffs were of two kinds, (1) the figure eight, which confined the hands close together either in front of or behind the prisoner; and (2) rings which fitted around the wrists and were connected by a short chain, the latter being somewhat like those used by the modern police forces. Handcuffs are made of steel, adjustable to the wrist size and equipped with an automatic locking device.

Thumb cuffs, made of lightweight, stainless steel also are used; these cuffs may be employed by juvenile officers and as an auxiliary restraining device by police officers and detectives. For transferring gangs of convicts an arrangement of handcuffs connected by a light chain has been used, the chain running through a ring on each fetter and made fast at both ends by what are known as endlocks.

Several appliances have been used as handcuffs; *e.g.*, snaps, nippers, twisters. They differ from handcuffs in being intended for one wrist only, the other portion being held by the captor. In the snap the smaller circlet is snapped onto the prisoner's wrist. The nippers can be instantly fastened on the wrist. The twister, which is liable to injure prisoners seriously, is a chain attached to two handles; the chain is put round the wrist and the two handles twisted until the chain is tight enough.

Leg irons are anklets of steel connected by light chains long enough to permit the wearer to walk with short steps. Modern leg irons are adjustable to the size of the leg or ankle and lock automatically when they are applied to the prisoner. Sometimes leg irons are combined with handcuffs, being attached to the latter by a chain.

An obsolete form of leg iron was an anklet and chain to the end of which was attached a heavy weight, usually a round shot. The Spanish used to secure prisoners in bilboes, shackles around the ankles secured by a long bar of iron. This form of leg iron was adopted by the English and was much employed by them during the 17th and 18th centuries. (R. *G.* CL.)

HANDEDNESS. It is the usual practice to classify individuals as right-handed, left-handed or ambidextrous. People differ considerably in the range of activities for which they prefer a given hand as well as in the degree of disparity in skill between their two manual members. Probably no one favours his right or left hand exclusively.

Origin and Development of Handedness.—There is no extensive agreement on the question of the origin of the manual preferences people show. Some authors believe laterality is inherited; others, that we are trained to it; and still others, that some organization of intrauterine forces, such as those producing twinning, or some extrauterine environmental influences initiate our biases. It is possible all three hypotheses are, in a measure, correct. It does seem clear that left-handed parents more frequently have left-handed offspring than do right-handed parents; that even at birth most babies tend to move one arm—usually the right—more than the other; and that, if a systematic effort is made to keep infants from being biased, they still come to favour one hand. It is equally apparent that most babies, if the hand used the more frequently in reaching or grasping is taken as the clue to their handedness, shift their preference a time or two during their first year. The consistency with which children use one hand in preference to the other increases with age, at least through the preschool years and probably longer. Although the incidence of left-handedness seems to vary with the way it is measured and with the population studied, it is probably not too far wrong to say that in the United States 18 to 24 children become right-handed for every one who persists in sinistral tendencies.

Effects of Interference with Handedness. — Most children can be trained to use and to prefer their right hand in any given operation and many have been so trained without obvious harmful effects. How wise it is to interfere with a child's spontaneous preference is, however, a question. There does seem to be some sort of relationship between left-handedness and stuttering. Some hold the view that a left-handed person in a right-handed society, by virtue of being disapproved, interfered with and inconvenienced, is under more emotional strain, on the average, than is a right-handed person, and this stress causes stuttering. Others believe that if a left-handed person has his hand preference

w changed, he does not develop the clear-cut dominance of one cerebral hemisphere over the other which is necessary for co-ordinated functioning. The individual's speech is a delicate indicator of this lack of co-ordination in neurological activity. Some workers maintain, on the other hand, that the cerebral organization which makes for a lack of consistent unilateral dominance is inherited.

Laterality in the Body.—There is good evidence that the speech centre tends to be in the hemisphere contralateral to the side of the dominant hand and that alpha waves from corresponding parts of the two cerebral hemispheres are more conspicuous on the nondominant side. Neither of these bits of evidence proves conclusively, however, that the cortical organization which an individual inherits is responsible for his hand preference. It is interesting in this connection that there is little support for the vie , as the theory of a dominant cerebral hemisphere might lead one to expect, that the body structures under the control of one hemisphere are uniformly more efficient than the other. The dominant hand is not always on the side of the dominant foot. About three-fourths of the dextrals and one-third of the sinistrals are right-eyed in sighting.

It is probable that a person's preference for a given hand is an expression of many influences. Since it is not a matter of great moment which manual member the individual uses, so long as he performs well, it seems a wise course to allow choice as to hand if a strong preference is indicated. Whatever the choice, however, there is evidence that it is desirable to work for a clear-cut dominance of one hand over the other.

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HANDEL, GEORGE FREDERICK (1685–1759), musical composer, was born at Halle, in Lower Saxony, on Feb. 23, 1685. His name was Händel, but, like most 18th century musicians who travelled, he compromised with its pronunciation by foreigners, and when in Italy spelt it Hendel, and in England (where he became naturalized) accepted the version Handel, which is therefore correct for English writers, while Händel remains the correct version in Germany.

LIFE

Early Training.—Handel's father was a barber-surgeon, who disapproved of music and wished George Frederick to become a lawyer. A friend smuggled a clavichord into the attic. and on this instrument, which is inaudible behind a closed door, the little boy practised secretly. Before he was eight his father went to visit a son by a former marriage who was a valet-de-chambre to the duke of Saxe-Weissenfels. The little boy begged in vain to go also, and at last ran after the carriage on foot so far that he had to be taken. He made acquaintance with the court musicians and contrived to practise on the organ when he could be overheard by the duke, who, immediately recognizing his talent, spoke seriously to the father, who had to yield to his arguments.

On returning to Halle Handel became a pupil of Zachau, the cathedral organist, who gave him a thorough training as a composer and as a performer on keyed instruments, the oboe and the violin. Six very good trios for two oboes and bass, which Handel wrote in his 11th year, are extant; and when he himself was shown them by an English admirer who had discovered them, he was much amused and remarked, "I wrote like the devil in those days, and chiefly for the oboe, which was my favourite instrument." These trios were mere parerga beside the study and composition of vocal music, and he had to show Zachau a motet every week. By the time he was 12 Zachau thought he could teach him no more, and accordingly the boy was sent to Berlin, where he made a great impression at the court.

His father, however, thought fit to decline the proposal of the elector of Brandenburg, afterwards King Frederick I. of Prussia, to send the boy to Italy in order afterwards to attach him to the court at Berlin. German court musicians, as late as the time of Mozart, had hardly enough freedom to satisfy a man of independent character, and the elder Handel had not yet given up hope of his son becoming a lawyer. Young Handel, therefore, returned to Halle and resumed his work with Zachau. In 1697 his father died, but the boy with great filial piety, finished the ordinary course of his education, both general and musical, and entered the university of Halle in 1702 as a law student. Rut in that year he succeeded to the post of organist at the cathedral, and after his "probation" year in that capacity he departed to Hamburg, where the only German opera worthy of the name was flourishing under the direction of its founder, Reinhold Keiser.

Friendship *with* Matheson.—Here he became friends with Matheson, a prolific composer and writer on music. On one occasion they set out together to go to Liibeck, where a successor was to be appointed to the post left vacant on the retirement of the great organist Dietrich Buxtehude. Handel and Johann Matheson made much music on this occasion, but did not compete, because they found that the successful candidate was required to marry the retiring organist's daughter. Another adventure might have had even more serious consequences. At a performance of Matheson's opera Cleopatra at Hamburg, Handel refused to give up the conductor's seat to the composer when the latter returned to his usual post at the harpsichord after singing the part of Antony on the stage. The dispute led to a duel outside the theatre, and, but for a large button on Handel's coat which intercepted Matheson's sword, there would have been no *Messiah* or Israel in Egypt. But the young men remained friends, and Matheson's writings are full of the most valuable facts for Handel's biography. He relates in his Ehrenpforte that his friend at that time used to compose "interminable cantatas" of no great merit; but of these no traces now remain, unless we assume that a Passion according to St. John, the manuscript of which is in the royal library at Berlin, is among the works alluded to. But its authenticity, while strongly upheld by Chrysander, has since been as strongly assailed on internal evidence.

On Jan. 8, 1705, Handel's first opera, Almira, was performed at Hamburg with great success, and was followed a few weeks later by another work, entitled Nero. Nero is lost, but Almira, with its mixture of Italian and German language and form, is extant. It contains many themes used by Handel in well-known later works; but the current statement that the famous aria in *Rinaldo*, "Lascia ch'io pianga," comes from a saraband in Almira, is based upon nothing more definite than the common form of saraband-rhythm.

Three Years in Italy.—In 1706 Handel left Hamburg for Italy, where he remained for three years, rapidly acquiring the smooth Italian vocal style which thereafter always characterized his work. He had before this refused offers from noble patrons to send him there, but had now saved enough money not only to support his mother at home, but to travel as his own master. He divided his time in Italy between Florence, Rome, Naples, and Venice; and many anecdotes are preserved of his meetings with Corelli, Lotti, Alessandro Scarlatti, the founder of the Neapolitan school, or rather of the classical language of music as understood by Handel himself, and Alessandro's unacademic son Domenico, whose wonderful harpsichord technique still furnishes problems for the modern pianoforte virtuoso. Handel soon became famous as *Il Sassone* ("the Saxon"), and it is said that Domenico on first hearing him play incognito exclaimed, "It is either the devil or the Saxon!"

There is also a story of Corelli's coming to grief over a passage in Handel's overture to *Il* Trionfo del tempo, in which the violins went up to A in altissimo. Handel impatiently snatched away the violin to show Corelli how the passage ought to be played, and Corelli, who had never written or played beyond the third position in his life (this passage being in the seventh), said gently, "My dear Saxon, this music is in the French style, which I do not understand." The story becomes more interesting in view of the fact that Handel's later treatment of the violin is hardly less restrained than Corelli's, though he often wrote for the greatest players of the day.

In Italy he produced two operas, *Rodrigo* and *Agrippina,* the latter a very important work, of which the splendid overture was remodelled 44 years afterwards as that of his last original oratorio, *Jephtha*. He also produced two oratorios, *La Resurrezione,* and *Il Trionfo del tempo*. The latter, 46 years afterwards, formed the basis of his last work, *The Triumph of Time and Truth,* which contains no original matter. All Handel's early works contain material that he used often with very little alteration later on, and, though the famous "Lascia ch'io pianga" does not occur in *Almira,* it occurs note for note in *Agrippina* and the two Italian oratorios. On the other hand the cantata *Aci, Galatea e Polifemo* has nothing in common with *Acis and Galatea.*

Besides these larger works there are several choral and solo cantatas of which the earliest, such as the great *Dixit Dominus,* show in their extravagant vocal difficulty how radical was the change which Handel's Italian experience so rapidly effected in his methods. Handel's success in Italy established his fame and led to his receiving at Venice in 1709 the offer of the post of Kapellmeister to the elector of Hanover, transmitted to him by Baron Kielmansegge, his patron and staunch friend of later years.

Career in England.— Handel at the time contemplated a visit to England, and he accepted this offer on condition of leave of absence being granted to him for that purpose. To England accordingly Handel journeyed after a short stay at Hanover, arriving in London towards the close of 1710. He came as a composer of Italian opera, and earned his first success at the Haymarket with *Rinaldo,* composed, to the consternation of the hurried librettist, in a fortnight, and first performed on Feb. 24, 1711. In this opera the aria "Lascia ch'io pianga" found its final home. The work was produced with the utmost magnificence, and Addison's delightful reviews in the *Spectator* poked fun at it from an unmusical point of view in a way that would have pleased Gluck 50 years afterwards. The success was so great, especially for Walsh the publisher, that Handel proposed that Walsh should compose the next opera and that he (Handel) should publish it! He returned to Hanover at the close of the opera season and composed a good deal of vocal chamber music for the princess Caroline, the step-daughter of the elector, besides the instrumental works known to us as the "oboe concertos."

In 1712 Handel returned to London and spent a year with Andrews, a rich musical amateur, in Barn Elms, Surrey. Three more years were spent in Burlington, in the neighbourhood of London He evidently was but little inclined to return to Hanover, in spite of his duties to the court there. Two Italian operas and the Utrecht Te Deum, written by the command of Queen Anne, are the principal works of this period. It was awkward for the composer when his deserted master came to London in 1714 as George I. of England. For some time Handel did not venture to appear at court, and it was only at the intercession of Baron Kielmansegge that his pardon was obtained. The king received the composer into his good graces and granted him a salary of £400 a year

Later Handel became music master to the little princesses and was given an additional £200 by the princess Caroline. In 1716 he followed the king to Germany, uhere he wrote a second German Passion to the popular poem of Brockes, a text which, divested of its worst features, forms the basis of several of the arias in Bach's Passion according to St John This was Handel's last work to a German text A copy much more accurate than Handel's autograph exists in Bach's handwriting The Water Music was composed expressly for the occasion of a royal water picnic on the Thames in July 1717.

Composer and Impresario.—On his return to England he entered the srrvice of the duke of Chandos as conductor of his concerts, receiving a thousand pounds for his first oratorio *Esther.* The music which Handel wrote for performance at Cannons, the duke of Chandos's residence at Edgware, is comprised in the first version of *Esther, Acis and Galatea,* and the twelve Chandos Anthems, which are compositions approximately in the same form as Bach's church cantatas but without any systematic use of chorale tunes. The fashionable Londoner would travel nine miles in those days to the little chapel of Whitchurch to hear Handel's music; of the magnificent scene of these visits all that now remains is the church.

In 1720 Handel appeared again in a public capacity as impresario of the Italian opera at the Haymarket theatre, which he managed for the institution called the Royal Academy of Music. Senesino, a famous singer, to engage whom Handel especially journeyed to Dresden, was the mainstay of the enterprise, which opened with a highly successful performance of Handel's opera *Radamisto.* To this time belongs the famous rivalry between Handel and Buononcini, a melodious Italian composer whom many thought to be the greater of the two. The controversy has been perpetuated in John Byrom's well-known lines:

Some say, compared to Buononcini
That Mynheer Handel's but a ninny;
Others aver that he to Handel
Is scarcely fit to hold a candle.
Strange all this difference should be
Twixt tweedle-dum and tweedle-dee.

It must be remembered that at this time Handel had not yet asserted his greatness as a choral writer. The fashionable ideas of music and musicianship were based entirely upon success in Italian opera, and the contest between the rival composers was waged on the basis of works which have fallen into almost as complete oblivion in Handel's case as in Buononcini's. Apart from scholarly revivals, none of Handel's 41 Italian operas survives, except in some few detached arias out of each opera; arias which reveal their essential qualities far better in isolation than when performed in groups of between 20 and 30 on the stage, as interruptions to the action of a classical drama which was nothing but an interruption to them. But even under these conditions Handel's inexhaustible inventive power proved decisive; as was shown when he wrote the third act of an opera *Muzio Scevola,* of which Buononcini and Ariosti (Chrysander says Mattei) wrote the other two. Buononcini soon got into discredit by failing to defend himself against the charge of producing as a prize-madrigal of his own a composition which proved to be by Lotti. As a consequence Buononcini left London, and Handel for the next ten years was without a rival in his ventures as an operatic composer.

From Opera to Oratorio.—He was not, however, without a rival as an impresario; and the hostile competition of a rival company which obtained the services of the great Farinelli and also induced Senesino to desert him led to his bankruptcy in 1737, and to an attack of paralysis caused by anxiety and overwork. The rival company, it may be added, also had to be dissolved from want of support Handel's artistic conscience was that of an opportunist, or he would never have continued till 1741 to work in a field that gave so little scope for his genius. But operas were the only music that was known to pay, and at all events he could supply better operas more quickly and easily than any other living composer And this he naturally continued to do so long as it seemed the best way to keep up his reputation. But his opportunism did not include a readiness to stand any nonsense; and when the prima-donna Cuzzoni tried to give herself other airs than he had written for her, he held her at arm's length out of a window until she capitulated.

Already before his last opera, *Deidamia,* produced in 1741, Handel had been making a growing impression with his oratorios. In these, freed from the restrictions of the stage, he was able to give scope to his genius for choral writing, and so to develop, or rather revive, that art of chorus singing which is the normal outlet for English musical talent. In 1726 Handel had become a naturalized Englishman, and in 1733 he began his public career as a composer of English texts by producing the second and larger version of *Esther* at the *King's Theatre.* This was followed early in the same year by *Deborah,* in which the share of the chorus is much greater. In July he produced *Athalia* at Oxford, the first work in which his eight-part double choruses appear. The share of the chorus increases in *Saul* (1738); and *Israel in* Egypt (also 1738) is practically entirely a choral work, the solo movements being few and, in spite of their fame, perfunctory. The public, who still considered Italian opera the highest form of musical art, not unnaturally obliged Handel at subsequent per-

formances of this gigantic work to insert more solos.

The Messiah was produced at Dublin on April 13, 1742. *Samson* (which Handel preferred to *The Messiah)* appeared at Covent Garden on March 2, 1744; *Belshazzar* at the King's theatre, March 27, 1745; the *Occasional Oratorio* (chiefly a compilation of the earlier oratorios, but with a few important new numbers), on Feb. 14, 1746, at Covent Garden, where all his later oratorios were produced; *Judas Maccabaeus* on April 1, 1747; *Joshua* on March 9, 1748; *Alexander Balus* on March 23, 1748; *Solomon* on March 17, 1749; *Susanna,* spring of 1749; *Theodora,* a great favourite of Handel's, who was much disappointed by its cold reception, on March 16, 1750; *Jephtha* (strictly speaking, his last work) on Feb. 26, 1752, and *The Triumph of Time and Truth* (transcribed from *Il Trionfo del tempo* with the addition of many later favourite numbers), in 1757. Other important works, indistinguishable in artistic form from oratorios but on secular subjects, are *Alexander's Feast,* 1736; *Ode for St. Cecilia's Day* (words by Dryden); *L'Allegro, il pensieroso ed il moderato* (Milton, with a third part by Jennens), 1740; *Semele,* 1744; *Hercules,* 1745; and *The Choice of Hercules,* 1751.

Last Years.—By degrees the enmity against him died away, though he had many troubles. In 1745 he had again become bankrupt; for, although he had no rival as a composer of choral music, it was possible for his enemies to give balls and banquets on the nights of his oratorio performances. As with his first bankruptcy, so in his later years, he was scrupulously honourable in discharging his debts, and, like Scott, he continued to work hard to the end of his life. Unlike Scott, he not only completely recovered his financial position (by the year 1750) but he must have made a good deal of money, for he then presented an organ to the Foundling Hospital, and opened it with a performance of *The Messiah* on May 15.

In 1751 his sight began to trouble him; and the autograph of *Jephtha,* published in facsimile by the *Händelgesellschaft,* shows pathetic traces of this in his handwriting, and so greatly reveals his methods of composition, all the accompaniments, recitatives, and less essential portions of the work being evidently filled in long after the rest. By a dramatic coincidence Handel's blindness interrupted him during the writing of the chorus, "How dark, oh Lord, are Thy decrees, . . . all our joys to sorrow turning . . . as the night succeeds the day." He underwent unsuccessful operations, one of them by the same surgeon who had operated on Bach's eyes. He was able to see at intervals during his last years, but his sight practically never returned after May 1752.

He continued nevertheless superintending performances of his works and writing new arias for them, or inserting revised old ones, and he attended a performance of *The Messiah* a week before his death, which took place, according to the *Public Advertiser* of April 16, not on Good Friday, April 13, according to his own pious wish and according to common report, but on April 14, 1759. He was buried in Westminster Abbey; and his monument is by L. F. Roubilliac, the same sculptor who modelled the marble statue erected in 1739 in Vauxhall gardens, where his works had been frequently performed.

Handel was a man of high character and intelligence, and his interest was not confined to his own art exclusively. He liked the society of politicians and literary men, and he was also a collect~:of pictures and articles of *vertu.* His power of work was enormous, so that the *Handelgesellschaft's* edition of his complete works fills 100 volumes, forming a total bulk almost equal to the works of Bach and Beethoven together. (F. Hu.; D. F. *T.)*

MUSIC

Handelian Opera.—No one has more successfully popularized the greatest artistic ideals than Handel; no artist is more disconcerting to critics who expect to follow a great man's mental development easily. Not even Wagner effected a greater transformation in the possibilities of dramatic music than Handel effected in oratorio, yet we have seen that Handel was the very opposite of a reformer. Indeed he hardly took the pains to ascertain what an art-form was, so long as something externally like it would convey his idea. But he never failed to convey his idea, and, if the hybrid forms in which he conveyed it had no historic influence and no typical character, they were none the less fit for each case. The same aptness and the same absence of method are conspicuous in his style.

The popular idea that Handel's style is easily recognizable comes from the fact that he overshadows all his predecessors and contemporaries, except Bach, and so makes us regard typical 18th century Italian and English style as Handelian, instead of regarding Handel's style as typical Italian 18th century. Nothing in music requires more minute expert knowledge than the sifting of the real peculiarities of Handel's style from the mass of contemporary formulae which in his inspired pages he absorbed, and which in his uninspired pages absorbed him.

His easy mastery was acquired, like Mozart's, in childhood. The sonatas for two oboes and bass which he wrote in his 11th year are, except in their diffuseness and an occasional slip in grammar, indistinguishable from his later works, and they show a boyish inventiveness worthy of Mozart's work at the same age. Such early choral works, as the *Dixit Dominus* (1707), show the ill-regulated power of his choral writing before he assimilated Italian influences. Its practical difficulties are at least as great as Bach's though they are not as necessary; but the grandeur of the scheme and nobility of thought are already those for which Handel so often in later years found the simplest adequate means of expression that music has ever attained. His eminently practical genius soon formed his vocal style, and long before the period of his great oratorios such works as The Birthday Ode for Queen Anne (1713) and the Utrecht Te Deum show not a trace of extravagance.

Operatic Methods.—The only drawback to his practical genius was that it led him to bury perhaps half of his finest melodies, and nearly all the secular features of interest in his treatment of instruments and of the aria forms, in that limbo of vanity, the 18th century Italian opera. The allegation is untrue that his operas are no better than those of his contemporaries; but it is certainly true that he never stirred a finger to improve the condition of dramatic musical art. He was notoriously masterful with singers; and was not bound by the operatic conventions of the time. In *Teseo* he not only wrote an opera in five acts when custom prescribed three, but also broke a much more rational rule in arranging that each character should have two arias in succession.

He also showed a feeling for expression and style which led him to write arias of new kinds. But he never made any innovation which had the slightest bearing upon the stage-craft of opera, for he never concerned himself with any artistic question beyond the matter in hand; and the matter in hand was neither to create dramatic music nor to make the story intelligible, but simply to provide a concert of between some 20 and 30 Italian arias and duets, wherein singers could display their abilities and spectators find distraction from the monotony of so large a dose of the aria form (which was then the only opportunity for solo vocal music) in gorgeous costumes and scenery.

The Transition to Oratorio.—When the question arose how such musical entertainments could be managed in Lent without protests from the bishop of London, Handelian oratorio came into being as a matter of course. But though Handel was an opportunist he was not shallow. His artistic sense seized upon the natural possibilities which arose as soon as the music was transferred from the stage to the concert platform; and his first English oratorio, *Esther* (1720), beautifully shows the transition.

The subject is as nearly secular as any that can be extracted from the Bible, and the treatment was based on Racine's *Esther,* which was much discussed at the time. Handel's oratorio was reproduced in an enlarged version in 1732 at the King's theatre; the princess royal wished for scenery and action, but the bishop of London protested. And the choruses, of which in the first version there are already no fewer than ten, are on the one hand operatic and unecclesiastical in expression, until the last, where polyphonic work on a large scale first appears; but on the other hand they are all much too long to be sung by heart, as is neces-

sary on the stage. In fact, the turning-point in Handel's development is the emancipation of the chorus from theatrical limitations. This had as great an effect upon his few but important secular English works as upon his other oratorios. Acis and *Galatea,* Semele, and Hercules are in fact secular oratorios; the choral music in them is pagan, but it is large, independent, and polyphonic.

Handel's scheme of oratorio is, then, operatic in its origin and has no historic connection with the German Passion music of his time; and nothing is more significant than that the chorus should have so readily assumed its proper place in a scheme which the public at first certainly regarded as a sort of Lenten biblical opera. And, as the chorus gains its musical freedom by the disappearance of theatrical necessities, it becomes the more powerful as a means of dramatic expression (as opposed to dramatic action).

Already in Athalia the "Hallelujah" chorus at the end of the first act is a marvel of dramatic truth. It is sung by Israelites almost in despair beneath usurping tyranny; and accordingly it is a severe double fugue in a minor key, expressive of devout courage at a moment of depression. On purely musical grounds it is no less powerful in throwing into relief the ecstatic solemnity of the psalm with which the second act opens. Now this sombre "Hallelujah" chorus conveniently illustrates the real originality and creative power of Handel's art. It was not originally written for its situation in Athalia, but it was chosen for it. It was originally the last chorus of the second version of the anthem, "As pants the Hart," from the autograph of which it is missing because Handel cut out the last pages in order to insert them into the manuscript of *Athalia.* The inspiration in Athalia thus lies not in the creation of the chorus itself, but in the choice of it.

In choral music Handel made no more innovation than he made in arias. His sense of fitness in expression was of little use to him in opera, because opera could not become dramatic until musical forms broke with architectural and decorative limitations (*see* GLUCK; MUSIC; SONATA FORMS; and INSTRUMENTATION). But in oratorio there was no necessity for reforming any art-forms The ordinary choral resources of the time had perfect expressive possibilities where there were no actors and actions to keep waiting Moreover, when ordinary decorum dictated an attitude of reverent attention towards the subject of the oratorio, then the man of genius could find the true scope for his dramatic sense and base immortal music thereon.

Musical Borrowings. — Handel must be estimated in terms of Shakespearean criticism. Originality, in music as in other arts, lies in the uhole, and in a sense of the true meaning of every part. When Handel wrote a normal double fugue in a minor key on the word "Hallelujah" he showed that he enjoyed the vigour and dignity of good 18th century double fugues. In putting it at the end of a melancholy psalm he showed his sense of the value of the minor mode When he put it in its situation in Athalia he shed upon it the light of a truly conceived dramatic situation. Handel himself did not more often transfer old work to new contexts than the first and greatest reformer of dramatic music who thrust Handelian opera into limbo (*see* GLUCK) Such procedures are interesting enough in any case; but musical criticism is unused to the cases where the borrowed material is not the composer's own. Desperate efforts have been made to vindicate Handel or explain away the composers who were to Handel what Holinshed's Chronicles, Sidney's Arcadia, and North's Plutarch were to Shakespeare.

On such matters heat is unaccompanied by light. No apology for Handel can plausibly maintain that his enormous physical industry was not compensated for by the Johnsonian indolence of a well-stocked mind. One writer (P Robinson, *Handel* and his Orbit) tries to explain away Handel's Holinsheds and Plutarchs by pointing out that Urio and Erba, etc , are place-names around the Italian lakes which Handel visited. You cannot explain away Palestrina and half the Italian masters of painting by pointing out that their names are place-names; nor can you thus explain why Handel, who cares so little for art-forms, should faithfully imitate the minutest features of a style 50 years earlier than his own, or why his manuscript of the archaic Erba Magnificat should break off as a copyist breaks off, from the top of the page downwards. Besides, why explain away these Italian masters (whose existence as persons is attested by other evidence) when Handel borrowed a chorus in Esther from Graun?

This disposes, on the other hand, of attacks made on Handel's morality in plagiarising from sources that could never be traced in his lifetime. Within four years of Handel's death the child Mozart dedicated a set of sonatas to Queen Charlotte with the assurance that, inspired by her Majesty's protection "je deviendrai immortel comme Händel et Hasse"; and if he had substituted Graun, his patroness and his public would have missed no point but the alliteration. The only plausible reason why Handel did not plagiarise from Bach is that he would have thought any chorus of Bach quite impracticable in England. With the old Erba Magnificat the puzzle is that Handel should have thought such leaden vocal writing worth borrowing for Israel in Egypt. He could not add four chords, with the words "my fathers' God" without producing a vocal colour that aggravates rather than relieves the surrounding muddiness.

The most probable explanation is that Handel, who never thought of writing an original eight-part fugue, seriously imagined like an examiner for a university musical doctorate, that eight-part fugues were objects of veneration, and that the British public would be the better for hearing some old Italian masterpieces in this form. At all events he made no attempt to improve the Erba fugues, or even to assign them to texts that gave a tolerable declamation. A fugue on *Sicut* erat in principio et nunc et *semper* has to be sung to the words "THE earth swal . . . lowéd them."

Plagiarism or Transmutation? — Handel's plagiarisms begin to be interesting when we turn from these wholesale pilferings to his real transmutations of foreign elements. For English readers Sedley Taylor's volume of analysed illustrations (The Indebtedness of *Handel* to the works of other Composers, Cambridge 1906) is indispensable for a true understanding of the case. Its appearance gave rise to renewals of controversy which proved how dangerous it would have been to Handel if the matter had been raised in his lifetime. His rival Buononcini was finally discredited by the discovery that he had sent in as his own work for a prize competition a madrigal by Lotti. What, say the moralists, was one madrigal against Handel's wholesale thefts? This query overlooks the distinction between a single prize composition, which is nothing if not wholly original, and a four-hours' entertainment which was so seldom entirely new that it was specially advertised to be so when that statement was permissible.

Hardly any two performances of Handel's oratorios took place, during his lifetime, without the addition and substitution of many favourite airs from other works Later on, in the time of Mozart, performances of operas (which had become much tighter unities than Handelian oratorios) were often adorned with inserted arias by other composers; Mozart's own contributions to other men's operas fill two stout volumes. Music was in the same condition as architecture; and Handel was as indebted to other composers as Wren was to Palladian architects, and as Mozart was (especially in his Requiem) to Handel. And no fear that discovery might discredit him seems to have entered into Handel's mind, for he left his whole musical library to his copyist, and it was from this library that the sources of his work were discovered.

The true plagiarist is the man who does not know the meaning of the ideas he copies, and the true creator is he in whose hands they remain or become true ideas. The theme "He led them forth like sheep" in the chorus "But as for his people" is one of the most beautiful in Handel's works, and we may be shocked by the bare statement that it comes from a serenata by Stradella. But, to any one who knew Stradella's treatment of it first. Handel's would come as a greater revelation than if he had never heard the theme before. Stradella makes nothing more of it than an agreeably frivolous tune which lends itself to comedic purposes by repetition, throughout eight pages of patchy aria and ritornello, at an ever-increasing pace. What Handel sees in it is what he makes of it, one of the most solemn and poetic things

in music.

Again, how shocking that the famous opening of the "Hailstone chorus" comes from the patchy and facetious overture to this same serenata, with which it is identical for ten bars all in the tonic chord representing, according to Stradella, someone knocking at a door. And how yet more shocking that the chorus "He spake the word, and there came all manner of flies" contains no idea oi Handel's own; at least, none except the realistic swarming violin passages. the general structure, and the vocal colouring; whereas the rhythmic and melodic figures of the voice parts come from an equally patchy *sinfonia concertata* in Stradella's work.

The effects of Handel's original inspiration upon foreign material are really the best indication of the range oi his style. The comic intention of Stradella's door-knocking overture becomes Handel's inspiration in the "Hailstone chorus." In the theme of "He led them forth like sheep" what Stradella thought frivolous Handel makes sublime.

The converse process is equally instructive. In the short carillon choruses in *Saul,* where the Israelitish women welcome David after his victory over Goliath. Handel uses a delightiul instrumental tune which stands at the beginning of a Te Deum by Urio, from which he drew extensively in *Saul, L'Allegro,* the Dettingen Te Deum, and other works. Urio's idea is first to make a jubilant and melodious noise from the lower register oi the strings, and then to bring out a flourish of high trumpets as a contrast. The tune could not bear and does not receive any iurther development, beyond statement and counterstatement. It has none of the solemnity of church music, and its value as a contrast to the flourish of trumpets depends, not upon itseli, but upon its position in the orchestra. Handel did not see in it a fine opening for a Te Deum, but he saw in it a periect type of popular jubilation, and. taking it at its face value as a popular tune he raised it to a high dramatic level. So he used it as an instrumental interlude accompanied with a jingle of carillons, while the daughters of Israel sing to a square-cut tune those praises of David which aroused the jealousy of Saul.

But now turn to the opening of the Dettingen Te Deum and see realized the other side of Urio's idea, the contrast between a jubilant noise in the lowest part of the scale and the blaze of trumpets at an extreme height. In the fourth bar of the Dettingen Te Deum we find the same florid trumpet figures as we find in the fifth bar of Urio's, but at the first moment they are on oboes. The first iour bars beat a tattoo on the tonic and dominant, with the whole orchestra, including trumpets and drums, in the lowest possible position, with all the drastic power of Handel's genius. Then the oboes appear with Urio's trumpet flourishes; the momentary contrast is not less brilliant than Urio's; but when the oboes are immediately followed by the same figures on the trumpets themselves the contrast gains gradation and climax. Moreover, these flourishes are more melodious than the sledge hammer opening, whereas in Urio's scheme they were mere conventionalities coming after a good melody. Lastly, Handel's primitive opening rhythmic figures inevitably underlie every subsequent inner part and bass that occurs at every half close and full close throughout the movement, especially where the trumpets are used. And thus every detail of his scheme is rendered alive with a rhythmic significance like that of the themes of Beethoven's second period, whereby he obtains the liveliness of polyphony without fussiness.

Greatness of the Oratorios.—No other great composer has ever so overcrowded his life with occasional and mechanical work as Handel, and in no othet artist are the qualities that make the difference between inspired and uninspired pages more elusive. The libretti of his oratorios are full oi absurdities, except when they are derived in every detail from Scripture, as in *The Messiah* and *Israel in Egypt,* or irom the classics of English literature, as in *Samson* and *L'Allegro.* The absurdities, and the. way in which all Handel's works exist by taking in each other's washing, only serve to strengthen the conviction of sound musicians that Handel's originality and greatness consist in his grasp of the works as wholes. They would not matter but for the fact that in English oratorio Handel created a true art form on the largest possible scale.

Though drama, in the proper and Aristotelian sense of action, was inherently beyond the terms of Handel's art, the two main qualities of dramatic language, viz., rhetoric and characterization, are at their highest power in all his music, and are, in spite of all that an obscurantist piety has done to conceal them, a main source of his popularity. The 18th-century love affairs of the Israelite warriors and their Israelite maidens cease to resemble the Loves of the Triangles when Handel's music begins to discriminate. It cannot always save the situation, unless we are prepared (as the bishop of London in 1740 was not) to be amused at the contrast between the passionate Elder and the crafty Elder in their trio mith the chaste Susannah. But it leaves no part of the work altogether lifeless! even where the music is most perfunctory. Neither the chorus nor the solo parts admit any lay figures. The heathen are so delightfully pagan that Handel has often been praised for his sympathy with them; but it is a feebly man-about-townish view that thinks his orthodox Jews and Christians less true to their ideals and to life. Their music is the work of the man who hoped to die on Good Friday that he might rise mith his Christ on Easter Day.

The power oi Handel's English declamation is famous and might with advantage be used as a touchstone for the originality oi his setting of words. For instance, the theme of "For unto us a child is born" puts an awkward strain on the word "For"; whereas the next theme, "And the government shall be upon his shoulder," is magnificently suggestive oi the action symbolical of assuming the load of government. The rest of the chorus "Wonderful Counsellor," etc., obviously goes straight to the point. Now the first two themes come irom an earlier Italian duet, of which the first words are *No, da voi non più fidarmi,* so that the word "For" replaces the exclamation "No." The other theme was meant to scold blind Love for its lying cajoleries, the word "shoulder" coinciding with *lusinghie . . . re.* Handel, seeing in this theme the possibility of a majestic interpretation, put up with a slight inconvenience in the opening theme for the sake of the spacious general structure of the whole movement which was easily expanded to include the new material of "Wonderful Counsellor."

It can hardly be doubted that the melody of "He shall feed his flock like a shepherd" was originally composed to some text, now lost, which gave the awkward expansion and fall of the word "shepherd" (scarcely better on the word "weary") a meaning as convincing as the famous "sheds delicious death" in *Acis and Galatea.*

The Additional Accompaniments Question.—*There* never has been a time when Handel has been overrated, except in so far as other composers have been neglected. But this iavourite musician of the non-musician suffers grievously irom pious misinterpretation and the popular admiration of the wrong externals. Chrysander spoke true and winged words about the burial of Handel's art beneath "mammoth" Handel Festivals at the Crystal Palace; but greater damage has been done to periormances on a normal scale by the use of "additional accompaniments" in the style of a later symphonic art, started most unfortunately by Mozart (whose share in the work has been corrupted in its turn) and continued throughout the 19th century in progressive stages of insensibility until Handel's style has become as unrecognizable as Nash's Regent street.

But while it is obvious that in *The Messiah* Mozart's orchestral colouring is for the most part an intrusion, the desire for purity of style overreaches itself when it leads to a condemnation of Mozart's work in *Acis and Galatea* and the smaller *Ode to St. Cecilia's Day.* (The accompaniments to *Alexander's Feast,* published in Mozart's name, are obviously by no artist of even ordinary competence.) Handel's secular style is by no means remote from Mozart's, and he leaves so much to the discretion of the performer that it is no indiscretion to allow Mozart to convert Handel's often very perfunctory sketch into a perfect Mozart-Handel work of art.

The result is at all events less heterogeneous than the cadenzas inserted by recent *Musikgelehrte* who out of the fullness of research achieve a style which no real composer at any period would receive without derision.

For the rest, when the worst has been said concerning either his own weaknesses or the misdeeds of his editors, musicians mill never cease to love and revere Handel as one of the greatest of composers, whose inspired work is a marvel of architectonic power, perfect sense of style and the power to rise to the most sublime heights by the simplest means. (D.'F. T.)

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HANDEL-MAZZETTI, ENRICA, FREIIN VON (1871–1955). Austrian writer, was born in Vienna on Jan. 10, 1871. She is known primarily as the author of many historical novels markedly Roman Catholic in outlook. Her manner of depicting the customs and modes of thought of earlier times first aroused notice because her direct realism was unfamiliar to Austrian Roman Catholic circles.

Meinrad Helmpergers denkwürdiges Jahr (1900) treats the theme of an English boy's conversion to Roman Catholicism in 13th-century Austria after his father has been tortured and killed as a freethinker by Berlin Protestants. Clashes between Protestant and Catholic are central issues in *Jesse und Maria* (1906) and *Die arme Margaret* (1910). *Der deutsche Held* (1920) and the Karl Sand trilogy *Das Rosenwunder* (1924), *Deutsche Passion* (1925) and *Das Blutzeugnis* (1926) have a 19th-century setting, while *Frau Maria* (1929–31) is a trilogy centring upon the 18th-century poet Johann Christian Giinther. She died on April 8, 1955, at Linz.

See *Enrica von Handel-Mazzetti zur* 75. *Jahrfeier,* ed. by F. Berger and K. Vancsa (1946). (H. M. WA.)

HANDICRAFTS, manual skill, or skilled work with the hand, more generally designating those visual arts which are actually practised by hand and associated with wearing apparel or deco-

ration in the home. In a sense handicrafts may be considered as synonymous with arts and crafts only of a less broad meaning; arts and crafts including those arts which are practised by hand and those which are practised with the aid of a machine.

HANDL, JACOB, also HÄNDL or HÄHNEL (1550–1591), German composer, was born at Reifnitz, Carniola (Ribnica Slovenia), on July 31, 1jjo. The nickname of GALLUS, by which he was generally known, nas a play on his surname, Hahnel, "little cock." He is known to have been in the service of the bishop of Olmütz as master of the chapel about 1j79 but is principally associated with Prague. where he was for many years cantor of St. Johann am Ufer. He died at Prague, July 18, 1591.

Although he hardly merited the name, freely given to him, of "the German Palestrina," Handl was undoubtedly an important figure in his day. His music shows a definite leaning toward the homophonic style which was so soon to take the place of 16th-century polyphony.

Most of his works were published in his lifetime. the most important being a collection of motets found in his Opus *Musicum* (4 vol., Prague, 1j86–go). Me also wrote 16 masses and other church music. His motet Ecce *quomodo moritur justus* was borrowed by G. F. Handel for his "Funeral Anthem"

See a selection of his motets with biographical notes in *Denkmäler der Tonkunst in Österreich (1894 et seq.)*; Paul Pisk, *Die Messen von Jakobus Gallus* (1917).

HAND TREE (*Chiranthodendron pentadactylon*), a tree of the family Sterculiaceae, native to Mexico, which takes its name from the peculiar formation of the flowers, the five bright red stamens of the calyx projecting in such a way as to resemble somewhat the fingers of a human hand—the corolla being absent. It is related to the baobab (*q.v.*) of west Africa.

HANDWRITING, or. chirography, writing with the hand as distinguished from print, as a term has come to be more or less restricted to mean the form of writing peculiar to each person. Thus, in addition to the actual motor act and the resulting script, "handwriting" includes also handwriting identification and graphology. These are the aspects of the subject discussed in this article. Other related aspects are discussed in the separate articles on CALLIGRAPHY; PALAEOGRAPHY; and WRITING.

Before the introduction of the typewriter for general use, when handwriting had a greater utilitarian value, schools stressed handwriting instruction. In the United States scales were developed by E. L. Thorndike. L. Xyers and others for gauging the quality of the script from grade to grade in the elementary schools. and a series of careful investigations of the handwriting movements were undertaken. Studies showed that the pressure on the penholder (grip pressure) as well as the pressure of the pen point on the paper (point pressurej varies continuously during writing, and the speed of writing is not uniform but depends upon the type of stroke being made. For example, speed of movement usually rises slowly as the stroke begins, comes to a maximum in the middle and drops off toward the end. The direction of the stroke, turns and loops, complexity of stroke and the type of stroke that preceded will alter the speed of-a given writing movement. Speed is affected also by length of letter elements, since it usually takes more time to make long strokes than to make short ones. By comparing the handwriting movements of good and poor writers, F. N. Freeman found that these two groups differ in position of writing hand. speed and types of movements in fingers and hand. Considerable relationship was found to exist between the changes in speed and the form of letters, and good writers showed greater uniformity in the speed of formation of similar strokes. Later, other educators, experimenting with manuscript writing and printed script, maintained that the latter type of handwriting is learned and executed more speedily because it resembles printed type more. Scales were developed for evaluating quality of manuscript writing. which is taught increasingly in modern schools in the U.S.

The handwriting of adults is so individual that it is considered unlikely that any two people could really write identical hands. This high degree of individualization occurs even among those who learned to write from the same school copy under the same teacher. Investigations into the handwriting characteristics of children have indicated that individualization in graphomotor development begins very early in life. The scribblings of the preschool child as well as the early versions of the child's copy work are often found to show individual characteristics sufficient to identify the author of a handwriting specimen. Among the anomalies of early writing development is mirror writing; that is, reversed script which reads from right to left and is seen as ordinary writing only when reflected from a mirror. Reversal of individual letters to some degree is part of normal spatial and motor development in children, but students of the subject disagree on the physiological processes involved in mirror writing. Most agree that it is the left-handed child's natural form of writing; these children however, tend to conform to the school standard as they gradually assimilate the conventional left-right direction. Brain injuries may result in partial or total mirror writing, which in these instances is considered a regression to the earlier reversal state. The most famous instance of mirror writing is that of Leonardo da Vinci who allegedly did it to keep his scientific work secret.

Despite the highly individualized character of mature writing, it is not always possible to determine age, sex and intelligence from the script itself, although expert estimates are better than chance. Alfred Binet, the first to investigate graphological claims scientifically! carried out a series of experiments in which two graphologists. one the talented Crepieux-Jamin, and 1j untrained judges participated. Binet found that in estimating the sex of the writer of 180 envelopes, the graphologists scored higher than the untrained judges. However, the highest score: 79%, made by Crepieux-Jamin, left too wide a margin for error for practical application when certainty of sex is crucial, as in court proceedings. Similar experiments were made for evaluation of age and intelligence, and again, though the graphologists mere consistently better than the untrained judges, the percentage of error was too high for certainty of evaluation. Nevertheless, Binet considered these results proinising for the future of graphology. Investigations of resemblances in handwriting of blood relatives have indicated that similarity in handwriting is not so great as in other characteristics such as height, weight and intelligence.

Handwriting Identification. — Identification of handwriting assumes great importance in courts of law when the authenticity of signature is contested. Even when the handwriting itself is not to be doubted: the conditions under which it was written sometimes become of great moment. Such questions as whether the writer's hand was forced or guided and whether alterations were introduced after the completion of the document often have to be answered by the expert. One of the first steps in the investigation of a suspected or disputed writing is to find some genuine writing of the disputed author with which to make a comparison. The writing characteristics which experts use in determining authenticity presuppose that each handwriting has certain permanent characteristic features from \\-hich the available handwriting sample may vary, and the question is whether the observed variation is within expected limits or beyond them. Many ingenious methods have been developed to determine the authenticity of a given piece of writing: comparison of dates with age of paper, determining whether writing at the creases preceded or followed the creasing, and chemical and physical examination of the paper and the ink to determine its origin, date of manufacture: date of writing, etc. The presence of tremors, types of final strokes for ending words, and other characteristics of handwriting which graphologists utilize in personality evaluations are also utilized by handwriting experts for identification purposes. However, handwriting experts usually limit themselves to problems of identification only.

Graphology. — Handwriting in its relation to personality has interested observers for many centuries. Peculiarities in the handwriting of Octavius Xugustus were noted by C. Suetonius Tranquillus as early as the 2nd century. The Chinese called attention to the relationship between handwriting and personality as early as the 11th century. In Europe in 1622 Camillo Baldi observed that all persons have a recognizably characteristic way of writing. Baldi began the analysis of handwriting into its elements: which later gave impetus to the French school of Abbé Hippolyte Michon (originator of the term graphology) and Crepieux-Jamin, some-

times known as the founders of the school of "isolated'signs." Their purpose was to relate specific elements in the handwriting to specific personality traits. In contrast, the intuitive graphologists evaluated handwriting by the total impression it made on them, without always being able to indicate the exact basis of their evaluation. The Chinese philosopher of the 11th century and the European poets, artists and philosophers of the 19th century, among then Goethe, Poe, Madame de Stael, Leibnitz and Gainsborough, who were amateur graphologists may be classed with the intuitive graphologists. It was not until the close of the 19th century that an attempt at a unified approach to graphological theory was provided by a study of the handwriting movement itself —the graphomotor process rather than the end product. In this way handwriting joined speech, gait and facial expression as an expressive movement. The features of these expressive movements were assumed to be determined internally, reflecting the stresses and strains. rhythms and inhibitions which the individual characteristically experiences in his everyday life.

In attempting to assess personality from handwriting many investigations have been conducted in which the script is analyzed into its component elements. Factors such as size of letters, width, slant, spacing between letters, degree of connectedness of strokes and letters and many other measurable aspects of writing have been studied. Other aspects of handwriting which do not lend themselves to geometrical measurement can also be rated. Among these are the form level (over-all evaluation of the character and type of form used in writing), degree of ornamentation or simplification of the basic form of the school copy, degree of angularity v. curvature, and types of connecting forms between strokes and letters. There are definite indicators in the handwriting from which the pressure of writing and its speed can be estimated. For example, pressure can be gauged by comparing the width and degree of darkness of the upstrokes, which usually bear little pressure, with the width and degree of darkness of the downstrokes, in which pressure is usually more pronounced. Similarly, increased speed of writing may be gauged from the smoothness of the writing, trimness of the strokes, "i" dots and periods that assume the form of commas as speed increases, increase in right-tending forms, increasing left-hand margins. prolonged lively finishing strokes and infrequency of changes in direction after breaks or pauses.

One of the most fundamental problems in graphology is that of finding an underlying dimension for evaluating all handwriting elements in measurable or ratable scales. With the provision of such a dimension, size of letters, a measurable element, and form level, a ratable one, could be evaluated on the same continuum as could all the other characteristics which graphologists consider important. Though a start in this direction was made by L. Klages. who regarded handwriting as an expressive movement and who tried to provide a systematic procedure for analyzing this movement along a specified continuum, many graphologists continued to be either atomistically analytic or intuitive. The analytic graphologists have claimed that each of the hand riting elements has specific meaning. Thus, unusually large handwriting is said to characterize the ambitious, imaginative person; very small writing, the pedantic person. However, it is recognized that there may be more than one cause for the same effect. Minute writing may be due to myopia; magnification of script may mask loss of motor control. Empirical studies in which attempts are made to relate individual handwriting elements to personality traits in an atomistic fashion rarely yield positive results. Many graphologists claim that only when the isolated elements are integrated into patterns is it possible to find significant relationship with personality.

Klages, maintaining that healthy people express themselves rhythmically in all expressive movements and especially in writing, suggested that the degree of rhythm exhibited by handwriting is a good measure of the wholesomeness of the personality. However, he gave no specific system for classifying degrees of rhythm. T. S. Lewinson and J. Zubin tried to correct this deficiency by providing scales in which the degree of rhythm present in each writing element can be judged. These scales have two opposite poles, extreme contraction and extreme release, with rhythmic balance centred between them. Writing which lacks rhythm as a result of inhibited movement is placed at the contraction end of the scale, while that which lacks rhythm as a result of deficient control is placed at the release end of the scale. The intermediate steps in the scale show an increasing degree of rhythm (or a decreasing degree of contraction or release) up to the point of rhythmic balance in the centre. Each handwriting element is classified on the seven-point scale, and the handwriting of well-adjusted normal persons is expected to vary in a bell-shaped curve of distribution about the point of rhythmic balance. Standards for classifying a given handwriting element on the contraction-release scale have been developed. Rose Wolfson applied these scales to the writings of delinquent and nondelinquent boys. She found that the scales differentiated significantly between the two groups, reflecting less rhythm and more release for the delinquent than for the nondelinquent subjects. Moreover, statistical analysis revealed a cluster of handwriting elements, consisting of size of letter, spacing and curvature, etc., which seem to be the most important elements in the handwritings of delinquents and may also prove to be the most important in all handwriting.

Another development in graphology was Max Pulver's interpretation of the symbolic in handwriting. Following Klages, Pulver studied the entire writing, but he interpreted its symbolic character according to dream symbolism and the relations between symbols and personality according to psychoanalytic theory.

Some broad claims have been made for graphology in predicting and diagnosing various physical and mental ailments — liver, heart and gastrointestinal disease, cancer, accident proneness, numerous psychiatric diagnostic categories and tuberculosis. It is difficult to evaluate the validity of many of these claims because too often the data on which they are based lack sufficient control, but studies in which scientific controls are utilized do not invariably disprove the claims of graphology. Careful comparisons of group data on epileptics, schizophrenics and manic-depressives with data obtained from comparable normal persons have shown significant differences, but such group differences are not suitable for the diagnosis of individuals. Similarly, differences have been noted between the premorbid and morbid handwriting of patients. Other investigators, however, have shown that there are no observable differences between the premorbid handwriting of schizophrenics and suicides and the handwriting of comparable normal persons. Group differences have been reported for stutterers and for criminals, and the handwriting of mental patients has been found to be more variable in its rhythmic qualities on the contraction-release continuum proposed by Lewinson and Zubin. A study of neurotic patients was conducted in which the answers of each patient to a personality questionnaire were compared with the answers to the same questions given to him by a graphologist based on an analysis of the patient's writing. This study indicated that the graphologist was right significantly more often than she was wrong.

The specific basis for the graphological judgment, however, rather than the accuracy or validity of an interpretation, is the issue in the development of graphology as a scientific method. Methods which match graphological interpretations with different indices (such as personality test scores, self-appraisal estimates and friends' opinions) may show that graphologists can evaluate personality with better than chance success, but the exact method of analysis is left undefined. Moreover. judges' opinions as to the validity of an analysis are not always conclusive. F. E. Krueger and Karl Ziets obtained handwritings from 80 individuals, then, without referring to the handwriting specimens, concocted a universal personality sketch of the type that astrologists use; each of the 80 subjects accepted this sketch uncritically as applying to himself.

After the late 1940s the following trends were discernible in graphology: it became more amenable to experiment; it was used more professionally; experimenters worked with subjects about whom extensive personal data were available against which to check findings. An outstanding example of this is the extensive research on alcoholic patients in which the findings from the handwritings and biochemical findings conspicuously agreed.

Finally, there were efforts to modernize existing instruments electronically and in other ways in order to study pressure. speed and tension. The question of the ultimate scientific value of graphology remained unanswered. however. The answer will depend largely on the development of more adequate laboratory techniques and preparation of more objective rating scales, but also on deeper insight into the factors underlying personality so that graphological results can be related to stable criteria of personality measurement.

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HANGAR: *see* **AIRPORT.**

HANGCHOW (HANG-CHOU), one of the notable historic cities of China and capital of Chekiang province. Pop. (1953) 696,600; (1957 est.) 784,000. Its importance is largely the product of its position. It lies at the mouth of the basin of the Ch'ien-T'ang river, which drains west Chekiang, and at the head of Hangchow bay. It is the natural link between the thickly peopled plains on either side of the bay and is the outlet of west Chekiang. Hangchow has a wider significance through its position on the south margin of the Yangtze delta and through its participation in the cultural development of the deltaic cities. It is the focal point for the southern ends of the waterways of the delta and is the southern terminus of the Grand canal (Yün Ho), which was from the time of the Mongols to the mid-19th century the main avenue of communication between the Yangtze delta and Peking. Yet the greatest days of Hangchow were before the completion of the Grand canal as a route between north and south. It was during the later Sung dynasty (A.D. 1127–1280), when the Chinese had retreated before the Mongols south of the Yangtze and had established their capital at Hangchow that the city reached the height of its importance. becoming the scene of intense literary activity of the period. Hangchow was then called Linan but popularly known as King-shih (the capital), from a corruption of which Marco Polo's *Kinsai* was derived.

Hangchow has been a commercial centre of great importance from the T'ang period onward. Although one of the points where the system of inland waterways which thread the Yangtze delta reaches the sea, Hangchow itself has never been a port for seagoing vessels, its port functions being restricted to inland navigational shipping. From the T'ang to the Yüan periods it utilized Kan-p'u farther down Hangchow bay, and with the continued silting of the bay, its seagoing trade has had to pass through Shanghai. The total trade of the port before World War II, was slightly less than that of Soochow or Chen-chiang, which are also within the delta and on the Grand canal. Hangchow is of some importance industrially, the most important industry being silk manufacture, based on the famous sericultural region of northwest Chekiang. Like Nanking, Hangchow is a silk-weaving rather than a silk-reeling centre.

After 1949, a jute-sack industry developed in Hangchow. A considerable number of rice-hulling and cleaning mills reflected the rice culture of the surrounding plains.

The city is built at the foot of a beautiful range of hills, the Hsi-t'ien-mu shan, or Eye of Heaven mountains, and by the shores of the famous Hsi Hu. the Western lake. The beauty of its buildings and gardens equals the charm of its situation among hills and valleys studded with some of the most famous monasteries in China. Hence the Chinese proverb: "There is Heaven above and Soochow and Hangchow below."

To Marco Polo it was incomparably the finest city in the world. This beauty was sadly tarnished in 1861 by terrible devastations during the Tai P'ing Rebellion, but the city, in a somewhat modernized form, largely recovered its prestige and still ranked as one of the leading cities of China.

After 1928, aith the establishment of the national government at Nanking. Hangchow gained new importance as the capital of the native province of Chiang Kai-shek. Emphasis on cleanliness of streets and buildings. and a model police force, were some of the accomplishments. No foreign treaty port rights were recognized in Hangchow itself where only foreigners in Chinese service or missionaries were permitted to reside.

The city became the home of the National Chekiang university and the Hangchow Christian college, which continued its work until 1941 in Shanghai.

Hangchow is linked by rail with Shanghai, Ningpo and Nanchang The city was held by the Japanese from 1937 until the end of World War II in 1945. In 1949 it was captured by Communist forces (T. SD.)

HANGING is one of five methods used in the western world for executing persons sentenced to death for crime. the others being electrocution, guillotining, gassing and shooting. Hanging is the method used in some U.S. states, in England, Scotland and the commonn ealth countries.

United States.—Execution by hanging was introduced early in colonial America by the English settlers In 1630, according to Joseph Dillaaay Sawyer in *History* of *Pilgrims and Puritans,* a John Billington was hanged at Plymouth in "ye first execution amongst them" for his murder of "one John New-comin" whom he "shote . . . with a gune, whereof he dyed."

Before the wide acceptance in the 19th century of the scaffold and the hangman's knot, which made possible a quick snapping of the spinal column, the victim often suffered slow strangulation before death.

In the United States the last public execution, a hanging, occurred in Kentucky in August. 1936. The number and type of witnesses attending executions are now highly restricted by law and administrative regulations. In the second part of the 20th century the lans of six states (New Hampshire. Iowa. Kansas. Montana Idaho and Washington) prescribed hanging as the method of execution. One other state, Utah, gave the prisoner the right to choose between hanging and shooting. The tendency in the United States to replace hanging with some other method of execution is reflected in the fact that of the 48 executions that took place during 1958, only one mas by hanging.

England and Scotland.—The procedure of an execution in England and Scotland is similar. The executioner and his assistant travel to the prison the day before that fixed for the execution. They observe the prisoner and are told his height and weight. They then go through the procedure of the execution using a sack of the same weight as the prisoner. The proper drop is calculated nith regard to the physical characteristics of the prisoner. The trap upon which the condemned person stands is formed of two hinged leaves held in position from below by bolts which are withdrawn when a lever is pulled. Above the trap a rope is attached to an overhead beam in such a way that it can be adjusted to the proper height.

The execution is carried out in the presence of the sheriff or undersheriff. At the time appointed the executioner enters the condemned "cell," pinions the prisoner's arms behind his back and leads him to the appropriate spot on the trap of the gallows. The assistant executioner then pinions the prisoner's legs, while the executioner puts a white cap over his head and the noose around his neck.

The knot of the noose is drawn tight on the left jaw where it is held in position by a sliding ring. The executioner then pulls the lever and the prisoner falls through the trap thereby suffering fracture or dislocation of the first three cervical vertebrae and so damaging the vital centres of the spinal cord. It is said that the dislocation of the vertebrae causes immediate unconsciousness and there is no chance of a later recovery since breathing is no longer

possible.

Apart from the sheriff the persons required to be present are the jailer, chaplain and prison surgeon and such other officers of the prison as the sheriff requires. Relatives and some other persons may be permitted to attend.

Hanging was derived by the Anglo-Saxons from their German ancestors (Tacitus, *Germ.*, 12). In England hanging was established as a punishment for homicide by the time of Henry II and in the middle ages every town, abbey and nearly all important manorial lords had the right of hanging. From the 12th century the jurisdiction of the royal courts became exclusive. Until 1868 hangings took place in public. During the early years of the modern period, the corpse was gibbeted (*i.e.*, hung in chains) and allowed to remain in a public place as a warning to evildoers.

See also CAPITAL PUNISHMENT.

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HANK: *see* YARN.

HANKEY, MAURICE PASCAL ALERS HANKEY, 1ST BARON (1877–), British soldier and politician, the first holder of the office of secretary to the British cabinet, was born at Biarritz, France. on April 1. 1877. Educated at Rugby, Eng.. and at the Royal Naval college, Greenwich, he served in the royal marine artillery (1895–1901) and in the naval intelligence department (1902–06). He became secretary to the committee of imperial defense in 1912 and, after World War I, was given in addition the new appointment of secretary to the cabinet. a post which he occupied until 1938. when he was raised to the peerage on his retirement. At the outbreak of World War II he was recalled to service, and was a cabinet minister until 1942. His knowledge. wisdom and experience were used by a succession of prime ministers, and he was British secretary at several international conferences. notably at Versaillcs. Washington, Genoa. The Hague. Lausanne and London. His retirement from public service was the prelude to an independent and very full life as a regular speaker in the house of lords. as chairman of several scientific and technical committees and as British representative on the Suez Canal company. In his *Politics, Trials and Errors* (1949) he strongly opposed the war crimes trials after World War II. especially those in Tokyo. In 1951 he delivered the Romanes lecture at Oxford. (F. S. G. P.j

HANKOW (HAN-K'OU), a member city of the tri-city conurbation of Wu-han on the left bank of the Han river where it joins the Yangtze in Hupeh province, China. Hankow was merged in 1950 with the adjacent cities of Han-yang and Wu-chang to form the single metropolis of R'u-han. *See* WU-HAN.

HANN, JULIUS (1839–1921), Austrian meteorologist and climatologist, acquired a world-wide reputation for his works on atmospheric dynamics and thermodynamics, the "atmospheric pulse." cyclones and 'climatology. He was born near Linz, Upper Austria, on March 23, 1839. In 186j he became editor of the *Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie*, and from 1877 was occupied in the Central Meteorological institute at Vienna. In 1873 he was appointed professor of physics at the University of Vienna.

He died in Vienna on Oct. 1. 1921.

Hann's principal works are *Die Erde als Ganzes; Die Atmosphäre und Hydrosphäre* (1872); *Handbuch der Klimatologie*, 3 vol. (1908; rev. ed. by Karl Knoch, 1932); *Lehrbuch der Meteorologie*, 3d ed. (1914) and many papers in his own *Zeitschrift* and the reports of the Akademie der Wissenschaften.

HANNA, MARCUS ALONZO (1837–1904), U.S. politician, was born at New Lisbon (now Lisbon), Columbia county. O.. on Sept. 24, 1837. In 1852 he moved with his father to Cleveland. He received his education in the public schools of that city and at the Western Reserve university. He was associated with his father in the wholesale grocery business and became a member of the firm. In 1867 he entered into partnership with his father-in-law. Daniel P. Rhodes. in the coal and iron business. In 1877 the firm became M. A. Hanna & Company and was extended to include the ownership of a fleet of lake steamships constructed in its own shipyards and the control and operation of valuable coal and iron mines. Hanna became largely interested in street railway properties and in various banking institutions. and after 1880 became prominent in the affairs of the Republican party in Cleveland. In 1884 and 1888 he was a delegate to the Republican national convention and was associated with William McKinley in the management of the John Sherman canvass. It was not, however, until 1896. when he personally managed the canvass that resulted in the Republican presidential nomination for William McKinley that he became known throughout the Cnited States as a political manager of great adroitness, tact, and resourcefulness. He was chosen chairman of the Republican national committee and managed with consummate skill the campaign of 1896 against William Jennings Bryan and "free-silver." In March 1897 he was appointed, by Governor Asa S. Bushnell (1834–1904), U.S. senator from Ohio. In the Senate: to which in Jan. 1898 he was elected for the short term ending March 3, 1899, and for the succeeding term, he was recognized as one of the principal advisers of the McKinley administration and his influence was large.

He took a deep and active interest in the problems of capital and labour, was one of the organizers (1901) and the first president of the National Civic Federation. whose purpose was to solve social and industrial problems. and in Dec. 1901 became chairman of a permanent board of conciliation and arbitration established by the Federation. After President Roosevelt's policies became defined Senator Hanna was regarded as the leader of the Conservative branch of his party and a possible presidential candidate in 1904. He died at Washington on Feb. 1j, 1904.

See C. *R.* Singdey, *Since the* Civil *War* (1926); *R.* F. Dibble, *Strenuous Americans* (1923); Mark Sullivan, Our *Times;* Thomas Beer, *Hanna* (1929).

HANNIBAL (247–183 B.C.), Carthaginian general. The name of Hannibal was a very common one in Carthage, but the most illustrious of its bearers was the son of Hamilcar Barca. Born in 247 B.C., at the age of nine Hannibal was taken by his father to Spain, after swearing eternal hatred against the Romans. In Spain he was trained by his father in the art of war. He also accompanied him on the expedition in the course of which Hamilcar, having assured the safety of his young son, was killed by the rebellious Oretani (229). Hannibal remained in Spain during the term of government of his brother-in-law, Hasdrubal, who succeeded Hamilcar Barca, and he served under Hasdrubal for some years. On the latter's death (221), Hannibal, at the age of little more than 25, assumed command of the army and province of Spain. In 221 also, he conducted a campaign against the Holcades, and in 220 he moved against the Vaccaei, and overcame the Carpetani in a battle near the Tagus. In the following year, notwithstanding a warning received from Roman ambassadors, he laid siege to Saguntum, the only city in eastern Spain south of the Ebro which still resisted his armies, and he took it after an eight months' siege. The Romans, who had threatened war if Hannibal should attack Saguntum, now demanded satisfaction from Carthage and, failing to obtain it, declared war. Thus began one of the most terrible wars of antiquity, the Second Punic War.

Inasmuch as he rejected the Roman warning, it is beyond dispute that Hannibal must bear the responsibility in history for initiating the war. On legal grounds we may ask whether in virtue of the treaties, the Romans were entitled to intimate to Hannibal that he must not attack Saguntum, and there can be no doubt as to the answer, in view of what we learn from the very historians who consider that Hannibal's attack on Saguntum was a violation of the treaties. The treaty concluded by the Romans with Hasdrubal prohibited the latter from crossing the Ebro in arms. Saguntum, however, is south of that river, though certain ancient historians committed the gross geographical error of placing it to the north. Again, it is by no means certain that the treaty contained a clause excluding the Greek colonies from the Carthaginian sphere of influence; but even if there was any such clause it did not apply to Saguntum, for it is a mere fable, due to the likeness of names, that Saguntum was a colony of Zacyn-

thus; it was undoubtedly an Iberian city, as is shown by its coins. While, however, legally the Romans had no right to intervene on behalf of Saguntum — their own alliance with the Saguntines constituting a violation of Hasdrubal's treaty, which, at all events implicitly, assigned the region to the south of the Ebro to the Carthaginian sphere of influence — politically it is clear that by attacking Saguntum Hannibal accepted responsibility for the war and all its consequences. He did so because he thought it necessary in order to uphold the position of Carthage as a great power, and at the same time he thought that he could win — not realizing the granite solidity of the Italic confederation centred in Rome, which he hoped to dismember by the hammer-blows of his army. Thus Hannibal's whole action was based on a grave and fatal error of valuation; but this error was inevitable, because he could have no idea of the solidity of the Roman confederation, which had never yet been tested, except partially and not very thoroughly in the time of Pyrrhus; he could only draw a fallacious analogy with the other, infinitely weaker, confederations with which he was acquainted from history or by personal experience. Granted that Hannibal believed in the possibility of a victorious war with Rome, and thought that Carthage was bound to initiate it in order to retrieve the disasters of the First Punic War, we must then consider whether the moment Hannibal selected was a good one, and whether his preparations and his plan of campaign were suited to the exigencies of that moment.

The moment itself could not have been better chosen. Later on, a victorious war in Italy would have been almost impossible. The Romans had indeed, during recent years, discomfited the Boii, and crossing the Po had subjugated the Insubres, but the power of the Gauls was not yet broken; hatred of the victors was still extreme, and the Romans had scarcely begun to establish themselves in the conquered territory. At that juncture, therefore, the valley of the Po offered Hannibal an excellent base for a war against Rome, with abundant recruiting material. Had the Romans but been able to consolidate themselves in the Transpadane, he could have had no such hopes. Indeed, from then onwards it was already beginning to be a little too late, and Hasdrubal, by allowing the Romans to conquer the Cisalpine Gauls, had paid dearly for the truce during which he had been left free to consolidate the Punic empire in Spain.

With regard to the plan of campaign, modern writers have discussed whether Hannibal was really its author or whether it was not essentially due to Hamilcar Barca, who had entered upon the conquest of Spain with the precise object of subsequently preparing for an invasion of Italy across the Alps with the help of the Gauls, who at that time were still not under Roman dominion. There seems no doubt that such was really Hamilcar's intention. That he nourished a deadly hatred for the Romans, that he prepared for a war of revenge after having been forced to give up Sicily to them and watch them seize Sardinia, and that his whole object in founding the empire in Spain was to prepare for that war, is beyond question. But he could have made use in two ways of the strength and wealth which Carthage drew from her Spanish empire against the Romans: either in the way which Hannibal afterwards chose, or by preparing to regain the command of the sea, which had been lost in the First Punic War. As, however, he did not direct the policy of Carthage along this latter channel, it is perfectly legitimate to conclude that it was he who laid the foundation of the plan of campaign which Hannibal subsequently carried out Hannibal's merit consists in having adopted that plan and putting it into execution with unequalled genius.

Nevertheless, Hannibal's conduct of the war had two fundamental defects. One was that — as his father, Hamilcar Barca, had previously done in Sicily, when he tenaciously defended the last remnants of Carthaginian territory there — he failed to realize with sufficient clearness the absolute necessity of naval supremacy for a definitive victory in the great duel with Rome, and, taking the view that the predominance gained by the Romans in the First Punic War was unalterable, he made no serious attempt at preparing to dispute it. Thus he lessened the efficiency of his conduct of the war; for there is no doubt that the ultimate victory of Rome in the Second Punic War was essentially due to the fact that her naval supremacy was maintained throughout.

Moreover, Hannibal, having to entrust the command of the Spanish forces which were left to themselves when he started for Italy to a tried and faithful officer, selected his brother Hasdrubal, who was certainly in every way loyal, but was very young and quite unequal to his heavy responsibilities — so much so, that he was not merely unable to make head for a moment against a really good general like Scipio (afterwards called Africanus), but was repeatedly defeated by mediocre leaders like the brothers Publius and Gnaeus Scipio, who had small resources and few troops at their command.

Having gone into winter quarters at Cartagena (219–218), Hannibal started slowly towards the Ebro in the spring of 218, not crossing the river till nearly the end of May; he then spent two months in operations against the tribes between the Ebro and the Pyrenees. This slow progress was intentional. He was anxious that his opponents should not have the slightest suspicion of his contemplated invasion of the Po valley, and (thinking it possible to stop him near the Rhone with the strong allied city of Marseilles as their base) should not soon enough make efficient preparations in upper Italy for the defence of the passes of the western Alps. This must have been exactly what the consul Publius Cornelius Scipio planned when, in the late summer of 218 (he had been detained in Italy by an unexpected rebellion of the Boii), he transported his army of two legions by sea from Pisa to the mouths of the Rhone. Here Scipio learned that Hannibal was already north of him, near the right bank of the river. When, after a successful cavalry reconnaissance, he moved northward along the right bank of the Rhone with his legions, he found that Hannibal had crossed the river and was proceeding northward on the left bank with intentions that were not too clear. Hannibal had been anxious to avoid a battle for the time being, and by marching northward to leave Scipio uncertain through which Alpine pass he had chosen to descend into Italy. In these circumstances, Scipio returned to the sea, embarked his legions for Spain with the intention of campaigning against the Carthaginian forces that still remained there, and accordingly entrusted the command to his brother Gnaeus, while he himself sailed from Marseilles for Pisa, whence he hastened to the Po to take command of the two legions stationed there to guard the territory and protect the two recently-founded Roman colonies near the river — Placentia and Cremona. Hannibal, however, as soon as he was assured that the Romans were not contemplating either pursuing him or closing the Alpine passes against him, returned southward, and crossing the pass of Mont Genèvre descended into Italy, into the valley of Susa. There he rested his forces, and having taken by assault the city of the Taurini tribe of Gauls, which offered resistance, proceeded to take the offensive, moving so rapidly in the direction of the Po as to anticipate Scipio's offensive.

Hannibal's march was thus, strategically, entirely successful. The Romans, failing to anticipate his movements, had not awaited him where with strong forces they could easily have given an initial and perhaps decisive check to his war worn and unacclimatized Africans — that is to say, in Piedmont, between Ivrea and Turin. After wasting time in seeking him near the Rhone, they had not acted rapidly enough to encounter him near the passes of the western Alps. Nevertheless, according to our tradition, this strategic success was very dearly bought, for between the Ebro and the Po Hannibal is said to have lost more than 50,000 men — about two-thirds of his army — reaching Italy with 20,000 infantry and 6,000 cavalry. This estimate of his losses is, however, quite inadmissible, and a critical scrutiny must reduce the total Carthaginian losses during the long march to not more than 5,000 or 10,000. It is indeed inconceivable that any army, after undergoing such hardships and suffering such enormous losses, could at once enter upon a victorious campaign; nor can it be supposed that Hannibal made such havoc of the best army Carthage ever had

A cavalry skirmish between the Ticino and the Sesia, known as the battle of the Ticino, informed Scipio of the enemy's strength and led him to recross not only the Ticinc but also the Po, abandoning the Transpadane to Hannibal and organizing his defence to the south of the Po, with the colony of Placentia as its base.

Near Placentia the Romans also concentrated the legions of the other consul, Tiberius Sempronius, who had been recalled from Sicily, where he was making preparations for a descent on Africa. Hannibal, crossing the Po higher up, moved in the direction of Placentia and encamped on the left bank of the Trebia. Here, crossing the river, the four Roman legions attacked him by order of Sempronius. The victory of the Trebia (about Dec. 218) was the first of the three great victories that Hannibal owed to his supreme tactical skill. This battle caused the Romans to abandon the whole of northern Italy except the colonies of Placentia and Cremona, so that in the following year (217) they stood on the defensive in the peninsula, with one army commanded by Gaius Flaminius at Arretium, and the other under Gnaeus Servilius at Ariminum. Eluding the vigilance of Flaminius, Hannibal now succeeded in crossing the Apennines and proceeded to ravage north-eastern Etruria under his very eyes; he then moved unexpectedly from Cortona along the northern shore of Lake Trasimene in the direction of Perusia, as if he intended to attack the other consul, Servilius, who was coming down by forced marches from Ariminum to effect a junction with his colleague in Etruria. Flaminius, who was in the enemy's rear, allowed himself to be surprised on the northern shore of Lake Trasimene, between the pass of Borghetto and Passignano, giving Hannibal the opportunity to gain the second of his great victories (June 217).

The dilatory and cautious methods of the dictator Fabius gave the Romans every facility for preparing for what they thought was bound to be the decisive campaign in the following year, but did not hinder Hannibal from ravaging along the Adriatic as far as Apulia and crossing into Campania, where he Iaid waste the fertile Ager Falernus. Thereafter, exhibiting admirable judgment and amazing skill in manoeuvre, he evaded the ambushes laid for him with considerably superior forces by the dictator, and returned to northern Apulia to take up his winter quarters (217–216).

Here, skirmishes near Geronium, one of which went in the Romans' favour and the other against them, did not alter the situation. It was altered by Hannibal, who at the end of the winter, without interference from the Roman army that was watching him, suddenly moved further south near the Aufidus and there seized the fortress of Cannae, where the Romans had a large supply depot. He thus secured stores for his army and at the same time had the advantage of moving into an undevastated area well suited to his skilful manoeuvring. Here, near the Aufidus, he was overtaken by the consuls for the year 216, Lucius Aemilius Paulus and Gaius Terentius Varro, with one of the largest armies that Rome had ever put in the field, about 50,000 strong (allowing for the exaggerations of tradition, which sets it at 80,000); their intention was to engage the enemy in a decisive battle. The Romans had two camps, one on either bank of the river, connected by a bridge; Hannibal had a camp on the right bank, further downstream.

The Romans drew up in order of battle on the left bank of the Aufidus, with their front facing the sea and their right resting on the river. If they were defeated, they thought they could fall back either on the left bank towards Asculum or Aquilonia, or, crossing the bridge between the two camps, on the right bank towards Canusium or Venusia. If he gave battle on the Apulian plain, Hannibal had to be prepared to fight with his back to the sea and risk a complete disaster if defeated, since he had no line of retreat. He relied, however, on the efficacy of a manoeuvre that has made the battle of Cannae famous, and has been successfully imitated several times in modern warfare, including the recent World War. Drawing up, as usual, his infantry in the centre and his cavalry on both wings, he advanced impetuously against the enemy with the middle part of the infantry line, consisting of the Gauls and Spaniards, while the detachments of Libyan infantry on both flanks remained inactive. The Romans not merely withstood the attack, but, with the weight of their deep columns, forced the enemy to give back beyond his original position. Thus the Libyan detachments, which had not moved during the attack, were projecting on both sides of the front as it bent before the drive of the legionaries; and now, at a given signal, the Romans, who were penetrating like a wedge into the Carthaginian front, were assailed on either flank, while to complete the enveloping movement there came up from the rear the cavalry, who had routed the Roman cavalry on the wings, and half of whom, giving up the pursuit, had returned to the field of battle. Thus the enveloping movement was completely successful, and, notwithstanding its bravery and its superiority in numbers, the Roman army was utterly defeated. It will be realized that Hannibal's manoeuvre, which brought about the complete encirclement of the enemy, presupposes that the Romans were not so enormously superior in numbers as tradition would suggest. Otherwise, in order to surround them, he would have had to weaken his lines proportionately, to such an extent as to make it almost impossible for them to withstand the enemy's attacks.

This tremendous victory bore its natural fruits. After the battles of the Trebia and Lake Trasimene, the Italic confederation had remained intact. Not one of the confederate cities had passed over to the enemy. Now, however, this terrible hammer-blow detached from the granite mass of the confederation those parts that were least firmly joined to it—first northern Apulia with the powerful city of Arpi, then nearly all the territory of the Caudini and Hirpini, then most of the Lucanians and Bruttians, and lastly Capua, the second city in Italy.

Both by the ancients and in our own day Hannibal has been blamed for not profiting by his victory to march directly on Rome. The criticism is wholly unjustified. Defended by the strong and recently-repaired wall of Servius Tullius, inhabited by a warlike people not accustomed to quail, commanded by a senate that had always known how to face difficult moments, situated on a river that ensured its supplies even if Hannibal had succeeded in blockading it by land, Rome was in such a position that in all probability a move against it would not have had the very slightest hope of success, immediate or remote, and would have prevented Hannibal from exploiting his victory and gaining the practical benefit he obtained by inducing southern Italy to rebel. But at this point comes the end of Hannibal's wonderful series of successes, and the character of the war entirely changes. Legend ascribes this to the fact that Hannibal's troops went into winter quarters at Capua and thus lost the fighting spirit. In reality it was due to the new Roman strategy, which no longer allowed Hannibal to exploit that fighting spirit in great pitched battles. For the Romans now adopted the strategy suggested by Fabius, which earned him the name of *Cunctator,* the Delayer: never to accept battle when the enemy offered it, never to offer it on equal terms, never to attack him in his camp; but to destroy his army in detail as time and opportunity offered, to defend vigorously all the places that had remained loyal to Rome, to try to recover by force or fraud the places that had fallen into Hannibal's hands, profiting by Rome's numerical superiority and Hannibal's inability to keep the two theatres of war, Apulia and Campania, both uhder his own eye. This plan of campaign undoubtedly called on the Roman people and its allies for immense sacrifices in men and money, and for an indomitable tenacity. Hannibal, inferior in strength and not adequately supported by the Carthaginian Government because the Romans held permanent command of the sea, was obliged to substitute for his audacious and victorious offensives a cautious and not always successful defensive in which all the resources of his genius could not prevent the recovery by the Romans of one place after another that had fallen into his hands; for when superior Roman forces sat down before a city friendly to Carthage his only way of saving it was to give battle with inferior numbers, or to attack the Romans in their firmly-defended entrenchments, offering them the choice of easy victory.

Thus Hannibal's genius was nullified by the force of circumstances. It is not surprising that he lost ground and gained no more great victories in the field. Rather is it surprising that, always unconquered, threading his way among armies superior to his own, without any hope of adequate reinforcements, he succeeded for so many years in gaining still here and there a success, in winning here and there, even if not for long, another position, in retaining possession of a little Italian territory to the

end, and maintaining in it a strong and fairly large army. The weak point in the strategy of attrition adopted by the Romans was the immense effort for which it called, and it is doubtful whether the citizens and their allies would have been equal to such an effort year after year if they had not been comforted by visible successes, which raised their moral when it had been lowered by weariness. Nor must it be supposed that because he was reduced to passive resistance, Hannibal had any idea of allowing the Romans to dictate to him, or even of accepting the transformation of the war into a war of pure attrition, as Fabius desired. He was no longer, indeed, in a position to strike unaided such decisive blows as Cannae. But he could hope for some assistance that would change the aspect of the war in Italy — not so much from Africa, whence reinforcements could only reach him intermittently, as from Spain, if Hasdrubal had succeeded in destroying the small forces which the Romans could send there, or from Macedon, if King Philip V., who had been induced by news of Hannibal's success to take up arms against Rome in order to expel the Romans from their possessions in what is now Albania, had ventured to cross the Strait of Otrantq and conduct an offensive war in Italy. Hannibal might also hope for assistance from Sicily, which, impressed by the Carthaginian victories, also rebelled against Rome immediately upon the death of the old king Hieron (215); or, at any rate, he might hope that the rebellious Syracusans, with effective help from Carthage, would succeed in containing considerable Roman forces for a long period, and thus indirectly assist him in his war in the peninsula. For reasons over which Hannibal had absolutely no control, none of these hopes were realized except the hope of reinforcements from Spain, which however, as we shall see, arrived too late to change the course of the war in Italy.

Meanwhile, however, the effects of the tenacious Roman resistance and the war of attrition were making themselves inexorably felt. In 213, Casilinum fell into the hands of the Romans, and later they recovered Arpi. True, Hannibal succeeded in surprising the Greek colony of Tarentum, the third city in Italy. This was not in every way of advantage to him; for as he never succeeded in occupying the citadel he was obliged to disperse his forces in a very dangerous manner, and meanwhile in his absence the Romans, with six legions, laid siege to Capua and surrounded it entirely with lines of circumvallation. Hannibal was not deaf to his allies' appeal, and in the spring of 211 he broke into Campania and offered battle to the Romans. They, however, refused to leave their fortified positions, and Hannibal was unable to relieve the city because he could not, without very great risk, persevere in his efforts to break the lines of circumvallation. Accordingly he made a very bold move. Leaving behind him the armies which were besieging Capua, he marched on Rome, and encamped three miles from the walls, between the Anio and the Tiber. The Romans were not intimidated; lining the walls with defending troops, instead of offering battle they sent a force out of the city to encamp a mile from Hannibal. In such circumstances it was madness to attempt an assault upon the walls, and equal madness to delay in the heart of the enemy's country, with difficult communications and with the danger of being surrounded by superior forces. Consequently, after a few days, Hannibal was forced to retire towards Bruttium, without realizing his hope of drawing away to the relief of Rome the powerful armies which were surrounding Capua, and thus securing an opportunity for a pitched battle and giving the besieged the respite of which they stood in need. A slight success over the consul Sulpicious Galba, who was following him up, did not recompense Hannibal for the complete strategic failure of his march, marvellous — almost miraculous — as it was in itself. Merely by remaining firmly at their posts the besiegers of Capua had decided the fate of the city, which not long afterwards opened its gates and received terrible punishment for its treachery. The fall of Syracuse a little earlier had marked the final destruction of the Greek power in Sicily. In 209, Hannibal received another heavy blow in the occupation of Tarentum by Fabius through treachery. In Spain also, after many years of indecisive warfare and following the momentary success represented by the rout of the two Scipios (of which. however, the Carthaginians had not been capable of taking full advantage), their empire was breaking up under the blows of Scipio. At this juncture it occurred to Hasdrubal to go to help his brother in Italy with the troops which he could not usefully employ in the defence of Spain. In the fine season of 208, while Hasdrubal, retracing his brother's route, was descending the Alps and continuing in the direction of central Italy as far as the Metaurus, it would seem that Hannibal, with the object of effecting a junction with him, advanced as far as Larinum, in the country of the Frentani. Such, however, was the numerical superiority of the Romans that, while he himself was obliged to proceed northward with extreme slowness and caution, he was unable to prevent the concentration of considerable forces against his brother. The defeat of Hasdrubal at the Metaurus deprived Hannibal of his last hope of making a recovery in Italy, and the fatal news was conveyed to him by the severed head of his brother being cast by the Romans into his camp. Thereupon, abandoning all idea of an offensive, he retired into Bruttium, where he also concentrated the forces of those allies who had remained loyal to him. Here for four more years he withstood the Romans, fiercely contesting every step of their advance, and making them pay heavily for such successes as they gained by their strategy of attrition. Had they persevered in this strategy to the end, it is doubtful indeed whether they would have gained the final decisive victory, and even had they done so they would probably have paid for it by such immense sacrifices that they themselves would have fallen exhausted upon the corpses of their conquered adversaries. Now, however, Publius Cornelius Scipio, the young general who had displayed genius of such a high order in destroying, with very limited resources, the Carthaginian empire in Spain, was anxious to substitute a strategy consisting in boldly taking the offensive in Africa; and, despite the reluctance of the senate, in which a strong party headed by the aged Fabius was opposed to such an audacious policy, regarding it as dangerous and foolish, he succeeded in obtaining permission to carry out his design.

Scipio's marvellous victories, which broke Carthage's principal ally, Syphax, king of the Massaesylian Numidians, and threatened Carthage herself, ultimately compelled Hannibal to abandon Italy in the autumn of 203 in order to go to the help of his country. When he landed with his army at Leptis Minor and encamped near Hadrumetum, the Carthaginians, reduced to the last extremity, had already concluded an armistice and accepted preliminaries of peace with Scipio on extremely severe terms. Meanwhile the forces with which, a little earlier, Hannibal's other brother Mago had tried somewhat unsuccessfully to take the war into Liguria, also collected at Hadrumetum. Mago, recalled, had also embarked for Africa, but had died of wounds during the voyage. The large forces collected at Hadrumetum and the presence of their greatest general now induced the Carthaginians to try once more the test of arms. Almost at the very moment when the ambassadors were returning from Rome with the peace preliminaries approved, the Carthaginians — perhaps with Hannibal's connivance — violated the armistice concluded with Scipio, and the war broke out again. Scipio promptly recalled his faithful ally, Masinissa, king of the Massilian Numidians, whom he had sent into Numidia to fight against Vermina, son of Syphax, king of the Massaesylians, and allied like his father to the Carthaginians. Then, in the fine season of 202, he decided to climb the Bagrada in order to make a junction with the Numidians. Hannibal, who had likewise sent for Vermina, moved from Hadrumetum into the interior to join him, and encamped not far from Scipio, near Zama Regia. Scipio, instead of retiring towards his base, boldly moved forward towards Naraggara, between the Bagrada and the Muchtul, where he effected a satisfactory junction with the Numidian cavalry that Masinissa was bringing him. Hannibal, who had been following him, always in the vain hope of being joined by Vermina, now found himself in a serious position, being something like 125 miles from his base and in the presence of an enemy immensely his superior in cavalry. A meeting between the two commanders, at which Hannibal asked for peace, proved fruitless — because Scipio, realizing the strategic advantage he had

gained, insisted on terms more severe than those which had been agreed to before the breach of the armistice; so that there was nothing for it but battle. Scipio disposed the maniples of his legions in column, in three lines capable of operating independently, and defended his wings with the Italian and Numidian cavalry. Hannibal posted in his first line the Ligurian and Celtic mercenaries who had been under Mago's command, in his second line the native Libyans and the Carthaginian citizens, and in his third, further back as a true reserve, the flower of his army—the veterans of the Italian war. The front was protected by the elephants, the flanks by the cavalry. The elephants' assault was ineffectual owing to the able resistance of the Roman light troops, who succeeded in directing them through the columns of maniples, after passing which they were disposed of by other light troops without having done any serious damage. In the centre, the Carthaginian front line failed to resist the charge of the Roman *hastati,* and defeat seemed inevitable when Scipio, employing a manoeuvre which he himself had first used in the war in Spain, brought up the second- and third-line maniples, the *principes* and the *triarii,* on the flanks of the *hastati.* Hannibal had foreseen this manoeuvre, and countered it by bringing up the African infantry on either side of the mercenaries. But his tactical foresight was not crowned with success. The mercenaries, who were already giving ground, were routed, and the Africans with them. The reserve of Italian veterans remained intact, and Hannibal had disposed them on purpose to attack the legions if the latter should be victorious and should enter upon an undisciplined pursuit. As soon, however, as he perceived that Hannibal's third line was intact, Scipio recalled his men and re-formed them behind the natural breastwork afforded by the bodies of the casualties in the first two Carthaginian lines; having done so, he led them to the attack. Coming up from the rear at the same moment were the Italian and Numidian cavalry under Laelius and Masinissa, who had driven back the weaker Carthaginian cavalry with ease and, abandoning the pursuit in time, were returning to attack the infantry. Hannibal's veterans were thus surrounded and cut up, only very few escaping, among whom, however, was Hannibal himself (Oct. 202).

After this battle, in which, though not victorious, he had given a most wonderful exhibition of his tactical genius, Hannibal advised his fellow-citizens to make peace—indeed, almost forced them to do so—notwithstanding the very severe terms now dictated by the victor. After the conclusion of peace Carthage, despite her defeat, displayed the greatest confidence in Hannibal, and placed him at the head of the Government, thus enabling him to reorganize public affairs. Hannibal, great in administration as in war, speedily restored the State finances—to such an extent that in a short time the Carthaginians were able to make Rome an offer of payment in full of the heavy war indemnity that had been exacted. Rome, however, could not allow Carthage to recover; and so, a few years later, Roman envoys came to the city to accuse Hannibal of conspiring against the peace. He was forced to escape secretly, and took refuge (196) with Antiochus IV. the Great, king of Syria; who, having reunited the old Seleucid empire, was in diplomatic conflict with Rome, since the latter, after her victory in the Second Macedonian War, had established herself in the hegemony of the Balkan peninsula. The diplomatic conflict between Syria and Rome dragged on for some years until in the autumn of 192, in response to an appeal from the Aetolians, who had taken up arms against Rome, Antiochus landed in Greece and began the so-called Syrian War.

To this war he had been incited by the great Carthaginian refugee, who hoped that it might lead to the liberation of his country. Hannibal is said to have asked to be sent to the west with a hundred warships to prepare for a descent on Italy. This was a chimerical project, in view of the failure of the great expedition which he had so carefully prepared and ably conducted in the peninsula. It is much more likely that Hannibal simply asked Antiochus for a small land and sea force, with a view to preparing for a descent on Africa and inducing the Carthaginians to resume the war of independence against Rome and her ally Masinissa in Africa, thus causing a diversion which might also turn greatly to the advantage of the king of Syria. But even if such were the original plans of Hannibal and Antiochus, there was no possibility of carrying them out. When the Aetolians took up arms, intervention by Antiochus in Greece became urgent and could no longer be delayed; and he was obliged to employ all his available land and sea forces in strengthening and maintaining his expeditionary forces in the peninsula. Moreover, it is obvious that, since he could not even find adequate forces in 191 to resist the attack of the Romans and Philip in Greece, he could certainly have none available for a diversion in Africa. When, defeated at Thermopylae (191), he took refuge in Asia Minor, his only thought was—inevitably—to prepare to defend by land and sea his ancestral kingdom, which the Romans were getting ready to attack.

Already in the year 191 the naval battle of the Corycus gave the Romans the command of the Aegaean. It was essential for Antiochus to regain it in the following year. With this object, while his admiral Polyxenides was operating in the Aegaean, Hannibal was sent to Phoenicia to collect a fleet with which to help the principal Syrian squadron. In 190 Hannibal moved north from Phoenicia with 37 warships. Near the promontory of Side he encountered the fleet of the Rhodians, allies of Rome, who disputed his passage. After a fierce fight Hannibal was defeated and forced to retire; nor did he succeed either then or later, in joining with Polyxenides to take part in the decisive struggle. By land as by sea the fortune of war was against the Syrians, and after the defeat of Polyxenides at Myonessus and that of Antiochus at Magnesia (the latter battle took place late in 190 or early in 189) the king was obliged to accept the peace terms imposed by the Romans, which included the surrender of Hannibal.

Hannibal. however, effected his escape, and after many vicissitudes—tradition gives us anecdotes of varying degrees of authenticity—we find him at the court of Prusias, king of Bithynia, one of the few despots who had not yet become dependent on Rome. It was Hannibal who suggested to his protector the magnificent site which was chosen for the foundation of the city of Prusa, the modern Brussa. Later he took part in the war between Prusias and Eumenes II., king of Pergamus, in which he gained his last success, the naval victory of the Bithynian fleet over that of Pergamus, commanded by Eumenes himself, who narrowly escaped capture. The war ended when Rome imposed her mediation on the contending parties. These events, however, drew the attention of the Romans upon Hannibal, and, through Titus Quintius Flamininus, they demanded that Prusias, who also had now been forced by circumstances to become dependent upon them, should surrender him. Prusias was cowardly enough to arrange for the great refugee's arrest; Hannibal, however, seeing his house surrounded by soldiers, committed suicide by taking poison, which he always carried on his person in readiness for emergencies (183).

The great Carthaginian had thus witnessed the complete failure of what had been the whole purpose of his life—the war of revenge by Carthage against Rome. That war had not merely ended in the defeat and destruction of the Carthaginian power, but had made Rome so conscious of her strength, and given rise to such a development of the spirit of militarism and imperialism among the Romans, that they had by now firmly established their predominance over the Eastern Greek world as well. This complete failure can in no way be laid to the charge of Hannibal, who, with unshaken patriotism, until his death employed all the resources of his genius in the unequal struggle; nor would it be fair to impute it to Carthage, whose tenacious resistance was marvellous, having regard to the forces at her command, and was at any rate immensely superior to that of the Hellenic powers, though in many respects the latter were in a much more favourable position. The failure was due to the strength of the Roman people and the Italians so firmly bound to them, to the admirable political-military organization of the Italic confederation, to the almost superhuman spirit of sacrifice exhibited by the Italians during the war, to the strategy of their leaders—the policy of attrition adopted at the beginning by Fabius when it represented

the only possibility of resistance, and the bold offensive policy later adopted by Scipio, who proved himself such a talented pupil of his great adversary as to profit by his own teaching to frustrate his most wonderful tactical inspirations.

Of the great Carthaginian's personality we know but little, and the tradition that has come down to us is often vitiated by the partisan hatred of his adversaries; but all the ancient writers without exception pay homage to his incomparable military genius, and all but a few moderns regard him as one of the greatest warriors of all time. Roman tradition charged him with acts of cruelty, and his memory lived as that of a man "abominated by the fathers" of Italy for the slaughter of their sons. But those of his cruel acts of which there is reliable evidence do not exceed what the customary laws of war in ancient times were cruel enough to permit, and the terrible tragedy of Carthage's struggle for existence affords them an extenuation which is not forthcoming for some of the atrocities committed by the Roman commanders in the second century. Moreover, on more than one occasion he displayed generosity towards a fallen enemy. The "Punic faith" of which the Roman sources accuse him seems to have no more foundation than resides in the military stratagems of which he made free use, and these were certainly far more innocent than the somewhat dishonourable stratagem employed by Scipio Africanus to surprise the camps of Hasdrubal and Syphax. For the rest, Hannibal was a cultured man, acquainted with several languages; he spoke and wrote Greek, and probably had not omitted to study the military science of the Greeks. Many of his sayings are given us by the various sources, and, though not all authentic, taken as a whole they illustrate his rough, frank, soldierly spirit. Little or nothing is known of his private life. We are told that he married a Spanish woman from Castulo, by whom he does not seem to have had any children. The ancient writers, who manage to find more or less well-authenticated scandalous anecdotes about almost all the greatest men of antiquity, laud his morality to the skies, and, much as they hate him, they can find no least speck on his fair fame in this regard. There is only one reference to be found in certain sources to a love affair with a Bruttinn girl, but its authenticity is by no means sure, and it is in any case too vague to arouse curiosity. For the rest, certain charges of avarice found in the ancient sources can easily be explained hy his constant need of large resources for his political and military activities. Even in this matter, however. his prudent administration of the finances of Carthage bears witness to his integrity. Taken for all in all, he proved one of the noblest, as he was one of the most unfortunate, of the great men of action of antiquity.

BIBLIOGRAPHY.—The history of Hannibal was written very shortly afterward by Greeks who were in his camp, such as Sosilus and Silenus. Sosilus, as also another Greek historian of Hannibal, Chaereas, is reprimanded by Polybius (iii., 25) for his "barber's-shop anecdotes"; but a fragment discovered later dealing with the war in Spain (Wilcken, *Hermes,* xli., pp. 103 *sqq.)* does not seem to confirm the condemnation. In addition to these Greek sources, all or nearly all of which are pro-Carthaginian, the ancients had Roman primary sources, chief of which were the *Annales* of Fabius Pictor. Later a full general history of the Second Punic War was composed in Latin by L. Caelius Antipater; it is lost, but, to judge from the fragments, it was of little value. There has come down to us the Greek history of the Second Punic War composed about the middle of the second century B.C. by the Greek historian Polybius of Megalopolis; it is complete as far as the battle of Cannae (lib. iii.), fragmentary thereafter. Polybius combined Carthaginian and Roman sources—in what proportions it is difficult to say, but it is certainly a mistake to suppose that our tradition regarding the Second Punic War is wholly of Roman origin (Dessau, *Hermes,* li., pp. *355 sqq.),* or to try to make a mechanical separation of the Roman and Carthaginian passages in the text of Polybius (Beloch, *Hermes,* 1.). The full story of the Second Punic War has come down to us in the third decade of Livy; and here again, while we have passages of undoubted annalistic origin and others, particularly dealing with the wars in Sicily and the East, that are mere versions of Polybius, regarding the remainder there are strong differences of opinion among the critics. Of the copious bibliography mention need only be made of Wesselbarth's *Historisch-kritische Untersuchungen zur dritten Dekade des Livius,* and for the rest the student may be referred to the historical works cited below. Of the minor sources, apart from those derived from Livy (Florus, Orosius, etc.), we need only mention here Plutarch's lives of Fabius and Marcellus, Appian's *Hannibalica.* and the fragments of Diodorus and Dion Cassius, all of which narrations appear to be based on the vulgate of Polybius, with additions and errors in varying degrees.

The modern Hannibalic bibliography is enormous. On a single episode in his career—the crossing of the Alps--a whole shelf of monographs could be collected. Neglecting entirely the earlier writings and those that deal with too specialized subjects, we may mention in the first place Mommsen's passage on Hannibal and his wars *(Röm. Geschichte,* vol. i., book iii.), and Neumann's *Das Zeitalter der punischen Kriege* (1883). Acute and original, though frequently hypercritical, is U. Kahrstedt, *Geschichte der Karthager von 218–146* (1919; published as vol. iii. of O. Meltzer's *Geschichte der Karthager,* but entirely different in character from the first two volumes). On the military aspect two works are of fundamental importance: Delbriick's *Geschichte der Kriegskunst,* 2nd ed. (1908), book v., and Kromayer's *Antike Schlachtfelder,* iii (1912); in addition, K. Lehmann, *Die Angriffe der drei Barkiden auf Italien* (1905), may be read with profit. An attempt at a comprehensive political and military appreciation of the history of the Second Punic War is made in De Sanctis, *Storia dei Romani* (1917). Lastly, special mention must be made of the *Untersuchungen zur Geschichte des zweiten punischen Krieges* collected by *E.* Meyer in his *Kleine Schriften,* ii. (1924), and his drawings of medallions of Hannibal and Scipio in *Meister der Politik, I.,* 2nd ed. (1923).

(G. DE S.)

HANNIBAL, a city on the Mississippi river, in Marion county, Mo., U.S., 100 mi. N.W. of St. Louis. As the boyhood home of Mark Twain (*q.v.*), the town provided the setting for several of his finest books, including *The Adventures of Tom Sawyer* and *The Adventures of Huckleberry Finn.*

The site, part of old Spanish land grants, was given to Abraham Bird in 1818 as compensation for earthquake damage to his property in New Madrid, Mo. Hannibal's first settler, Moses Bates, arrived in 1819, and in 1845, with a population of about 1,000. it was incorporated as a city. A river landing in the Louisiana Purchase territory. the settlement took its name from the small stream (later Bear creek) flowing through the site, which was named in the classic tradition and mapped by a pioneer Spanish surveyor. The Mark Twain Memorial bridge (1935) spans the Mississippi river, linking Missouri and Illinois. The city lies between two peaks, Lovers' Leap (225 ft.) and Cardiff hill, on which rises the Mark Twain Memorial lighthouse. Beyond is Riverview park (250 ac.) with commanding views of the mile-wide Mississippi. Once an important steamboat port, Hannibal's industries include railroad repair yards; shoe, machinery and drill tools factories; cement and printing plants; food, dairy and building products. The surrounding farm land is devoted to dairying, corn and grain. The Hannibal-La Grange college (Baptist) was moved from La Grange, Mo., to Hannibal in 1929.

Memorials to Mark Twain include: his boyhood home at 208 Hill street. built by his father in 1844; the city-built Mark Twain museum (1937); Judge J. M. Clemens's law office; the Becky Thatcher house; and the house of the Pilasters. The famous Tom Sawyer cave is 2 mi. S. Discovered in 1819 by Jack Simms, a hunter, it is reputed to have been a hiding place of Jesse James, and in slavery days a station on the Underground Railroad (*q.v.*). Jackson's Island. an adventure ground of Tom Sawyer and Huck Finn, lies across the river near the Illinois shore. Mark Twain's two-room cabin birthplace is preserved in the Mark Twain State park at Florida. 25 mi. S.W. of Hannibal. For comparative population figures *see* table in MISSOURI: *Population.* (J. A)

HANNINGTON, JAMES (1847–1885), English missionary, was born at Hurstpierpoint, Sussex, on Sept. 3, 1847, and was educated at St. Mary's Hall, Oxford. He was curate in charge at Hurstpierpoint when his thoughts were turned to mission work by the murder of two missionaries on the shores of Victoria Nyanza. He sailed on May 17, 1882, at the head of a party of six, for Zanzibar, and thence set out for Uganda; but, prostrated by fever and dysentery, he was obliged to return to England in 1883. On his recovery he was consecrated bishop of Eastern Equatorial Africa (June 1884), and in January 1885 started again for the scene of his mission, and visited Palestine on the way. He reached a spot near Victoria Nyanza in safety. His arrival, however, roused the suspicion of the natives, and under King Mwanga's orders he was lodged in a filthy hut swarming with rats and vermin. After eight days his men were murdered, and on Oct. 29, 188j he himself was speared in both sides, his last words to the soldiers appointed to kill him being, "Go, tell Mwanga I

have purchased the road to Uganda with my blood."

His ***Last Journals*** were edited in 1888. ***See*** also ***Life*** by E. C. Dawson (1887); and W. G. Berry, ***Bishop Hannington*** (1908).

HANNINGTON, a shallow lake (7 mi. by 2 mi.) in Kenya colony, south of Lake Baringo, just north of the equator. It lies in the eastern rift-valley, in the shadow of the Laikipia escarpment. It was named after Bishop Hannington; its waters are brackish, its shores having on them remnants of an ancient forest which serve as an eyrie for storks, herons and eagles, while on the flat banks congregate thousands of flamingoes. There are valuable guano deposits.

HANNO, the name of many Carthaginian soldiers and statesmen, the most important of whom are:

1. HANNO, Carthaginian navigator, who flourished c. 500 B.C. He wrote an account of a coasting voyage on the west coast of Africa, undertaken for the purpose of exploration and colonization. The original, inscribed on a tablet in the Phoenician language, was hung up in the temple of Melkarth on his return to Carthage. A supposed Greek translation of this is still extant, under the title of *Periplus*, but its authenticity has been questioned. Hanno appears to have advanced beyond Sierra Leone as far as Cape Palmas.

Valuable editions by T. Falconer (1797, with translation and notes) and C. W. Miiller in ***Geographici Graeci minores,*** i.; ***see*** also ***E. H.*** Bunbury, ***History of Ancient Geography,*** i. and treatise by C. T. Fischer (1893), with bibliography.

2. HANNO (3rd century B C.), called "the Great," Carthaginian statesman and general, leader of the aristocratic party and the chief opponent of Hamilcar and Hannibal. He appears to have gained his title from military successes in Africa, but of these nothing is known. In 240 B.C. he drove Hamilcar's veteran mercenaries to rebellion by withholding their pay, and when invested with the command against them was so unsuccessful that Carthage might have been lost but for the exertions of Hamilcar (*q.v.*). Hanno subsequently remained at Carthage, exerting his influence against the democratic party. During the Second Punic War he advocated peace with Rome, and according tc Livy even advised that Hannibal should be given up to the Romans. After the battle of Zama (202) he was one of the ambassadors sent to Scipio to sue for peace. See also CARTHAGE; HANNIBAL; PUNIC WARS.

HANOI, the capital of the Democratic Republic of Vietnam (see VIETNAM: Partition), lies on the right bank of the Red (Koi) river, 80 mi. from the Gulf of Tonkin. Pop. (1953) 297,900. The town possesses several ancient monuments among which are the pagoda of the Great Buddha, so named because of the great bronze statue, 12 ft. high, that it contains, and the One Column pagoda, which dates from the 11th century. The Temple of Literature, also built in the 11th century, was dedicated to Confucius and 72 sages, and was once the seat of a university. The beautiful Sword lake lies in the centre of the town and the botanical gardens are near the palace of the president of the republic. There are two theatres, the Grand theatre built in 1901, and the open-air People's theatre, built in the 1950s, which has a seating capacity of 15,000. Hanoi has a university, several technical schools, a museum and a large public library. The Red river at Hanoi is spanned by the Long Bien bridge, which is more than a mile in length. Modern highuays extend from Hanoi to Haiphong, to Saigon and to three different points on the Chinese border. The town is also the junction for railway lines to Haiphong, Vinh, Dong Dang and Lao Kay. The Lao Kay and Dong Dang lines are connected with the Chinese lines to Kunming and Peking respectively. The Gia-Lam aerodrome (about 2½ mi. from the town) is one of the biggest in Vietnam. Hanoi has a large power station and a number of factories. Flourishing handicrafts include the making of carved and inlaid objects, bronze and other metalwork, and embroidery. (VN. T.)

HANOTAUX, ALBERT AUGUSTE GABRIEL (1853–1944), French statesman and historian, was born at Beaurevoir, Aisne, on Nov. 19, 1853. He studied at the École des Chartes, and became *maître* de *conférences* in the École des Hautes Études. In 1879 he entered the ministry of foreign affairs as archivist, and rose step by step through the diplomatic service, being appointed councillor of embassy at Constantinople in 1885. In 1886 he was elected Republican deputy for Aisne, but, defeated in 1889, he returned to his diplomatic career. On May 31, 1894 he became foreign minister in the Dupuy cabinet. With one interruption (during the Ribot ministry, Jan. 26–Nov. 2, 1895), he held this portfolio until June 14, 1898. During his ministry he developed the rapprochement of France with Russia, visiting St. Petersburg with the President, Félix Faure, and sent expeditions to delimit the French colonies in Africa. The Fashoda incident of July 1898 was a result of this policy, and Hanotaux's distrust of England is frankly stated in his literary works.

During the World War Hanotaux, who was already known as a distinguished historian, and had been elected to the French Academy on April 1, 1897, was active as propagandist. He was employed on more than one semi-official mission, notably to the Vatican. In 1921 he was the third French delegate to the League of Nations Assembly. He died April 11, 1944.

Hanotaux's works include: ***Origines de Pinstitution des intendants de provinces*** (1884), the authoritative study on the intendants; ***Etudes historiques sur les XVIe et XVIIe siècles en France*** (1886); ***Histoire de Rickelieu*** (2 vols. 1888); ***Histoire de la France contemporaine, 1871–1900*** (4 vols. 1903–8), the standard history of contemporary France; ***Histoire de la Guerre de 1914*** (9 vols. 1914 ff.); ***Le Traité de Versailles*** (1919); ***Histoire de la Nation française*** (15 vols. 1920–4); ***La Bataille de la Marne*** (2 vols. 1923). He also edited the ***Instructions des ambassadeurs de France à Rome, depuis les traités de Westphalie*** (1888).

HANOVER, an administrative district of Lower Saxony, formerly an independent kingdom, Germany, after 1866 a province of Prussia bounded on the north by the North sea, Schleswig-Holstein, Hamburg and Mecklenburg-Schwerin, east and south-east by Prussian Saxony, Brandenburg and Brunswick, southwest by Lippe and the Prussian provinces of Hesse-Nassau and Westphalia, and west by Holland. These boundaries included after 1919 the German *Lands* of Oldenburg and Bremen, the former stretching southward from the North sea nearly to the southern boundary of Hanover. A small part of the province in the south was separated from Hanover proper by the interposition of part of Brunswick. In 1873 the province was increased by the addition of the Jade territory (purchased by Prussia from Oldenburg), southwest of the Elbe, with the naval station and arsenal of Wilhelmshaven.

The area of the former province was 14,983 sq.mi., of the present department, 2,535 sq.mi.

The plain of Hanover is mainly sandhills, heath and moor. On the Elbe and near the North Sea, rich meadows are preserved from encroachment of the sea by dikes and ditches. The so-called *Lüneburger* Heide in the north is an expanse of moor and fen, with oases of beech and oak woods, extending almost due north from the city of Hanover to the southern arm of the Elbe at Harburg. The south part of the province is hilly, rising to the forested Harz mountains. The east part of the northern plain is covered with fir forests. The Elbe forms the north-east boundary and receives the navigable Jeetze, Ilmenau, Lühe, Seve, Este, Schwinge and Medem; the Weser drains the centre, with its tributary the Aller (navigable from Celle downwards); and the Ems, the west, with its tributaries Aa and Leda. Numerous canals connect these river systems. A few small lakes are found here and there in the province.

The climate in the coastal lowlands is moist and foggy, in the plains mild, on the Harz mountains severe and variable. In spring the prevailing winds are easterly, in summer they blow from the south-west. In the town of Hanover the average monthly temperature ranges from 32° F in January to 63° F in July, and the average annual rainfall is about 23.5 in. In the west the Herauch, a thick fog arising from the burning of the moors, is frequent.

The population of the former Prussian province was 5,114,910 in 1950, giving a density of 341 to the sq.mi. The province had been divided into the six *Regierungsbezirke* (or departments) of Hanover, Hildesheim, Luneburg, Stade, Osnabriick and Aurich, and these again into Kreise (circles, or local government districts) —82 in all. The chief towns are Hanover, Osnabruck, Hildesheim, Wesermünde, Wilhelmshaven, Harburg, Liineburg, Celle, Göttingen and Emden. Above 80% of the population are Protestant.

The province has the university of Göttingen, a technical college in Hanover, an academy of forestry in Münden, a mining college in Clausthal, and a veterinary college in Hanover.

The greater part of the soil is of inferior quality, and one-third of the province is uncultivated moor and heath; about half the remainder is arable and the rest pasture and forest. The best agriculture is to be found in the districts of Hildesheim, Calenberg, Gottingen and Grubenhagen, on the banks of the Weser and Elbe, and in East Friesland. Rye is widely grown for bread. Flax is extensively cultivated and exported, chiefly in the form of yarn. Potatoes, hemp, turnips, hops, tobacco and beets are also grown, the latter in connection with the sugar industry. Apples, pears, plums and cherries are the principal fruits cultivated, while the wild red cranberries from the Harz and the black bilberries from the Luneburger Heide form an important article of export.

Hanover is renowned for its cattle and live stock. The Lüneburger Heide yields excellent sheep, while horses are reared in Aurich and Stade, in Hildesheim, Hanover and in Celle. Bees are principally kept on the Luneburger Heide, and the yield of honey is considerable. Large flocks of geese are kept in the moist lowlands. The rivers yield trout, salmon (in the Weser) and crayfish. The sea fisheries are important and have their chief centre at Wesermiinde.

The Harz mountains are rich in silver, lead, iron and copper; coal is found around Osnabruck, on the Deister, at Osterwald, etc., lignite in various places; salt-springs exist at Egestorfshall and Neuhall near Hanover, and at Luneburg; and petroleum is obtained south of Celle. In the northern lowlands peat occurs. Low-grade iron ore is extensively mined at Salzgitter.

Works for the manufacture of iron, copper, silver, lead, vitriol and sulphur are carried on. The iron works are important: smelting is carried on in the Harz and near Osnabruck; there are extensive foundries and machine factories at Hanover, Linden, Osnabruck, Hameln, Wesermunde, Harburg, Osterode, etc., and manufactories of cutlery in the towns of the Harz and in the Sollinger Forest. Linen yarn and cloth are largely manufactured, and bleaching is engaged in extensively; woollen cloths are made in the south about Einbeck, Gottingen and Hameln; cotton-spinning and weaving have their seats at Hanover and Linden. Glass houses, paper-mills, potteries, tile works and tobacco-pipe works are numerous. There are numerous tobacco factories, tanneries, breweries, vinegar works and brandy distilleries. Shipbuilding is an important industry, especially at Wilhelmshaven, Papenburg, Leer, Stade and Harburg; and at Munden river-barges are built.

The carrying trade of Hanover is largely absorbed by Hamburg and Bremen, while the Weser forms the chief commercial artery of the province. The province has good roads connecting the chief towns and is intersected by trunk lines of railway; notably the lines from Berlin to Cologne, from Hamburg to Frankfort-on-Main, from Hamburg to Bremen and Cologne, and from Berlin to Amsterdam.

HISTORY

The name Hanover (*Hohenufer*=high bank), originally confined to the town which became the capital of the duchy of Liineburg-Calenberg, came gradually into use to designate, first, the duchy itself, and secondly, the electorate of Brunswick-Lüneburg; and it was officially recognized as the name of the state when in 1814 the electorate was raised to the rank of a kingdom.

The early history of Hanover is merged in that of the duchy of Brunswick (*q.v.*), from which the duchy of Brunswick-Luneburg and its offshoots, the duchies of Luneburg-Celle and Lüneburg-Calenberg, have sprung. In 1692, in return for lavish promises of assistance to the empire and the Habsburgs, the emperor granted Duke Ernest Augustus of Calenberg the rank and title of elector of Brunswick-Luneburg with the office of standard bearer in the Holy Roman empire. Indignant protests followed, but in 1708 George Louis, the son and successor of Ernest Augustus, was recognized as an elector by the imperial diet. Through his mother, the elector George Louis became, by the terms of the Act of Settlement of 1701, king of Great Britain and Ireland in 1714.

Under British Sovereignty. — From this time until the death of William IV. in 1837, Luneburg or Hanover, was ruled by the same sovereign as Great Britain. Both George I. and George II. preferred Hanover to England as a place of residence, and it was a frequent and perhaps justifiable cause of complaint that the interests of Great Britain were sacrificed to those of the smaller country. But George III. was more British than either his grandfather or his great-grandfather, and owing to a variety of causes the foreign policies of the two countries began to diverge in the later years of his reign. During the Napoleonic wars Hanover was occupied by Prussia in 1805, but after the battle of Jena (1807) became part of the kingdom of Westphalia. The northern portion was added to France in 1810. The elector was granted the title of king by the Vienna Congress, which restored the independence of Hanover. On the conclusion of peace in 1814 the estates of the several provinces of the kingdom were fused into one body, consisting of 85 members, but the chief power was exercised as before by the members of a few noble families. In 1819, however, this feudal relic was supplanted by a new constitution. Two chambers were established, the one formed of nobles and the other of elected representatives; but although they were authorized to control the finances, their power with regard to legislation was very circumscribed. This constitution was sanctioned by the prince regent, afterwards King George IV.; but it was out of harmony with the new and liberal ideas which prevailed in Europe, and it hardly survived George's decease in 1830. The revolution of that year compelled George's brother and successor, William, to dismiss Count Munster, who had been the actual ruler of the country, and to name his own brother, Adolphus Frederick, duke of Cambridge, a viceroy of Hanover, one of the viceroy's earliest duties being to appoint a commission to draw up a new constitution. This was done, and after William had insisted upon certain alterations, it was accepted and promulgated in 1833. Representation was granted to the peasants; the two chambers were empowered to initiate legislation; ministers were made responsible for all acts of government; a civil list was given to the king in return for the surrender of the Crown lands; and, in short, the new constitution was similar to that of Great Britain.

King Ernest Augustus. — By the law of Hanover a woman could not ascend the throne, and accordingly Ernest Augustus, duke of Cumberland, the fifth son of George III., and not Victoria, succeeded William as sovereign in 1837, thus separating the crowns of Great Britain and Hanover after a union of 123 years. Ernest, a prince with very autocratic ideas, had disapproved of the constitution of 1833, and his first important act as king was to declare it invalid. He appears to have been especially chagrined because the Crown lands were not his personal property, but the new arrangements were quite repugnant to him. Seven Göttingen professors who protested against this proceeding were deprived of their chairs; and some of them, including F. C. Dahlmann and Jakob Grimm, were banished from the country for publishing their protest. To save the constitution an appeal was made to the German Confederation, which Hanover had joined in 1815; but the federal diet declined to interfere, and in 1840 Ernest altered the constitution to suit his own illiberal views. Recovering the Crown lands, he abolished the principle of ministerial responsibility, the legislative power of the two chambers, and other reforms, virtually restoring affairs to their condition before 1833. The inevitable crisis was delayed until the stormy year 1848, when the king probably saved his crown by hastily giving back the constitution of 1833. Order, however, having been restored in 1850 he dismissed the Liberal ministry and attempted to evade his concessions; a bitter struggle had just broken out when Ernest Augustus died in Nov. 1851. During this reign the foreign policy of Hanover both within and without Germany had been coloured by jealousy of Prussia and by the king's autocratic ideas. Refusing to join the Prussian Zollverein, Hanover had become a member of the rival commercial union, the Steuerverein, three years before Ernest's accession; but as this union was not a great success the Zollverein was joined in 1851. In 1849, after the

failure of the German parliament at Frankfort, the king had joined with the sovereigns of Prussia and Saxony to form the "three kings' alliance"; but this union with Prussia was unreal, and with the king of Saxony he soon transferred his support to Austria and became a member of the "four kings' alliance."

Annexation to **Prussia.**—George V., the new king of Hanover, who was unfortunately blind, sharing his father's political ideas, at once appointed a ministry whose aim was to sweep away the constitution of 1848. This project, however, was resisted by the second chamber of the *Landtag*, or parliament; and after several changes of government a new ministry advised the king in 1855 to appeal to the diet of the German Confederation. This was done, and the diet declared the constitution of 1848 to be invalid. Acting on this verdict, not only was a ministry formed to restore the constitution of 1840, but after some trouble a body of members fully in sympathy with this object was returned to parliament in 1857. But these members were so far from representing the opinions of the people that popular resentment compelled George to dismiss his advisers in 1862, and the more liberal government which succeeded did not enjoy his complete confidence. In 1865 a ministry was once more formed which was more in accord with his own ideas. This contest soon lost both interest and importance owing to the condition of affairs in Germany. Bismarck, the director of the policy of Prussia, was devising methods for the realization of his schemes, and it became clear after the war over the duchies of Schleswig and Holstein that the smaller German states would soon be obliged to decide definitely between Austria and Prussia. After a period of vacillation Hanover threw in its lot with Austria, the decisive step being taken when the question of the mobilization of the federal army was voted upon in the diet on June 14, 1866. At once Prussia requested Hanover to remain unarmed and neutral during the war, and with equal promptness King George refused to assent to these demands. Prussian troops then crossed his frontier and took possession of his capital. The Hanoverians, however, were victorious at the battle of Langensalza on June 27, 1866, but the advance of fresh bodies of the enemy compelled them to capitulate two days later. By the terms of this surrender the king was not to reside in Hanover, his officers were to take no further part in the war, and his ammunition and stores became the property of Prussia. The decree of Sept. 20, 1866, formally annexed Hanover to Prussia.

HANOVER, capital of the *Land* of Lower Saxony, in a sandy, fertile plain on the Leine, which there receives the Ihme. Pop. (1950) 444,296. Hanover is first mentioned in the 12th century, when it belonged to the Welf family, later dukes of Brunswick. It joined the Hanseatic League, and was later the residence of the electors of Hanover. In 1866 it was annexed by Prussia, after having been the capital of the kingdom of Hanover since its foundation in 1815. The Leine flows through the city. having the old town, with narrow streets and old-fashioned gabled houses, on its right. In its centre lies the Markt Kirche, a red-brick edifice of the 14th century, with its interior restored in 1855, and containing fine stained-glass windows. On the market square is the red-brick medieval town hall (Rathaus), containing the civic archives and museum. The new town surrounds the old on the north and east. Among the other churches are the Neustadterkirche, with a shrine containing the tomb of Leibnitz; the Kreuzkirche, built about 1300, with a curious steeple; and the Aegidienkirche. Of secular buildings the most remarkable is the royal palace—Schloss—built 1636–40. In its chapel are preserved the relics of saints which Henry the Lion brought from Palestine. Its museums have important art collections. The Welfenschloss has been occupied since 1875 by the technical high school, an academy with university privileges. Close to it lies Herrenhausen, the summer palace of the former kings of Hanover, with fine gardens, an open-air theatre, a museum and an orangery.

Almost all industries are represented; chief among them are machine-building, the manufacture of indiarubber, cotton, cork, hardware, chemicals, cocoa, asphalt, tobacco. pianos, furniture and groceries. The commerce consists principally in wine, hides, horses, coal, wood and cereals. There are extensive printing establishments. It is the birthplace of Sir William Herschel, the astronomer, and the philosopher Leibnitz died there in 1716.

HANOVER, a village in Grafton county, west New Hampshire, U.S., is located on the east bank of the Connecticut river 5 mi. N. of White River Junction, Vt. The village precinct of Hanover was organized in 1885 by state legislative action as a subdivision of the "town" of Hanover (chartered 1761). Since the village's first settlement in 1770 it has existed primarily as the seat of Dartmouth college. The college was an outgrowth of Moor's Indian Charity school organized in the 1750s by the Rev. Eleazar Wheelock in Lebanon (now Columbia), Conn. It was chartered as a college in 1769 under authority of George III, taking the name of the 2nd earl of Dartmouth, president of the trustees of English funds, and located on Hanover plain in 1770.

The college is a men's liberal arts institution with an undergraduate enrollment of approximately 3,000. It has three associated professional graduate schools: the Dartmouth medical school (1797); the Thayer school of engineering (1871); and the Amos Tuck school of business administration (1900). Baker library contains more than 800,000 volumes, and while it functions mainly for undergraduates, visiting scholars make it their headquarters for research every summer. A notable holding is the extensive Vilhjalmur Stefansson collection of Arctic material. the chief American collection in this field. On the walls of the reading rooms are 3,000 sq.ft. of frescoes, "An Epic of American Civilization," a series of panels by the Mexican artist José Clemente Orozco. Located in the foothills of the White mountains, Dartmouth is nationally known for its pioneering in skiing and other winter sports and has attained fame as an "outdoor college."

Connected with the Mary Hitchcock Memorial hospital, the largest medical installation in northern New England, are the Hitchcock clinic with about 150 resident medical and surgical specialists, the Hitchcock foundation, a research organization, and the Dartmouth medical school. The village is primarily residential. For comparative population figures *see* table in NEW HAMPSHIRE: *Population.*

See Leon *B.* Richardson, *History of Dartmouth College (1932).*

(W. H. McCR.)

HANRIOT, FRANÇOIS (1761–1794). French revolutionist, was born at Nanterre (Seine) of poor parentage. He became one of the orators of the sans-culottes, and commanded the armed force of that section during the insurrection on Aug. 10, 1792, and the massacres of September. He was appointed by the Commune to the command of the armed forces of Paris on May 30–31, from June 2 to June 11, and again after the failure of his impeachment in the Convention, from July 1 until the revolution of the 9th Thermidor (July 27, 1794). He was then arrested, after a vain attempt to rescue Robespierre, and was guillotined with Robespierre and his friends on the 10th Thermidor of the year II (July 28, 1794).

HANSARD, LUKE (1752–1828), English printer, was born in St. Mary's parish, Norwich, educated at Boston grammar school, and apprenticed to Stephen White. a Norwich printer. As soon as his apprenticeship had expired Hansard started for London with only a guinea in his pocket and became a compositor in the office of John Hughs (1703–71), printer to the House of Commons. In 1774 he was made a partner, and in 1800 the business went completely into his hands. He printed the *Journals of the House of Commons* from 1774 until his death. The promptitude and accuracy with which he printed parliamentary papers were often of the greatest service to the government—notably on one occasion when the proof sheets of the report of the secret committee on the French Revolution were submitted to Pitt 24 hours after the draft had left his hands. He devised numerous expedients for reducing the expense of publishing the reports; and in 1805, when his workmen struck at a time of great pressure, he and his sons themselves set to work as compositors. Luke Hansard died on Oct. 29, 1828.

His son, THOMAS CURSON HANSARD (1776–1833), established a press of his own in Paternoster row, and began in 1803 to print the *Parliamentary Debates,* which were not at first independent reports, but were taken from the newspapers. After 1889

the debates were published by the Hansard Publishing Union, Ltd. The original business remained in the hands of his younger brothers, James and Luke Graves Hansard (1777–1851). The firm was prosecuted in 1837 by John Joseph Stockwell for printing by order of the House of Commons, in an official report of the inspector of prisons, statements regarded by the plaintiff as libellous. Hansard sheltered himself on the ground of privilege, but it was not until after much litigation that the security of the printers of government reports was guaranteed by statute in 1840.

HANSARD is the name given to the official report of the debates of both houses of the British parliament. It is so called after T. C. Hansard (1776–1833), the first printer. and later publisher, of the unofficial series of parliamentary debates inaugurated by William Cobbett in 1803. The series known as the fifth, dating from 1909, when the report first became both official and verbatim, comprised more than 200 vol. for the lords and over 600 for the commons by the end of the 1950s. The daily parts, of which these volumes are composed, are produced in the lords by an editor, assistant editor and six reporters and in the commons by an editor. assistant editor, 2 subeditors and 18 reporters. The complete report of the lords debate is generally in print by first post the following morning. The commons report, as published by that time, always covers the debate up to approximately 10:30 P.M. the previous evening but, should the house have sat later. the report of the subsequent proceedings precedes the report of the following day. The reports of both houses are printed, and sold to the public, by the stationery office, which also issues a Weekly Hansard consisting of several daily parts. Printing is expressly sanctioned by both houses, for either, if it so desired, could uithhold its proceedings from the public. (E. *C.* TN.)

HANSEATIC LEAGUE. It is impossible to assign any precise date for the beginning of the Hanseatic League or to name any single factor which explains the origin of that loose but effective federation of north German towns. Associated action and partial union among these towns can be traced back to the 13th century. In 1241 we find Lubeck and Hamburg agreeing to safeguard the important road connecting the Baltic and the North sea. The first known meeting of the "maritime towns," later known as the Wendish group and including Lubeck, Hamburg, Luneburg, Wismar, Rostock and Stralsund, took place in 1256. The Saxon towns, during the following century, were joining to protect their common interests, and indeed at this period town confederacies in Germany, both north and south, were so considerable as to call for declaration against them in the Golden Bull of 1356. The decline of the imperial power and the growing opposition between the towns and the territorial princes justified these defensive town alliances, which in south Germany took on a peculiarly political character. The relative weakness of territorial power in the north, after the fall of Henry the Lion of Saxony, diminished without however removing this motive for union, but the comparative immunity from princely aggression on land left the towns more free to combine in a stronger and more permanent union for the defence of their commerce by sea and for the control of the Baltic.

While the political element in the development of the Hanseatic League must not be underestimated, it was not so formative as the economic. The foundation was laid for the growth of German towns along the southern shore of the Baltic by the great movement of German colonization of Slavic territory east of the Elbe. This movement, extending in time from about the middle of the 11th to the middle of the 13th century and carrying a stream of settlers and traders from the north-west, resulted not only in the Germanization of a wide territory but in the extension of German influence along the sea-coast far to the east of actual territorial settlement. The German trading towns, at the mouths of the numerous streams which drain the north European plain, were stimulated or created by the unifying impulse of a common and long-continued advance of conquest and colonization.

The impetus of this remarkable movement of expansion not only carried German trade to the east and north within the Baltic basin, but reanimated the older trade from the lower Rhine region to Flanders and England in the west. Cologne and the Westphalian towns, the most important of which were Dortmund, Soest and Munster, had long controlled this commerce but now began to feel the competition of the active traders of the Baltic, opening up that direct communication by sea from the Baltic to western Europe which became the essential feature in the history of the League. The necessity of seeking protection from the sea-rovers and pirates who infested these waters during the whole period of Hanseatic supremacy, the legal customs, substantially alike in the towns of north Germany, which governed the groups of traders in the outlying trading posts, the establishment of common factories, or "counters" (Komtors) at these points, with aldermen to administer justice and to secure trading privileges for the community of German merchants — such were some of the unifying influences which preceded the gradual formation of the League. In the century of energetic commercial development before 1350 the German merchants abroad led the way.

The **Gothland** Association. — Germans were early pushing as permanent settlers into the Scandinavian towns, and in Wisby, on the island of Gothland, the Scandinavian centre of Baltic trade, equal rights as citizens in the town government were possessed by the German settlers as early as the beginning of the 13th century. There also came into existence at Wisby the first association of German traders abroad, which united the merchants of over 30 towns, from Cologne and Utrecht in the west to Reval in the east. We find the Gothland association making in 1229 a treaty with a Russian prince and securing privileges for their branch trading station at Novgorod. According to the "Skra," the by-laws of the Novgorod branch, the four aldermen of the community of Germans, who among other duties held the keys of the common chest, deposited in Wisby, were to be chosen from the merchants of the Gothland association and of the towns of Lubeck, Soest and Dortmund. The Gothland association received in 1237 trading rights in England, and shortly after the middle of the century it also secured privileges in Flanders. It legislated on matters relating to common trade interests, and, in the case of the regulation of 1287 concerning shipwrecked goods, we find it imposing this legislation on the towns under the penalty of exclusion from the association. But with the extension of the east and west trade beyond the confines of the Baltic, this association by the end of the century was losing its position of leadership. Its inheritance passed to the gradually forming union of towns, chiefly those known as Wendish, which looked to Lubeck as their head. In 1293 the Saxon and Wendish merchants at Rostock decided that all appeals from Novgorod be taken to Lubeck instead of to Wisby, and six years later the Wendish and Westphalian towns, meeting at Lubeck, ordered that the Gothland association should no longer use a common seal. Though Lubeck's right as court of appeal from the Hanseatic counter at Novgorod was not recognized by the general assembly of the League until 1373, the long-existing practice had simply accorded with the actual shifting of commercial power. The union of merchants abroad was beginning to come under the control of the partial union of towns at home.

A similar and contemporary extension of the influence of the Baltic traders under Lübeck's leadership may be witnessed in the west. As a consequence of the close commercial relations early existing between England and the Rhenish-Westphalian towns, the merchants of Cologne were the first to possess a gild-hall in London and to form a "hansa" with the right of admitting other German merchants on payment of a fee. The charter of 1226, however, by which Emperor Frederick II. created Lubeck a free imperial city, expressly declared that Lubeck citizens trading in England should be free from the dues imposed by the merchants of Cologne and should enjoy equal rights and privileges. In 1266 and 1267 the merchants of Hamburg and Lubeck received from Henry III. the right to establish their own hansas in London, like that of Cologne. The situation thus created led by 1282 to the coalescence of the rival associations in the "Gild-hall of the Germans," but though the Baltic traders had secured a recognized foothold in the enlarged and unified organization, Cologne retained the controlling interest in the London settlement until 1476. Lubeck and Hamburg, however, dominated the German trade in the ports of the east coast, notably in Lynn and Boston,

while they were strong in the organized trading settlements at York, Hull, Ipswich, Norwich, Yarmouth and Bristol. The counter at London, first called the Steelyard in a parliamentary petition of 1422, claimed jurisdiction over the other factories in England.

The Counter of **Bruges.**—In Flanders, also, the German merchants from the west had long been trading, but here had later to endure not only the rivalry but the pre-eminence of those from the east. In 1252 the first treaty privileges for German trade in Flanders show two men of Lubeck and Hamburg heading the "Merchants of the Roman Empire," and in the later organization of the counter at Bruges four or five of the six aldermen were chosen from towns east of the Elbe, with Lubeck steadily predominant. The Germans recognized the staple rights of Bruges for a number of commodities, such as wool, wax, furs, copper and grain, and in return for this material contribution to the growing commercial importance of the town, they received in 1309 freedom from the compulsory brokerage which Bruges imposed on foreign merchants. The importance and independence of the German trading settlements abroad were exemplified in the statutes of the "Company of German merchants at Bruges," drawn up in 1347, where for the first time appears the grouping of towns in three sections (the "Drittel"), the Wendish-Saxon, the Prussian-Westphalian and those of Gothland and Livland. Even more important than the assistance which the concentration of the German trade at Bruges gave to that leading mart of European commerce was the service rendered by the German counter of Bruges to the cause of Hanseatic unity. Not merely because of its central commercial position, but because of its width of view, its political insight and its constant insistence on the necessity of union, this counter played a leading part in Hanseatic policy. It was more Hanse than the Hanse towns.

The last of the chief trading settlements, both in importance and in date of organization. was that at Bergen in Norway, where in 1343 the Hanseatics obtained special trade privileges. Scandinavia had early been sought for its copper and iron, its forest products and its valuable fisheries, especially of herring at Schonen, but it was backward in its industrial development and its own commerce had seriously declined in the 14th century. It had come to depend largely upon the Germans for the importation of all its luxuries and of many of its necessities, as well as for the exportation of its products, but regular trade with the three kingdoms was confined for the most part to the Wendish towns, with Lubeck steadily asserting an exclusive ascendancy. The fishing centre at Schonen was important as a market, though, like Novgorod, its trade was seasonal, but it did not acquire the position of a regularly organized counter, reserved alone, in the north, for Bergen. The commercial relations with the north cannot be regarded as an important element in the union of the Kanse towns, but the geographical position of the Scandinavian countries, especially that of Denmark, commanding the Sound which gives access to the Baltic, compelled a close attention to Scandinavian politics on the part of Lubeck and the League and thus by necessitating combined political action in defence of Hanseatic sea-power exercised a unifying influence.

Energetic and successful though the scattered trading settlements had been in establishing German trade connections and in securing valuable trade privileges, the middle of the 14th century found them powerless to meet difficulties arising from internal dissension and still more from the political rivalries and trade jealousies of nascent nationalities. Flanders became a battle-field in the great struggle between France and England, and the war of trade prohibitions led to infractions of the German privileges in Bruges. An embargo on trade with Flanders, voted in 1358 by a general assembly, resulted by 1360 in the full restoration of German privileges in Flanders, but reduced the counter at Bruges to an executive organ of a united town policy. It is worth noting that in a document connected with this action the union of towns, borrowing the term from English usage, was first called the "German Hansa." In 1361 representatives from Lubeck and Wisby visited Novgorod to recodify the by-laws of the counter and to admonish it that new statutes required the consent of Lubeck, Wisby, Riga, Dorpat and Reval. This action was confirmed in 1366 by an assembly of the Hansa which at the same time, on the occasion of a regulation made by the Bruges counter and of statutes drawn up by the young Bergen counter, ordered that in future the approval of the towns must be obtained for all new regulations.

Hanseatics in England. — The counter at London was soon forced to follow the example of the other counters at Bruges, Novgorod and Bergen. After the failure of the Italians, the Hanseatics remained the strongest group of alien merchants in England, and, as such, claimed the exclusive enjoyment of the privileges granted by the *Carta Mercatoria* of 1303. Their highly favoured position in England, contrasting markedly with their refusal of trade facilities to the English in some of the Baltic towns and their evident policy of monopoly in the Baltic trade, incensed the English mercantile classes, and doubtless influenced the increases in customs duties which were regarded by the Germans as contrary to their treaty rights. Unsuccessful in obtaining redress from the English Government, the German merchants finally, in 1374, appealed for aid to the home towns, especially to Lubeck. The result of Hanseatic representations was the confirmation by Richard II. in 1377 of all their privileges, which accorded them the preferential treatment they had claimed and became the foundation of the Hanseatic position in England.

In the meanwhile, the conquest of Wisby by Waldemar IV. of Denmark in 1361 had disclosed his ambition for the political control of the Baltic. He was promptly opposed by an alliance of Hanse towns, led by Lubeck. The defeat of the Germans at Helsingborg only called into being the stronger town and territorial alliance of 1367, known as the Cologne Confederation, and its final victory, with the peace of Stralsund in 1370, which gave for a limited period the four chief castles on the Sound into the hands of the Hanseatic towns, greatly enhanced the prestige of the League.

The assertion of Hanseatic influence in the two decades, 1356 to 1377, marks the zenith of the League's power and the completion of the long process of unification. Under the pressure of commercial and political necessity, authority was definitely transferred from the Hansas of merchants abroad to the Hansa of towns at home, and the sense of unity had become such that in 1380 a Lubeck official could declare that "whatever touches one town touches all." But even at the time when union was most important, this statement went further than the facts would warrant, and in the course of the following century it became less and less true.. Dortmund held aloof from the Cologne Confederation on the ground that it had no concern in Scandinavian politics. It became, indeed, increasingly difficult to obtain the support of the inland towns for a policy of sea-power in the Baltic. Cologne sent no representatives to the regular Hanseatic assemblies until 1383, and during the 15th century its independence was frequently manifested. It rebelled at the authority of the counter at Bruges, and at the time of the war with England (1469–74) openly defied the League. In the east, the German Order, while enjoying Hanseatic privileges, frequently opposed the policy of the League abroad, and was only prevented by domestic troubles and its Hinterland enemies from playing its own hand in the Baltic. After the fall of the order in 1467, the towns of Prussia and Livland, especially Danzig and Riga, pursued an exclusive trade policy even against their Hanseatic confederates. Lubeck, however, supported by the Bruges counter, despite the disaffection and jealousy on all sides hampering and sometimes thwarting its efforts, stood steadfastly for union and the necessity of obedience to the decrees of the assemblies. Its headship of the League, hitherto tacitly accepted, was definitely recognized in 1418.

The League Assembly. — The governing body of the Hansa was the assembly of town representatives, the "Hansetage," held irregularly as occasion required at the summons of Liibeck, and, with few exceptions, attended but scantily. The delegates were bound by instructions from their towns and had to report home the decisions of the assembly for acceptance or rejection. In 1469 the League declared that the English use of the terms "societas," "collegium" and "universitas" was inappropriate to so loose an organization. It preferred to call itself a "firma con-

federatio" for trade purposes only. It had no common seal, though that of Liibeck was accepted, particularly by foreigners, on behalf of the League. Disputes between the confederate towns were brought for adjudication before the general assembly, but the League had no recognized federal judiciary. Lubeck, with the counters abroad, watched over the execution of the measures voted by the assembly, but there was no regular administrative organization. Money for common purposes was raised from time to time, as necessity demanded, by the imposition on Hanse merchandise of poundage dues, introduced in 1361, while the counters relied upon a small levy of like nature and upon fines to meet current needs. Even this slender financial provision met with opposition. The German Order in 1398 converted the Hanseatic poundage to a territorial tax for its own purposes, and one of the chief causes for Cologne's disaffection a half-century. later was the extension from Flanders to other parts of the Netherlands of the levy made by the counter at Bruges. Since the authority of the League rested primarily on the moral support of its members, allied in common trade interests and acquiescing in the able leadership of Lubeck, its only means of compulsion was the "Verhansung," or exclusion of a recalcitrant town from the benefits of the trade privileges of the League. A conspicuous instance was the exclusion of Cologne from 1471 until its obedience in 1476, but the penalty had been earlier imposed, as in the case of Brunswick, on towns which overthrew their patrician Governments. It was obviously, however, a measure to be used only in the last resort and with extreme reluctance.

The decisive factor in determining membership in the League was the historical right of the citizens of a town to participate in Hanseatic privileges abroad. At first the merchant Hansas had shared these privileges with almost any German merchant, and thus many little villages, notably those in Westphalia, ultimately claimed membership. Later, under the Hansa of the towns, the struggle for the maintenance of a coveted position abroad led to a more exclusive policy. A few new members were admitted, mainly from the westernmost sphere of Hanseatic influence, but membership was refused to some important applicants. In 1447 it was voted that admission be granted only by unanimous consent. No complete list of members was ever drawn up, despite frequent requests from foreign powers. Contemporaries usually spoke of 70, 72, 73 or 77 members, and perhaps the list is complete with Daenell's recent count of 72, but the obscurity on so vital a point is significant of the amorphous character of the organization.

The towns of the League, stretching from Thorn and Krakow on the east to the towns of the Zuider Zee on the west, and from Wisby and Reval in the north to Gottingen in the south, were arranged in groups, following in the main the territorial divisions. Separate assemblies were held in the groups for the discussion both of local and Hanseatic affairs, and gradually, but not fully until the 16th century, the groups became recognized as the lowest stage of Hanse organization. The further grouping into "Thirds," later "Quarters," under head-towns, was also more emphasized in that century.

Decline **of** the League.—In the 15th century the League, with increasing difficulty, held a defensive position against the competition of strong rivals and new trade-routes. In England the inevitable conflict of interests between the new mercantile power, growing conscious of its national strength, and the old, standing insistent on the letter of its privileges, was postponed by the factional discord out of which the Hansa in 1474 dexterously snatched a renewal of its rights. Under Elizabeth, however, the English Merchant Adventures could finally rejoice at the withdrawal of privileges from the Hanseatics and their concession to England, in return for the retention of the Steelyard, of a factory in Hamburg. In the Netherlands the Hanseatics clung to their position in Bruges until 1540, while trade was migrating to the ports of Antwerp and Amsterdam. By the peace of Copenhagen in 1441, after the unsuccessful war of the League with Holland, the attempted monopoly of the Baltic was broken, and, though the Hanseatic trade regulations were maintained on paper, the Dutch with their larger ships increased their hold on the herring fisheries, the French salt trade and the Baltic grain trade. For the Russian trade new competitors were emerging in southern Germany. The Hanseatic embargo against Bruges from 1451 to 1457, its later war and embargo against England, the Turkish advance closing the Italian Black sea trade with southern Russia, all were utilized by Nuremberg and its fellows to secure a land-trade outside the sphere of Hanseatic influence. The fairs of Leipzig and Frankfurt-on-Main rose in importance as Novgorod, the stronghold of Hanse trade in the east, was weakened by the attacks of Ivan III. The closing of the Novgorod counter in 1494 was due not only to the development of the Russian State but to the exclusive Hanseatic policy which had stimulated the opening of competing trade routes.

Within the League itself increasing restiveness was shown under the restrictions of its trade policy. At the Hanseatic assembly of 1469, Danzig, Hamburg and Breslau opposed the maintenance of a compulsory staple at Bruges in the face of the new conditions produced by a widening commerce and more advantageous markets. Complaint was made of south German competition in the Netherlands. "Those in the Hansa," protested Breslau, "are fettered and must decline and those outside the Hansa are free and prosper." By 1477 ,even Lubeck had become convinced that a continuance of the effort to maintain the compulsory staple against Holland was futile and should be abandoned. But while it was found impossible to enforce the staple or to close the Sound against the Dutch, other features of the monopolistic system of trade regulations were still upheld. It was forbidden to admit an outsider to partnership or to co-ownership of ships, to trade in non-Hanseatic goods, to buy or sell on credit in a foreign mart or to enter into contracts for future delivery. The trade of foreigners outside the gates of Hanse towns or with others than Hanseatics was forbidden in 1417, and in the eastern towns the retail trade of strangers was strictly limited. The whole system was designed to suppress the competition of outsiders, but the divergent interests of individuals and towns, the pressure of competition and changing commercial conditions, in part the reactionary character of the legislation, made enforcement difficult. The measures were those of the late-mediaeval town economy applied to the wide region of the German Baltic trade, but not supported, as was the analogous mercantilist system, by a strong central government.

Among the factors, economic, geographic, political and social, which combined to bring about the decline of the Hanseatic League, none was probably more influential than the absence of a German political power comparable in unity and energy with those of France and England, which could quell particularism at home, and abroad maintain in its vigour the trade which these towns had developed and defended with their imperfect union. Nothing was to be expected from the declining empire. Still less was any co-operation possible between the towns and the territorial princes. The fatal result of conflict between town autonomy and territorial power had been taught in Flanders. The Hanseatics regarded the princes with a growing and exaggerated fear and found some relief in the formation in 1418 of a thrice-renewed alliance, known as the "Tohopesate," against princely aggression. But no territorial power had as yet arisen in north Germany capable of subjugating and utilizing the towns, though it could detach the inland towns from the League. The last wars of the League with the Scandinavian powers in the 16th century, which left it shorn of many of its privileges and of any pretension to control of the Baltic basin eliminated it as a factor in the later struggle of the Thirty Years' War for that control. At an assembly of 1629, Liibeck, Bremen and Hamburg were entrusted with the task of safeguarding the general welfare, and after an effort to revive the League in the last general assembly of 1669, these three towns were left alone to preserve the name and small inheritance of the Hansa which in Germany's disunion had upheld the honour of her commerce. Under their protection, the three remaining counters lingered on until their buildings were sold at Bergen in 1775, at London in 1852 and at Antwerp in 1863.

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HANSEN, EMIL CHRISTIAN (1842–1909), Danish botanist, whose pure-culture studies on yeasts revolutionized the brewing industry, was born on May 8, 1842, at Ribe, Jutland. He studied art at Copenhagen but in 1871 turned to science. From 1879 he was head of the physiological department of the Carlsberg institute. Hansen's researches were concerned chiefly with fungi and alcoholic fermenting yeasts. He perfected the methods of culture and isolation begun by Pasteur. He devised a method of sowing cultures with a single cell and so isolating one species from another. He defined with precision the morphological and physiological characters of different species and crowned his work by devising a system of classification which is still universally used. The yeast grown from single cells was largely adopted in the bottom-fermentation breweries of the continent. Hansen died at Copenhagen on Aug. 27,1909,

He wrote *Untersuchungen aus der Praxis der Gärungsindustrie,* 2 vol., 3rd ed. (1892–95; Eng. trans., 1896) and *Gesammelte theoretische Abhandlungen über Gärungsorganismen* (1911).

See BREWING: *Fermentation.*

HANSEN, PETER ANDREAS (1795–1874), Danish astronomer, whose most important work was for the specific purpose of improving the theories and tables of the motion of the principal bodies in the solar system, was born on Dec. 8, 1795, at Tondern, in the duchy of Schleswig. He learned the trade of a watchmaker but in 1820 went to Copenhagen, where he won the patronage of H. C. Schumacher. He acted as Schumacher's assistant in work connected with the Danish survey, chiefly at the new observatory of Altona, 1821–25. He then went to Gotha as director of the Seeberg observatory, where he worked until his death there on March 28, 1874.

Hansen had great practical talents but the observatory was poorly equipped and it was not until 1857 that a new observatory was built for him. In the meantime he had made investigations into the theory of instruments and devised improvements in their construction and use. He also worked on theoretical geodesy, on optics and on the theory of probability. A paper on the mutual perturbations of Jupiter and Saturn won for him a prize of the Berlin academy in 1830. His two most important works on the theory of the motion of the moon are the *Fundamenta* (1838) and the *Darlegung* (1862–64). The tables based on his theory were printed in Great Britain in 1857 at the expense of the British government, the author receiving a gratuity of £1,000. These tables were used for the *Nautical Almanac.* A few errors had been corrected, but as the difference between theory and observation continued to grow, empirical terms calculated by S. Newcomb were introduced to bridge the gap. These terms had no theoretical foundation and it was later recognized that the discordances are largely due to irregular fluctuations in the rate of rotation of the earth. Hansen's tables remained in use until they were replaced by Brown's tables in 1923. From his theory of the moon Hansen deduced that the accepted distance of the sun must be reduced by about 3% and so obtained a value close to that now accepted. Hansen, assisted by Christian Olufsen, compiled new tables of the sun in 1854. He received world-wide recognition for his work, being twice awarded the gold medal of the Royal Astronomical society; in 1850 the Copley medal of the Royal society was awarded to him. (J. JN.)

HANSON, JOHN (1721–1783), American Revolutionary leader, was the first president under the Articles of Confederation. Born in Charles county, Md., on April 13, 1721, he became a political leader of note in Maryland, serving in the general assembly from 1757, upon many important committees during the Revolutionary War, and as a representative of Maryland in the Continental Congress elected Dec. 22, 1779. On Kov. 5, 1781, he was elected by the Continental Congress "President of the United States in Congress Assembled," which office he held one year. He is sometimes referred to as "the first president of the United States," but he was a congressional presiding officer and had none of the powers of the first president under the constitution. Hanson died on Nov. 22. 1783, at Oxon Hill, Prince Georges county. Md.

HANSSON, OLA (1860–1925), Swedish poet, prose-writer and critic, belatedly recognized as one of the most original modern Swedish writers, was born at Gronby, Skbne, Nov. 12, 1860. After studying at Lund, he went to Copenhagen where he met many Danish writers. He was enormously influenced by foreign literature, especially by contemporary psychological writers who fostered his almost morbid sensitivity; yet, a descendant of a long line of Skbne farmers, he felt kinship with the placid plains of his native province. Out of this fundamental dichotomy came the conflict in his personality. His first publication, *Dikter* (1884), contains some poems describing nature and others inspired by social injustice. In *Notturno* (1885) he had already achieved poetic mastery, expressing in exquisite lyrics complex, subjective moods. His prose sketches, *Sensitiva Amorosa* (1887), in which he explored the "physiology of the soul," shocked contemporary Sweden and, embittered by their reception, from 1889 he lived abroad. first in Germany, and later in France, Switzerland and Turkey. In 1889 he married Laura Marholm, herself a writer, and they worked to make Scandinavian authors, especially Strindberg. known abroad and to introduce contemporary foreign writers to Sweden. Hansson's admiration for Kietszche was reflected in *Ung Ofegs visor* (1892; Eng. trans., *Young Ofeg's Ditties,* 1895). This was followed by remarkable short stories, the autobiographical novel *Resan hem* ("The Journey Home"; 1895), and numerous critical essays. Hansson later became a Roman Catholic for a time. His opinions became more violent and bizarre with age, but he continued to write, sometimes recapturing the lyrical beauty of his early poetry, until his death at Buyukdere, Turkey, Sept. 26, 1925.

His collected works were published in 17 vol. (1919–22); a further selection was edited by H. Gullberg, 5 vol. (1928–31).

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HANSTEEN, CHRISTOPHER (1784–1873), Norwegian astronomer and physicist, associated with the study of terrestrial magnetism, was born at Christiania (Oslo) on Sept. 26, 1784. From the cathedral school he went to the University of Copenhagen, where he studied mathematics. In 1807 he began his inquiries into terrestrial magnetism. He was appointed lecturer at the University of Christiania in 1814 and two years later, professor of astronomy and applied mathematics. An astronomical observatory was erected in 1833, to which a magnetic observatory was added in 1839. To further his researches in terrestrial magnetism he traveled not only throughout Norway and Finland but in 1828–30 undertook an expedition to western Siberia with G. A. Erman. Various publications gave an account of his expeditions and the final results were published in 1863 *(Resultate magnetischer Beobachtungcn).* He especially wrote on the magnetic poles and axes. Hansteen also supervised survey and topographical work in Norway begun in 1837. He continued his studies in magnetism after his retirement in 1861. He died at Oslo on April 11, 1873. (J. JN.)

HANSWURST, a comic character in Viennese plays created

by the Austrian playwright Joseph Anton Stranitzky (1676–1726), who replaced the somewhat tired Italianate Harlequin (*q.v.*) with a homebred clown type. Hanswurst sported the modified costume of a Salzburg peasant and supposedly embarrassed Lady Mary Wortley Montagu, who, in her letters, gave an account of the coarseness of his speech and gestures after she saw him perform in Vienna in 1716. In nontheatrical usage the name Hanswurst occurs first in 1519 in Sebastian Brant's satire *Das Narrenschiff* (1494). (A. M. N.

HANTHAWADDY, a district in the Pegu division of Lower Burma, the home district of Rangoon, from which the town was detached to make a separate district in 1880. It has an area of 1,931 sq.mi., with a population in 1941 of 459,522, of whom about 50,000 lived in the towns of Syriam, where the oil refineries are situated, and Thongwa. Maubin and Hanthawaddy are the two most densely populated districts in the province. It consists of a vast plain stretching up from the sea, and lies on either side of the Rangoon river by which the port of Rangoon is approached from the sea. The country is intersected by numerous tidal creeks, many navigable by large boats and some, like the Bassein creek which connects the Rangoon river with the To or China Bakir mouth of the Irrawaddy, by steamers. The Twante canal affords a more direct communication between the Rangoon and China Bakir rivers, and is used by the regular steamer services between Rangoon and Bassein across the delta.

The British admiralty oiling base, constructed between 1922 and 1927, lies on the east bank of the Rangoon river in the Hanthawaddy district. Cultivation in, the district is almost wholly confined to rice, and there are considerable tracts of unreclaimed marshland.

HANTZSCH, ARTHUR (1857–1935), German theoretical chemist, won fame at the age of 25 by devising the celebrated synthesis of substituted pyridines from β-ketonic esters, aldehydes and ammonia. Born in Dresden, March 7, 1857, Hantzsch studied at Dresden and Wiirzburg universities. He became a professor at Zürich (1885), at Wiirzburg (1893) and at Leipzig (1903).

With his pupil, Alfred Werner (*q.v.*), Hantzsch founded the stereochemistry of nitrogen, enunciating the theory that the three valences of nitrogen are not coplanar, and elucidating and proving the configurations of the stereoisomeric oximes and hydrazones. An attempt to extend the work to diazo compounds led to the discovery that many diazonium compounds are salts or bases. Hantzsch demonstrated the transformation $ArN_2+OH \rightleftharpoons Ar NNOH$, whereby a strong base is changed into a nonelectrolyte and showed that similar transformations occur between the aciforms and normal forms of nitro compounds and in the triphenylmethane dyes.

In the last case, the transformation is accompanied by a colour change, the investigation of which led Hantzsch to make pioneer studies in spectrophotometry and in the relationship between colour and constitution. He advanced a theory of indicators, emphasizing that the amount of the dissociable form present, and not the extent of dissociation, determines the colour.

Hantzsch conducted an extensive study of the dissociation of acids at all concentrations and in various solvents. He demonstrated the formation of oxonium salts with water and ether and came to the conclusion that acid dissociation does not occur except after solvation or association of the acid molecules.

Hantzsch was a man full of ideas; he was responsible for nearly 1,000 papers. He was remarkable for his early adoption of the methods of the science of physical chemistry.

He wrote *Grundriss der Stereochemie,* 2nd ed. (1904); *Diazoverbindungen,* 2nd ed., with S. Reddelien (1921); and *Theorie der ionogenen Bindungen* (1923). He died in Dresden, March 14, 1935.

See T. S. Moore, *Journal Chemical Society,* p. 1051 (1936); Fr. Hein, *Berichte d. deutschen chemischen Gesellschaft,* 74A:147 (1941); and *Zeitschrijt f. Elektrochemie,* 42:1 (1936). (P *O.)*

HANUKKAH (lit. "dedication," *cf.* Num. vii), the feast instituted by Judas Maccabaeus on 25 Kislew, 165 B.C., for the purification of the Temple, on the third anniversary of the setting up of the "Abomination of Desolation" (Dan. xi. 31; 1 Macc. i, 41–64, iv, 59; 2 Macc. vi, 2; Mark xiii, 14) by Antiochus Epiphanes. The name ἐγκαίνια corresponds to ἐγκαίνια (John x, 22). Wellhausen maintained that Hanukkah represents a primitive winter solstice festival. On this *see* ch. xii of C. C. Keet, *Liturgical Use of Psalter* (London, 1928). The feast lasts eight days, but the legend in 2 Macc. i, 18, is probably not the reason for this. One light is kindled on the first night, an extra one being added on each successive night, Hillel's rule thus prevailing over that of Shammai. The scroll of Antiochus still survives in some liturgies. For the service *see* the prayer books of S. Singer (Ashkenazic rite, London, 1928, and I. Abraham's notes in the annotated edition) and M. Gaster (Sephardic rite, with variants, Oxford, 1901); I. Elbogen in *Jüd. Gottesdienst* (Frankfurt-am-Main, 1924); and G. F. Moore, *Judaism,* ii, 49 (Harvard, 1927). The *Jewish Encyclopedia* (*s.v.*) article contains numerous illustrations of Hanukkah lamps. *See* also the catalogue of the Anglo-Jewish Historical exhibition of 1887 (published by the *Jewish Chronicle,* London). Specimens are in museums and private collections.

HANUMAN, in Hindu mythology the monkey god, a central figure in the Ramayana. Child of a nymph by the wind god, he aided Rama to recover his wife, Sita, from the demon Ravana, bridging the strait between India and Ceylon with boulders brought from the Himalayas with the help of a host of monkeys. Temples in his honour are numerous, especially in southern India. He is also a popular deity in Japan, where many temples are erected to his honour and districts of towns bear his name. The hanuman monkey (*Semnopithecus entellus),* called after the god, is one of the commonest Indian monkeys. *See* PRIMATES.

HAN-YANG, a member city of the tri-city conurbation of Wu-han on the north bank of the Yangtze at the mouth of the Han river in Hupeh province, China. It was merged in 1950 with the adjacent cities of Hankow and Wu-chang to form the single metropolis of Wu-han. *See* WU-HAN.

HAN YU (HAN WEN-KUNG) (768–824), Chinese poet and essayist of the T'ang dynasty, was born in Teng-chou, Honan, in 768. He regarded himself as a transmitter of Confucianism in the orthodox tradition of Mencius. As part of his program of returning to antiquity, he revived the literary style practised by the Confucians of the 4th and 3rd centuries B.C. The style he advocated was a free, simple prose unencumbered by the mannerisms and elaborate verselike regularity of parallel prose, the style then prevalent. In his poetry he reveals a tendency toward experimentation and unconventionality. His frequently polemical writings led him to be banished on two occasions, once in 803, when, as a member of the Censorate, he protested to the throne against overtaxation and the economic abuses of the eunuchs, and again in 819, when, in his famous Buddha-bone memorial, he attacked the veneration of a Buddhist relic on the grounds that Buddhism was a foreign religion. This memorial, together with the short essays "On the Way," "On Man," "On Spirits" and "On Inborn Qualities," became the most famous models of the prose style he espoused. His initial failure to find examiners sympathetic to his style kept him from embarking on the official career to which he aspired. He presented himself to the ministry of rites four times before being admitted to its examinations for the degree of Doctor of Letters. Having earned it at the age of 24, he spent the following three years attempting unsuccessfully to pass other qualifying examinations until, at the age of 28, he accepted his first post under a provincial governor. Later, as a compiler in the office of historiography, he edited the official record of the brief reign of the emperor Shun-tsung, which survives as the earliest example, and only T'ang specimen, of its genre. He served at times as vice-president in each of the ministries of justice, war and personnel. The prestige of his high office lent respectability to his literary reforms. At his death, in 824. the title of president of the ministry of rites was posthumously conferred upon him, as well as the epithet "Prince of Letters." *See* also CHINESE LITERATURE.

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HARA KEI (HARA TAKASHI) (1856–1921), Japanese politician, the first untitled prime minister of that nation and the first authentic Japanese party boss, was born at Morioka on Feb. 9, 1856.

Hara was educated in the justice ministry law school and entered the foreign service in 1882. Like many Japanese politicians of his era, he used the journalistic as well as the bureaucratic road to power, becoming chief editor of the ***Osaka Mainichi*** in 1897. When Prince Ito Hirobumi organized the Seiyukai party in 1900, however, Hara returned to politics as minister of communications. Elected to the house of representatives in 1902, he rose rapidly to become home minister in two Saionji cabinets (1905 and 1911) and Seiyukai president in 1914. Astute, often ruthless strategy brought him not only firm party control but the premiership on Sept. 29, 1918. This broke the hold of the Meiji oligarchy and ushered in almost two decades of "normal constitutional government" in which the Seiyukai party machine and its Mitsui business allies dominated civilian politics.

As prime minister, Hara pushed through a small-district electoral reform that gave the Seiyukai an absolute majority in the 1920 diet election. He failed to obtain approval of a racial equality clause in the covenant of the League of Nations or withdrawal of Japanese troops from Siberia.

Hara's administration opposed the universal suffrage movement and promoted the spoils system, primarily the close alliance of the Seiyukai with the Mitsui, and this corruption eventually helped to destroy public confidence in the party system. It inspired the young assassin who killed Hara in front of Tokyo station on Nov. 4, 1921. (D. H. ML.)

HARA-KIRI, self-disembowelment (Japanese ***hara,*** belly, and ***kiri,*** cutting), the method of suicide permitted to offenders of the noble class in feudal Japan and later the national form of honourable suicide. The more commonly used modern term is ***Seppuku,*** the Chinese reading of the same characters. Hara-kiri was a growth of mediaeval militarism, prompted by the desire of the noble to escape the humiliation of falling into an enemy's hands. By the end of the 14th century the custom had become a valued privilege. Hara-kiri was of two kinds, obligatory and voluntary. The first is the more ancient. An official or noble, who had broken the law or been disloyal, received a message from the mikado, couched always in gracious terms, courteously intimating that he must die. The mikado usually sent a jewelled dagger with which the deed might be done. The suicide made dignified preparations for the ceremony. In his own baronial hall, or in a temple, a dais, 3 or 4 in. from the ground, was constructed. Upon this was laid a rug of red felt. The suicide, clothed in his ceremonial dress, and accompanied by his second (Kaishaku), took his place on the mat, the officials and his friends ranging themselves in a semi-circle. The weapon was then handed to him with many obeisances by the mikado's representative, and he made a public confession of his fault. A moment later he plunged the dagger into his stomach below the waist on the left side, drew it slowly across to the right and, turning it, gave a slight cut upward. At the same moment the Kaishaku, who crouched at his friend's side, leaping up, brought his sword down on the outstretched neck. The bloodstained dagger was taken to the mikado as a proof of the consummation of the act. The performance of hara-kiri carried with it certain privileges. If it was by order of the mikado half only of a traitor's property was forfeited to the State. If the gnawings of conscience drove the disloyal noble to voluntary suicide, his dishonour was wiped out, and his family inherited all his fortune.

Voluntary hara-kiri was the refuge of men rendered desperate by private misfortunes, or was committed from loyalty to a dead superior, or as a protest against what was deemed a false national policy. This voluntary suicide still survives, a characteristic case being that of the citizen who despatched himself in 1925 as a protest against the Government's foreign policy. The popularity of this self-immolation is testified to by the fact that for centuries no fewer than 1,500 hara-kiris are said to have taken place annually, at least half being entirely voluntary. Stories of amazing heroism are told in connection with the performance of the act. Obligatory hara-kiri was actually abolished in 1868.

See A. B. Mitford, ***Tales*** of ***Old Japan;*** Basil Hall Chamberlain, ***Things Japanese*** (1898).

HARALD I. (85—33), surnamed Haarfager ("Fairhair"), first king over Norway, succeeded on the death of his father Halfdan the Black in A.D. 860 to the sovereignty of several small and somewhat scattered kingdoms, which had come into his father's hands through conquest and inheritance and lay chiefly in south-east Norway. (***See*** NORWAY.) In 866 he made the first of a series of conquests over the many petty kingdoms which then composed Norway; and in 872, after a great victory at Hafrsfjord near Stavanger, he found himself king over the whole country. His realm was, however, threatened by dangers from without, as large numbers of his opponents had taken refuge, not only in Iceland, then recently discovered, but also in the Orkneys, Shetlands, Hebrides and Faeroes, and in Scotland itself; and from these winter quarters sallied forth to harry Norway as well as the rest of northern Europe. Their numbers were increased by malcontents from Norway, who resented Harald's claim of rights of taxation over lands which the possessors appear to have previously held in absolute ownership. At last Harald was forced to make an expedition to the west to clear the islands and Scottish mainland of Vikings. Numbers of them fled to Iceland, which grew into independent commonwealth, while the Scottish isles fell under Norwegian rule. The latter part of Harald's reign was disturbed by the strife of his many sons. He gave them all the royal title and assigned lands to them which they were to govern as his representatives; but this arrangement did not put an end to the discord, which continued into the next reign. When he grew old he handed over the supreme power to his favourite son Erik "Bloody Axe," whom he intended to be his successor. Harald died in 933, in his 84th year.

The tale goes that the scorn of the daughter of a neighbouring king induced Harald to take a vow not to cut or comb his hair until he was sole king of Norway and that ten years later he was justified in trimming it whereupon he exchanged the epithet "Shockhead" for the one by which he is usually known.

HARALD II., surnamed Graafeld, a grandson of Harald I., became, with his brothers, ruler of the western part of Norway in 961; he was murdered in Denmark in 969.

See H. Hermannson, ***Islandica III.*** (Bibliography of ***the*** Sagas of the Kings of Norway) (1910). A. Bugge, *Norges Historie* Vol. I. part II. (1909–10).

HARALD III. (1015–1066), king of Norway, surnamed Haardraade, which might be translated "ruthless," was the son of King Sigurd and half-brother of King Olaf the Saint. At the age of fifteen he was obliged to flee from Norway, having taken part in the battle of Stiklestad (1030), at which King Olaf met his death. He took refuge for a short time with Prince Yaroslav of Novgorod (a kingdom founded by Scandinavians), and thence went to Constantinople, where he took service under the empress Zoe, whose Varangian guard he led to frequent victory in Italy, Sicily and North Africa, also penetrating to Jerusalem. In the year 1042 he left Constantinople, the story says because he was refused the hand of a princess, and on his way back to his own country he married Ellisif or Elizabeth, daughter of Yaroslav of Novgorod. In Sweden he allied himself with the defeated Sven of Denmark against his nephew Magnus, now king of Norway, but soon broke faith with Sven and accepted an offer from Magnus of half his kingdom. In return for this gift Harald is said to have shared with Magnus the enormous treasure which he had amassed in the East. The death of Magnus in 1047 put an end to the growing jealousies between the two kings, and Harald turned his attention to subjugating Denmark, which he ravaged year after year; but in 1064 he gave up the attempt and made peace. In 1066, possibly instigated by the banished Earl Tostig, he invaded England. In September 1066 he landed in Yorkshire with a large army, reinforced from Scotland, Ireland and the Orkneys; took Scarborough by casting flaming brands into the town from the high ground above it; defeated the Northumbrian forces at Fulford; and entered York on Sept. 24. But

on the 25th the English Harold arrived from the south. and routed his forces at Stamford bridge after the fall of their king. His many victories in the face of great odds prove him to have been a remarkable general, of never-failing resourcefulness and indomitable courage, in spite of the fact that he was an unpopular king

HARALD IV (d 1136), king of Norway, surnamed Gylle (probably from *Gylle Krist, i.e.*, servant of Christ), was born in Ireland about 1103 About 1127 he went to Norway and declared he was the son of King Magnus III (Barefoot), who had visited Ireland just before his death in 1103, and consequently a half-brother of the reigning king, Sigurd. He appears to have submitted successfully to the ordeal of fire, and the alleged relationship was acknowledged by Sigurd on condition that Harald did not claim any shdre in the government of the kingdom during his lifetime or that of his son Magnus.

Harald kept this agreement *until* Sigurd's death in 1130. Then war broke out between himself and Magnus. who was captured in 1134. blinded, and imprisoned. Harald now ruled the country until 1136, when he was murdered by Sigurd Slembi-Diakn, another bastard son of Magnus Barefoot. Four of Harald's sons, Sigurd. Ingi, Eysteinn and Magnus, were subsequently kings of Norway

HARAR, a province and city of Ethiopia. The province is one of the most fertile in the country, situated at an elevation of some 4.000 to 5,000 ft. above sea level, enjoying a pleasant climate and a rainfall of between 35–60 in, and rich in varied cultivation. Area 156,000 sq.mi.

The duke of Harar is its governor, although the emperor takes a personal interest in its affairs since it was as governor of Harar he arose to power

Harar is famous for its excellent coffee, which is grown extensively and largely exported

Along its northern extremity runs the Franco-Ethiopian railway from Jibuti to Addis Ababa, on which 193 mi. from Jibuti is the town of Diredawa, the most progressive town in Ethiopia (population about 30 000), with roads. a water supply and electricity; it was for many years the terminus of the railway. Thirty-five miles southwest of Diredawa lies the town of Harar, the capital of the province and for long its most important centre until the advent of the railway transferred its commercial predominance to Diredawa. It remains the centre of the caravan trade of the province and in addition to coffee there is considerable trade in durra, chat (used as a drug), ghee. cattle, mules and camels. skins and hides and gums. Cotton and metal goods form the bulk of the import trade. Harar is built on the slopes of a hill at an elevation of more than 5 000 ft. A lofty stone wall, pierced by five gates and flanked by 24 towers, encloses the city, which has a population (1956 est.) of 40.500. The streets are steep, narrow. dirty and unpaved, the roadways consisting of rough boulders. The houses in general are made of undressed stone and mud and are flat-topped, the general aspect of the city non-Ethiopian.

A few houses, including the palace of the governor and the foreign consulates, are of more elaborate and solid construction.

Harar is believed to owe its founddtion to Arab immigrants from Yemen in the 7th century of the Christian era. In the region of Somaliland, the Arabs established the Muslim state of Adel or Zaila, with their capital at Zaila, Harar becoming the seat of government in 1521. A subsequent amir of Harar Mohammed surnamed Grañ (left-handed), probably a Somali, is famous for his invasion of Ethiopia, of which country he was virtual master until his defeat and death in 1541. It was first visited by a European in 1854 when (Sir) Richard Burton spent ten days there in the guise of an Arab. In 1875 Harar was occupied by an Egyptian force and remained in the possession of Egypt until 1885, when the garrison was withdrawn in consequence of the rising of the Mahdi in the Sudan. A son of the ruler who had been deposed by Egypt was installed as amir, the arrangement being carried out under the superintendence of British officers. The new amir held power until Jan. 1887, in which month Harar was conquered by Menelek II, king of Shoa (afterward emperor of Ethiopia). The governorship of Harar was by Menelek entrusted to Ras Makonnen, who held the post until the time of his death in 1906.

The Harari proper are of a stock distinct from the neighbouring peoples. and speak a special language. Hararese is "a Semitic graft inserted into an indigenous stock" (Sir R. Burton, *First Footsteps in East Africa*). The Harari are Muslims of the Shafa'i or Persian sect, and they employ the solar year and the Persian calendar. In addition to the native population there are in Harar colonies of Amharas, Somalis and Gallas By the Somalis the place is called Adari, by the Gallas Adaray. *See* also ETHIOPIA (ABYSSINIA).

See P Paulitschke, *Harar: Forschungreise nach den Somâl- und Galla-Landern Ost-Afrikas (1888).* (C F. R.; X.)

HARBIN, the chief city of Heilungkiang province, central Manchuria, China. It lies on the right bank of the Sungari river in latitude 45° 30' N and longitude 126° 40' E.. 220 mi. N N.E. of Mukden and 250 mi W N W. of Vladivostok, with both of which towns it is connected by railway.

The gronth of the town has been phenomenal. In 1898 Harbin was only a local wheat market, but it was developed by the Chinese Eastern railway and became rapidly a populous industrial city and a centre of former tsarist activities in Manchuria in the generation after the Russian October Revolution of 1917. Because of this origin it has remained a city of outspoken Russian character although the Russian population has declined.

In 1911 the city had 40,500 inhabitants. The population increased to 332.000 in 1931 and to 662,000 in 1940; in 1953 (census) it was 1,163.000 and increased to an estimated 1,552,000 in 1957. The city is divided into various sections: the "new town." the mart, Machiakou, Chuanchiatien and the Russian town, one of the colourful sections of the metropolis. On Dec. 1, 1934, after the creation of the puppet state of Manchoukuo, Harbin became the seat of the provincial government of the new province of Pinkiang

Harbin has been an important commercial centre. The surrounding plain, composed mainly of fertile black loam and some yellow clays, is very suitable for the growth of wheat, maize (corn) and that very adaptable plant, the soybean. Harbin is also well situated in relation to markets.

Five railway lines converge in the city. The northwest-southeast line of the former Chinese Eastern railway connects Harbin with Manchouli in the west and—through Mutankiang from where a branch line leads to the Korean border—with Vladivostok in the east. The line to Hsinking (Ch'ang-ch'un) leads to Mukden Dairen and to the Korean border. Another southern line from Harbin connects at Lafachan uith the railroad from Hsinking via Kirin to the Korean border; a northern line leads to Hailun and Ai-Hun (Aigun) on the Amur river.

These lines make Harbin the strategic centre of the Manchurian railway system. Harbin is also connected by steamships and junks with all important towns on the Sungari river and its tributaries. Airlines connect the city nith Manchouli via Tsitsihar and with Dairen and Shingishu (Korea) via Hsinking and Mukden. In the city itself street cars. omnibuses and automobiles and the regular rickshas and sleds (in winter) provide an elaborate transportation system.

Harbin had a number of industries on an agricultural basis, as flour milling, soybean factories, distilleries, leather industries, etc. It exported soybeans, bean oil, bean cake, wheat flour, tobacco, cotton piece goods, furs, leather, beer, beet sugar, veneer, lumber, woolens, soap, candles, jewelry and confectionery. After 1936 the exports declined rapidly while at the same time the import of Japanese goods connected with the Japanese economic development of north Manchuria increased very strongly.

After 1939 Harbin was developed into a major industrial base of northeast China. In addition to the traditional food-processing industries. new enterprises included production of ball bearings, wire and cable, film projectors, tractors, electric-power generators, nylon and plastics.

HARBINGER, originally one who provided shelter for an army (from M.E. *herbergere,* formed from O.H. Ger. *heri,* an

army, and *bergen,* shelter). The meaning was enlarged to include any place where travellers could be lodged, and also the person who provided lodgings or one who went on before a party to secure lodgings; hence, figuratively, in literature a forerunner. A harbinger was also the herald sent to announce the king's coming, and until 1846 a knight harbinger was an officer in the royal household.

HARBINGER-OF-SPRING *(Erigenia bulbosa),* a small North American plant of the parsley family (Umbelliferae), native to moist low woods from southern Ontario to Minnesota and southward to Pennsylvania, Alabama and Missouri. It is a low, smooth, almost stemless perennial, rising from a deep round tuber and bearing near the ground from two to four compound leaves thrice divided into narrow leaflets and a flower stalk (scape), three to nine inches high, terminating in small umbellate clusters of white flowers.

In the southern part of its range the plant blooms as early as February, and at the north in April, whence its name. It is somewhat rare and local in many sections but is especially abundant in the vicinity of Washington, D.C.

HARBORD, JAMES GUTHRIE (1866–1947), U.S. army officer, was Gen. John J. Pershing's chief of staff during World War I. Born at Bloomington, Ill., March 21, 1866, he graduated from the Kansas State Agricultural college, Manhattan, in 1886. He joined the 4th infantry as a private in 1889 and was commissioned in the cavalry in 1891. Thereafter he was promoted through the grades and in 1917 became brigadier general. He was chief of staff of the American Expeditionary force in France, May 1917–May 1918, and again from May 1919. He commanded the marine brigade near Chateau-Thierry, June 1918, and the 2nd division of the A. E. F. in the Soissons offensive, July 1918, after which he was placed in command of the service of supply. He served as deputy chief of staff, U.S. army, 1921–22, and retired from the army as lieutenant general.

He became president (1923) and later chairman of the board (1930) of the Radio Corporation of America. Harbord died Aug. 20, 1947, in Rye, N.Y.

HARBOURS. A harbour is a refuge for ships, a port or haven, and is taken from the old English *hereberge* meaning protection or shelter. From the very earliest understanding of the term, a harbour was a sheltered arm of the sea in which vessels could be built and launched and taken for repair, or seek refuge in time of storm. One of the requisites was a good anchorage or holding ground. Such cargo as was carried by the vessel was transported to the shore by smaller craft or carried to the vessel by hand.

Natural harbours are those which, in themselves, are usable without resort to engineering works of improvement. Primitive harbours were almost always of this character. With the increase in size and draught of vessels, most of the so-called natural harbours have required works of extension and improvement. As a distinctive term, a natural harbour may now be considered as one located on an estuary or an enclosed bay.

Artificial harbours, in a more restricted sense, are those requiring construction of extensive engineering works, such as breakwaters for protection of the shipping from wave action, or harbours in which shallow or otherwise unsuitable areas have been excavated and deepened and other improvements made in order to make them available for the purpose intended.

The present article describes some of the more important and typical examples, both natural and artificial, the principles on which artificial harbours are—or should be—planned and the means by which natural facilities have been improved and supplemented by artificial works. The guiding principles to be followed in the making of small harbours are the same, *mutatis mutandis,* as those which are applicable to the great achievements of maritime engineering construction on which millions of money have been expended.

Breakwaters, which constitute the principal protection works of most artificial harbours, are described in a separate article; for the interior works and facilities of a port *see* DOCKS; river and estuarine harbours are also referred to in the article RIVER AND RIVER ENGINEERING; and for the lighting and buoying of harbours *see* LIGHTHOUSES and BUOY. *See* DREDGES AND DREDGING and JETTY and further particulars of individual harbours under place names; *e.g.,* CHERBOURG; RIO DE JANEIRO.

Classification. — Harbours may be classified in several ways:

1. Natural harbours, possessing, in a large degree, natural shelter. These require only the provision of such facilities as docks or piers, and sometimes deepening by artificial means, to make them serviceable as shipping ports. Such are the landlocked harbours of Hong Kong, Rio de Janeiro, New York city, Portsmouth and Sydney.

Some estuarine harbours, such as those formed by the lower tidal compartments of the Thames, Mersey and Yangtze, also come under this heading.

2. Harbours possessing partial natural shelter improved by artificial means; *e.g.,* Plymouth and Table bay.

3. Harbours entirely (or almost entirely) of an artificial nature formed on open sea coasts. A notable example of this class is Madras harbour (fig. 2).

Another classification, of an arbitrary and somewhat artificial nature, divides harbours according to their respective purposes; *e.g.,* harbours of refuge, commercial harbours, naval harbours and fishery harbours. It may be explained here that the term "harbour of refuge" (now almost obsolete) ordinarily denotes a harbour constructed specifically and primarily for the purposes of shelter (usually for small craft) and not as an essential factor of a naval or commercial port.

Still another method classifies harbours according to their physical characteristics and the nature of the artificial works employed for their creation or improvement; as for instance: (1) lagoon harbours; (2) jetty harbours; (3) harbours formed by converging breakwaters projected from the shore; (4) those protected by breakwaters parallel with the shore; (5) those formed by the projection of breakwaters from one or both horns of a bay; (6) harbours where island breakwaters cover and protect embayments; and (7) prefabricated harbours.

EARLY HISTORY

There is no conclusive evidence as to the date or the locality of the first artificial harbour construction. The use of natural havens and places of shelter must, of course, have been contemporary with the origins of navigation, and there are evidences of intercourse between Egypt and Crete in the predynastic period of Egypt more than 6,000 years ago. It is recorded on the Palermo stone that about 3000 B.C. King Seneferu built 60 great ships to go to the Syrian coast to bring cedarwood for his works. Gaston Jondet claimed, in *Les ports submerge's de l'ancienne Ile* de *Pharos* (Institut Egyptien, 1916) to have discovered on the seaward side of the island of Pharos an ancient harbour in the Cretan manner dating to 2000 B.C.; but the date and origin of these remains were disputed. The Phoenicians built harbours at Sidon and Tyre in the 13th century B.C. The second city of Tyre was built on a small island off the coast. T o harbours were built on the island, the Sidonian harbour on the north end and the Egyptian on the south end. The Sidonian harbour was built about 1100 B.C. and the Egyptian harbour was constructed by Hiram, king of Tyre, about 940 B.C. A main feature of this harbour was a 2,500-ft. mole formed of rubble stone surmounted by masonry walls. The true location of the southern or Egyptian harbour was not known until 1934–36, when Père A. Poidebard determined it by means of extensive investigation. (*See* L. H. Savilles, "Ancient Harbours," *Journal Inst. C.E.,* 1940.) Almost 600 years after the death of Hiram, Alexander the Great attacked the island from the land (332 B.C.) by building a 100-ft.-wide mole, one-half mile long in three fathoms of water, and captured and destroyed the city. The mole stopped the drifting sands and Sur, the ancient Tyre, became connected to Syria by a broad neck of land.

It was after the capture of Tyre that Alexander founded Alexandria and built the second harbour. He connected the Island of Pharos with the mainland by a causeway, called the Heptastadion—one mile long and 600 ft. wide. The two harbours lying east and west of the causeway were the Great Harbour and Eu-

nostos or the haven of happy return. The Great Harbour was protected on three sides by the mainland, the Heptastadion and the eastern end of the Island of Pharos. On the open or eastward side it was protected by a pier built out from the mainland and by a line of reefs which made entrance to the harbour difficult. It was for this reason that Ptolemy built the famous lighthouse of Pharos.

Many other Mediterranean harbours, both natural and artificial, were of considerable commercial or military importance in Greek and Roman times. The natural harbours of Tarentum (Taranto) and Brundisium (Brindisi) are still in use. Ostia, once the port of Rome, is said by some classical writers to have been founded in the 7th century B.C., but the port of the empire was built by Claudius and extended by Trajan about 100 A.D. (See *Proc.* Inst. C.E., vol. iv, 1845.) In Trajan's reign Centum Cellae (modern Civitavecchia) was founded 30 mi. N. of the Tiber mouth. As the name implies the harbour was provided with 100 covered *cellae* or dock for warships. Ostia, abandoned because of silting up of the approaches, is now more than one mile from the sea.

In mediaeval times the prosperity of such Mediterranean cities as Venice and Genoa led to the building of harbour works for the accommodation of their seaborne trade. Some of the early works at Genoa and on the Venetian lagoons remain to this day. Natural harbours suitable to the needs of the trade of the middle ages are more numerous in northern Europe than in the tideless Mediterranean sea, and for many centuries these natural facilities, combined in some cases with artificial works of the simplest character, sufficed for the shipping of the times.

One of the earliest protection works built at a seaport in England was the Cobb at Lyme Regis dating from the 14th century. This was a pier or jetty constructed of rough boulders held in place between rows of oak piles. A pier occupying the same site still bears its name. Harbour works are said to have existed about 1250 at Hartlepool and at Arbroath in Scotland *c.* 1394. Dover was a busy port in the time of Henry VIII., and a stone and timber breakwater was built there in his reign. Towards the end of the 16th century the first of the jetties at the entrance to the Yare at Yarmouth was constructed; and in the 17th century protection piers were built at Whitby and Scarborough, portions of which still exist. It was not, however, until the second half of the 18th century when John Smeaton (*q.v.*) began his career, that the building of harbour works on any considerable scale was undertaken in England, Smeaton must be regarded as the founder in England of the science of harbour engineering. His work and that of his successors, Thomas Telford and John Rennie, permanently established British seaports in the forefront of progress in harbour construction.

On the other side of the channel, Le Havre, Dieppe, Rochelle and Dunkirk were among the earliest ports to embark on harbour construction; in Bélidor's *Architecture Hydraulique* (Paris, 1737–53) is a detailed account of the early harbour at Dunkirk as well as of other ancient port works.

PRINCIPLES OF DESIGN

In designing the works of a harbour one of the most important considerations is that of exposure. Such information as can be obtained from reliable charts must be supplemented by more detailed marine surveys and soundings, and the nature of the sea bed must be ascertained by borings and probings. Among the points to be noted are:—the geological and other physical characteristics of the site; the slope of the sea bed; the depth of water seaward of the proposed site as well as over it; the presence of any outlying reefs, rocks, shoals or islands of which advantage can be taken as affording protection, or as good foundations for sheltering works; and the tidal phenomena, such as the vertical range. Investigation must be made of the nature and directions of the currents and tidal streams; the effect of littoral drift; the nature and extent of natural shelter; the directions of the prevailing and of the strongest winds; the line of maximum exposure, or the greatest fetch or reach of the sea in any unobstructed line of direction; the probable maximum height of the waves due to the exposure; and the direction from which the heaviest seas come. These and other considerations determine the character of the works to be constructed. In the case of harbours proposed to be made at the mouths of rivers or in estuaries, many other problems relating to river flow, bars, the maintenance of channels, etc., call for investigation.

There is a great diversity in the height of waves experienced in different positions on the same coastline. In some places shores lie open to the full force of the ocean waves while other parts of the same coast are protected by projecting headlands or islands, or by outlying reefs or sandbanks. Then again, inlets and enclosed arms of the sea, creeks, and river mouths, estuaries and land-locked lagoons provide sites more or less sheltered from wind and waves according to the degree of natural protection afforded them. At the other extreme is the exposed open site where breakwaters are necessary to protect an anchorage harbour, and where secondary breakwaters or piers may be required to provide local and complete shelter for the inner works of the port.

In planning a harbour to be formed in an exposed situation, certain important points must be kept in view, *e.g.*, (1) The entrance should be so placed as to afford ample sea room, free from rocks and shoals on a lee shore, for a vessel when on the point of entering or immediately after leaving the shelter of the outer and covering breakwater or breakwaters. (2) The alignment of the works should be such as to minimize the wheeling effect of waves around a breakwater head and the projection of seas across the entrance. (3) If possible the entrance should be so placed that one breakwater overlaps the other in such a way that some shelter from the direction of the heaviest seas is afforded to a ship when passing the harbour entrance. (4) The entrance should be planned so as to avoid strong currents sweeping across it. (5) Ample expending beaches or wave traps should be provided inside a harbour whose entrance is exposed, to allow the waves that pass the entrance to spend and break themselves. For this reason such a harbour surrounded with vertical walls, where there is not ample spending room, becomes a "boiling pot" of reflected waves; and in these circumstances sloping walls are preferable.

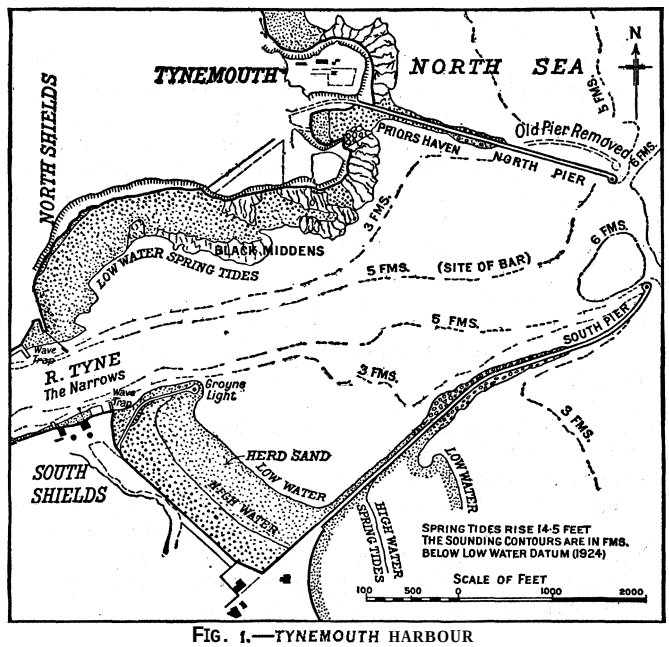
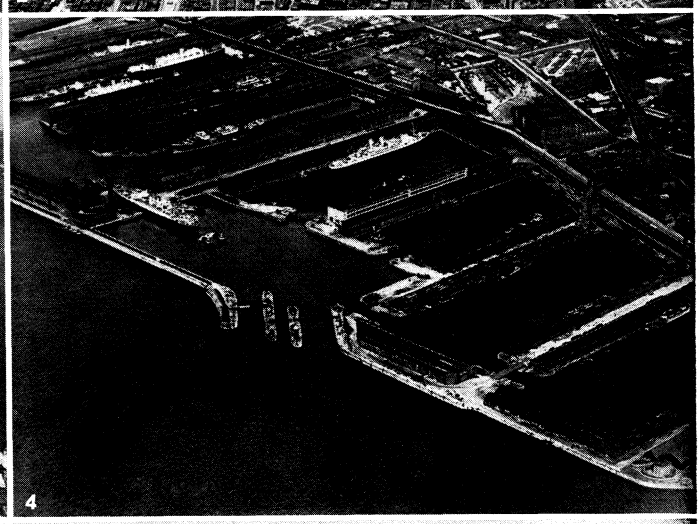


FIG. 1.—*TYNEMOUTH* HARBOUR

(6) The width of entrance, while being sufficient for the safe passage of ships, should be restricted as much as practicable, for upon the relation of the entrance width to the internal width and area of the harbour largely depends the reduction of range[1] of sea waves particularly when they are propagated into a harbour; *windlop* describes the short wind waves generated in narrow waters as distinct from the ocean wave. The amplitude of the vertical motion of a ship due to range of waves is known as *scend; tidal range* is the vertical rise and fall of a tide; *tidal rise* the height of a tide at high-water above the chart datum which is usually the level of the lowest low-water.

[1] *Range*, applied to waves, denotes the vertical rise and fall of



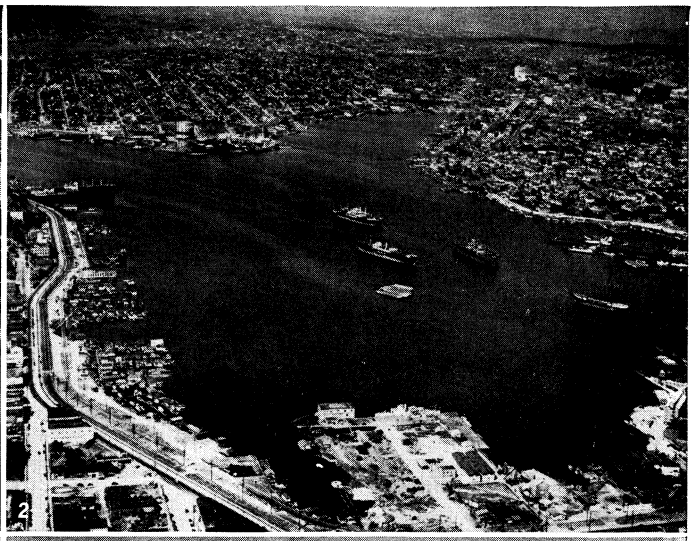



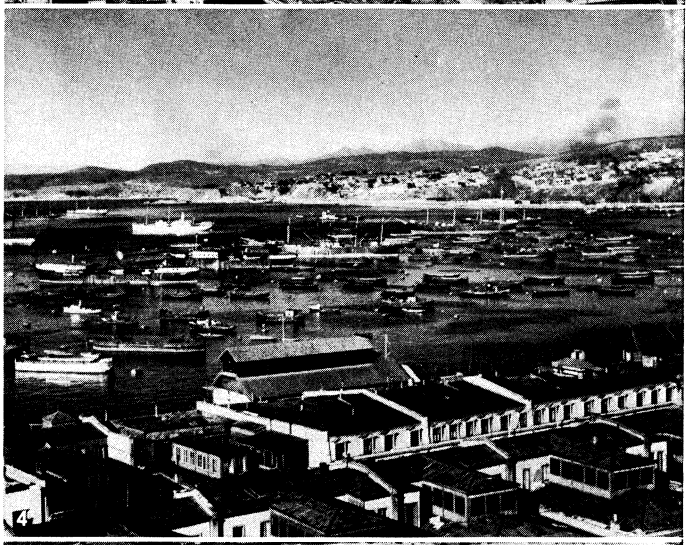
PHOTOGRAPHS, (1) COMPAGNIE AÉRIENNE FRANÇAISE, (2) FAIRCHILD AERIAL SURVEYS. INC., (3) BURTON HOLMES FROM EWING GALLOWAY, (4) AEROFILMS FROM EWING GALLOWAY, (5) SIR ALAN COBHAM FROM EWING GALLOWAY, (6) FRITZ HENLE

BAY, ESTUARY AND DEEPWATER RIVER-HARBOURS

1. The inner harbour, entrance lock and docks at Le Havre, France, before World War II. The port works suffered considerable damage during the war. Originally constructed in sheltered water at the mouth of the Seine estuary, the port was later extended into more exposed water
2. View of New York harbour showing the Upper and Lower bays and the harbour entrance with the Atlantic ocean in the extreme background. The East and Hudson rivers, important arteries of coastwise and inland commerce, are in the left and right foregrounds respectively
3. Hone Kong harbour as seen from the heights above Victoria, capital of the island of Hong Kong. The naturally sheltered harbour, 10 sq.mi. in area and possessing an east and a west entrance, is one of the chief ports on the coast of China
4. Group of the older docks at Liverpool, England, including the Sandon entrance and half-tide dock entered from the river Mersey. The docks at Liverpool and at Birkenhead on the opposite side of the Mersey cover an enclosed water area of more than 650 ac. and are provided with more than 37 mi. of quayage
5. The harbour at Alexandria, Egypt. The city occupies a strip of land between the Mediterranean and Lake Mareatis, also a peninsula which forms two harbours
6. Palermo, Italy, bay and harbour. The harbour has a water area of 144 ac. and quayage of about 9,000 ft.

HARBOURS



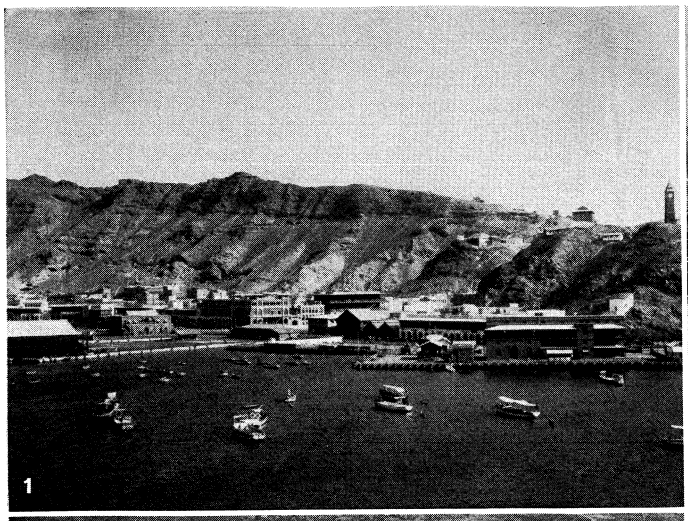


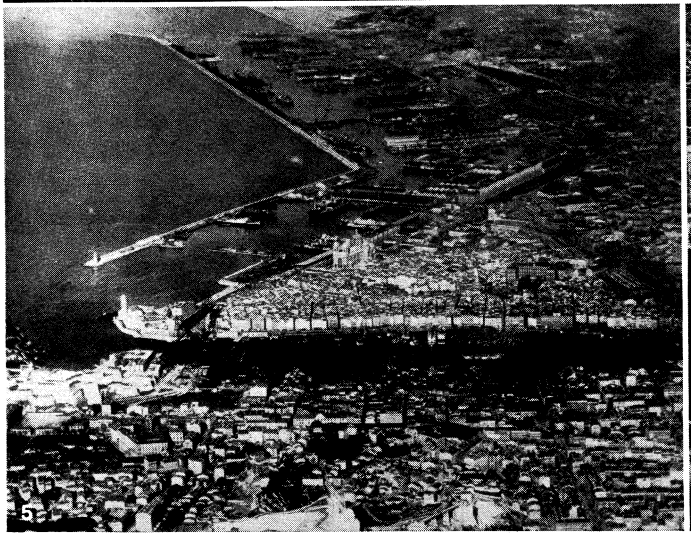
PHOTOGRAPHS, (1) PAUL'S PHOTOS, (2, 4-6) EWING GALLOWAY, (3) FAIRCHILD AERIAL SURVEYS, INC.

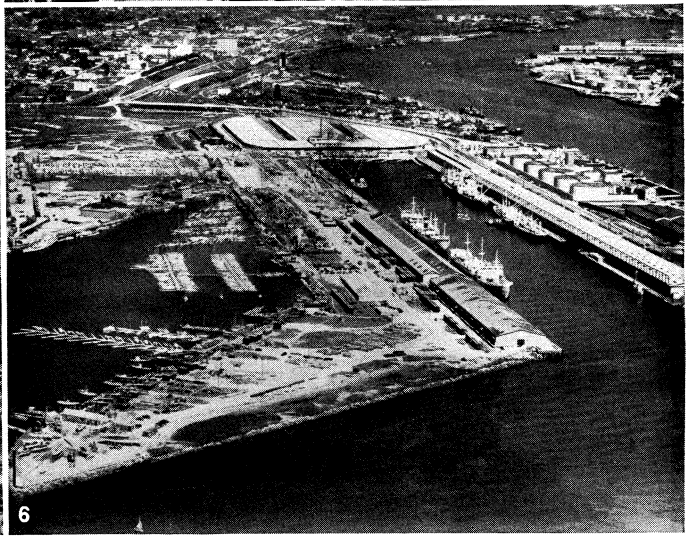
HARBOURS OF THE WESTERN HEMISPHERE

1. Entrance to the harbour at Havana, Cuba, with the city on the left. This narrow entrance leads to the inner harbour east and south of the city (lower right in the picture)
2. Section of the waterfront of Seattle. Wash., showing Lake Union, a fresh-water part of the harbour entered through locks
3. The waterfront at Jacksonville, Fla., an important shipping centre on the St. Johns river about 23 mi. from the sea
4. Harbour at Valparaíso, Chile, on the wide, semicircular Bay of Valparaiso
5. Callao, chief seaport of Peru, about 6 mi. west of Lima. The harbour, partly sheltered by two islands, is one of the best on the Pacific side of South America
6. The commercial Port at Rio de Janeiro. Brazil

HARBOURS







BY COURTESY OF (3) MERL LA VCY; PHOTOGRAPHS, (1, 4.6) EWING GALLOWAY, (2) FAIRCHILD AERIAL SURVEYS, INC.

HARBOURS OF THREE CONTINENTS

1. The port of Aden, Arabia, important especially in wartime because of its location near the southern entrance to the Red sea. The outer harbour is protected by an island but is liable to filling by mud

2. View of Corpus Christi, Tex., showing the rubble breakwater in Corpus Christi bay with Nueces bay in the background

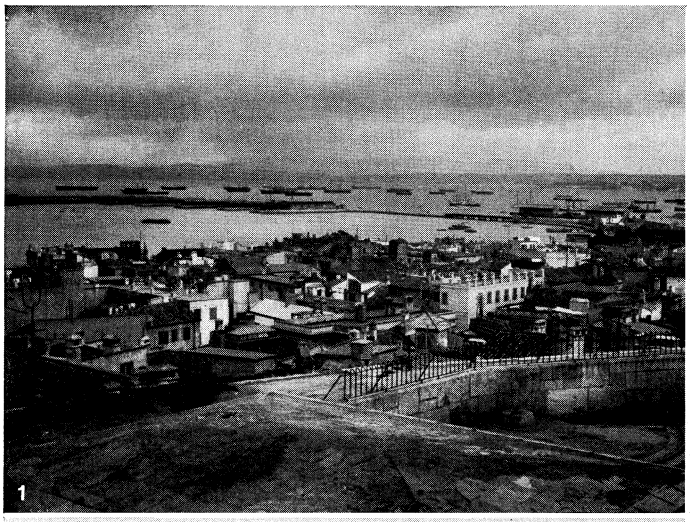
3. Aerial view of Istanbul. Turkey, showing its harbour, the Golden Horn, an inlet of the Bosporus about 4 mi. long. It is divided by Galata bridge into an outer harbour and an inner harbour and naval port

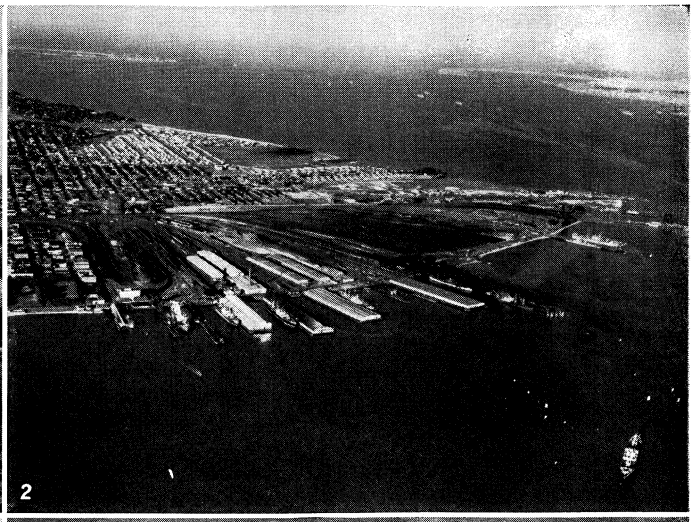
4. General view of Naples, Italy. The harbour reaches across the bay from west to east for a distance of more than **2½** mi. and is protected by breakwaters. It has a depth ranging from **30** to **35** ft.

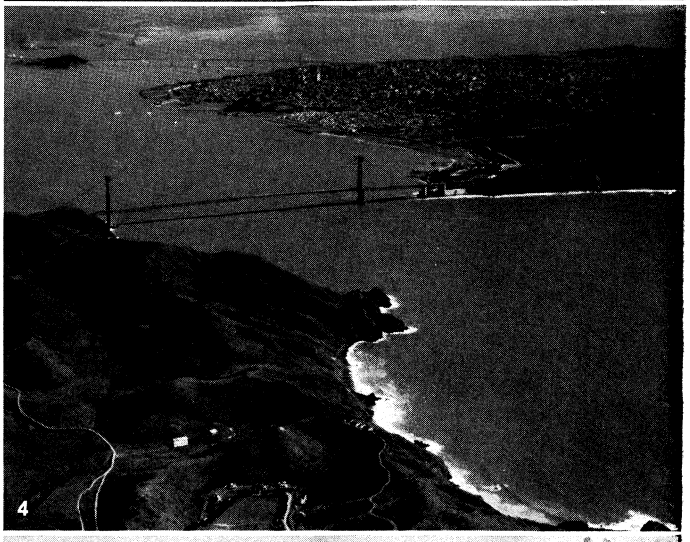
5. View of Marseille on the Mediterranean coast of France, showing the Bassin de la Joliiette, part of the great range of basins enclosed by the breakwater (background), which extends for more than **3½** mi. parallel with the coast

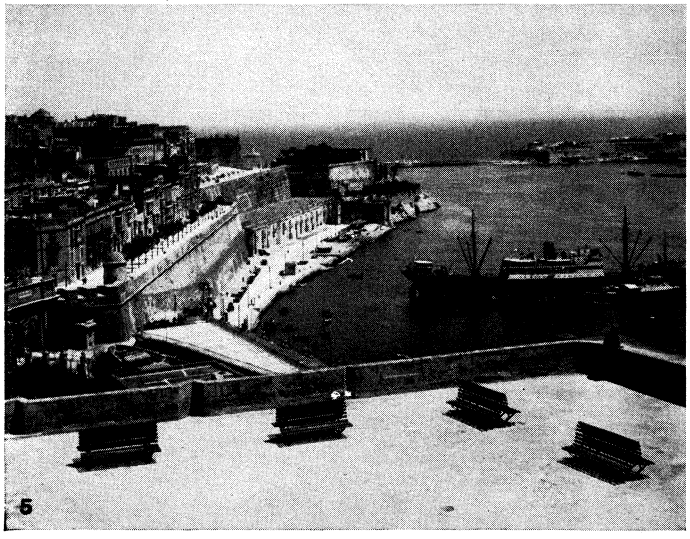
6. View of portion of the inner harbour of Los Angeles, Calif. Until 1910 practically all this area consisted of mud flats; later the main channe' in the immediate foreground, **1,000** ft. wide, was dredged to a depth of **35** ft., as were also the turning basin in the foreground together with the channel leading to the east basin on the right hand and the west basin on the left

HARBOURS









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NATURAL AND JETTY HARBOURS OF EUROPE AND AMERICA

1. View of Gibraltar harbour on the bay of Algeciras. The commercial moles are used as a wharf for naval destroyers. There are three breakwaters, two of which are connected with the shore on the north and south. The third is on the west. The port has been valued chiefly as a naval harbour
2. The harbour at Hampton Roads, Va., a natural harbour large enough to accommodate 1,000 ships. Newport News is in the foreground
3. Aerial view of Dieppe, France, on the English channel. The entrance from the outer harbour is protected by jetties (background) and leads into the winding Arques river, along which are quays for the accommodation of vessels drawing up to 20 ft.
4. View of waterfront, San Francisco, Calif., showing the Golden Gate bridge, and in the background the San Francisco-Oakland Bay bridge
5. Grand harbour of Valletta. Malta. a bav harbour further protected by two breakwaters. It affords anchorage-for the largest war vessels
6. Vancouver, B.C., Canada's chief western port and one of the finest natural harbours on the Pacific coast. Situated on Burrard inlet, an arm of the Strait of Georgia, it is the principal westward outlet of Alberta's wheat crop and is served by many steamship lines

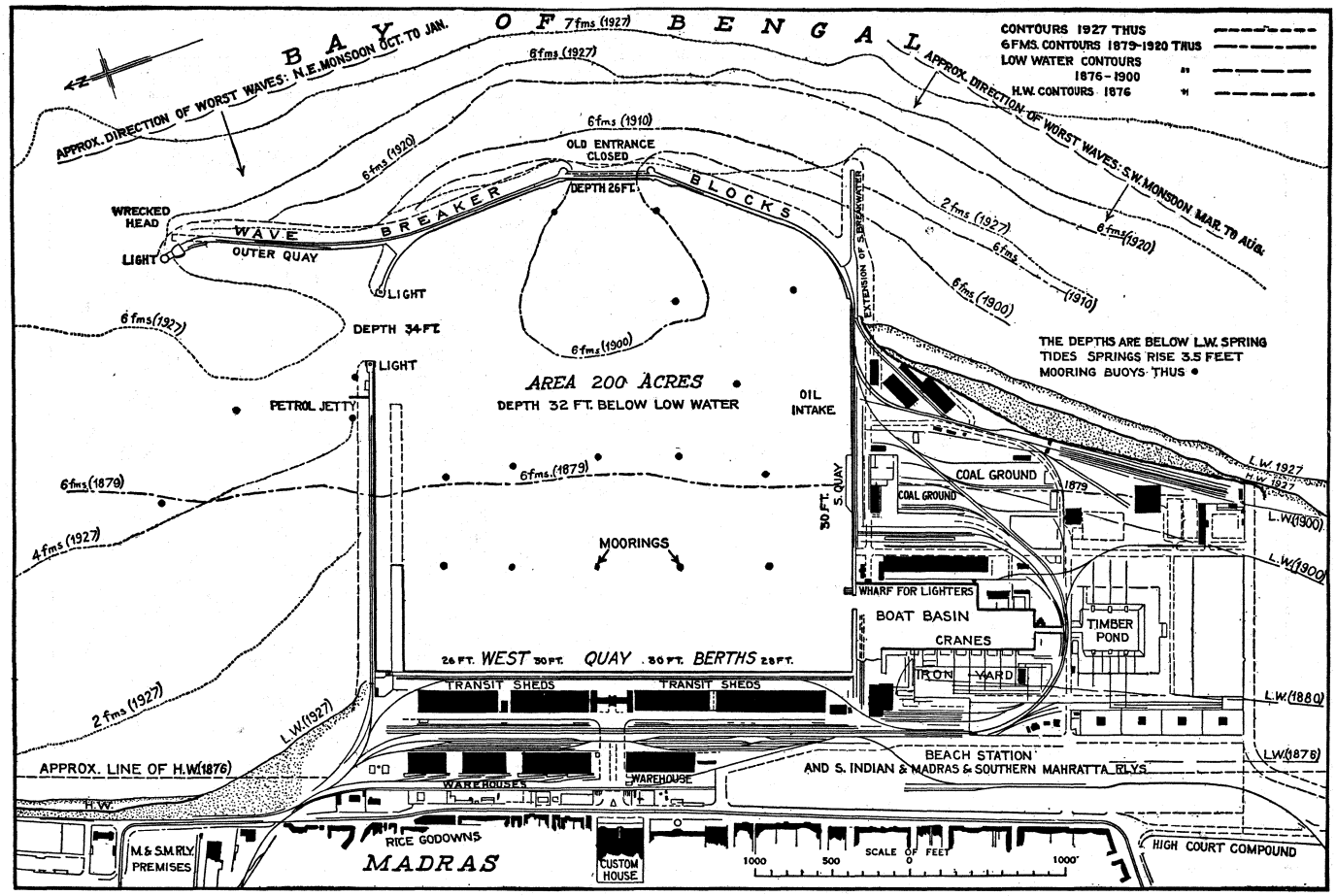


FIG. 2.—MADRAS HARBOUR

in the latter. (7) The entrance width to a tidal harbour must not however be so restricted as to produce through the opening a current interfering with safe navigation. (8) The approaches to the entrance from seaward should not be obstructed by submerged dangers in or close to the recognized channel. If there be any such dangers in the vicinity of the harbour entrance they must be removed or, at least, suitably marked. (9) There should be sufficient extra depth of water (over the nominal depth of the harbour) in the approaches and at and near the entrance to allow for the effect of range.

Waves.—The action of waves on solid structures is discussed under BREAKWATER (*q.v.*), and for theories concerning them and their phenomena *see* WAVES OF *THE* SEA; the writings of the authorities mentioned in those articles should also be consulted. Here we will mention one matter closely connected with the selection of harbour sites.

The height of waves depends mainly on the strength and duration of the wind, and the fetch or distance the waves have run. The importance of this last factor can be realized when it is considered that the sea is always smooth under the windward shore, regardless of how strong the wind may be, or for how long it has been blowing. Studies at the Scripps Institute of Oceanography, Woods Hole, Mass., of the basic energy relationships between wind and waves made by H. U. Sverdrup and W. H. Monk, showed that a 40-knot wind blowing for a sufficient duration to generate the highest waves will produce a 7-ft. wave when the fetch is 10 mi., a 19-ft. wave when the fetch is 100 mi., and a 36-ft. wave when the fetch is 1,000 mi. This relationship presupposes unobstructed deep water, for waves of great height cannot reach any coast line or artificial obstruction unless there is an unbroken stretch of deep water for their propagation. Reefs and sandbanks, even though entirely submerged, materially reduce the range of undulation; and a sudden change in the level of the sea bed, even in comparatively deep water, may produce a breaking wave. The heights of waves are increased when they are propagated up tunnel shaped or converging channels and are decreased when they pass into expanding channels.

Effect of the Angle of Incidence of Waves.—*If* the line of the outer face of a harbour work, such as a breakwater, is at right angles to the direction of the waves, the blow delivered by a wave against the solid structure will be at its maximum. When, however, seas strike the face in an oblique direction so as to be deflected towards the breakwater head and harbour entrance, the waves will sweep across the entrance, or wheel round the head, thus causing a turbulent cross sea at the point where vessels enter or leave the harbour. It is an advantage when the face of the breakwater can be aligned so that the heaviest seas assail it obliquely at such an angle that the waves are deflected away from the entrance and towards the inner or shore end of the structure. But in such cases the shore must be adequately protected, naturally or artificially, against scour.

It is a matter of common observation that the direction of waves is sometimes changed on passing a headland and that they will wheel round and enter a bay on the lee side of the head and break on a lee shore. A similar effect is often noticed in the case of islands and it frequently occurs at the head of breakwaters. The phenomenon is no doubt due to the frictional retardation of the inshore portion of the wave in shallow water. The deflection of waves during their passage up a wide channel between two shores is susceptible of similar explanation. Even if the wind is blowing and the waves are travelling up the channel in the direction of the centre line, the waves will be deflected and curve round so as to approach the shore on lines almost parallel with it.

Spending Beaches and Range.—*The* best method of quickly reducing the height of waves entering a harbour is to secure their lateral expansion. This may be effected by widening the harbour immediately inside the entrance and providing for expending beaches; or by intercepting, by means of spurs, groynes or wave traps, the ends of the entering waves, thus admitting of endwise expansion after the interception has taken place; or by a com-

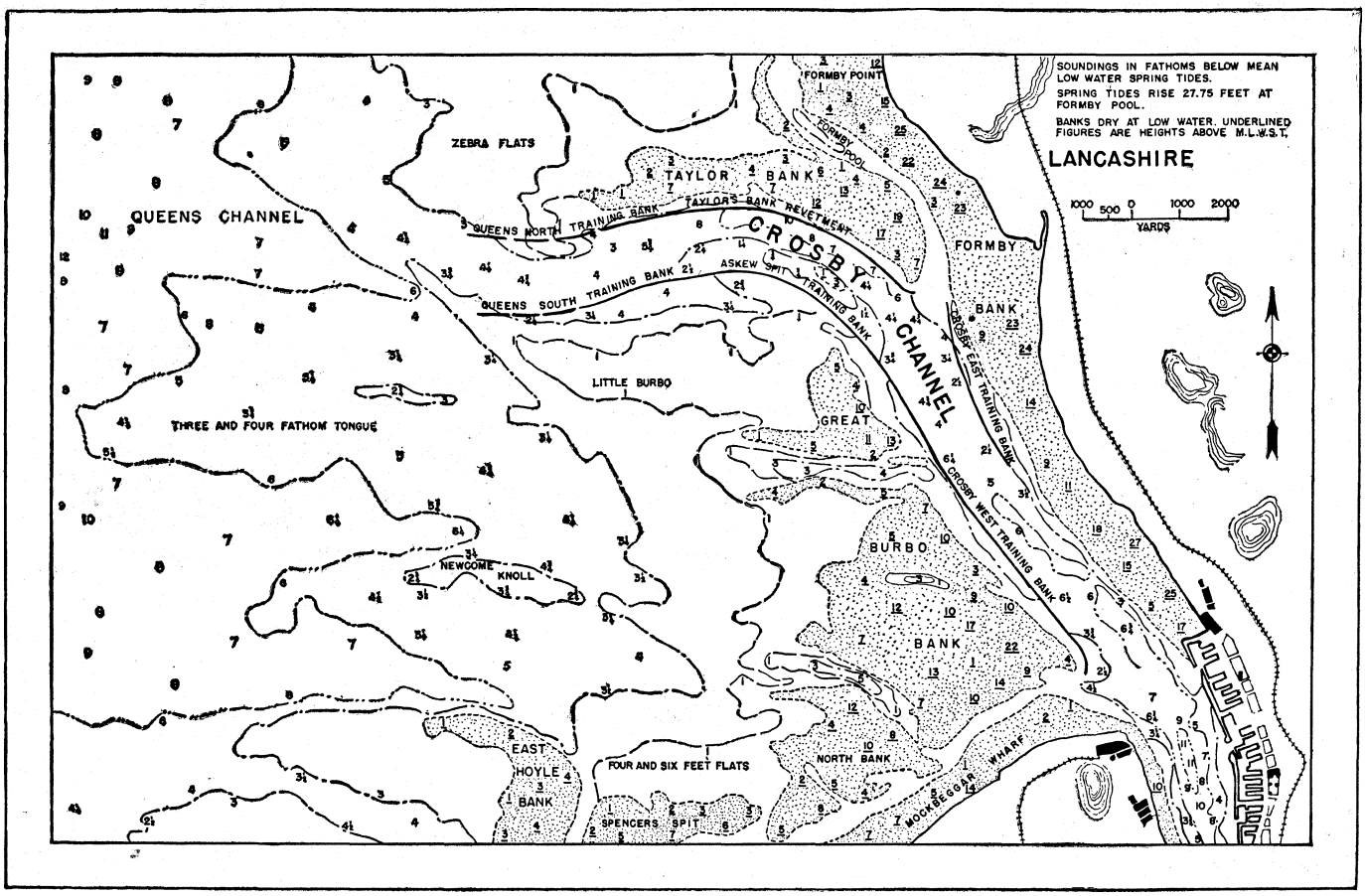


FIG. 3.— LIVERPOOL BAY AND MERSEY ENTRANCE CHANNELS

bination of these means. (See *Proc.* Inst. C.E. vol. CCIX, **1921.**) The first method is the more effective and is to be preferred for harbours whose entrances are exposed to heavy seas. The harbour at the Tyne entrance (fig. 1) illustrates the combined effect of widening within the breakwater heads, expending beaches and wave traps. Waves **30** ft. in height have been observed just outside the entrance during a sustained gale from the northeast. The reduction of range between the pierheads and the Narrows at Shields, a mile inshore, is more than 90%. The entrance between the outer pierheads is 1,180 ft., and the greatest width in the outer harbour is about 5,000 ft. The arrangement of breakwaters and spending beaches in the outer harbour at Sunderland, Eng., and in that at Ymuiden, Neth., is somewhat similar to the Tyne. Wave traps are frequently introduced in the planning of jetty harbours. (See below.)

TYPES OF HARBOURS

Natural Harbours.— A sheltered anchorage in its simplest form is sometimes found under the lee of outlying reefs, sandbanks or islands. Where there is good holding ground and the shelter afforded is sufficient to give protection from heavy seas, such an anchorage is termed a roadstead. Examples are the Downs under the shelter of the Goodwin sands; Dunkirk road, under the lee of the Braekbank sand; Yarmouth roads and the anchorages in sheltered positions in some wide estuaries such as that of the Thames. Others are found in deep embayments where shelter is afforded from the worst winds by projecting headlands, as in Weymouth and Portland roads. A well-known example of a roadstead protected by an island is that sheltered by the Isle of Wight.

Natural havens to which the term harbour is ordinarily applied are those inlets or arms of the sea which are almost completely landlocked. Where such natural shelter is found combined with ample depth of water, both in the approaches and in the anchorage, and in positions convenient for sea-borne trade, it is of great value to shipping; such havens, even without artificial works, serve as harbours of refuge, and the necessary interior works of a port can usually be constructed in them without difficulty and at much less cost than in an exposed and open situation. Well-known examples in addition to those already mentioned are the harbours of Port Royal and Kingston in Jamaica, Southampton Water, Eng., the landlocked sea inlets of San Francisco, Calif., Cromarty Firth and Scapa Flow, Scot., Milford Haven, Wales, Queenstown, Ire., Falmouth, Eng., and Kiel, Ger. In many situations, however, there are large enclosed water areas having openings into the sea which are either obstructed by a bar at the entrance, as in the lagoon harbour of Venice and the enclosed bay harbour of Durban, or are shallow. Works of considerable magnitude are often required for the improvement and maintenance of such harbours.

Estuary Harbours and Entrances.— Some rivers which possess sufficient depth of water in the tidal compartment for the navigation of vessels of considerable draught up to the docks or wharves of the port are obstructed in the estuary, or where they discharge into the open sea, by banks of sand or silt which, sometimes, are liable to change of position. In other estuaries the approach channels from the open sea to the river proper may be sufficient for all the requirements of shipping while the river channels are of insufficient depth.

Not only are such obstructions or bars met with in the estuaries of rivers which discharge into seas that are either tideless or of small tidal range, but they are frequently present when the rise and fall of the tide is considerable, as in the Mersey (fig. **3**). Rivers opening out into large expanding estuaries, such as the Severn, Scheldt and Clyde, are usually free from bars; and rivers which gradually widen out as they approach the sea are not ordinarily impeded by bars, though they may be obstructed by sandbanks, as in the Thames and Humber, through which the tidal streams form good channels to the sea. The formation of a navigable channel through a bar, or the improvement of natural channels to provide for the increased draught of vessels. has been effected in a few cases by dredging alone, in some by training

works or jetties, and in many cases by a combination of the two methods. The Mersey at Liverpool and the harbour of New York city are notable examples of the first case of estuarine conditions embracing the presence of a bar with deep water in the river above it.

The Mersey Entrance.—The inner estuary of the Mersey has a depth in some places of about 63 ft. at low water; however, by 1890 the bar in the principal channel maintained a depth of 10 ft. to 12 ft. at low tide. In 1890 dredging started which was later carried on continuously and there was no difficulty in maintaining a go-ft. depth over the bar. By 1906, 105,000,000 tons of material had been removed. However, despite the dredging the Queen's and Crosby's channels were becoming more and more distorted and growth of what later was named Taylor's spit continued. (See fig. 3.) To fix the channel and prevent its encroachment on Taylor's bank, and in an effort to lessen the dredging required, building of the various submerged revetments and rubble stone training walls was begun in 1909 and proceeded almost continuously except for interruptions during World Wars I and II. As many as 22,000,000 tons were dredged from the sea channels in one year (1936), but after World War II this quantity was less than 10,000,000 tons annually. Construction of the Queens training banks was still proceeding at mid-century. It was hoped that when the training works had reached their full length, the tides would work together and drain the river automatically. For the complete history of revetments and training walls in the sea channel approaches, see J. A. Cashin, "Engineering Works for the Improvement of the Mersey," (Journal *Inst.* C.E., May 1949).

New York Harbour Entrance.—Until 1885 the natural channels in the southern approach to New York harbour sufficed for all the requirements of shipping. The Gedney channel had then a depth of about 24 ft. at low water and about 28 ft. at high water neap tides. Above the sandbanks which obstruct the lower bay there was ample natural depth—more than 44 ft. at low water—in the harbour (fig. 4).

In 1885 the deepening of the Gedney channel by suction dredging was commenced and by 1892 30 ft. at low water had been obtained over a channel width of 1,000 ft.

In 1899 Ambrose channel, an entirely artificial and shorter dredged cut through the sand banks, 40 ft. deep and 2,000 ft. wide, was started. In 1939 both channels were deepened an additional five feet. The dredging of the Gedney channel was the earliest successful attempt to mainain an open channel through exposed sandbanks by means of dredging alone.

Such attempts had been made, for instance, at the bar at the mouth of the practically tideless Mississippi where, for years before the training works were commenced (see RIVER AND RIVER ENGINEERING), a dredger was employed for forming a channel for the waiting vessels, the channel, however, silting up almost as rapidly as it was made.

Other Instances of Dredging.—Suction dredging of the open sea channels of many estuaries has been carried out with success, as for instance. in the Scheldt which gives access to Antwerp, Belg.; in the Rio de la Plata in the approaches to Buenos Aires, Arg., and Montevideo, Urug.; in the sea approaches to Brisbane, Queensland, and through the sea bar known as the Fairy Flats at the mouth of the Yangtze. The success of these operations has only been made possible by the improvements effected in the construction of large and powerful sand pump dredgers (see DREDGERS AND DREDGING).

Lagoon and Jetty Harbours.—The formation or improvement of harbours on the sea coast by the construction of jetties across the beach and foreshore, at points where river mouths or lagoons or, in some cases, low marshy land afforded suitable sites, has been practised for more than 200 years.

Lagoons.—A marine lagoon is a shallow lake separated from the sea by a narrow belt of coast formed of deposit from a deltaic river or of sand dunes heaped up by onshore winds along a sandy shore. Many such lagoons possessing good natural shelter have outlets which are maintained through the fringe of coast, even when the tidal rise is quite small, by the scour of the water flowing into and out of the large expanse at each tide, aided by the discharge from any rivers falling into it. These outlets afford navigable access to the lagoon in which, moreover, natural channels are formed by the action of the currents. Because of the scour of the issuing current becoming gradually too enfeebled, on entering the open sea, to overcome the heaping up action of the waves along the shore, the sea entrance to a lagoon is however usually obstructed by a bar which tends to form a continuous beach across the opening.

The depth over the bar in front of a lagoon entrance can sometimes be improved by concentrating the current through the outlet by jetties on each side. This has been done with success and, up to a point, without recourse to dredging, in the cases of the three entrances to the lagoon harbour of Venice at Malamocco, Lido and Chioggia, where the tidal range at springs is no more than three and one-half ft. (fig. 5). At Malamocco the low-water depth on the bar was increased from $11\frac{1}{2}$ to 31 ft., and at the Lido entrance from 8 to more than 22 ft. The two training jetties at Chioggia, completed in 1934, resulted in the channel over the bar being scoured to a depth of 20 ft. Since 1921, however, the Lido entrance has been dredged in order to maintain a low-water depth of 30 ft.

Dredging, in combination with the scour induced by jetties constructed after 1909, provided a deep entrance channel through the bar at Rio Grande do Sul on the southeast coast of Brazil which formerly obstructed the access to a series of deep landlocked lagoons of very large area. On the other hand dredging alone is relied on to form and maintain a channel 40 ft. deep through the bar which fronts the narrow entrance to a lagoon of great extent and depth at Cochin on the southwest coast of India, and the construction of jetties is not intended.

Jetty Harbours in English Channel, *etc.*—On the sandy shores of the English channel and North sea there are several well-known harbours where, formerly, flat marshy ground, lying below

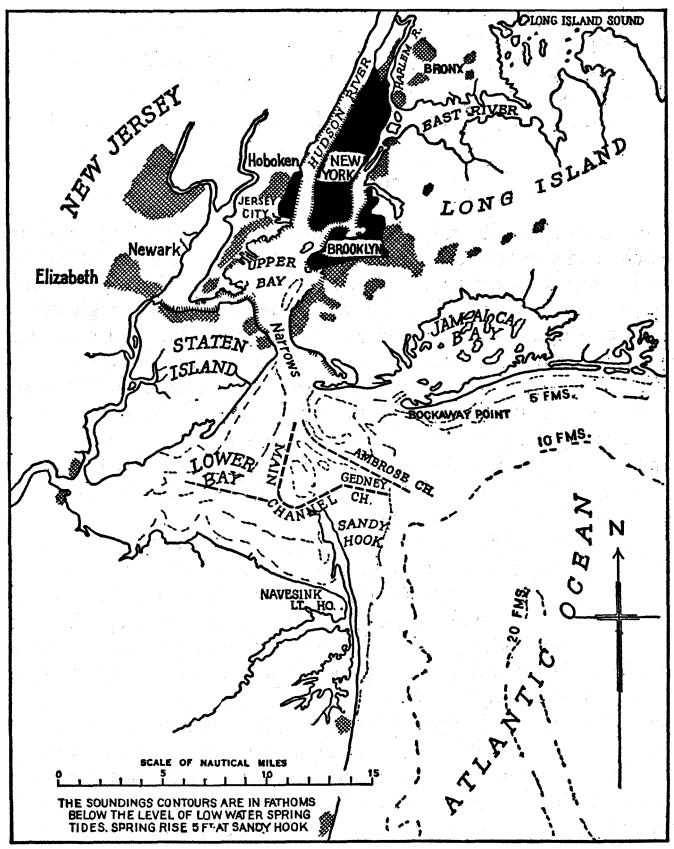


FIG. 4.—NEW YORK HARBOUR

the level of high water and shut off from the beach by dikes or sand dunes, was connected with the sea by a small creek or river. In their original condition these ports presented some resemblance, although on a very small scale, to lagoons. Such are the old harbours of Dieppe, Boulogne, Calais and Dunkirk, Fr.,

and Nieuport and Ostend, Belg. The passage of water from these tidal areas through a narrow opening served to maintain a shallow channel to the sea. When deeper channels were required the scour was concentrated by erecting jetties across the beach. This obstruction to the littoral drift of sand caused a building-up of the beach, and as a reclamation of the low-lying areas was effected, the tidal scour was reduced. Sluicing basins were therefore formed into which the tide flowed; the water, being shut in at high tide by gates or sluices, was released at low water producing a rapid current through the channel. The sluicing current, however, gradually lost its velocity in passing down the channel and was not effective in maintaining the full length of the channel. The introduction of powerful mechanical dredging appliances, particularly the improved suction dredgers, led to the substitution of dredging for artificial sluicing, and made it possible to form and maintain channels of uniform depth.

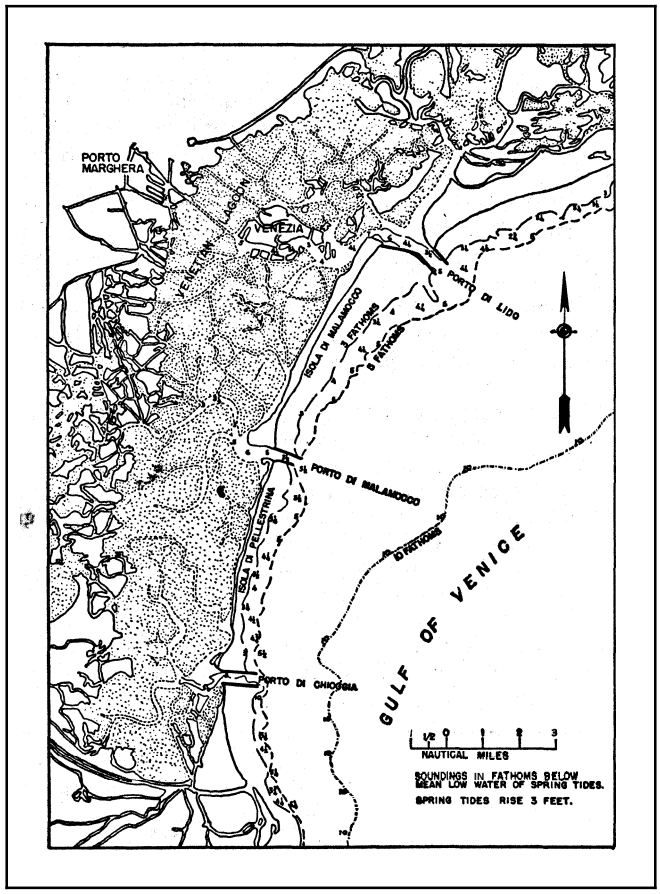


FIG. 5—THE VENETIAN LAGOON

During the past half century jetty construction has been applied with varying success to the improvement of harbour entrances on a much larger scale than in the channel ports, not only in Europe but in America and other parts of the world, particularly where a river having a considerable flow or an extensive backwater provides the means for effective scour. Instances where scour alone has been effective in securing depths sufficient for large vessels are rare, and dredging has generally to be resorted to for this purpose. It should be noted here that entrances formed by jetties with a narrow channel between them are, from the point of view of the navigator, unsatisfactory in positions of considerable exposure on the open coast, particularly at ports used by large vessels.

Jetty Harbours in North America.—In the United States there are many examples of jetty harbours. At Charleston, S.C., for instance, a landlocked bay 15 sq.mi. in extent and with ample depth of water, provides an adequate harbour, but the narrow entrance was obstructed by a bar. Converging entrance jetties, each more than two miles long, with openings at their inner ends, were constructed to concentrate the scour, caused by the tidal range of about five and one-half feet at springs, and to protect the channel from littoral drift. The jetties, however, caused an advance of the foreshore and a corresponding progression seaward of the bar with the result that extensive dredging is required to maintain a low-water depth of 30 ft. beyond the ends of the jetties and in the channel. At Aransas Pass, Tex., in the Gulf of Mexico, two jetties have been constructed at the narrow sea entrance to a lagoon or enclosed bay through which a dredged channel, 21 mi. long, and 32 ft. deep has been made between the pass and the port of Corpus Christi. In addition a 25½-ft. channel, seven miles long, branches off from this channel to Encial. In this case the channel between the jetties was formed and maintained entirely by dredging.

Among other jetty entrances to lagoon harbours in the Gulf of Mexico are those at Sabine pass and Galveston bay. Sabine pass is the outlet into the Gulf of Mexico for Sabine lake and its two important tributaries, the Sabine and Neches rivers. The ports of Port Arthur, Orange and Beaumont are on the lake and the two rivers respectively. The bar and pass were improved by dredging and by the construction of two jetties extending from the entrances about four miles across the bar and into the Gulf. The pass was dredged to 34 ft. below mean low water. Bolivar channel, the outlet of Galveston bay on which lie the ports of Galveston and Texas City, also marks the end of the so-mi. channel to the inland port of Houston. Converging jetties from Galveston Island and Bolivar peninsula extend about four miles into the Gulf, and are one and one-half miles apart at their end. The bar was improved by the jetties, and by dredging to 34 ft., and extends nearly four miles into the Gulf of Mexico.

Lagoons of Coral Formation.—Lagoons of coral formation and waters sheltered by coral reefs often furnish valuable natural harbours as in many of the islands of Oceania; examples are Pago-Pago in the Samoan Islands and Honolulu in the Hawaiian group. In them the problems presented by sandy bars and entrance channels do not as a rule arise. Port Sudan in the Red sea is an example of a deepwater inlet, bordered by coral reefs rising to just above water level, which has been converted into a useful commercial port by the construction of low quay walls along the margin of the steep-to coral. The entrance is a natural opening 900 ft. in width through the coral reef.

Other Jetty and Bar Harbours.—The physical features of semiartificial harbours formed in lagoons, backwaters, enclosed bays and at the mouths of barred rivers, differ so much that they exhibit an almost endless variety of works applied to their formation and improvement. A few examples only can be mentioned here.

Hook of Holland.—When the artificial channel for the river Maas was cut, during the 1870s, from Rotterdam to the North sea at the Hook, the sea entrance was flanked by diverging jetties. Rapid silting in the entrance led to the construction of a third and internal jetty to contract the channel to a width of 2,100 ft., and thereby increase the scour. The low water depth of 30 ft. at mid-century was maintained chiefly by the tidal action, although some dredging was performed.

Durban.—The entrance to the landlocked harbour of Durban, U. of S. Af., (see Proc. Inst. C.E., vol. clxvi, 1906; cxciii, 1914; cxcvi, 1914) is between two nearly parallel breakwaters or jetties about 600 ft. apart, though the channel is no more than 400 ft. wide (fig. 6). Before 1883, when the first breakwater was begun, the bar at the entrance often shoaled so much that there was sometimes less than three feet of water over it. The constant travel of littoral drift from south to north across the harbour mouth almost completely neutralized the scour induced by the great volume of water flowing between the piers every tide, into and out of the large landlocked bay; and it was not until intensive suction dredging was employed, about 1896, that the low-water depth in the entrance was increased beyond 16 ft. It has since been steadily improved by continuous dredging until now a depth of about 42 ft. is available. Narrowness of the channel between the jetties has always made the entrance a difficult one.

Karachi *and Vizagapatam.*—Karachi, capital of Pakistan, is a natural harbour, with an ample backwater, extensive creeks, and

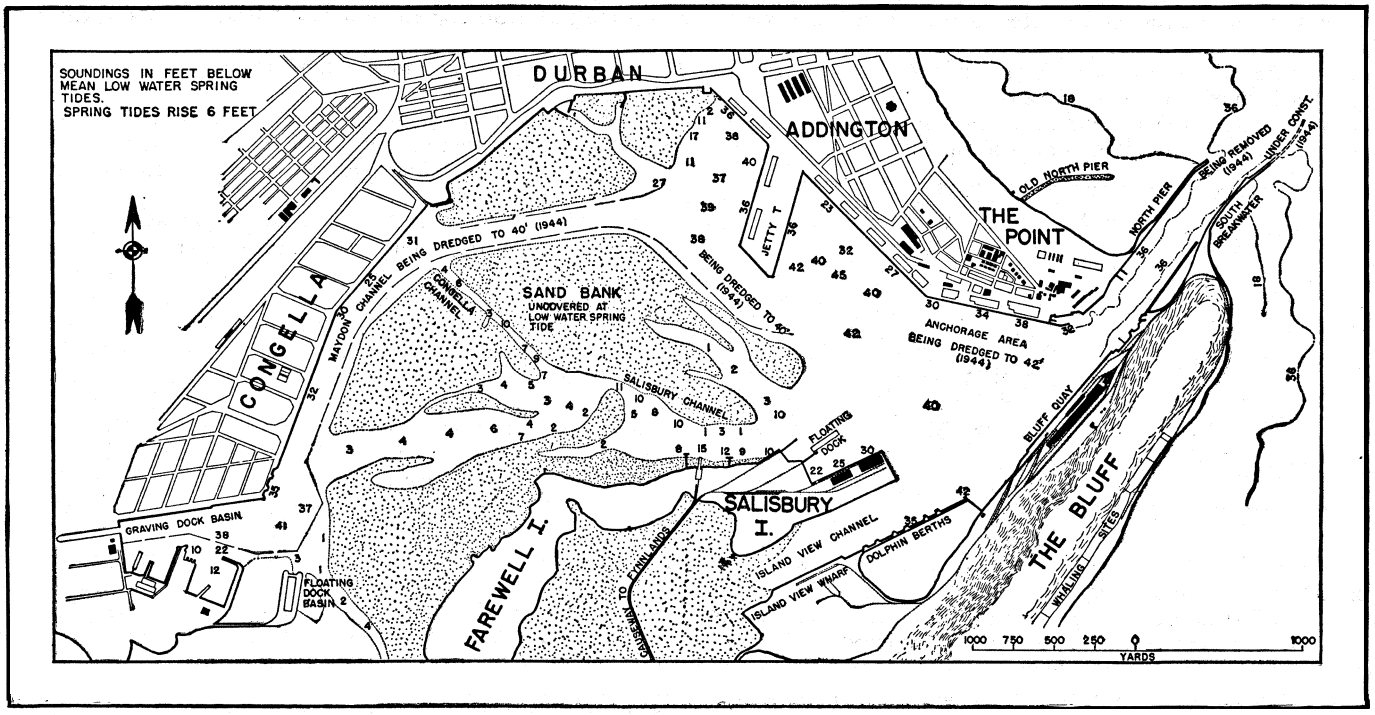


FIG. 6.—DURBAN HARBOUR ENTRANCE

a tidal range of eight and one-half feet, which has been developed by building entrance jetties and dredging, and by the construction of deepwater quays within the harbour. Somewhat similar natural conditions exist at Vizagapatam (spring rise, four and one-half feet), a port halfway between Madras and Calcutta, where there is a tidal creek and backwater of lagoon character with a narrow and shallow entrance in an exposed position on the coast line. Deepwater internal port works were begun in 1928 and an interesting and bold attempt was made to form and maintain, by dredging, a channel of 30 ft. at low water through the narrow entrance and into the backwater, protected by a rubble stone jetty on its northern side only. This attempt was attended with success and the least depth in the entrance channel in 1940 was 37 ft. This depth was maintained without difficulty for several years.

The channel leading to the harbour entrance was, in 1933, further protected on its south or weather side by the construction of an island breakwater about 1,000 ft. long of stone rubble, the nucleus of which was formed by sinking two old ships filled with stone in the desired position.

Lagos, the principal port of southern Nigeria, has an entrance 1,700 ft. wide, formed by dredging between converging jetties of rubble stone.

Australian Bar Herbours.—The harbour of Newcastle, N.S.W., the principal coal port of Australia, is in a backwater into which flows the Hunter river. The entrance was obstructed by a sand bar with less than 13 ft. over it at low water. Jetties constructed to shelter and improve the passage over the bar, where the spring rise is 5 ft., had little effect in the latter direction, but since 1905 dredging has increased the depth to about 26 ft., and a moderate amount of sand dredging suffices to maintain the channel depths. The width of channel between the jetties at the entrance, about 1,400 ft., is larger, on account of the exposure, than is usual in jetty harbours. Range in the harbour is considerable and the slight divergence of the jetties tends to increase it. Wave traps have been formed at the sides of the channel between the jetties.

Fremantle harbour, the principal port of Western Australia, at the mouth of the Swan river, has been made by the removal of a bar of rock and sand which completely blocked the entrance to the river. At the site of this bar and within it there is now a harbour 36 ft. deep at low water protected by jetty breakwaters. The river mouth is sheltered by outlying islands and shoals and the sand travel is not a serious problem.

New Zealand Bar Harbours.—Otago harbour, one of the few New Zealand natural harbours at which improvement works in the entrance have been necessary, is in the South Island. A training mole at the bar entrance, training works in the inner channel and a moderate amount of dredging have been effective in providing a channel with a least depth of 30 ft. at low water where formerly a sandy bar and inner shoals restricted it to about 15 ft. (See Proc. Inst. C.E., vol. cx, 1892; cxxi, 1895; and cc, 1915.) The harbour is a long narrow sea inlet at the head of which, about 11 mi. from the entrance, is situated the town of Dunedin.

Westport, on the west coast of the South Island and the principal coal port of the dominion, furnishes an example of the provision of wave traps (fig. 7) in an entrance between converging training jetties or breakwaters built in 1886–93. The position is one of moderate exposure, the entrance being open to the Pacific. The combined effect of the contracted river and tidal scour and a moderate amount of dredging has increased the low-water depth over the bar from 4 to about 18 ft., the rise of springs being $9\frac{1}{2}$ ft. (See Proc. Inst. C.E., vol. cxii, 1893; cxxxvi, 1899.) For other examples of jetty harbours at river mouths see JETTY and for harbours at river outlets see RIVER AND RIVER ENGINEERING.

Bay Harbours Protected by a Single Breakwater.—The adoption of a deepwater bay for a harbour reduces the necessity for providing artificial shelter and, in most situations, secures a site not exposed to silting, where sheltering works do not interfere with any littoral drift along the open coast. In favourable situations a deep and narrow bay or inlet may be sheltered by a single breakwater extended out from one shore across the outlet of the bay, having a single entrance between its extremity and the opposite shore. Sometimes—where the exposure is from one direction only approximately parallel with the coast line at the site, and there is some natural shelter in the opposite direction—a single breakwater extending at right angles to the shore, with a bend or curve inward at its outer end, suffices to afford the necessary shelter. An example of this form of harbour construction is Newhaven breakwater, Eng., protecting, on the west side, the approach to the river port which is somewhat sheltered from the moderate easterly storms by Beachy head. Other examples are Holyhead and Fishguard, Wales, Brixham, Eng., Victoria, B.C., and Valparaiso and other harbours on the Chilean coast. The Folkestone harbour pier is an example of a single curved breakwater, sheltering the harbour formed on its east and north sides,

which also has berths on its outer face used in heavy weather from the east or northeast.

Fishguard.—The harbour here was made by the building (1900–18) of a breakwater across Fishguard bay. The internal shelter was increased by the subsequent construction of a second breakwater thrown out from the shore in the middle of the bay.

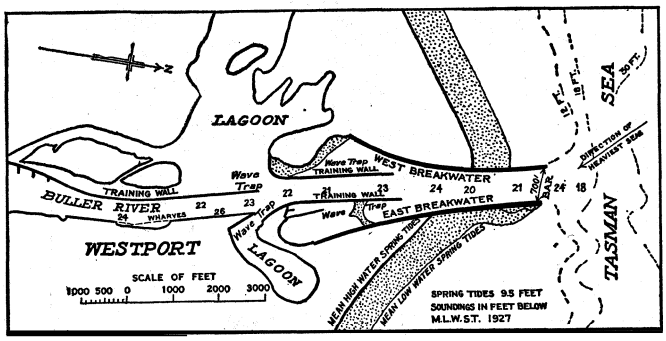


FIG. 7.— WESTPORT HARBOUR. NEW ZEALAND

Chilean Ports.—The breakwater at Valparaiso (see BREAKWATER) is a remarkable structure projecting from the western shore of Valparaiso bay. The seaward termination is in a depth of 180 ft. of water. The water area, fully sheltered by the breakwater approximately 3,230 ft. long, is small and the cost (reported to be almost £800 per lineal foot) very large in proportion to the benefit.

Single breakwaters were also built in the bays of San Antonio (1911–18) and Antofagasta (1918–27). In each of these cases the breakwater is bent in plan having two straight arms connected by a curved portion. The sites are somewhat more sheltered than Valparaiso bay and the depths of water considerably less. The outer arm of the Antofagasta breakwater was almost completely demolished within a few hours on Aug. 9, 1929; but the work was later rebuilt. At both harbours piers and other inner port works were reconstructed under the lee of the breakwater.

Island Breakwaters Protecting *Embayments*.—A well-known example is the breakwater converting the natural harbour of Plymouth, Eng., into a place of almost perfect shelter. Plymouth sound, one of the most famous and historic roadsteads of the world, and the deep inlets or creeks above it, form a harbour into which fall the rivers Tamar and Plym. The breakwater is one mile in length, stretching across the middle part of the sound. Begun by John Rennie in 1812, it was completed about 1827. In the harbour itself are the naval dockyard establishments at Devonport and Keyham, and a small commercial dock and port works at Millbay and in the Cattewater.

Cherbourg.—The breakwater across the wider but shallower bay forming Cherbourg harbour and roadstead, in France, is another example of an island structure but in a more open and exposed position than Plymouth. Begun in 1784, its construction was continued under Napoleon, but it was not completed until 1858. More than $2\frac{1}{4}$ mi. in length it is built, for the most part, in a depth of about 42 ft. at low water. It is of composite construction, a solid superstructure surmounting a rubble stone mound. The sheltered water area is more than 2,000 ac. in extent, but less than one-half of this is of sufficient depth for large vessels. The two entrances on the east and west are between the breakwater ends and islands which are joined to the mainland by breakwater walls. In 1933, deepwater quays were brought into use, having a depth alongside of 46 ft. at low water.

Delaware Bay.—The Delaware breakwaters at Cape Henlopen, Del., the south horn of the entrance to Delaware bay, are both of the island type. The first, built (1828–69) inshore under the shelter of the headland, is the prototype of American rubble-mound breakwaters. The national harbour of refuge of about 800 ac. formed outside the old breakwater by the U.S. government (1897–1901) is protected by a rubble-mound breakwater 8,025 ft. in length built in a depth at low water of about 30 ft.

Another excellent example of island breakwaters is that at Duck Island harbour, near Grove Beach, Conn. Two breakwaters projecting at right angles from Duck Island partially enclose a 16-ft. anchorage basin and a third breakwater one and one-half miles to the southwest protects the anchorage from the remaining exposure.

Island breakwaters frequently form portions of the artificial protection of harbours in conjunction with breakwaters projected from the shore line. Some examples of this combination are referred to hereunder.

Bay Harbours with Two or More Breakwaters.—The method most generally adopted for the completion of the shelter of deeply indented bay harbours is the construction of a breakwater extended across the outlet from each shore, leaving a single entrance between their ends, where usually the deepest water is found as at Peterhead, Scot., and Monaco. If one breakwater placed somewhat farther out is made to overlap an inner one, and so cover it to some extent from the direction of the heaviest seas, a more sheltered entrance is sometimes obtained. This arrangement was adopted when additional protection works were built at the entrance to the old bay harbour at Genoa (fig. 8) and for the harbour in Bilbao bay, Sp., at the mouth of the Nervion. The breakwaters at Valletta, Malta, and those at the entrance to the almost landlocked Spanish naval harbour at Cartagena are also planned in this way. Many harbours formed in wide or open bays, and in other positions where some abrupt projection from the coast line has been utilized as providing shelter from one quarter, have their protection completed by two or more breakwaters enclosing the site. Dover (fig. 9) and Colombo, Ceylon, (fig. 10) furnish typical and somewhat similar examples. Both of these were begun

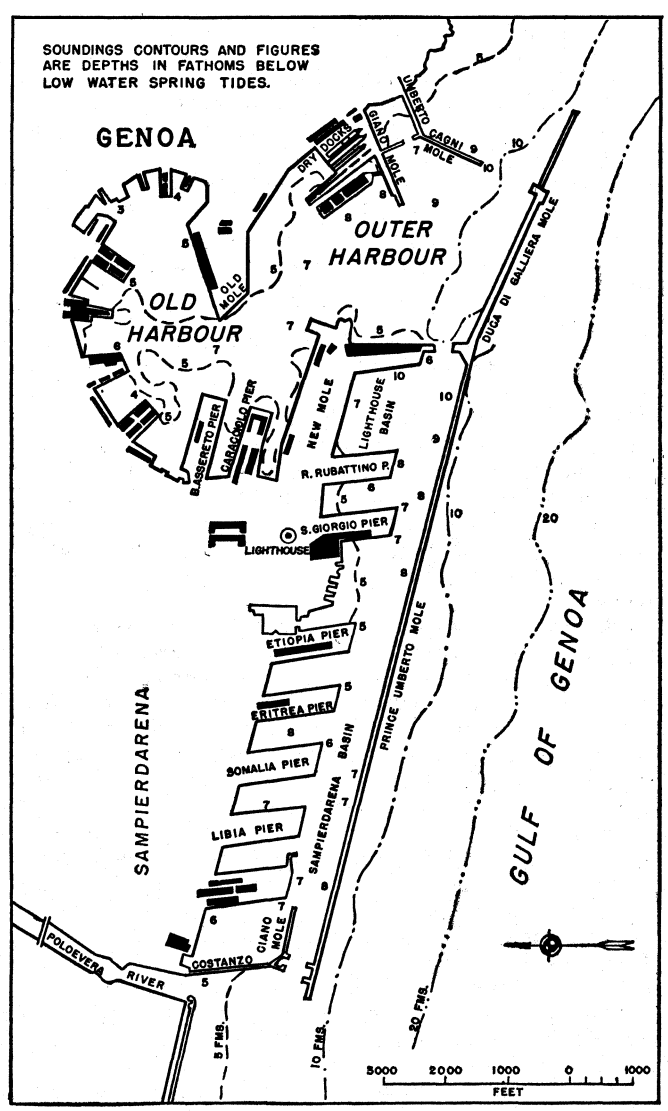


FIG. 8.—GENOA HARBOUR

as single breakwater harbours, and their conversion into enclosed harbours was not completed until many years later.

The extension of artificial shelter has often been brought about not only by the demand for more complete protection against heavy seas and consequent range in a harbour, but also by the growth in the dimensions of ships and the increase in the trade of a port. Thus, greater depth of water and extended accommodation have been obtained at one and the same time with the improvement of the shelter by building additional breakwaters.

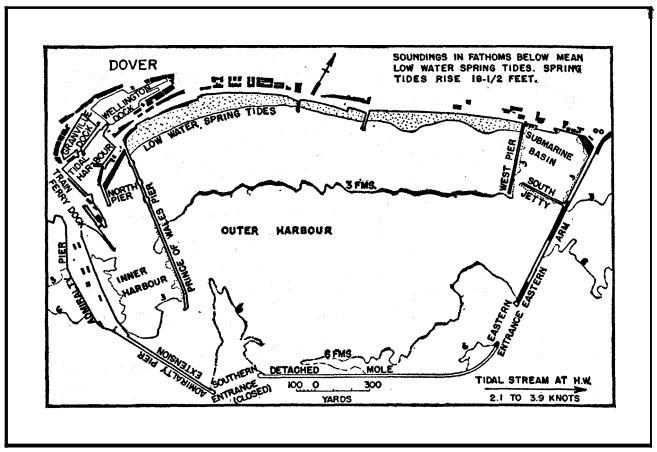


FIG. 9.— DOVER HARBOUR

In some instances a wide or exposed entrance to a harbour formed by breakwaters thrown out from the shore has been sheltered by an island breakwater built in front of the opening and thus providing two entrances, one at each end of the island structure; Bizerta, Tunisia, and Cette, Fr., furnish examples. In other cases, as at Dover, Portland and Colombo, the line of breakwaters enclosing the harbour has been made discontinuous, two, and in some cases more, openings being formed between them. The Gibraltar harbour works (1893–1904), made in the sheltered Bay of Algeciras on the west of the rock, include a detached mole with two entrances between it and the breakwaters which are connected with the shore.

Dover.—This is an example of an artificial harbour formed on a coast of moderate exposure—the narrowest part of the Straits of Dover. The nucleus of the harbour which exists today was the Admiralty pier, commenced in 1844 and extended to form the western arm of the outer harbour. The pier afforded shelter from the south and west, and protection from the north is given by the coast line and was increased later by the building of the Prince of Wales pier. The works carried out between 1897 and 1909 enclose a low-water area of 690 ac. and comprise, in addition to the Admiralty pier, now 4,000ft. long, an island breakwater of 4,212 ft. and an eastern arm of 2,942 ft. connected with the shore (*see* BREAKWATER). The harbour was handed over by the admiralty to the Dover harbour board in 1923 for commercial use, and it has been proposed, with the object of reducing the severe range in the harbour, to close the western entrance (740 ft.), leaving only the eastern opening (650 ft.) available for shipping.

Portland.—The refuge and admiralty harbour of Portland furnishes an instance of the conversion of a naturally sheltered roadstead into an enclosed harbour by the construction of breakwaters projecting from the horns of a bay. The Isle of Portland—actually a peninsula joined to the mainland of Dorset by the Chesil bank—shelters the roads from the south and the anchorage is exposed to storms only from east to south. The southern, or inner, and the eastern, or outer, breakwaters were begun in 1849 and completed in 1872, the latter being in eight to ten fathoms at low water. Later two additional breakwaters were added, one projecting from the Bincleave rocks near Weymouth on the north side, and the other, an island structure, on the northeast of the harbour. The last was finished in 1904, the building of the later breakwaters being carried out, partly at any rate, as a protection against torpedo attack. There are three entrances between the four breakwaters; but one of them, the southern, was closed in 1914 by sinking a blockship in it, and it is not proposed to reopen it. The breakwaters have a total length of three and one-fourth miles and shelter a water area of four square miles. Portland is one of the largest artificially enclosed harbours in existence.

Colombo.—The artificial harbour at Colombo (fig. 10) begun in 1875, occupies an exposed situation in an embayment on the west coast of Ceylon. The site is sheltered to some extent from southerly winds and to a lesser degree from the north. The breakwaters are fully exposed to westerly gales from the Indian ocean. The southwest breakwater, the first to be constructed, is 4,212ft. long and was completed in 1885 (see BREAKWATER). Two additional breakwaters, the northwest and northeast, 2,670 ft. and 1,080ft. respectively, were built between 1892 and 1906, thus completing the enclosure of the harbour except for two openings of 800 and 700 ft. respectively. The shelter afforded was still in-

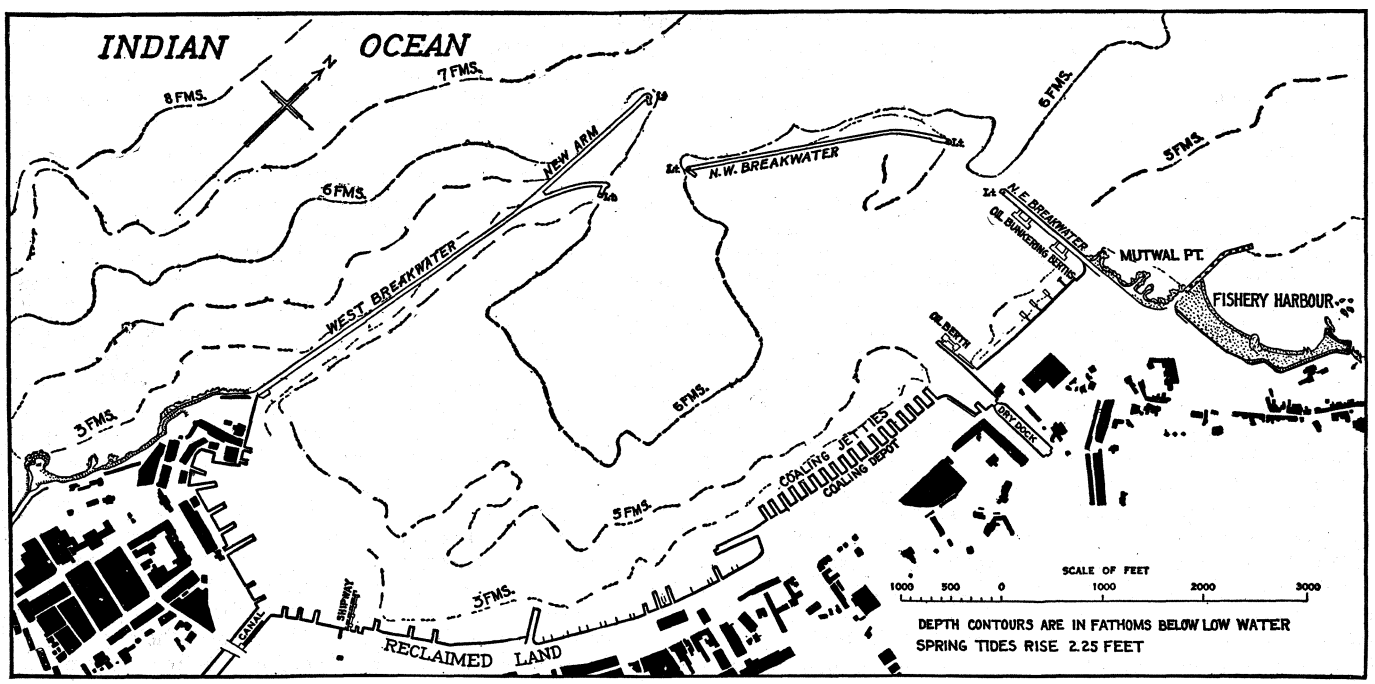


FIG. 10.— COLOMBO HARBOUR. CEYLOW

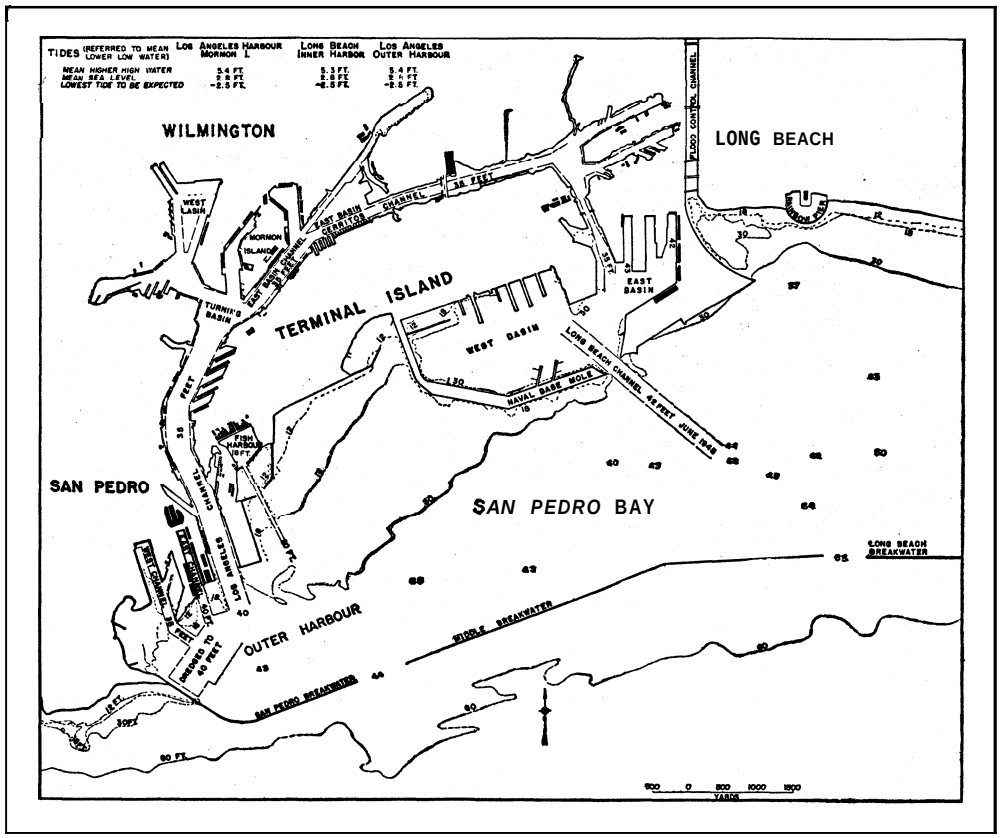


FIG. 11.—LOS ANGELES HARBOUR

sufficient to tranquilize the northern part of the water area, where are situated most of the coaling and oil berths, during the southwest monsoon. Consequently a sheltering arm, 1,800 ft. in length, was completed in 1912 as an extension of the original southwest breakwater. The harbour has an area of 643 ac. Of this 246 ac. are dredged to greater than 36 ft.; another 246 ac. are dredged to 30 to 36 ft., and the remainder is less than 30 ft. deep. The western entrance has a navigable depth of 36 ft. above low water and the navigable depth at the northern extrance is 30 ft.

Le *Havre.*—The outer harbour at Le Havre furnishes an example of a port, originally formed in a sheltered embayment along the margin of an estuary, where it has been necessary to build long breakwaters extended into more exposed waters, in order to provide the additional accommodation demanded by its increasing trade. The modern deepwater quays in the tidal outer harbour are situated on areas which have been reclaimed from the sea under the shelter of the breakwater walls.

Los Angeles and Long Beach.—The outer harbours of Los Angeles and Long Beach on San Pedro bay furnish examples of ports, originally protected by a single embayment, later protected by several breakwaters. From 1912–37 the outer harbour of Los Angeles, on the western side of San Pedro breakwater (fig. 11), was protected by the 11,152-ft.-long San Pedro breakwater extending eastward from Point Fermin. In 1937 a 12,500-ft. section of island breakwater, separated from the San Pedro breakwater by a 2,200-ft. opening, was completed. This island breakwater has been extended in the easterly direction an additional 6,000 ft. A second island breakwater separated from the first island breakwater by a 1,800 ft. opening was to extend due east an additional 13,350 ft. The total protected area in the Los Angeles-Long Beach outer harbours would amount to approximately 6,000 ac. upon completion of the island breakwater. The entrance channel to the Los Angeles harbour is dredged to 40 ft. and the channel to Long Beach is dredged to 45 ft.

The inner harbour at Los Angeles contains a water area of approximately 900 ac. dredged to 35 ft., and consists of a series of channels with turning basins and numerous slips. Cerritos channel, 400 ft. wide and 35 ft. deep connects the inner harbour of Los Angeles with the inner harbour at Long Beach.

The harbour at Long Beach was originally protected by the 7,300-ft. curved breakwater sheltering the area known as the East Basin. The series of breakwaters extending eastward from Point Fermin now afford protection to the Long Beach outer harbour, and a second curved earth-mole-type breakwater now protects the West Basin in the outer harbour. The inner harbour is reached by a channel 35 ft. deep and 300-500 ft. wide.

Artificial Harbours on **Open** Coasts.—It sometimes happens that harbours have to be constructed where little or no natural shelter exists. When, in such cases, the only possible site is an open sandy shore, considerable littoral drift may occur. Breakwaters, carried out from the shore at some distance apart, and converging to a central entrance of suitable width, provide the requisite shelter. Such works may be necessary, not only on open unindented coasts, but also to afford increased shelter at a river mouth on an unprotected coast line. Harbours of this description have, for instance, been made at Madras, Ind., and Ymuiden on open shores; while the breakwaters at the mouth of the Tyne and those at Sunderland, Eng., furnish examples of the protection of river entrances.

If there is little littoral drift from the most exposed quarter, the amount of sand brought into the harbour during storms can be readily removed by dredging. The quantity is, moreover, smaller in proportion to the depth into which the entrance is carried; and the scour across the projecting ends of the breakwaters tends, in some cases, to keep the outlet free from deposit. If a river discharges into the harbour the detritus and matter in suspension brought down by it must also be taken into consideration.

Where there is littoral drift in both directions on an open sandy coast, caused by winds blowing alternately from opposite quarters, sand accumulates in the sheltered angles outside the harbour on both sides at the junction of the breakwater with the shore line. This has occurred at Ymuiden. Silting also frequently occurs just inside the breakwater heads under the shelter of the arms. The worst results occur when the littoral drift is mainly in one direction, so that the projection of a solid breakwater out from the shore causes a very large accretion on the side facing the exposed quarter, while, because of the arrest of the travel of sand, erosion of the beach occurs beyond the lee breakwater (see COAST PROTECTION). Such effects have been produced by the works at Port Said. Egy., and Madras. The harbour of Salina Cruz, Mex., on the Pacific coast of the Isthmus of Tehuantepec, where two breakwaters projecting from the shore were built (1900–06), rapidly sanded up and narrow channels to the berths are maintained only by constant dredging.

Madras and *Ymuiden Harbours.*—Considering first of all harbours formed by converging breakwaters on an open unindented coast, the two examples mentioned above are both typical and instructive. Madras furnishes an instance of difficulties and unforeseen happenings overcome by continuous effort and drastic modification of the original plans. At Ymuiden the original forecast of the designers has been more nearly, but not entirely, realized. The harbour of Madras, begun in 1877, comprised, when

first completed, two breakwaters 3,000 ft. apart carried straight out to sea at right angles to the shore for 3,000 ft. with two return arms inclined slightly to seaward. The breakwaters originally enclosed an area of 220 ac. and left a central entrance, 515 ft. wide, facing the Indian ocean in a depth of about eight fathoms. The position and form of this entrance were determined mainly on navigational grounds as suitable to the needs of the sailing vessels, still at that time largely employed in the eastern trade. The breakwaters, in a position of extreme exposure on an open coast without any natural shelter, have suffered severe damage from the sea on many occasions necessitating rebuilding from time to time. The great drift of sand from south to north resulted in an advance of the shore against the outside of the south breakwater as it was projected seaward (fig. 2), and erosion, but to a lesser extent, occurred beyond the north breakwater. The progress of the foreshore in course of time extended so far seaward as to produce shoaling at the entrance; so rapidly in fact that in the ten years from 1893 the depth was diminished by ten feet. Moreover, the original entrance, facing east, was exposed to the full force of waves during both the northeast and the southwest monsoons. At these seasons the range within the harbour was severe and at times vessels could not ride at moorings in safety. A new entrance was therefore constructed by forming an opening in the breakwater on the north side of the harbour, protected by a sheltering arm, the original eastern entrance being closed when the new entrance had been made (1906–11). The harbour is now comparatively tranquil and vessels are able at all times to lie at the quays in safety.

The advance of the shore line seaward on the south side of the harbour still appears to average more than 25 ft. a year, but the rate of progression tends to decrease as the sand deposit extends into deeper water. The drift of sand along the outside face of the eastern breakwater wall has been checked, at any rate temporarily, by the construction of an extension seaward of the south breakwater 700 ft. in length which was begun in 1924. This spur breakwater or groyne is protected by concrete blocks placed pell mell on each side. Incidentally the accretion of sand on the south side of the harbour is not an unmixed evil for the value of the land so formed is increasing with the expansion of the city and much of it has been sold for over £3,000 per acre. Since the tranquilizing of the water area in 1911, the quay accommodation has been largely increased (see *Proc.* Inst. C.E., *Passim*).

The harbour at Ymuiden, constructed during the 1870s, is an entirely artificial one formed, on the open sandy shore and bed of the North sea, to serve as the entrance to the Amsterdam ship canal. The breakwaters, each about a mile in length, are converging and the entrance faces west. A dredged channel extends from deep water outside the breakwaters to the canal locks. This channel has been deepened to more than 40 ft. below mean sea level (spring rise, five and one-half feet). The actual entrance to the canal channel is between parallel jetties built on the original foreshore where the cut through the sand dunes was first made. The entrance between the breakwater heads is about 800 ft. in width, the harbour widening to 3,800 ft. at the shore line, thus providing broad expending beaches on either side of the canal entrance. The construction of the large entrance lock (*see* WATERWAYS, INLAND) necessitated the sacrifice of a part of the northern spending beach to the formation of an additional and wider canal entrance. In order to compensate for this loss the inner portion of the north breakwater was reconstructed so as to form a large wave trap on the north side of the new channel jetties. The advance of the shore on both sides of the harbour at Ymuiden appears to have reached its limit only a short distance out from the old shore line on each side. The only evidence of drift consists in the advance seaward of the line of soundings alongside, and in the considerable amount of sand which enters the harbour and has to be removed by bucket dredging. For dredging outside the breakwaters suction dredgers are employed. A condition of balance has now been reached. Dredging operations, fairly uniform and continuous in amount (about 1,700,000 cu.yd. per annum), but not economically burdensome in proportion to the commercial importance of the harbour, serve to maintain the required depths of water. It is interesting to note here that an early instance of the employment of sand-pump dredgers was in connection with the construction of the harbour by British engineers about 1874 (see *Proc.* Inst. C.E., vol. lxii, 1880).

Port Said Harbour, at the Mediterranean entrance of the Suez canal, is interesting as an example of the successful formation of an artificial harbour on an open shore where the littoral drift is almost wholly in one direction. The exposure is moderate and the sea bed slopes very slowly toward deep water. Because of the prevalence of northwest winds, the drift is from west to east, and is augmented by the alluvium issuing from the Nile. The original harbour was formed by two converging breakwaters or jetties, of which the western has been extended seaward from time to time as successive deepenings of the canal were effected. Its total length in 1939 was 8,100 yd. and its termination in a depth of water of 38 ft. (*see* E. Quellennec, *Breakwaters of Egyptian Harbours,* Paper *31* bis., and P. Solente, Paper 54; xiv, Int. Congress of Navigation, Cairo, 1926). The outer portion is a submerged mound serving merely to prevent sand and silt from entering the dredged channel except around the seaward extremity. The east breakwater, on the less exposed side, is 2,625 yd, long (fig. 12). The shore has advanced considerably against the outer face of the west breakwater and at the same time erosion has taken place on the east side of the east breakwater. The advance on the western side between 1858 and 1939 was about 5,200 ft., but the rate of progress has decreased in recent years. Though the progress seaward of the lines of soundings close to the harbour continues, a depth of about 40 ft. below normal low water is main-

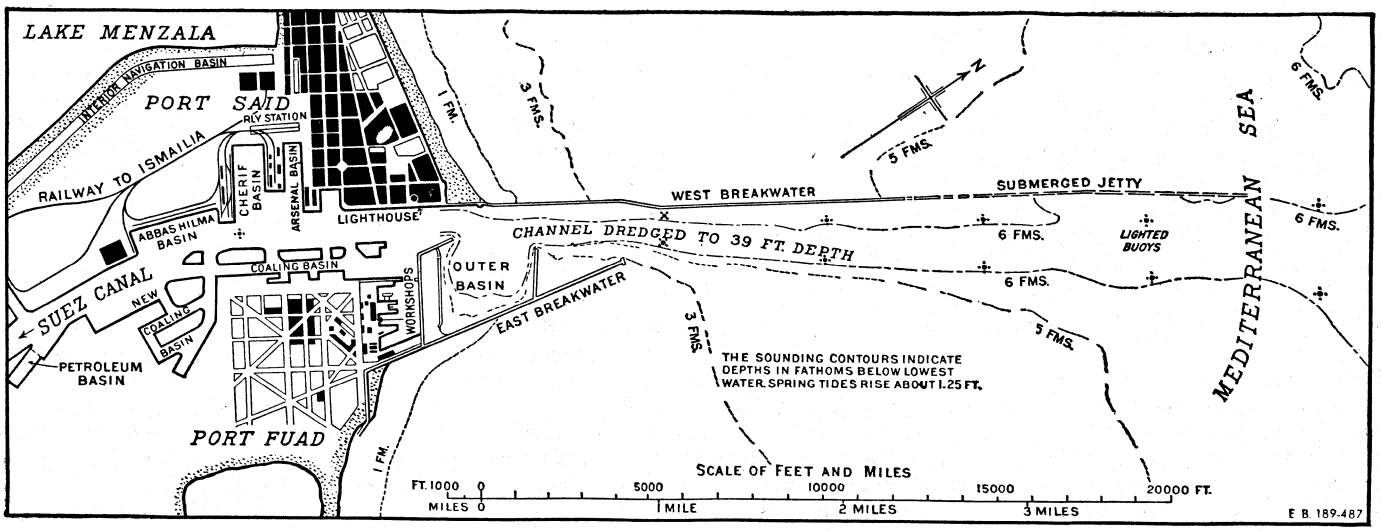


FIG. 12.—PORT SAID HARBOUR AND SUEZ CANAL ENTRANCE

tained without difficulty by the continuous working of powerful bucket and suction dredgers in the channel and outer approaches. Since 1938, the powerful suction dredger "Pierre-Lefort" has been employed in dredging the approach channel.

The Tyne and Sunderland.—The breakwaters at the mouths of the Tyne and Wear furnish outstanding instances of the successful adoption of the converging plan in situations where a river outfalls on an exposed coast line and there is no protecting estuary or sheltered sea inlet (see Proc. Inst. C.E., vol. clxxv, 1910 and cclx, 1921). In the case of the Tyne sand travel has occasioned no difficulty, neither has erosion taken place on the lee side of the harbour, a small rocky headland less than a mile south forming a natural groyne which has trapped sand and shingle in the embayment between it and the south pier. At Sunderland some accumulation, though not to a serious extent, has occurred on the north side of the harbour works and erosion of the foreshore to the south has necessitated the carrying out of costly protection works. The building of the Tyne breakwaters (fig. 1) was commenced in 1855; they were originally designed to terminate in a depth of 15 ft. at low water, but when more than half finished it was decided to extend them seaward to near the six-fathom contour. This involved changes in the plan of the harbour and accounts for the somewhat peculiar curved form of the south pier. The north pier was originally completed in a similar manner but the outer portion was partially destroyed (1895–6) and subsequently rebuilt on a straight line (see BREAKWATER). The formation of the outer harbour at Tynemouth has provided a safe deepwater approach to the river whose mouth was, about the middle of the last century, obstructed by a sand bar with no more than five-feet depth at low water and was, moreover, notorious on account of the difficulty of entrance and the frequency of wrecks. The channel from harbour to docks is being dredged to 35 ft. at low water spring tides (see RIVER AND RIVER ENGINEERING).

Casablanca.—An example of harbour construction carried out on a large scale on an exposed shore is the making of this artificial port on the Atlantic, the largest and most important harbour in French Morocco (fig. 13). The construction of a small

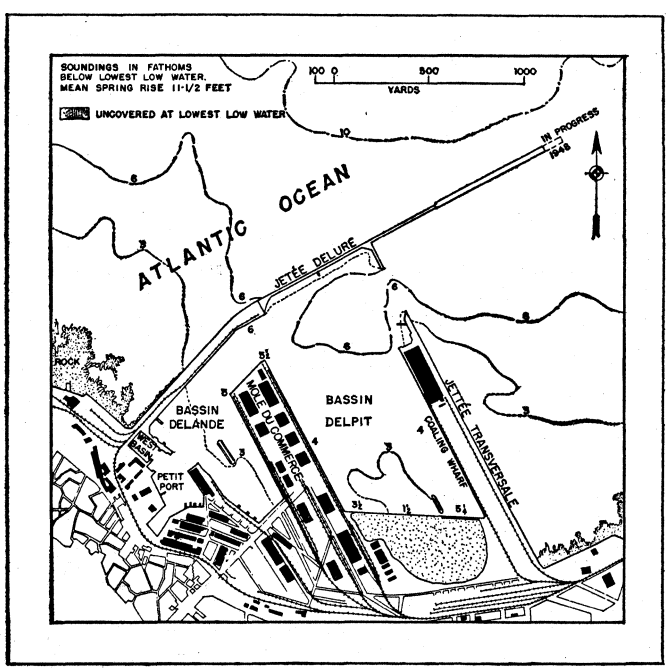


FIG. 13.—CASABLANCA HARBOUR

inshore harbour and jetty was commenced in 1907; the sheltering harbour enclosing about 350 ac., for the most part having a depth of 30 ft. or more at low water, was begun in 1913, and the main harbour works were completed in 1927. Later the northern breakwater, more exposed, was further extended to more than 8,000 ft. The works are fully exposed to the Atlantic swell.

Takoradi.—The artificial deepwater harbour of Takoradi, on the Gold Coast (constructed 1921–28), affords an instance of advantage being taken of a rocky reef extending out from the shore to form the foundation for a large part of the main protecting breakwater, which is of the rubble mound type. The plan of the harbour is in some ways similar to that of Casablanca, the main breakwater affording shelter on the side exposed to the prevailing winds and heaviest seas, while a transverse breakwater built under its lee has wharves constructed along its side, and the deepwater entrance between the breakwater heads is well sheltered. The site selected for the harbour is on an open coast, but is free from the trouble of littoral drift.

Boulogne.—The old harbour of Boulogne is of the conventional jetty type common to the French and Belgian ports of the English channel and North sea. The formation of a large outer harbour sheltered by breakwaters projected from the shore was commenced as far back as the 1880s. The south or Carnot breakwater was completed in 1938, its length being more than one and three-quarters miles. The north breakwater was begun in 1935. When completed, the enclosed low-water area would be more than one and one-half square miles. The Carnot breakwater is L shaped in plan; its shore end is more than 6,000 ft. south of the jetty entrance to the inner harbour, the intervening foreshore forming an ample expending beach. Boulogne harbour is not free from the troubles arising from littoral drift. The sand travel along the shore from south to north led to considerable accretion along the outer face of the Carnot breakwater and the depth contours are being gradually pushed seaward. The channel through the outer harbour is being dredged to 45 ft.

Prefabricated Harbours.—Prefabricated harbours were installed on the flat, sandy beaches of the invasion coast of Normandy (1944) to maintain supply lines of the Allied expeditionary force. They consisted of a series of breakwaters manufactured in England in sections, towed across the channel with the invading forces and installed at the time of assault. Three types of breakwaters were used: floating steel units anchored far out to break surface waves; the main or open concrete caissons, "Phoenixes," sunk in about 33 ft. of water forming the deepwater harbour; and a line of sunken ships in 12 ft. of water forming the shallow harbour. Behind the protection of the breakwaters, prefabricated "Lobnitz" pierheads, floating steel platforms steadied by spuds, were fixed in position. These pierheads, in turn, were connected to the beach high-water line by means of prefabricated and assembled pontoon bridge structures.

Breakwaters Connected with the Shore by an Open Viaduct.—Proposals have been brought forward from time to time to evade the advance of the foreshore against a solid obstacle by extending an open viaduct across the zone of littoral drift inshore, and forming a closed harbour or a sheltering breakwater against which vessels can lie, farther seaward and beyond the influence of accretion. It should, however, be pointed out that the single curved arm breakwater can afford adequate protection only in situations of moderate exposure and where the harbour is naturally sheltered on its open side.

Zeebrugge Harbour.—This principle was carried out on a fairly large scale at the port of call formed by the sheltering breakwater constructed (1900–09) in front of the entrance to the Bruges ship canal at Zeebrugge on the sandy North sea coast. A solid breakwater, provided with a wide quay furnished with sidings and sheds, and curving round toward the east so as to overlap the entrance to the canal and shelter an ample water area, is approached by an open steel and iron viaduct extending out 1,000 ft. from low water into a depth of 20 ft. The solid breakwater is carried out into a depth of 33 ft. at low water near the head. It was hoped that by thus avoiding interference with the littoral drift close to the shore, coming mainly from the west, the accumulation of silt and sand to the west of the harbour, and also in the harbour itself, would be prevented, or at any rate reduced to a very moderate amount. These hopes have not, however, been realized, and considerable dredging is necessary in the harbour and at the entrance to the canal in order to maintain the required depths. The probable explanation of the failure to avoid the troubles of sand accretion and silting is, in this as in other similar cases where

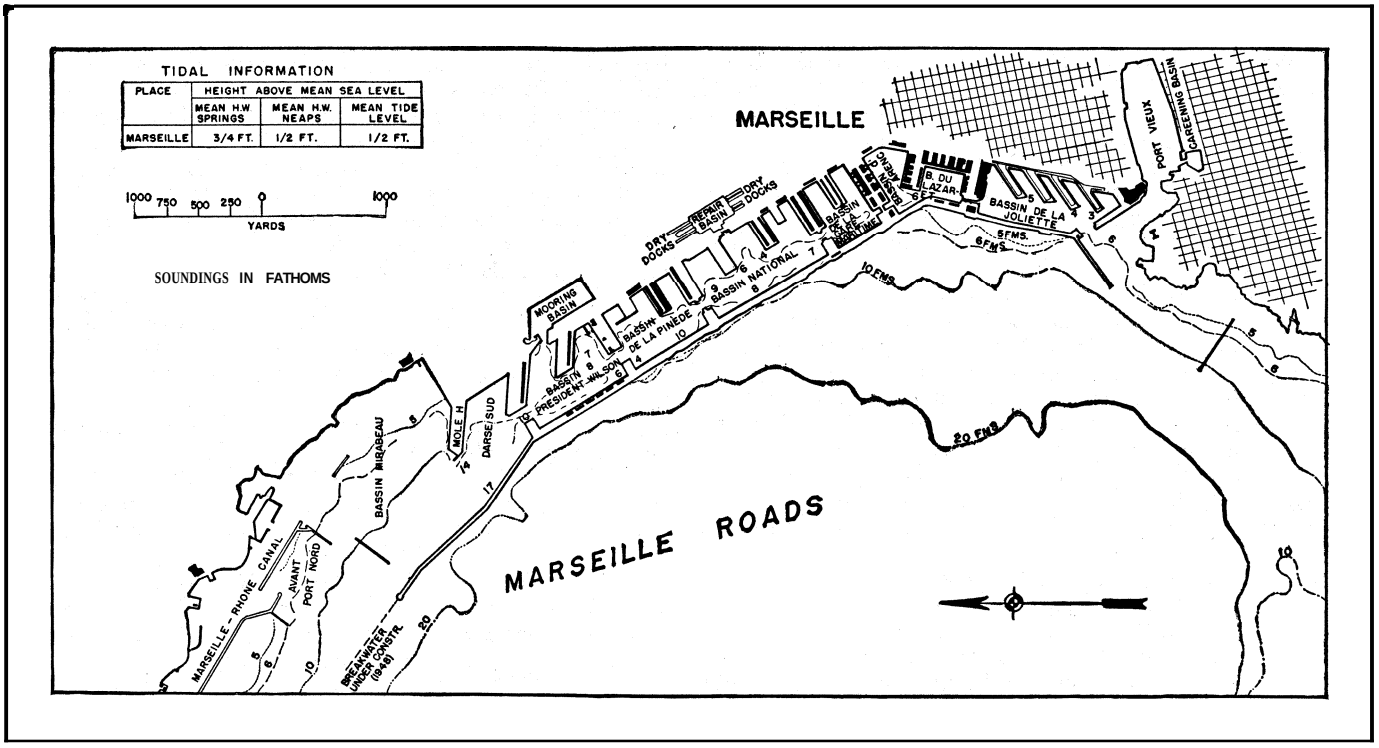


FIG. 14.—PORT OF MARSEILLE

the accretion has been still more serious, that the shelter caused by anything in the nature of an island near the shore must result in interference with the natural littoral current and drift and consequent stoppage of the travelling material.

Ceará and Rosslare: A plan somewhat similar to that adopted later at Zeebrugge was carried into effect at Ceará on the northeast coast of Brazil about 1886. Sand accumulated very rapidly both inside and outside the harbour; in a few years the low-water line had receded as far as the breakwater head and the harbour was ultimately abandoned. Work on a new port of Ceará or Fortaleza was started in Aug. 1938; the site chosen was the natural shelter formed by the spur of land running out to the Mucuripe lighthouse. This spur, extending roughly at right angles from the coast, is composed of a low reef on which very high sand dunes had formed, and is about six miles from the old port. Rosslare harbour, near Wexford, on the southeast coast of Ireland, is another and more favourable example of this type of construction. Here also dredging must be carried on periodically to maintain adequate depths for navigation.

Port Elizabeth.—Construction of the harbour of Port Elizabeth, S. Af., was started in 1933 when it was proposed to enclose about 700 ac. between two curved breakwaters. Only one breakwater had been constructed by mid-century. The south breakwater which extends about 2,300 ft. northeast from the old 1,400-it. Dom Pedro jetty, then curves and runs an additional length of approximately 2,300 ft. to the northwest, was constructed between 1919–38. The inner harbour is afforded additional protection by a 4,000-ft. pier extending at nearly right angles from the coast at a point approximately parallel with the end of the south breakwater. Another solid pier approximately 1,200 ft. long extends into the 314-ac. harbour protected by the south breakwater and the north pier. A northern breakwater was intended to complete the scheme.

Harbours Sheltered by Works Parallel to Coast.—Many important modern harbours of artificial construction in the Mediterranean and other tideless seas have been formed by building sheltering breakwaters in deep water at some distance from the shore and more or less parallel with it, leaving openings at one or both ends, or at intervals. Under the shelter of these breakwaters inner port works have been constructed (see DOCK). This characteristic of Mediterranean harbours is caused. first of all, by the absence of good river harbours; for in tideless seas the rivers are usually barred by deltas at their outlets, as the Rhone and Tiber. Secondly, many ancient ports were formed in narrow sheltered sea inlets as, for instance, the old harbour of Marseille; or in small bays as at Genoa, Naples and Trieste. In course of time the maritime commerce of such ports outgrew the limited resources of the old harbours and it became necessary to provide enlarged accommodation near by and in deeper water. The only sites available for such extensions have usually been in more open and exposed situations in deep water fronting the adjacent coast line. Moreover, the great depths of water near the shore at many Mediterranean ports, as for example. Marseille and Naples, make lateral extensions more economical and practically convenient than seaward enlargements. (See BREAKWATER.)

Marseille.—The great breakwater at Marseille has a total length of more than three and one-half miles along the shore (fig. 14), and the range of basins enclosed by it is still being extended both north and south.

Genoa, Italy's second port, was a centre of maritime trade long before the days of Columbus, whose statue overlooks the harbour and who was a native of the city. The old harbour is in a semicircular bay less than three-quarters of a mile in width at its entrance. Around its shores moles and jetties were built from time to time, first in sheltered positions and later in more exposed parts of the bay open to the south; still later protection moles were thrown out from the two horns of the bay, and the continued expansion of the port has necessitated the construction of an island breakwater—the Galliera mole—(begun in 1877 and subsequently extended) stretching east and west in front of the old harbour. Under its shelter port works have been constructed which are further sheltered by subsidiary moles projected more or less at right angles to the shore. With its eastern and western extensions, the latter named Principe Umberto mole, it was in 1940 nearly three miles long.

Trieste.—The Adriatic port of Trieste furnishes another example of lateral expansion. The old port, situated in a small sheltered bay, called the Doganale basin, is now used mainly for coastwise shipping. Along the coast to the northward and again to the southward across the entrance to the Bay of Muggia, several island breakwaters, having an aggregate length of more than two miles have been built to shelter the port works which stretch

along the coast line.

Naples. — The old harbour of Naples was formed by building small moles or breakwaters in sheltered positions on the western side of the bay. The San Vincenzo breakwater, which is the nucleus of the modern harbour, was begun in 1836. The harbour now reaches across the wide bay from west to east for a distance of more than two and one-half miles and is protected by a series of breakwaters parallel with the shore. Practically the whole of the modern harbour, having a sheltered area of more than one square mile, is in deep water and little dredging has been required except alongside some of the quays.

Lateral Breakwaters in Sheltered Positions. — In large landlocked natural harbours and arms of the sea lateral breakwaters parallel with the shore form convenient and effective means of providing shelter from the short wind waves which are generated in them and protection from as much of the ocean swell as may be propagated into the enclosed water area. Behind the shelter of such works, wharves and other port works can be constructed where vessels may berth without risk of damage.

In this manner the naval and commercial harbours in the landlocked Rade at Brest are protected by island breakwaters fronting them.

Another example is the harbour of Kobe, situated in a sheltered part of the inland sea of Japan, where wide, solid and well equipped piers, projecting 1,000 to 1,500 ft. from the shore, have been afforded additional protection by the construction of a series of island breakwaters generally parallel with the shore in depths of 35 to 45 ft.

Many of the ports on the shores of the Great Lakes of North America also furnish examples of lateral breakwater protection as, for instance, Chicago, Ill., Buffalo, N.Y., Port Arthur and Toronto, Ont. American lake breakwaters are commonly formed of rubble stone mounds or of timber cribwork filled with stone (see BREAKWATER). Breakwaters made in comparatively sheltered positions such as these are naturally of less massive construction than those required in situations exposed to the full force of ocean waves.

Entrances. — Seamen always wish for a wide entrance to a harbour as giving greater facility for safe access; on the other hand, it is important to keep the width as narrow as practicable consistent with easy access, to exclude waves and swell as much as possible and secure tranquillity inside. The result of this conflict is often a compromise. Examples which illustrate the divergence of practice in the dimensions of entrances to artificial harbours have already been mentioned; these differences are mainly the result of the equally wide variations in circumstances and exposure, and no generally applicable rule or guiding principle can be formulated, though some authorities maintain that the space between breakwater heads should never be less than the over-all length of the largest vessel expected to enter the port. The advantages which can sometimes be secured by overlapping breakwaters, covering island breakwaters and double entrances, have already been mentioned; on one point, however, there can be no difference of opinion; that is, the increasing length and beam of ocean-going vessels require the provision of entrances of ample width, and the more exposed such entrances are to heavy cross seas and strong cross-currents the wider they must be in the interests of the navigator. The difficult nature of the present Durban entrance is an example of this. In tidal harbours, and in those with a large volume of river water discharge, an undue restriction of the width of the entrance may produce a current unsafe for navigation. A strong outgoing stream meeting onshore waves at an entrance is bound to increase the turbulence and create a dangerous sea at a critical point.

The Natural Harbours of America. — The North American continent is well endowed with naturally sheltered harbours in positions where they serve the necessities of sea-borne trade. In the United States deepwater river harbours meet these needs at such ports as New York city, at the mouth of the Hudson; Philadelphia, Pa., on the Delaware, 88 nautical miles from the sea entrance to Delaware bay; Portland and Astoria, Ore., on the Columbia, where, however, dredging has been necessary to deepen parts of the river; and Newport News and other places on the James river, Va. Deep landlocked bays or sea inlets provide the harbours of Baltimore, Md., at the head of Chesapeake bay; Portland, Me.; Boston, Mass.; and San Francisco, Calif.; and those at Seattle and Tacoma, Wash., and other ports in Puget sound.

Two of the most important Canadian ports, Montreal and Quebec, are situated on the magnificent St. Lawrence river, the former 1100 mi. from the Gulf of St. Lawrence. Halifax in Nova Scotia is in a large landlocked, deepwater harbour free from ice all the year round. Vancouver harbour, in the sheltered Burrard inlet, is one of the finest on the Pacific coast and is capable of internal development on a large scale. Victoria and Esquimalt harbours are in well protected inlets at the southern end of Vancouver Island; and Prince Rupert, in British Columbia, is a comparatively new deepwater port on a narrow and well sheltered arm of the sea.

The finest and most beautifully situated natural harbour in South America is that formed by the landlocked bay of Rio de Janeiro, Braz. Buenos Aires, Montevideo and Bahia Blanca, Arg., are all estuary ports in sheltered positions, but where dredging operations are necessary to form and maintain deep water channels.

New York Harbour. — The harbour of New York (fig. 4) is one of the most perfect natural havens in the world. It enjoys the advantages of ample water area and depth, shelter, good access, a small tidal range — no more than five feet at springs — and moderate tidal streams. The outer harbour, or Lower bay, is sheltered by the New Jersey shore and Sandy Hook on one side, and by Long Island on the other. The inner harbour is entered through a channel, called the Narrows, between Staten Island on the west or New Jersey shore, and Brooklyn on the east. It comprises the deep Upper bay, the rivers which isolate Manhattan Island, namely, the Hudson, East and Harlem, and numerous bays and creeks of which Newark bay is the most important. The shore lines have a combined length of more than 480 mi. and, if the total berthing space of the piers be added, this figure is increased by about 150 mi. Excluding the Lower bay, the sheltered water area within the harbour is approximately 150 sq.mi. In recent years the development of the trade of the port has led to the building of shipping piers on an extensive scale in positions remote from the old centre of trade in Manhattan Island. In this way Staten Island, Jersey City, Newark and the Long Island shores have become busy centres of maritime trade. More recently still, Jamaica bay, a sheltered inlet on the south side of Long Island with access direct from the Lower bay, has been developed as a new centre of port activity.

The entrance to the Lower bay is open to the Atlantic, but shelter is afforded by outlying sandbanks. Sandy Hook itself is a long, low spit of sand. Until about 1885 the natural channels through the banks afforded, when suitably marked and buoyed, ample depth and width for all ships using the port. The subsequent deepening of the sea channels, consequent on the growth in the dimensions of transatlantic vessels, has already been referred to. The depths in the sea approaches are now maintained by periodical suction dredging.

The entrance to the harbour through Long Island sound from the north and east is sheltered, but the channel is obstructed by rocky islets and reefs. The navigation of this approach was at one time difficult and even dangerous, but it has been improved by the removal of many of the rocks by blasting and dredging, notably in the neighbourhood of Hell Gate, to provide a channel 35 ft. deep from Throgs Neck to the Brooklyn navy yard and 40 ft. thence to the Upper bay with widths from 300 ft. to 1,000 ft. The Hudson river channel has been dredged to a low-water depth of 40 ft. for full river width from Upper bay to W. 59th street, and in 1940 the construction of a channel 45 ft. deep to W. 40th street, thence 48 ft. to W. 30th street over a width of 2,000 ft. was in progress. Many berths alongside piers and wharves in New York harbour have depths of 40 ft. or more at low water.

San Francisco. — The landlocked bay of San Francisco is 11 mi. long and has a water area of about 420 sq.mi. with about 200 mi. of shore line. Two large rivers, the Sacramento and San Joaquin,

flow into it. The entrance to the bay, known as the Golden Gate, is a mile wide and has a greatest depth of 360 ft. Outside the Golden Gate a semicircular bar obstructs the entrance. The northern portion of this bar, the Four Fathom bank, has a minimum depth of 22 ft. and the depths over the remainder range from 31 to 36 ft.

The main channel is dredged to a minimum of 46 ft., and the comparatively narrow Bonita channel, paralleling the coast north of the Golden Gate, is 54 ft. deep. These channels afford entrance to the harbour having a natural depth of 54 ft. The ports of San Francisco, Oakland, Richmond and Alameda all lie on San Francisco bay.

The Natural Harbours of Australasia.— Some of the most important harbours of Australia and most of the frequented harbours in New Zealand are of natural formation. Pre-eminent is the great landlocked harbour of *Sydney*, one of the finest and most beautiful in the world. No artificial protection is required and no deepening or enlargement of its entrance channel has been necessary to meet the needs of the largest ships. The outer entrance, facing southeast between two bluffs, known as the north and south heads, is less than a mile in width at its narrowest part and has a minimum depth in the channel, nearly one-half mile wide, of 84 ft. The outer part of the harbour is known as Port Jackson, so named by Capt. James Cook in 1770. Its shores, as well as those of the upper harbour near and above Sydney, are indented by many sheltered coves. The tidal rise is about five feet at springs and shipping is berthed at open piers. The trade of the port is large, Sydney ranking fifth among the commonwealth ports in this respect. Although only 12 mi. in a straight line from the heads to the upper limit of the harbour, the length of the indented shore line is 188 mi. Of its water area of 23 sq.mi., nearly 5 sq.mi. have a depth of more than 35 ft. at low water. Channels 40 ft. deep have been dredged where necessary to give access to the overseas piers some of which have berths 45 it. deep at low water.

Melbourne is less fortunately placed than is Sydney, for the city itself is situated on the shallow Yarra river, which discharges into the large landlocked Port Phillip bay. In its natural state the river had a depth of little more than 13 ft. The approach channels to the wharves on Hobsons bay were dredged to 34 ft., and the river channel up to Melbourne was dredged to 26–30 ft.

Tasmania has several fine natural harbours. *Hobart* is a port on the wide 60-ft.-deep Derwent river. There is a perfect approach to the river entrance; no dredging is required; open jetties furnish all the needs of shipping and the capacity for extension is almost unlimited. The Tamar provides in its lower reaches a sheltered deepwater harbour for the port of *Launceston*.

New Zealand is rich in good natural harbours. *Port Lyttleton* in the South Island is a sheltered deepwater inlet with no bar. Dredging has been required only to deepen and maintain a channel in the approaches to the inner harbour. *Wellington*, at the southern end of the North Island, is a splendid landlocked harbour with more than 30 sq.mi. of sheltered water, from 6 to 14 fm. in depth. The entrance is 3,600 ft. in width with a depth of 42 ft. at low water. Open wharves, most of which have a low-water depth of more than 30 ft., and some as much as 41 ft., project from the shores of the inner or Lambton harbour. *Auckland* harbour, also in the North Island, is an arm of the sea, with an entrance over one-half mi. wide, well protected by outlying islands, providing deepwater accommodation for the largest vessels.

The Harbours of the East.—The great majority of the important harbours east of Suez are natural havens. Some possess such advantages of depth and shelter that little more than the provision of wharves and other internal port works has been necessary to convert them into first class ports. In others dredging and river training works have been required. Great artificial harbour works in exposed situations such as these at Colombo and Madras are rare in the east; but harbour works on a very large scale have been made in recent years in sheltered waters, particularly in Japan and Indonesia and at Singapore. A few only of the more important harbours not already referred to can be mentioned here. The harbour of *Bombay* is a well-sheltered arm of the sea situated between the island of Bombay and the mainland. *Calcutta* and *Rangoon* are river ports in both of which sand bars and shoals are serious problems *(see* RIVER AND RIVER ENGINEERING); *Singapore*, one of the greatest trading ports of the east, occupies a sheltered position, protected by outlying islands and shoals, with a deepwater anchorage. The principal British naval base in the east, completed in 1938, is on the channel separating Singapore from the mainland of Johore. *Hong Kong* Island is situated at the mouth of the Canton river. Between it and the mainland at Kowloon is a natural and well-sheltered deepwater harbour of great extent.

Kobe and *Osaka* are large breakwater harbours in sheltered positions in the inland sea of Japan. *Yokohama*, the principal port of Japan, is in the bay of Tokyo. At mid-century there were about 27.000 ft. of breakwater protecting the harbour. *Darien*, the principal port of Manchuria, was energetically developed when it was in the hands of the Japanese. It is in a sheltered bay where two island breakwaters projected from the shore, having a total length of more than two and one-half mi., cover a protected water area of 780 ac. At *Manila* in the Philippines, breakwaters were made in an almost landlocked bay to protect a harbour of 1,250 ac.

BIBLIOGRAPHY —The Nautical Charts and the Sailing Directions issued by the Hydrographic Office of the US. Navy and the Sailing Directions published by the Hydrographic Department of the Admiralty, give full descriptions of the harbours of the world For US. harbours, *see* the *Port Series* and *Lake Series* published by the Corps of Engineers. United States Army, and the charts issued by the U.S. Coast and Geodetic Survey. (N. G. G.; F. R H)

HARBURG, former seaport town of Germany, on the left hank of the southern arm of the Elbe, 6 mi. S. of Hamburg by rail. In 1927 Harburg was united with the city of Wilhelmsburg and in 1938 was incorporated into the city of Hamburg (*q.v.*) as the district of Harburg-Wilhelmsburg.

Harburg belonged originally to the bishopric of Bremen, and received municipal rights in 1297. In 1376 it was united to the principality of Liineburg, along with which it fell in 1705 to Hanover, and in 1866 to Prussia. It possesses a palace, which from 1524 to 1642 was the residence of the Harburg line of the house of Brunswick. The leading industries of Harburg were the crushing of palm-kernels, for which it was famous, and linseed and the manufacture of india-rubber, gutta-percha, phosphates, nitrate and jute.

HARCOURT, a noble French family which took its name from the village of Hal-court (Eure), and traces its origin back to the 11th century. The fief of Harcourt was raised to a countship in 1338, and passed in the 15th century, by a marriage, into the house of Lorraine. HENRI DE LORRAINE, COMTE D'HARCOURT (1601–1666), nicknamed Cadet la perle, fought in Italy against Spain in 1639, and captured Turin. He took sides with Condé in the Fronde, but made his submission in 1654.

The most distinguished among the younger branches of the family are those of Montgomery and of Beuvron. To the former belonged Jean d'Harcourt (d. 1452), bishop of Amiens and Tournai, archbishop of Narbonne and patriarch of Antioch; and Guillaume d'Harcourt, count of Tancarville, and viscount of Melun (d. 1487), who was head of the administration of the woods and forests in the royal domain.

From the branch of the marquises of Beuvron sprang Henri d'Harcourt, marshal of France, and ambassador at the Spanish court, who was made duke of Harcourt (1700) and a peer of France (1709); also François Eugène Gabriel, count, and afterwards duke, of Harcourt, who was ambassador first in Spain, and later at Rome, and died in 1865.

The English family of Harcourts trace their descent to Ivo de Harcourt, son of William de Harcourt who acquired English land at the date of the Conquest.

See G. *A.* de la Rogne, *Histoire généalogique de la maison d'Harcourt* (4 vols., *1662)*; P. Anselme, *Histoire généalogique de la maison de France,* v. 114, etc.; and Dom le Noir, *Preuves généalogiques et historiques de la maison de Harcourt* (1907); and the *Harcourt Papers.*

HARCOURT, LEWIS VERNON HARCOURT, 1ST VISCOUNT (1863–1922), British politician, was born in London on Feb. 1, 1863, the elder son of Sir William Harcourt (*q.v.*). He was educated at Eton and afterwards travelled, becoming well known for his interest in art. In 1899 he married the only daughter of Walter H. Burns, of New York. From 1904 to 1916 he was Liberal M.P. for the Rossendale division of Lancs., and on the formation of Sir Henry Campbell-Bannerman's Government (1905) he became first commissioner of works. In 1910 he became secretary of State for the colonies in the Asquith Cabinet, and on the formation of the Coalition Government in 1915 again became first commissioner of works. In 1917 he was raised to the peerage. He died in London on Feb. 24, 1922, being succeeded in the title by his son, William Edward Harcourt (b. 1908).

HARCOURT, SIMON HARCOURT (c. 1661–1727), 1ST VISCOUNT, lord chancellor of England, only son of Sir Philip Harcourt of Stanton Harcourt, Oxfordshire. On the accession of George I he was deprived of office and retired to Cokethorpe, where he enjoyed the society of men of letters, Swift, Pope, Prior and other famous writers being among his frequent guests. With Swift, however, he had occasional quarrels, during one of which the great satirist bestowed on him the sobriquet of "Trimming Harcourt." In 1721 Harcourt was created a viscount and returned

to the privy council; and on several occasions during the king's absences from England he was on the council of regency. He died in London on July 23, 1727.

HARCOURT, SIR WILLIAM GEORGE GRANVILLE VENABLES VERNON (1827–1904), English statesman, was the second son of Canon William Vernon. The family name was changed to Harcourt in 1831 on the succession of Edward Vernon, archbishop of York and father of William Vernon, to the Harcourt estates. Canon Harcourt is separately noticed. William was born at the Old Residence, York, on Oct. 14, 1827. He was educated privately at Dumford, near Salisbury, and at Preston, where he witnessed the bread riots of 1842. From his tutor at Preston he went up to Trinity college. Cambridge. He was a member of the famous Society of the Apostles at Cambridge, and among his close friends were Fitzjames Stephen and Julian Fane. He was called to the bar at the Inner Temple in 1854, became a Q.C. in 1866, and was appointed Whewell professor of international law, Cambridge, 1869. He quickly made his mark in London society as a brilliant talker; he wrote for *The Morning Chronicle* and *Saturday Review*, and began in 1862 to write letters to *The Times* over the signature of "Historicus" on questions of international law arising out of the American Civil War. The earlier letters were directed against the recognition of the Southern States as belligerents in the American Civil War and towards defining the duties of neutrality on the part of England. These letters had a profound effect on public opinion. He maintained that the launching of the "Alabama" was an illegal act, and throughout the period was in close touch with Lord John Russell and Lord Clarendon.

He entered parliament as Liberal member for Oxford, and sat from 1868 to 1880, when, upon seeking re-election after acceptance of office, he was defeated by Hall. A seat was, however, found for him at Derby, by the voluntary retirement of Plimsoll, and he continued to represent that constituency until 1895, when, having been defeated at the general election, he found a seat in West Monmouthshire. He was appointed solicitor-general and knighted in 1873; and, although he had not shown himself a very strenuous supporter of Gladstone during that statesman's exclusion from power, he became secretary of state for the home department on the return of the Liberals to office in 1880. His name was connected at that time with the passing of the Ground Game Act (1880), the Arms (Ireland) Act (1881), and the Explosives Act (1883). As home secretary at the time of the dynamite outrages he acted promptly, and the Explosives Act was passed through all its stages in the shortest time on record. He was constantly in conflict with the Irish members in the House of Commons. In 1884 he introduced an abortive bill for unifying the municipal administration of London. He was indeed at that time recognized as one of the ablest and most effective leaders of the Liberal party; and when, after a brief interval in 1885, Gladstone returned to office in 1886, he was made chancellor of the exchequer. The government fell on the Home Rule queston in July. In Jan. 1887 Harcourt, who had been a close ally of Joseph Chamberlain before the split in the Liberal party over Home Rule, now made an effortto secure reunion, and the Round Table Conference of Herschell, Harcourt, Morley, Chamberlain and Trevelyan met at his house. It failed disastrously.

Between 1880 and 1892 Harcourt acted as Gladstone's loyal and indefatigable lieutenant in political life. In 1892 he became chancellor of the exchequer for the second time. In 1894 he introduced and carried a memorable budget, which equalized the death duties on real and personal property and put the budget on a basis which enabled it to stand the strain of the South African War. After Gladstone's retirement in 1894 and Lord Rosebery's selection as prime minister, Sir William became the leader of the Liberal party in the House of Commons, but it was never probable that he would work comfortably in the new conditions. His title to be regarded as Gladstene's successor had been too lightly ignored, and from the first it was evident that Lord Rosebery's ideas of Liberalism and of the policy of the Liberal party were not those of Harcourt. Their acute differences were patched up from time to time, but the combination could not last. At the general election of 1895 the divisions in the party were obvious. The effect of Harcourt's abortive Local Veto Bill on the election was seen in his defeat at Derby, which gave the signal for the Liberal rout. In Dec. 1898 the crisis arrived, and he resigned his leadership of the opposition, alleging as his reason, in letters exchanged between John Morley and himself, the cross-currents of opinion among his old supporters and former colleagues.

Harcourt strongly condemned the government's financial policy and their attitude towards the Transvaal in 1899–1900; and was a constant critic of Chamberlain's policy. At this time he engaged in a violent controversy, conducted in letters to *The* **Times,** against ritualism in the Church of England. His last great political effort was against Chamberlain's tariff reform proposals. In March 1904, just after he had announced his intention not to seek election again to parliament, he succeeded, by the death of his nephew, to the family estates at Nuneham. But he died suddenly there on Oct. 1 in the same year. He married, first, in 1859, Thérèse Lister (d. 1863), a niece of the 4th Lord Clarendon (*q.v.*), by whom he had one son, Lewis Vernon Harcourt (*q.v.*); and secondly, in 1876, Elizabeth, widow of T. Ives and daughter of J. L. Motley, the historian, by whom he had another son, Robert (b. 1878). Lady Harcourt survived until 1928.

Sir William Harcourt was one of the great parliamentary figures of the Gladstonian Liberal period. He was essentially an aristocratic type of the late 19th century Whig, with a remarkable capacity for popular campaign fighting. He had been, and remained, a brilliant journalist in the non-professional sense. He was one of those who really made the *Saturday Review* in its palmy days, and the "Historicus" letters on international law published in *The Times* showed him to be a great international lawyer. In later years he found himself somewhat isolated and disappointed. A tall, fine man, with the grand manner, he was a great personality in the life of his time.

See A. G. Gardiner, ***The Life*** of *Sir William* ***Harcourt,*** 2 vol. (1923).

HARCOURT, WILLIAM VERNON (1789–1871), founder of the British association, was born at Sudbury, Derbyshire. in 1789, a younger son of Edward Harcourt, archbishop of York, youngest son of George Vernon, 1st Lord Vernon (Edward took the name Harcourt in 1831). William Harcourt served for five years in the British navy and then went to Christ Church, Oxford, took holy orders and held a living at Bishopthorpe, Yorkshire. He was one of the founders of the Yorkshire Philosophical society and its first president.

The laws and the plan of proceedings for the British Association for the Advancement of Science were drawn up by him, and Harcourt was elected president in 1839. In 1824 he became canon of York and in 1837 rector of Bolton Percy. His spare time until quite late in life was occupied with scientific experiments. Inheriting the Harcourt estates in Oxfordshire from his brother in 1861, he moved to Nuneham, where he died in April 1871.

HARDANGER FJORD, an inlet on the west coast of Norway, penetrating 70 m. inland apart from the deep fringe of islands off its mouth, the distance from the sea to the head of the fjord being 114 miles. Its extreme depth is about 350 fathoms. With Toro at the entrance, the general direction is north-east from that point. Magnificent mountains, from which pour many waterfalls flank the fjord. The main fjord is divided into parts under different names, and there are many fine branch fjords. The fjord is frequented by tourists, and the principal stations have hotels. The outer fjord is called the Kvindherredsfjord, flanked by the Melderskin (4,680 ft.); then follow Sildefjord and Bonde Sund, separated by Varalds island. Here Mauranger-fjord opens on the east; from Sundal on this inlet the great Folgefond snowfield may be crossed. Bakke and Vikingnaes are stations on Hisfjord, Nordheimsund and Östensö on Ytre Samlen, which throws off a fine narrow branch northward, the Fikensund. There follow Indre Samlen and Gtnefjord, with the station of Utne opposite Oxen (4,120 ft.), and its northward branch, Gravenfjord, with the beautiful station of Eide at its head, uhence a road runs north-west to Vossevangen. From the Utne terminal branches of the fjord run south and east; the

Sorfjord, steeply walled by the heights of the Folgefond, with the frequented resort of Odde at its head; and the Eidfjord, with its branch Osefjord. terminating beneath a tremendous rampart of mountains, through which the sombre Simedal penetrates. Vik is the principal station on Eidfjord, and Ulvik on a branch of the Ose, with a road to Vossevangen. A small stream entering Sorfjord forms in its upper course the Skjaeggedalsfos, of equal height with the Voringfos, and hardly less beautiful.

HARDEE, WILLIAM JOSEPH (1815–1873), U.S. soldier, was born in Savannah, Ga., on Nov. 10, 1815 and graduated from West Point in 1838. As a subaltern of cavalry he was employed in 1839 on a special mission to Europe to study the cavalry methods in vogue. He was promoted captain in 1844 and served aith distinction under Generals Taylor and Scott in the Mexican War. After the war he served as a substantive major of cavalry under Col. Sidney Johnston and Lieut. Col. Robert E. Lee. For some time before 1856 he was engaged in compiling the official manual of infantry drill and tactics which. familiarly called "Hardee's Tactics," afterward formed the textbook for the infantry arm in both the Federal and the Confederate armies. From 1856 to 1861 he was commandant of West Point, resigning his commission on the secession of his state in the latter year. Entering the Confederate service as a colonel, he was shortly promoted brigadier general. He distinguished himself greatly by his tactical leadership on the field of Shiloh, and was immediately promoted major general. As a corps commander he fought under Gen. Braxton Bragg at Perryville and Stone river, and for his distinguished services in these battles was promoted lieutenant general. He served in the latter part of the campaign of 1863 under Bragg and in that of 1864 under J. E. Johnston. When the Civil War came to an end in 1865 he retired to his plantation near Selma, Ala. He died at Wytheville, Va., on Nov. 6, 1873.

See James Kendall Hosmer, *Outcome of the Civil War,* "American Nation" series, vol xxi (1907).

HARDEN, SIR ARTHUR (1865–1940), English biochemist, was awarded the Nobel prize in chemistry for 1929 jointly with Hans von Euler-Chelpin (*q.v.*) for work on the fermentation of sugar and the enzyme action in the process. He was born Oct. 12, 1865, at Manchester, Eng. He studied chemistry at Owens college (later the Victoria University of Manchester) and at the University of Erlangen in Germany. After serving as lecturer and demonstrator in chemistry at the University of Manchester (1888–97), he took charge of the chemical and water laboratory at the Jenner Institute of Preventive Medicine (later Lister institute). From 1907 to 1930 he was head of the department of biochemistry. In 1912 he received the title of professor of biochemistry from the University of London. Harden applied the knowledge of a trained chemist to the investigation of biological phenomena. His studies of the fermentation of sugar by expressed yeast juice occupied most of his working time for over 30 years, and advanced the knowledge of the processes of intermediary metabolism in all living forms. He pioneered also in studies of bacterial enzymes and metabolism. His best-known work, *Alcoholic Fermentation,* appeared in four editions. He was co-author (with Sir Henry Enfield Roscoe) of a history of John Dalton's theories of atomic structure, published several chemical texts and numerous scientific papers and served as joint editor of *The Biochemical Journal* irom 1913 to 1937. Recipient of the Davy medal in 1935, he was knighted in 1936. He continued his scientific work from the time of his retirement from the Lister institute in 1930 until his death at Bourne End, June 17, 1940.

(B. V.)

HARDEN, MAXIMILIAN (1861–1927), German journalist, founder and editor of *Die Zukunft,* was born at Berlin on Oct. 20, 1861. He commenced journalism as a keen admirer of Bismarck, and *Die Zukunft,* founded in 1892, made its name by its attacks on the court camarilla, which resulted in a prosecution for libel in 1907. Harden's statements proved to be justified. and Count Kuno von Moltke, who had instituted the prosecution, withdrew from the case and Prince P. Eulenburg fled the country. During World War I Harden was a candid critic of the German government and the German high command. He was just as unsparing in his criticisms of the German revolutionary government and of subsequent administrations. He died on Oct. 30, 1927.

Many of his writings and essays were published under the title of *"Kopfe," 4* vol. (1910–24). See *Kautsky and Harden,* by *H.* Delbriick (1920).

HARDENBERG, KARL AUGUST VON, PRINCE (1750–1822), Prussian statesman, was born at Essenroda, Hanover, on May 31, 1750. He studied at Leipzig and Gottingen, and entered the Hanoverian civil service in 1770. Finding the promotion slow, he spent some time in travel, visiting the South German courts and those of France, Holland and England. On his return he married the countess Reventlow, became privy councillor and a count. He then went to London in the hope of obtaining the post of Hanoverian envoy there, but his wife formed a liaison with the prince of Wales, and he was forced to leave the Hanoverian service. He entered (1782) that of Brunswick, but there again his wife's conduct made his position untenable. They were divorced, and he then married a divorced woman. In 1792 Hardenberg was made administrator of the principalities of Ansbach and Bayreuth, which had just fallen to Prussia. He filled this difficult office with great skill, and used it to expand Prussian influence in south Germany. He then received a rising commission as Prussian envoy to the Rhenish courts, and presently succeeded Count Goltz as Prussian plenipotentiary at Basle where he signed (Feb. 28, 1795) the treaty with France.

In 1797, on the accession of Frederick William III, Hardenberg became a member of the Prussian cabinet. He acted as deputy for the foreign minister, Hangwitz, in 1803, and in 1804 succeeded him. The king desired to continue the policy of Prussian neutrality, though he had made an agreement with Russia to take up arms in case of further aggression by Napoleon in north Germany. If there was to be war, Hardenberg would have preferred the French alliance, which was the price Napoleon demanded for the cession of Hanover to Prussia; for the eastern powers would scarcely have conceded, of their free will, so great an augmentation of Prussian power. But he still hoped to gain the coveted prize by diplomacy, backed by the veiled threat of an armed neutrality. Napoleon's contemptuous violation of Prussian territory by marching three French corps through Ansbach turned the scale, and the king signed (Nov. 3) with the tsar Alexander the terms of an ultimatum to be laid before the French emperor. The battle of Austerlitz, however, compelled submission. Prussia, indeed, by the treaty signed at Schonbrunn on Dec. 15, 1805, received Hanover, but in return for all its territories in south Germany. One condition of this arrangement was the retirement of Hardenberg, whom Napoleon disliked. He was again foreign minister after the crisis of 1806 (April–July 1807); but Napoleon's resentment was implacable, and one of the conditions of the terms granted to Prussia by the treaty of Tilsit was Hardenberg's dismissal.

After the enforced retirement of Baron Heinrich von Stein in 1808 and the interlude of the feeble Altenstein ministry, Hardenberg was again summoned to Berlin, this time as chancellor (June 6, 1810). The campaign of Jena had profoundly affected him. He broke with the old diplomacy, and was inspired with a passionate desire to restore the position of Prussia and crush its oppressors. In his retirement at Riga he had worked out a plan for reconstructing the monarchy on Liberal lines; and though circumstances did not admit of his pursuing an independent foreign policy, he prepared for the struggle with France by carrying out Stein's far-reaching schemes of social and political reorganization. The military system was completely reformed, serfdom was abolished, municipal institutions were fostered, the civil service was thrown open to all classes, and great attention was devoted to the educational needs of every section of the community.

After the Moscow campaign of 1812, Hardenberg, supported by the noble Queen Louise, determined Frederick William to take advantage of Gen. Yorck's loyal disloyalty, and declare against France. He was rightly regarded by German patriots as the statesman who had done most to encourage the spirit of national independence; and immediately after he had signed the first peace of Paris he was raised to the rank of prince (June 3, 1814) in

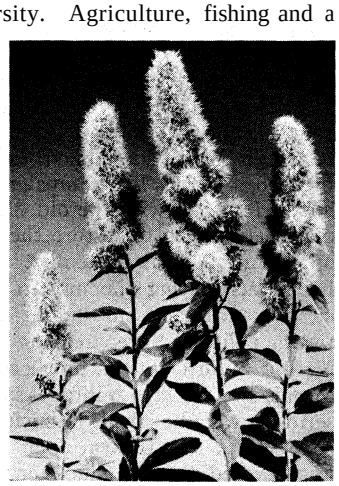
recognition of the part he had played in the War of Liberation.

Hardenberg now had an assured position in that close corporation of sovereigns and statesmen by whom Europe, during the next few years, was to be governed. He accompanied the allied sovereigns to England, and at the congress of Vienna (1814–15) was the chief plenipotentiary of Prussia. But from this time the zenith of his influence, if not of his fame, was passed. In diplomacy he was no match for Metternich. At Vienna, in spite of the powerful backing of Alexander of Russia. he failed to secure the annexation of the whole of Saxony to Prussia; at Paris. after Waterloo, he failed to carry through his views as to the further dismemberment of France; he had weakly allowed Metternich to forestall him in making terms with the States of the Confederation of the Rhine, which secured to Austria the preponderance in the German federal diet; on the eve of the conference of Carlsbad (1819) he signed a convention with Metternich, by which—to quote the historian Treitschke—"like a penitent sinner, without any formal *quid* pro *quo,* the monarchy of Frederick the Great yielded to a foreign Power a voice in her internal affairs." At the congresses of Aix-la-Chapelle, Troppau, Laibach and Verona the voice of Hardenberg was but an echo of that of Metternich. The cause lay partly in the difficult circumstances of the loosely-knit Prussian monarchy, but partly in Hardenberg's character, which had deteriorated with age. He continued amiable, charming and enlightened as ever; but the excesses which had been pardonable in a young diplomatist were a scandal in an elderly chancellor, and could not but weaken his influence with so pious a *Landesvater* as Frederick William III. Hardenberg clung to office, and when the tide turned strongly against Liberalism he allowed himself to drift with it. He died at Genoa, on Nov. 26, 1822.

See L. v. Ranke, *Denkwürdigkeiten des Staatskanzlers Fürsten von Hardenberg,* 5 vol. (Leipzig, 1877); J. R. Seeley, *The Life and Times of Stein,* 3 vol. (Cambridge, 1878); E. Meier, *Reform der Verwaltungsorganisation unter Stein und Hardenberg (ib.,* 1881); Chr. Meyer, *Hardenberg und seine Verwaltung der Fürstentümer Ansbach und Bayreuth* (Breslau, 1892); Koser, *Die Neuordnung des preussischen Archivwesens durch den Staatkanzler Fürsten v. Hardenberg* (Leipzig, 1904); F. Hartung, *Hardenberg und die preussische Verwaltung in Ansbach-Bayreuth, 1792–1806* (1906); P. Haake, *Der preussische Verfassungskampf vor hundert Jahren* (1921).

HARDERWYK, a seaport in the province of Gelderland, Netherlands, on the shores of the Ijsselmeer, 17 mi. by rail N.N.E. of Amersfoort. Population (1957 est.) 15,484 (mun.).

The principal buildings are the town hall, with some ancient furniture, and a large 15th century church with a notable square tower, named after the famous botanist Linnaeus. In the 17th century Harder~vykhad a university. Agriculture, fishing and a few ddmestic industries form the only employment of the inhabitants. As a seaport its trade was confined exclusively to the Zuider Zee. Plans for the draining of the major part of this sea reduced Harderwyk to a rather unimportant town.



ROCHE

HARDHACK (SPIRAEA TOMENTOSA)

HARDHACK (Spiraea *tomentosa*), a North American shrub of the rose family (Rosaceae, *q.v.*), called also steeplebush, native to open grounds from Nova Scotia to Manitoba and southward to Georgia and Kansas. It has an upright, woolly, reddish-brown stem, 2 to 4 ft. high, bearing, oval. pointed, sharply-toothed leaves, which are grayish or yellowish and woolly beneath. and a slender, steeple-like flower spike crowded with tiny deep-pink flowers, blooming in late summer. The hardhack, which is sometimes planted for ornament, is especially abundant in eastern New York and New England, where in many localities it occurs in weedlike profusion, becoming pestiferous in meadows and pastures. See SPIRAEA.

HARDICANUTE (more correctly HARTHACNUT) (*c.* 1019–1042), son of Canute, king of England, by his wife Emma. On the death of Canute in 1035 the claims of Hardicanute were supported by Emma and her ally, Godwine, earl of the West Saxons, in opposition to those of Harold, Canute's illegitimate son, who was backed by the Mercian earl Leofric and the chief men of the north. Godwine held Wessex for a time on Hardicanute's behalf. Harold's party rapidly increased; and early in 1037 he was definitely elected king. Emma was driven out and took refuge at Bruges. In 1039 Hardicanute joined her, and together they concerted an attack on England. Next year Harold died; and Hardicanute succeeded. His short reign was marked by great oppression and cruelty. He caused the dead body of Harold to be dug up and thrown into a fen; the exaction of a heavy geld for the support of his foreign fleet in Worcestershire, provoked a rising whereupon he burned the city of Worcester to the ground and devastated the surrounding country; in 1041 he permitted Edwulf, earl of Northumbria, to be treacherously murdered after having granted him a safe-conduct.

Hardicanute died on June 8, 1042.

HARDIE, JAMES KEIR (1856–1915), British Labour leader, was born on Aug. 15, 1856, at Legbrannock, Lanarkshire. His early life was one of great hardship; he was employed in the mines from the age of ten. Originally a Liberal in politics, he started, with some friends, in 1887 the Miner, afterwards the *Labour* Leader, the first Socialist paper in western Scotland. In the same year he opened the attack, as delegate of the Ayrshire miners at the Trades Union congress. upon the dominant Liberal members of the parliamentary committee, and continued this struggle, in which his chief allies were John Burns and Tom Mann, up to the decisive defeat of Henry Broadhurst, M.P.. his chief opponent, at the Liverpool congress in 1890. In 1888 he entered politics as an "Independent Labour" candidate for Mid-Lanark, polling only 617 votes; in 1892 he was elected on the same program for South West Ham, but did not retain the seat in 1895. In 1900 he was elected for Merthyr. He was very largely responsible for the foundation of the Scottish Labour party in 1888, and the Independent Labour party (I.L.P.) in 1893. His first great triumph came in 1899, when the Trades Union congress was induced to authorize the formation of labour representation committees in conjunction with the I.L.P. and other Socialist bodies. Socialist-Labour candidates were, for the first time, run systematically at the ensuing election, and at the 1906 election 29 were returned to parliament.

This number was raised to more than 40, but the Socialist character of the party was diluted by the adhesion en bloc of most of the Liberal miners' M P.'s. Hardie was selected as first chairman, and during the years before World War I had as chief tasks firstly, the persuading of the Liberal trade union representatives to advance further on the Socialist path; secondly, the extension of Socialism by public propaganda outside. In attempting these, he was severely criticized by the Social-Democrats as compromising and muddled in theory; for the right wing of the Labour party he was too rugged. But there was no doubt of his success, as chief propagandist for the I.L.P., in spreading Socialist tenets in every manufacturing and mining district, until, in 1914, there was scarcely a big industrial town in which there was not a powerful and active I.L.P. or other Socialist branch.

For such pioneering work Hardie's strong personality, his unquestioned honesty and his lovable character notably fitted him.

In concert with Edouard Vaillant he had made a vain endeavour to bind the Socialist international to calling a general strike in the event of war. The complete failure of this body to act in 1914 was a great disappointment to Hardie; the progress of the war seemed to be undoing his life's work; depression and dejection hastened his death in 1915.

See W. Stewart, *J. Keir Hardie* (1921); *D.* Lowe, *From Pit to Parliament* (1923).

HARDING, CHESTER (1792–1866), U.S. portrait painter, was born at Conway, Mass., on Sept. 1, 1792. He marched as a drummer nith the militia to the St. Lawrence in 1813 and became

subsequently chairmaker, peddler. innkeeper and house painter, painting signs in Pittsburgh. Pa.. and eventually going on the road. self-taught. as an itinerant portrait painter. He soon became proficient. and in the early 1820s had such a vogue in Boston—80 portraits in six months—that he could afford a trip to England. He set up a studio' in London and there met with great success. painting royalty and the nobility, and becoming. despite his lack of education and social experience. a favourite in all circles. Returning to the United States. he settled in Boston and painted portraits of many of the prominent men and women of his time. He died on April 1. 1866.

Harding's portraits may be seen at many galleries in the U.S., including the Essex institute. Salem. Mass.; the National Gallery of Art. Washington. D.C.; the Boston Athenaeum; and the Philadelphia Museum of Art.

HARDING, WARREN GAMALIEL (1865–1923), 29th President of the United States, was born at Corsica (then Blooming Grove), Morrow county, Ohio, on Nov. 2, 1865, son of George Tryon Harding, a farmer and country doctor, and Phebe Elizabeth Dickerson. He studied in the common schools, and from 14 to 17 at the Ohio Central college at Iberia. He taught in a country school for a year, read law for a short time, worked in a newspaper office and in 1884 became editor and proprietor of the Marion *Star*. On July 8, 1891, he married Florence Kling. Having attracted the notice of Senator Joseph B. Foraker, he was encouraged to enter State politics, and was early recognized as an effective speaker. He served two terms in the Ohio senate (1900–04), and during the second was influential in securing Senator Foraker's re-election to the U.S. Senate. From 1904 to 1906 he was lieutenant-governor of Ohio, but in 1910, when nominated for governor by the Republicans, was defeated by a plurality of 100,000. In the campaign of 1912 his paper supported President Taft. In 1914 he defeated Foraker in the Republican primaries as candidate for the U.S. Senate, and was elected with a majority of 100,000 for the term of 1915–21; his friendship with Foraker remained unchanged.

In 1916 Mr. Harding was delegate-at-large from Ohio to the Republican National Convention, of which he was chosen permanent chairman. In the Senate he was regarded as a "safe" man, who could be relied upon to support orthodox Republican policies. In 1915 he urged "preparedness" for naval defence. In 1916 he voted against the confirmation of Louis D. Brandeis as associate justice of the U.S. Supreme Court. In 1917 he gave his support to the declaration of war against Germany, and also to all the war measures, including the Selective Draft and Espionage bills. He favoured the death penalty for spies, but after the war advocated amnesty for political prisoners. He opposed the suggested Federal control of food and fuel. He favoured the Prohibition amendment and voted for the Volstead Act over the President's veto. He favoured the anti-strike clause of the Cummins Railway bill, and voted for return of the lines to their owners within a year after the end of the war. He was for exempting American shipping from Panama Canal tolls and also supported woman suffrage. He was opposed to the Covenant of the League of Nations, holding that "either the Covenant involves a surrender of national sovereignty and submits our future destiny to the League, or it is an empty thing, big in name, and will ultimately disappoint all of humanity that hinges its hopes upon it." He voted for the Lodge resolution of ratification of the Versailles Treaty, with reservations, and against the Underwood resolution of unconditional ratification. He maintained that Americans should show chief concern for America, and opposed all tendencies toward internationalism. He supported the Knox resolution declaring that war with Germany was ended.

At the Republican National Convention in 1920 Mr. Harding was not at first among the prominent candidates for president. On the first ballot he received 65½ votes (493 being necessary for choice), 39 of these being from his own State. On the eighth ballot he received 133½ votes, on the ninth 374½ votes, and on the tenth he secured the nomination with 6923 votes, the result being due largely to the support of certain influential U.S. Senators, deiegates to the convention, who hoped that as president he would be amenable to the Senate. He did not "stump" the country, but conducted his campaign from the "front porch" of his own home. Mr. Harding based his campaign chiefly upon criticism of the Wilson administration, denouncing especially the excessive power that, as he maintained, had been exercised by the executive as a result of war centralization; he demanded as speedy as possible a return to normal conditions, political and industrial.

While opposing the Covenant of the League of Nations, Mr. Harding gave to many of his supporters the impression that he desired an "association of nations," which, without the characteristics of a super-state (such as he believed the League to be), might safeguard peace. But he retained the political support of many who were opposed, like Senators Borah and Johnson, to any sort of international association. In the November elections he won an overwhelming victory over James M. Cox, the Democratic nominee, also from Ohio; he carried, generally by immense majorities, all the northern States and all but one of the States on the border between North and South, and he cut down materially the Democratic majorities in the South. The electoral vote was 404 for Harding against 127 for Cox. The popular vote was 16,133,000 for Harding against 9,142,000 for Cox. In Ohio the popular vote was 1,182,000 for Harding against 780,000 for Cox. The sweeping character of his victory was due less to his own personal strength than to the national reaction against the Democratic Party and the popular feeling against President Wilson. Mr. Harding resigned from the C.S. Senate in Dec. 1920, and was inaugurated on March 4, 1921, the sixth President to come from Ohio.

President Harding's cabinet, like most cabinets, was a *mélange* of men of native ability and political or industrial experience and Party leaders who claimed office as a reward for services rendered the new President. The outstanding names were those of Charles E. Hughes and Herbert C. Hoover, who became Secretary of State and of Commerce respectively. The distinguished career of the former and the widespread confidence in his ability and political integrity had marked him for the most important position in the Cabinet; and there had been a general demand that the new administration should utilize the organizing ability displayed by Hoover in many fields. The choice of Andrew W. Mellon, a wealthy banker and ironmaster of Pittsburgh, as Secretary of the Treasury, was welcomed by men of business. Political and personal debts were paid by the choice of Albert B. Fall as Secretary of the Interior, Harry M. Daugherty as Attorney General and Will H. Hays as Postmaster General. The conduct of administrative and political affairs by these and others less prominent in the new administration, later brought intense criticism upon the President and the Republican Party.

Mr. Harding's inaugural address, and his first message to Congress, delivered in person on April 12, voiced his desire to return to "normalcy," as he expressed it. Retrenchment in expenditure formed a major item in his programme, together with a prompt and thorough revision of taxation. He advocated the adoption of a national budget system, and the Congress having passed a Budget bill similar to that vetoed by Wilson in 1920, he approved it on June 10, 1921; it provided for a Budget Bureau in the Treasury Department and the appointment of a director of the budget, the first being Charles G. Dawes, formerly general purchasing agent of the American Expeditionary Force. President Harding's first budget was presented on Dec. 5, 1921. The President was insistent upon the need of repealing the excess profits taxes and reducing transportation taxes and income surtaxes. The need of financial retrenchment led to his opposing the proposal that war veterans should receive a cash bonus In this matter, as in others, he proved his ability at this early stage to resist political pressure. As regards the tariff he advocated, as a temporary stop-gap, the passing of the emergency tariff, which had been vetoed by President Wilson, but which with slight alteration was approved by Harding on May 27, 1921. He urged the need of adopting a permanent tariff policy, and on Dec. 5. 1921, suggested a "flexible tariff" which might provide for the adjustment of rates to meet unusual and changing conditions. Such

adjustments might be made, in his opinion, by the executive on the advice of the Tariff Commission.

As regards domestic legislation, the President, in general, assumed the rôle of moderator. He disclaimed any desire to enlarge the powers and responsibilities of the executive, which, he declared, were already too large; and he aimed at close co-operation with Congress.

Foreign policy was largely determined by Hughes, financial by Mellon, and the problem of unemployment was thrown upon Hoover. The President, however, frequently played an active rôle in the conferences necessary to secure general agreement, as on Aug. 9, 1921, when an accord was reached between the Treasury and the Representatives on the taxation plan.

The foreign policy of the administration at first seemed likely to emphasize independence of action, in contradistinction to that of President Wilson; the threatened war between Panama and Costa Rica was prevented by a sharp note from Secretary Hughes; the claims of the Japanese to a mandate over Yap were stoutly denied; the administration refused to follow Great Britain in resuming trade relations with Soviet Russia. President Harding made plain in his first message that the United States would not enter the League of Nations.

In rejecting the League Covenant, he said, "we make no surrender of our hope and aim for an association to promote peace, in which we would most heartily join." The President advocated a declaration of peace with Germany by resolution, and the immediate negotiation of a treaty. This policy was adopted by Congress, which agreed upon a joint peace resolution, signed by him on July 2. On Aug. 25, 1921, a treaty with Germany was signed, embodying the President's plan of including most of the stipulations of the Versailles Treaty, but repudiating adherence by the United States to any clause referring to the League of Nations. This treaty and similar pacts with Austria and Hungary were ratified by the Senate on Oct. 18. 1921.

The most important step taken by President Harding during the first year of his administration was the calling of an international conference on the limitation of armaments. On May 25, 1921, the Senate adopted an amendment of Senator Borah to the Navy bill, authorizing and inviting the President to call such a conference.

Mr. Harding's preliminary invitations to the principal naval Powers (Great Britain, Japan, France and Italy) were sent July 10, and formal invitations Aug. 11. He indicated his belief that the question mas closely connected with the problems of the Pacific and Far East, and invitations were also sent accordingly to China and to the smaller European Powers with Far-Eastern interests—Holland. Belgium and Portugal.

The invitations were accepted. and the conference assembled at Washington on Nov. 12. The President made it clear that he regarded the conference merely as a step in securing international understanding and good-will; he advocated the convening of succeeding conferences as a possible means of securing an international association for the promotion of peace, and he approved the principle of substituting an understanding between the United States, Great Britain, France and Japan regarding Far-Eastern problems for the existing Anglo-Japanese Treaty. See WASHINGTON CONFERENCE.

The Washington Conference was the highwater mark of the Harding Administration. Thereafter he faced the development of blocs in the Republican Party which destroyed its solidarity, and the growth of criticism which was manifested in the elections of 1922, as a result of which the Republican majority in the House was reduced. The administrative incompetency of office-holders in Washington was widely heralded and there was more than a suspicion of corrupt dealing on the part of cabinet members and their political followers, who were known to be close to the President. Government investigations later verified such suspicions and revealed an extent of political immorality in Washington such as had no parallel in recent times. Harding himself enjoyed personal popularity; his nature was kindly and genial, and there was general confidence in his honesty and devotion to his duties; but he was regarded as easy-going in his relations with friends and disinclined to scrutinize their activities critically. Resentment was voiced against the Republican national organization controlled by the Old Guard; there was outspoken criticism of the new tariff; keen discontent among the farmers led to the election to the Senate of Shipstead and Magnus Johnson. Again the threat of a Third Party became imminent.

In the summer of 1923 Mr. Harding set forth on a tour across the United States and to Alaska, designed to reassure the farmers and reawaken enthusiasm for the administration. The President, already tired, became ill on the trip back from Alaska and was stricken with pneumonia in San Francisco. On Aug. 2, 1923, he died suddenly. (C. SEY.)

HARDINGE, HENRY HARDINGE, VISCOUNT (1785–1856), British field marshal and governor general of India, was born at Wrotham, Kent, on March 30, 1785. He entered the army in 1799 as an ensign in the queen's rangers, a corps then stationed in Upper Canada. He served right through the peninsular campaigns, and in the Waterloo campaign was British commissioner at Prussian headquarters. He was wounded at Ligny on June 16, 1815, where he lost his left hand by a shot, and thus was not present at Waterloo, fought two days later. He received a pension of £300, a knight commander of the Bath and Wellington presented him with a sword that had belonged to Napoleon.

In 1820 and 1826 Sir Henry Hardinge was returned to parliament as member for Durham; and in 1828 became secretary for war in Wellington's ministry, a post which he also filled in Peel's cabinet in 1841–44. In 1830 and 1834–35 he was chief secretary for Ireland. He succeeded Lord Ellenborough as governor general of India. During his term of office (1844–48) the first Sikh War broke out; and Hardinge, waiving his right to the supreme command, magnanimously offered to serve as second in command under Sir Hugh Gough; but disagreeing with the latter's plan of campaign at Ferozeshah, he temporarily reasserted his authority as governor general (see SIKH WARS). After the Sobraon campaign he was created a viscount, and received a pension of £3,000 for three lives.

Hardinge's term of office in India was marked by many social and educational reforms. In 1852 he succeeded Wellington as commander-in-chief of the British army. In the Crimean War he endeavoured to direct the army on Wellington's principles—a system not altogether suited to the changed mode of warfare. In 1855 he was promoted field marshal.

Hardinge resigned in July 1856, and died on Sept. 24, of the same year at South Park near Tunbridge Wells.

HARDINGE OF PENSHURST, CHARLES HARDINGE, 1ST BARON (1858–1944), British diplomat, was born in London on June 20, 1858, second son of the 2nd Viscount Hardinge. He was educated at Harrow and Trinity college, Cambridge, and in 1880 entered the diplomatic service. He became secretary of legation at Tehran in 1896, and in 1898 went to St. Petersburg (Leningrad) as secretary of embassy. In 1903 he returned to England and became assistant undersecretary for foreign affairs. Later (1906–10) he became permanent undersecretary and accompanied Edward VII on his foreign visits.

He was created knight commander of the order of St. Michael and St. George in 1904, knight of the grand cross of the order of St. Michael and St. George in 1905 and knight of the garter in 1916. From 1904 to 1906 he was ambassador to Russia, and in 1910 was appointed viceroy of India and raised to the peerage. Lord Hardinge returned to England in 1916 and was reappointed to the post of permanent undersecretary of foreign affairs. In Nov. 1920 he succeeded Lord Derby as ambassador in Paris, retiring in 1923. He died Aug. 2, 1944, in London.

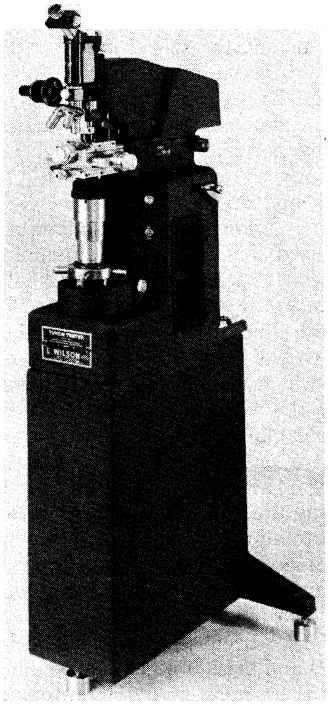
HARD MONEY, a term used in the United States, but not in Great Britain, to designate metallic money and to distinguish it from paper money. It came into existence in the days of the Greenback party. See GREENBACKS.

HARDNESS TESTING. History is replete with references to the preoccupation of man with tools, that is, materials hard enough to cut or otherwise deform softer materials. Attempts to evaluate relative resistance to deformation are noted in early

historical records, for example, the use of a file test in 1640 is recorded.

Although others anticipated it, F. Mohs' scale of resistance to indentation as judged by which material will scratch another has been widely accepted and is used by mineralogists. His scale first described in 1812 assigns numbers to natural minerals.

With development of the arts, there was an increasing demand for more precise evaluation of hardness, particularly of metals, characterized by some ability to deform without fracture. J A. Brinell met this demand very effectively about 1900 with his test for hardness. As commonly used, a load of 3.000 kg. is applied to a hardened steel ball 10 mm. in diameter which is in contact with the plane surface of the metal. The load is maintained for 10 seconds or more and then removed. The diameter of the impression remaining is measured and its spherical area calculated, assuming the same radius for the ball indenter and the indentation. The Brinell hardness number is then obtained by dividing the load in kilograms by the area in square millimetres.



COURTESY OF THE WILSON MECHANICAL INSTRUMENT DIVISION OF AMERICAN CHAIN AND CABLE COMPANY

THE "TUKON" HARDNESS TESTER

A limitation of the Brinell test is that its use is restricted to metals softer than the indenter. Metals used in tools frequently attain this level of hardness. Rockwell introduced about 1920 a test applicable to high levels. It employs a diamond cone indenter nith a spherical point. A hardness number isobtained from the difference between the depth of the impression in millimetres for the major load and that for a minor load. This number is read directly from a dial on the machine. Since fast and reliable readings are readily obtained, it is widely used in industrial inspection. The hardness scale used, however, is nonlinear relative to the Brinell scale and. moreover: has a limited range of high sensitivity, so a variety of other scales are in use and are described in the literature. These scales embrace a range of major loads from 15 to 150 kg. applied to spherical hardened steel indenters from $\frac{1}{16}$ to $\frac{1}{2}$ in. diameter, as well as to the diamond cone. Low loads and large indenters are used to test soft materials such as bearing metals and plastics.

The first hardness tester to meet acceptably the demand for a continuous sequence of comparable numbers over the very aide range of hardness found in metals was the Vickers hardness tester, apparently invented by R. L. Smith and C. E. Sandland. In this method a square-based diamond pyramid indenter is used with 136° angle between opposite faces. This angle was chosen as the mean for the range of penetrations recommended with the Brinell test. At this angle, identical hardness numbers are obtained on relatively soft metals with both the Brinell and Vickers tests. Loads from 10 to 100 kg. are used and the length of the impression diagonals is measured with a micrometer ocular in a microscope that swings over the work after the impression is made. While this machine is much preferred for laboratory work, its operation is rather slow for routine inspection.

There still remain many materials such as glass and minerals whose hardness is of interest but which will crack under the diamond indenters already described. The Knoop hardness test overcomes this limitation by use of an elongated diamond-shaped indenter. An undistorted impression has a length 7.1 times its width and go.j times its depth. With this indenter. the hardness of extremely brittle materials, including glass and even diamonds, can be measured without cracking or spalling either the indenter or the test piece.

The Knoop hardness test number embodies several important departures from conventional hardness testing practice. First, the hardness number is defined as the ratio of the load to the unrecovered lateral area of the indentation in kilograms per square millimetre. The unrecovered area, as distinct from the recovered contact area measured in the Brinell method! is the theoretical lateral area of the indentation while the load is being applied. The Knoop hardness number is found by measuring the length of the impression which is sharply defined and calculating the lateral area from the known ratio of width to length of the indenter. This area is equivalent to that under load because there is lateral spring back. However, width of the unloaded impression relative to length varies widely among the materials tested as a result of differences, among other things, in elastic deformation. A measure of this effect is taken as the ratio of the recovered impression width to that as loaded.

This concept of hardness evaluation found much support when the Brinell test was introduced though Brinell promulgated the use of the ratio of applied load to recovered contact area for an assumed unloaded ball diameter. In the late 1950s this was still current. Knoop *et al.* effectively justified their break with precedent in the following words:

The use of areas which depend upon the elastic recovery of a material is rejected as a method of expressing the results of indentation tests because this associates an applied load with an area other than that involved at the time the load was applied. Furthermore, an unrecovered area is chosen to express the indentation number because it seems to afford the most rational interpretation of the results, placing as it does, vastly different materials such as rubber, copper, glass, and hardened steel in some logical order; whereas, no reasonable sequence results from the use of recovered areas. (F. Knoop, C. G. Peters and W. B. Emerson, "A Sensitive Pyramidal-Diamond Tool for Indentation Measurements," J. *Res. Sat. Bur. Stand.*, 23:39–61, July 1939.)

The merit of the Knoop test. as applied to brittle materials, is well attested to by the evaluation of minerals of the Mohs' hardness scale shown in the table.

Material	Hardness Number	
	Mohs	Knoop
Pitch (for optical polishers)	...	1–22
Gypsum	2	32
Calcite	3	135
Fluorite	4	163
Flint glass	...	180–390
Apatite (parallel to axis)	5	360
Apatite (perpendicular to axis)	5	430
Crown glass	...	420–470
Fused quartz	...	475
Albite	6	490
Orthoclase	6	560
Crystalline quartz (parallel to axis)	7	710
Crystalline quartz (perpendicular to axis)	7	790
Nitrided annealed high-speed steel	...	800
Chromium plate	...	850–900
Carboloy	...	1,050
Nitrided hardened high-speed steel	...	1,100
Topaz	8	1,250
Alundum	...	1,635
Silicon carbide		2,000
Boron carbide (molded)	...	2,230
Diamond	...	8,000–8,100

10

From F. Knoop, C. G. Peters and W. B. Emerson, "A Sensitive Pyramidal-Diamond Tool for Indentation Measurements," *J. Res. Nat.* Bur. *Stand.*, 23:39–61, July 1939.

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HARDOI, a municipality. tehsil (subdivision) and district in the Lucknow division of Uttar Pradesh. India. The town is 63 mi. N.W. of Lucknow. Population in 1951 was 29,881. It has a wood-carving industry, saltpetre works and conducts trade in

grain. HARDOI TEHSIL (632 sq.mi.) had a population in 1951 of 387,734.

HARDOI DISTRICT has an area of 2,320 sq.mi. It is a level district watered by the Ganges, Ramganga, Deoha or Garra, Sukheta, Sai, Baita and Gumti rivers—the first three being navigable by local boats. Toward the Ganges the land is uneven, and often rises in hillocks of sand cultivated at the base, and their slopes covered with lofty munj grass. There are several large *jhils* or swampy meres in the district, the largest being that of Sandi, 3 mi. long by ¾ mi. broad.

Large tracts of forest jungle still exist. Leopards, black buck, spotted deer and nilgai are common; the mallard, teal, gray duck, common goose and all kinds of waterfowl abound. In 1951 the population of the district was 1,361,562.

The first authentic records of Hardoi are connected with the Mohammedan colonization. Bawan was occupied by Salar Masaud in 1028, but permanent occupation did not begin until 1217 Between Bilgram and Sandi was fought the great battle between Humayun and Sher Shah, in which the former was utterly defeated. Hardoi, along with the rest of Oudh, became British territory under Lord Dalhousie's proclamation of Feb. 1856.

HARDOUIN, JEAN (1646–1729), French classical scholar, was born at Quimper in Brittany. About the age of 16 he was admitted into the order of the Jesuits. He eventually became librarian of the Collège Louis le Grand in Paris, and died there on Sept. 3, 1729.

He edited Pliny's *Natural History* for the Delphin series and in the course of this work became interested in numismatics. His work in this department was marred, 'like the rest of his work, by a passion for originality. It includes *Nummi antiqui populorum et urbium illustrati* (1684), and *Antirrheticus de nummis antiquis* (1689). He also supervised the *Conciliorum collectio regia maxima* (1715), holding the view that all councils prior to the council of Trent were fictitious.

Among his many paradoxical theories, the most remarkable is that contained in *Prolegomena ad censuram veterum scriptorum*, to the effect that the vast majority of the existing classical works are spurious productions of the monks of the 13th century.

HARDT, THE, a mountainous district of Bavaria, forming the northern end of the Vosges range. It is, in the main, an undulating plateau of sandstone, of a mean elevation of 1,300 ft., and the highest point is the Donnersberg (2,254 ft.).

The eastern slope, toward the Rhine, is diversified by deep well-wooded valleys, such as the Lauter and the Queich, and by conical hills surmounted by ruins of feudal castles and monasteries; *e.g.*, the Madenburg near Eschbach, the Trifels (long the dungeon of Richard I of England), and the Maxburg near Neustadt.

Three-fifths of the area is occupied by forests, principally oak, beech and fir. The lower eastern slope is highly cultivated and produces excellent wine.

HARDWAR, an ancient town and Hindu place of pilgrimage, in the Saharanpur district of Uttar Pradesh, India, on the right bank of the Ganges at the point where the Ganges debouches from the foothills of the Himalayas into the plains. Pop. (1951) 56,175.

The position is of great natural beauty, and the river at this point has special sanctity. The town is of great antiquity and has borne many names. It was originally known as Kapila from the sage Kapila. Hsuan Tsang, the Chinese Buddhist pilgrim, in the 7th century visited a city which he calls Mo-yu-lo, the remains of which still exist at Mayapur, a little to the south of the modern town.

Among the ruins are a fort and three temples, decorated with broken stone sculptures. The goal of the vast numbers of Hindus who visit Hardwar is the Hari-ka-charan, or bathing ghat. with the adjoining temple of Gangadmara. The *charan* or footmark of Vishnu, imprinted on a stone let into the upper wall of the ghat, forms an object of special reverence; and water from the pool below is carried off all over India, for use on solemn occasions. A great assemblage takes place annually, at the beginning of the Hindu solar year (April–May), when the sun enters Aries.

After 1892 many sanitary improvements were made for the benefit of the annual concourse of pilgrims. In early days riots and also outbreaks of cholera were of common occurrence. It is at Hardwar that the main Ganges canal takes off from the river; and the headworks are an engineering feat of much interest.

HARDWARE, a term applied to a large variety of metal goods, especially domestic ironmongery and appliances. hand tools, small metal manufactures such as stoves used in building, garden appliances, etc. There are millions spent annually on builder's hardnare for new buildings of all kinds, and by gas and electricity supply undertakings on lighting, cooking and heating appliances.

Inventive genius is constantly widening the scope of the trade, and the tendency is specially marked in the multiplicity of modern laboursaving appliances for the house. It is impossible to indicate accurately the relative importance of various sections of the trade, but the furnishing side covers a large part of it.

Birmingham, "the city of a thousand trades," is known the world over as the great hardware metropolis, practically every class being made there. One leading branch is the manufacture of hollow ware—cast-iron, galvanized, enameled and aluminum products for domestic and other uses. Cast-iron pots are still sold both for home and export, but the trade has suffered from the competition of enameled goods and aluminum ware. A notable development in the enameled branch has been the introduction of colours. Aluminum hollow ware—which may be cast, deep-drawn under heavy pressure or spun from the flat disk of metal—enjoys great popularity, on account of its cleanliness, lightness and purity. Cast aluminum ware is the most expensive kind and is largely used for ships and hotel kitchens. The manufacture of hearth suites, curbs and companion sets, and fire screens, is another great industry. New metals and finishes to eliminate labour of cleaning have been adopted; the goods are made in copper, Grecian bronze, satin brass. oxidized silver and stainless steel. Birmingham is a centre for electroplated ware, and also for brass foundry.

Cutlery and electroplate trades have been centred in Sheffield for generations. Machine processes and mass production methods are increasingly applied in the cutlery industry. Hand-forged crucible steel blades are still made, but machine processes have been brought to a fine pitch of perfection, and the tradition for quality products is well maintained. The manufacture of stainless steel (*q v.*) by Harry Brearley in the Brown-Firth Research laboratory prior to World War I was one of the most far-reaching developments in the history of steel; not only did it largely revolutionize the cutlery trade, but it proved of great value in the engineering and allied industries. Great improvements have been made in precision grinding, and especially in measures for safeguarding the health of the workers engaged in grinding operations. Safety razor blades are produced—millions per week—in the United States, Great Britain and Germany.

In plated goods, chromium plating applied to base metal is used for flatware like spoons and forks, and for hollow ware, plumbers' fittings, bathroom taps. plugs and wastes, and other goods for domestic and industrial uses where the stainless requisite is desirable.

Builders' Hardware.—This is produced in many centres. Light castings—stoves, ranges, grates, baths and rainwater pipes—are staple manufactures of Falkirk, where the industry was established in 1759. Stoves and ranges for solid fuel have long been made; now, in addition, the industry is meeting needs for cooking and heating appliances using gas or electricity. Here again stainless steel is being more extensively utilized. Mechanical methods are rapidly superseding old laborious hand practice. Machine molding, for instance, is extending. Large outputs of light castings are made from foundries at Rotherham, Leeds, Warrington, Birmingham. in the Black Country and at Luton. Wire manufacture is the chief industry of Warrington; and wire netting works are situated there and also in Manchester, Norwich, and London.

Willenhall and Wolverhampton are the most important centres for locks and latches. Corrugated iron is largely produced in London. Ellesmere Port. Glasgow and South Wales, and in the West Riding of Yorkshire; metal casements are made in Essex;

plumbers' brass foundry and fittings in various centres. but largely in Birmingham. and screws and nails also in the Midlands. Sheffield manufacturers produce saws and woodworking tools, engineering tools and appliances, tools for road making and agricultural work and garden requisites In the Midlands there are norks devoted to the manufacture of edge tools. Agricultural implement making is carried on in Scotland, Yorkshire and the eastern counties. The domestic washing machine trade is carried on in Lancashire, Torkshire and in Glasgow; and Keighley (Yorks) is the leading centre of production for laundry machinery. Carpet sweepers and domestic mops are largely produced in Lancashire; and brushes of all kinds at Oldham, St. Albans. London and Wymondham. An outstanding feature of the hardware trade is its tremendous scope and its varied range of patterns. However. the trend is now toward simplification by the elimination of many patterns and sizes. (N. F.; X)

THE UNITED STATES

At the beginning of the 19th century this term meant chiefly mechanics' tools and builders' hardware. but, in the United States. it has come to mean all small metal articles used in the construction of houses or for household purposes, tools of mechanics' trades, furnishing goods for kitchen and dining room service, tin plate, sheet iron, nails, screws, fence wire, etc.

In the early American colonial period supplies were brought from the mother countries of Europe. As the colonies assumed a definite shape, the village blacksmith established the foundation of American hardware manufacture. Immigrants brought their own tools. the patterns of which were at once copied and improved. Village blacksmiths in Connecticut and thereabouts began to make farm implements and simple hand tools about 1850, and in 1860 American manufacturers began to pull trade away from competitors by virtue of higher quality goods.

The hardware-manufacturing industry began in New England. The business gradually spread into the Middle Atlantic states. especially New Pork and Pennsylvania. In the latter part of the 19th century New York became the undisputed centre of the trade. Here were located the majority of the great importing houses. and here also were founded and flourished the jobbers who distributed to the retail trade. With the growth of the country new advance manufacturing centres were created, and New Pork was no longer the pre-eminent trade centre. (W. H. SIE.; X.)

HARDWICKE, PHILIP YORKE, 1ST EARL OF (1690–1764), English lord chancellor, whose grasp of legal principle and study of the historical foundations of equity, combined with his knowledge of Roman civil law. enabled him to establish the principles and limits of the English system of equity. He was born at Dover on Dec. 1, 1690. Called to the bar at the Middle Temple in 1715, he afterward joined Lincoln's Inn, of which he was bencher and treasurer in 1724. He sat in parliament for Lewes (1719) and Seaford (1722–34); was solicitor general (1720), attorney general (1724), lord chief justice and baron Hardwicke (1733) and lord chancellor (1737).

For many years from 1740 onward Hardwicke held the controlling power in the government. Duripg the king's absences on the continent he was an influential member of the council of regency, and he had to cope with the Jacobite rising of 1745. After Culloden he presided at the trial of the Scottish Jacobite peers. He carried out the great reform of 1746, which swept away the private heritable jurisdictions of the Scottish landed gentry; among his other great legal services was the reform of the English marriage laws (1753).

Hardwicke, who was created earl in 1754, retired with Newcastle in Nov. 1756, but helped to secure the coalition between Newcastle and Pitt in 1757. He died in London on March 6, 1764.

Hardwicke was not a statesman of the first rank, but he was one of the greatest judges who ever sat on the English bench. Lord Campbell pronounces him "the most consummate judge who ever sat in the court of chancery, being distinguished not only for his rapid and satisfactory decision of the causes which came before him, but for the profound and enlightened principles which he laid down, and for perfecting English equity into a systematic science."

Born within two years of the death of Chief Justice Jeffreys, Hardwicke had a powerful influence in obliterating the evil traditions of the judicial bench under the Stuart monarchy.

BIBLIOGRAPHY.—The contemporary authorities for the life of Hardwicke are voluminous, being contained in the memoirs of the period and in numerous collections of correspondence in the British museum. *See,* especially, the *Hardwicke Papers;* Horace Walpole, *Letters,* ed. by *P.* Cunningham, 9 vol. (1857–59); *see* also Lord Campbell, *Lives* of *the Lord Chancellors,* 8 vol., vol. v (1845). (W. T. Ws.; X.)

HARDWOODS. A trade term employed by lumbermen to designate timbers obtained from broad-leaved trees. Coniferous trees, in turn. produce the softwoods of the trade. These two terms often lead to confusion: they should be used only to indicate classes of material rather than specific mechanical properties exhibited by either class. Actually there are several hardwoods, such as yellow poplar, aspen or balsa. which in the mechanical sense are much softer than softwoods of the order of longleaf pine. Douglas fir or yew.

Many beautiful hardnoods are known to the trade, and to this group are traceable such renowned cabinet timbers as American black walnut, Indian rosenood. teak, ebony, primavera, maple, satinwood. American and African mahoganies. greenheart and vermilion. *See* TIMBER.

HARDY, ALEXANDRE (1569?–1631), French dramatist, was born in Paris. He was one of the most fertile of all dramatic authors, and himself claimed to have written some 600 plays. of which, however, only 34 are preserved. He seems to have been connected all his life with a troupe of actors headed by a clever comedian named Valleran-Lecomte, whom he provided with plays. Hardy toured the provinces with this company, which gave some representations in Paris in 1599 at the Hôtel de Bourgogne.

Valleran-Lecomte occupied the same theatre in 1600–03, and again in 1607. apparently for some years. In consequence of disputes with the Confrérie de la Passion. who owned the privilege of the theatre. they played elsewhere in Paris and in the provinces for some years; but in 1628, when they had long borne the title of "royal," they were definitely established at the Hôtel de Bourgogne. Hardy's numerous dedications never seem to have brought him riches or patrons. His most powerful friend was Isaac de Laffemas (d. 1657), one of Richelieu's most unscrupulous agents, and he was on friendly terms with the poet Theophile, who addressed him in some verses placed at the head of his *Théâtre* (1632), and Tristran l'Hermite had a similar admiration for him. Hardy's plays were written for the stage, not to be read; and it was in the interest of the company that they should not be printed and thus fall into the common stock. But in 1623 he published *Les Chastes et loyales amours de Théagène et Cariclée,* a tragi-comedy in eight "days" or dramatic poems; and in 1624 he began a collected edition of his works, *Le Théâtre d'Alexandre Hardy, parisien,* of which five volumes (1624–28) were published, one at Rouen and the rest in Paris. These comprise eleven tragedies: *Didon se sacrifiant, Scédase ou l'hospitalité violée, Panthée, Méléagre, La Mort d' Achille, Coriolan, Marianne,* a trilogy on the history of Alexander, *Alcméon, ou la vengeance féminine;* five mythological pieces; 13 tragi-comedies, among them *Gésippe,* drawn from Boccaccio; *Phraarte,* taken from Giraldi's *Cent excellentes nouvelles* (1584); *Cornélie, La Force du sang, Félismène, La Belle Égyptienne,* taken from Spanish subjects; and five pastorals, of which the best is *Alphée, ou la justice d'amour.*

Hardy's importance in the history of the French theatre can hardly be overestimated. Up to the end of the 16th century mediaeval farce and spectacle kept their hold on the stage in Paris. The French classical tragedy of Étienne Jodelle and his followers had been written for the learned, and in 1628 when Hardy's work was nearly over and Rotrou was on the threshold of his career, very few literary dramas by any other author are known to have been publicly represented. Hardy educated the popular taste, and made possible the dramatic activity of the 17th century. He had abundant practical experience of the stage, and modified tragedy accordingly, suppressing chorus and monologue,

and providing the action and variety which was denied to the literary drama. He was the father in France of tragi-comedy, but cannot fairly be called a disciple of the romantic school of England and Spain. It is impossible to know how much later dramatists were indebted to him in detail, since only a fraction of his work is preserved, but their general obligation is amply established.

See Le Théâtre d'Alexandre Hardy, edited by *E.* Stengel (1883–84, 5 vol.); E. Lombard, "Étude sur Alexandre Hardy," in *Zeitschr. für neufranz. Spr. u. Lit.* (vol. i and ii, 1880–81); K. Nagel, *A. Hardy's Einfluss auf Pierre Corneille* (1884); and especially E. Rigal, *Alexandre Hardy . . .* (1889) and *Le Théâtre français avant la période classique* (1901).

HARDY, SIR GODFREY HAROLD (1877–1947), English mathematician, one of the leading mathematicians of his time, was born at Cranleigh, Surrey, on Feb. 7, 1877, and died on Dec. 1, 1947. He was educated in Cranleigh school, Winchester college and at Trinity college, Cambridge, where he became a Prize fellow (1900–06). From 1906 to 1919 he was a lecturer in mathematics in Trinity college. In 1910 he was elected a fellow of the Royal society and in 1914 was made Cayley lecturer in Cambridge university. In 1919 he was appointed to the Savilian chair of geometry at Oxford university. He returned to Cambridge in 1931 as Sadleirian professor of pure mathematics, a post which he occupied until his retirement in 1942. He received a royal medal of the Royal society in 1920, the society's Sylvester medal in 1940 and its Copley medal in 1947. Many other distinctions and honorary degrees were bestowed upon him. His main mathematical interests lay in analysis and he wrote a number of treatises. contributing more than 300 papers to mathematical periodicals.

(ID. McK.)

HARDY, THOMAS (1840–1928), English novelist and poet, was born at Upper Bockhampton, near Stinsford in Dorset, on June 2, 1540. His father was a master mason, of a family originally connected with the Le Hardys of Jersey, who had settled in the west of England in the 1 jth century. His mother also came of a family long established in Dorset: smallholders in the parish of Melbury Osmond. Hardy owed much to his parents and their rural background, inheriting from his father a love of music, from his mother a love of reading, and from both strength of personality as well as the stability which connected him in an age of change with a world already vanishing.

He went first to the village school and then to a school in Dorchester, and added to the good grounding they provided by his own studies, teaching himself Greek and reading thoughtfully. In 1856 he was articled to John Hicks, an ecclesiastical architect in Dorchester; he continued his own reading, encouraged by William Barnes, the Dorset poet, who kept a school next door to Hicks's office, and by Horace Moule, the brilliant son of the vicar of Fordingbridge, to whose friendship he owed much intellectual stimulus. He continued to live at home, and to find in the life of the small rural community the refreshment and strength which were always necessary to him. In about 1857 he began to write verse and essays but, advised by Moule, decided not to give up architecture. After spending some time sketching and measuring many old Dorset churches with a view to their restoration, he went in 1862 to look for work in London. He became assistant to Arthur (later Sir Arthur) Blomfield, and worked hard at his profession (in 1863 winning both the medal of the Royal Institute of British Architects for an essay, *The Application of Coloured Bricks and Terra Cotta in Modern Architecture,* and the Architectural association's prize for design), although uncertain whether literature or architecture should be his life's work. He read and wrote, attended evening classes and went to art galleries and concerts. In March 186 j his first prose work, a humorous sketch. was published in *Chambers's Journal,* but he was more interested in poetry. Often lonely and depressed, he became ill, and in 1867 he returned to Dorset, working again for John Hicks. and. at Weymouth, for the architect who took over the business when Hicks died. During 1867 and 1868 he wrote a "purpose" story, *The Poor Man and the Lady,* which in 1869 was accepted by Chapman and Hall. It had been read by George Meredith, who asked the writer to call on him, and advised him not to print it, but to try another with more plot. The manuscript was withdrawn and rewritten, but never published, and although Hardy made use of parts of it later, he destroyed the original.

In 1870 Hardy took Meredith's advice too literally, and constructed a novel that was all plot, nhich was published in 1871 under the title *Desperate Remedies.* In 1872 appeared *Under the Greenwood Tree,* subtitled "a Rural Painting of the Dutch School," in which Hardy found himself, and which he never surpassed in delicate perfection of art. *A Pair of Blue Eyes,* in which tragedy and irony come into his work together. was published in 1873. In 1874 Hardy married Emma Lavinia Gifford, whom he had met when working on a church in Cornwall His first popular success was *Far From tlze Madding Crowd* (1874), which, on its appearance anonymously in the *Cornhill Magazzne,* was attributed by many to George Eliot. Then came *The Hand of Ethelberta* (1876) subtitled not inaptly, as "a Comedy in Chapters"; *Tlze Return of the Native* (1878), the most sombre and, in some ways. the most powerful and characteristic of Hardy's novels; *The Trumpet-Major* (1880); *A Laodicean* (1881); *Two on* a *Tower* (1882), a long excursion in constructive irony; *The Mayor of Casterbridge* (1886); *The Woodlanders* (1887); a collection of *Wessex Tales* (1888); *A Group of Noble Dames* (1891); *Tess of tlze D'Urbervilles* (1891), Hardy's most famous novel; *Life's Little Ironies* (1894); *Jude tlze Obscure* (1896), his most thoughtful and least popular book; *Tlze Well-Beloved* (1897), a reprint, with some revision, of a story originally published in the *Illustrated London News* in 1892.

In all his novels Hardy is concerned with one thing, under tno aspects; not civilization, nor manners, but the principle of life itself, invisibly realized in humanity as sex, seen visibly in the world as what we call nature. He is a fatalist, perhaps rather a determinist, and he studies the workings of fate or law (ruling through inexorable moods or humours) in the chief vivifying and disturbing influence in life, women. His view of women is more French than English; it is subtle, a little cruel. not as tolerant as it seems. thoroughly a man's point of view, and not, as with Meredith, man's and woman's at once. He sees all that is irresponsible for good and evil in a woman's character. all that is untrustnorthy in her brain and will, all that is alluring in her variability. He is her apologist. but always with a reserve of private judgment. No one has created more attractive women of a certain class, women whom a man would have been more likely to love or to regret loving. In his earlier books he is somewhat careful over the reputation of his heroines; gradually he allows them more liberty, with a franker treatment of instinct and its consequences. *Jude the Obscure* is, perhaps. the most unbiased consideration in English fiction of the more complicated questions of sex. There is almost no passion in his work. neither the author nor his characters ever seeming able to pass beyond the state of curiosity, the most intellectually interesting of limitations, under the influence of any emotion. In his feeling for nature. curiosity sometimes seems to broaden into a more intimate communion. The heath, the village with its peasants, the change of every hour among the fields and on the roads of that English countryside which he has made his own—the Dorsetshire and Wiltshire "Wessex"—mean more to him, in a sense. than even the spectacle of man and woman in their blind and painful and absorbing struggle for existence. His knowledge of women confirms him in a suspension of judgment; his knowledge of nature brings him nearer to the unchanging and consoling element in the world. All the entertainment which he gets out of life comes to him from his contemplation of the peasant, as himself a rooted part of the earth, translating the dumbness of the fields into humour. His peasants have been compared with Shakespeare's; he has the Shakespearean sense of their placid vegetation by the side of hurrying animal life, to which they act the part of chorus, with an unconscious wisdom in their close, narrow and undistracted view of things.

The order of merit was conferred upon Hardy in July 1910, and in his later years he received increasing recognition, not only as a great novelist but also as a poet, until by common consent he was admitted the undisputed sovereign of English letters. His great epic-drama *The Dynasts,* in three parts (1903–04, 1906,

1908), a chronicle play of England's struggle against Napoleon, with an accompaniment of philosophic comment chanted by a chorus of "phantom intelligences," was in part produced by Harley Granville-Barker in the early months of World War I, and again at Oxford in 1920 Several volumes of lyric poetry followed. His first nife died in 1912, and in 1914 he married Florence Emily Dugdale, herself a writer of children's books and articles in periodicals.

Both on his 70th and his 80th birthday he received at Max Gate (the house he had built himself near Dorchester in 1883, and from which, latterly, he seldom moved) tributes of respect and admiration from the whole English-speaking world. When he died there, on Jan. 11, 1928, his death was felt as a loss, not only of a figure unique in literature because of his great age and of his eminence, but also as a snapping of the last link with the 19th century, and he was mourned as "the last of the great Victorians." His ashes were buried in Westminster abbey, but in consideration of his deep affection for his native Wessex and the peculiar inspiration it gave him, his heart was buried in his parish churchyard.

Aspects of Hardy's Genius. — Thomas Hardy's career naturally divides itself into three periods. The first of these contains his work as a novelist: and ends with *Jude* the *Obscure.* Throughout the series of the novels there gradually become more and more insistent — first as an element of irony, but later as the tragic essence of the narrative — a characteristic metaphysic, in which the strivings and passions of individuals are in fruitless conflict with the inexorable process of the world. *Jude the Obscure,* despite its splendid qualities, made it clear that such a theme could not be adequately developed in the form of the novel; a form was required in which the author could speak out his own convictions without violating aesthetic propriety.

Accordingly! the second period consists of Tlze Dynasts; no doubt the greatest single achievement of his career. It may be said that this great poem was written in order to give full utterance. in artistic form, to his peculiar metaphysic. That, however, was not its originating intention. which was simply to celebrate in a chronicle play England's part in the Napoleonic wars. But as the conception grew and deepened, and as to the human action the superhuman comment of "phantom intelligences" was added. the poem became the summation of Hardy's vision of life; and thereby achieved a unity which. in its intrinsic grandeur and in its perfect command over immense wealth of matter. can only be compared nith such monuments of man's destiny as Faust and Paradise Lost. In diction, honever, Tlze *Dynasts* will not bear any such comparison.

The third period may be said to begin with *Time's Laughing* Stocks in 1909, and is devoted to lyric poetry. It is not often that an artist's life can be divided so definitely into separate stages, each stage characterized by the use of a difierent form; and, next to its length and plenty, and consistently noble idiosyncrasy, this tripartite division is, perhaps, the most remarkable feature of Hardy's career as a whole. The lyrical period. however. does not give us an entirely new development of his genius While he nas nriting novels. he had occasionally experimented with poetry and some of the results were published in *Wessex Poems* (1898) and Poems of *the* Past and *the* Present (1901), between *Jude the Obscure* and *The* Dynasts. The volumes published after The Dynasts also contained a good many more of these earlier poems. But after 1909 Hardy wrote little but lyrical poetry. and this may therefore be truly called his lyrical period. (A Changed *Man.* 1913, merely rescued from the periodicals of former years several stray pieces of minor fiction; Tlze *Queen oj Cornwall,* 1923, was a mummers' play written for a local group of players.) It represents a new concentration of his poner, but certainly no diminution of it.

Devotion to lyrical expression produced a mastery almost as signal in its kind as his command of the art of fiction; and his 70th year san hitn beginning, with Time's *Laughing* Stocks, the series of volumes — Satzres of *Circumstance* (1914), *Moments of Vision* (1917), Latr Lyrics and Earlier (1922), *Human Shows, Far* Phantasies (192j), and the posthumous volume *Winter Words* (1928), which revealed him as the most original, the most poignant and also the most copious of contemporary lyric poets.

The originality of the technique in these volumes did not by any means consist in a mere breach with the accepted conventions, but rather in its highly individual — to some, perhaps, rather disconcerting — compound of the conventional and the unconventional. Most of these lyrics maintain an exact and even rigid formality of stanza. in which a scheme of rhymes is imposed, as it seems, arbitrarily and at all costs. The effect is sometimes justified by its music; but more often by the compact force its pressure gives to language almost conversational in its idiom and choice of words. Yet the diction which defies poetic tradition and seems to despise the magic of elaborated verbal suggestion, is oddly blended with stiff literary phrases and even with words one might expect only lexicographers to think of. The truth seems to be that, in lyrical technique. Hardy had no prejudices either for or against the conventions. He is simply concerned with the matter which intense feeling and profound understanding have enabled him to imagine in a way peculiarly his own. and to express this faithfully he has iorged a technique peculiarly his own, out of whatever the language of literature or of speech could offer him. Readers who are willing to allow him this liberty can hardly fail to be impressed by the subtlety. depth and variety of his versions of the experiences common to humanity; the commonplace becomes in his hands something rich and strange. Naturally. the habits of thought and outlook on the world, which we find progressively insistent in the series of the Wessex novels, and which inspire the turbulent matter and monumental structure of The *Dynasts,* are evident also in the lyrics; which, indeed, are often in the nature of marginal comments on themes previously used.

But something like the quintessence of his tragic power may be found in such ballads as "A Trampwoman's Tragedy," or such keen discrimination of pathos as "Near Lanivet," and something too like the quintessence of his irony to be altogether comfortable in Satires of *Circumstance* or "Ah, Are You Digging on My Grave?" Nor is the rustic humour of his beloved Dorset villagers wanting, nor the vivid delight in nature. in the extraordinary range of his lyrical art. It is. in fact, the same Hardy in the lyrics as in the novels and *The* Dynasts; but a Hardy who, if his lyrics were all me had of him, would surely, by virtue of them alone, hold a secure, indeed a unique, position in modern English literature.

(L. A.; X.)

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HARDY, SIR THOMAS DUFFUS (1804–1878), English antiquary, belonged to a family famous in the annals of the British navy. Born at Port Royal in Jamaica on May 22. 1804, he crossed over to England and in 1819 entered the Record Office in the Tower of London. Trained under Henry Petrie (1768–1842) he gained a sound knowledge of palaeography. and soon began to edit selections of the public records. From 1861 until his death on June 15, 1878, he was deputy-keeper of the Record Office. which just before his appointment had been transferred to its new London headquarters in Chancery Lane. Hardy. who was knighted in 1873, had much to do with the appointment of the I-listorical Manuscripts Commission in 1869. Sir T. Hardy edited the Close Rolls, *Rotuli* litterarum *clausarum, 1204–1227* (2 vols.,

1833–44), and the Patent Rolls, *Rotuli litterarum patentium, 1201–1216* (1835) with introduction, "A Description of the Patent Rolls, to which is added an Itinerary of King John." He also edited the *Rotuli de oblatis et finibus* (1833), which deal also with the time of King John. He edited many other important series of documents. His best known work is the invaluable *Descriptive Catalogue of Materials relating to the History of Great Britain and Ireland* (3 vols., 1862–71).

HARDY, SIR THOMAS MASTERMAN, Bart. (1769–1839), British vice-admiral, of the Portisham (Dorsetshire) family of Hardy, was born on April 5, **1769,** and in 1781 began his career as a sailor. He became lieutenant in 1793, and in **1796,** being then attached to the "Minerve" frigate, attracted the attention of Nelson by his gallant conduct. He continued to serve with distinction, and in 1798 was promoted to be captain of the "Vanguard," Nelson's flagship. In the "St. George" he did valuable work before the battle of Copenhagen in 1801. He was Nelson's flag-captain on the "Victory" at the battle of Trafalgar in 1805, witnessed Nelson's will, and was in close attendance on him at his death. Hardy was created a baronet in **1806.** He was then employed on the North American station, and later (1819), was made commodore and commander-in-chief on the South American station. In **182j** he became rear-admiral, and in December **1826** escorted the expeditionary force to Lisbon. In **1830** he was made first sea lord of the admiralty, being created G.C.B. in **1831.** In **1834** he was appointed governor of Greenwich hospital, where he died on Sept. **20, 1839.**

See Broadley and Bartelot, *The Three Dorset Captains at Trafalgar* (1906), and *Nelson's Hardy, his Life, Letters and Friends* (1909).

HARDYNG or **HARDING, JOHN** (1378–1465), English chronicler, was born in the north, and as a boy entered the service of Sir Henry Percy (Hotspur), with whom he was present at the battle of Shrewsbury (1403). He then passed into the service of Sir Robert Umfraville, under whom he was constable of Warkworth Castle, and served in the campaign of Agincourt in 1415 and in the sea-fight before Harfleur in **1416.** In 1424 he was on a diplomatic mission at Rome, where at the instance of Cardinal Beaufort he consulted the chronicle of Trogus Pompeius. Umfraville, who died in **1436,** had made Hardyng constable at Kyme in Lincolnshire, where he probably lived till his death about **1465.** Under Henry V. Hardyng was employed to investigate the feudal relations of Scotland to the English Crown. For this purpose he visited Scotland, at much expense and hardship. For his services he says that Henry V. promised him the manor of Geddington in Northamptonshire. Many years after, in 1439, he had a grant of £10 a year for similar services. In 1457 there is a record of the delivery of documents relating to Scotland by Hardyng to the earl of Shrewsbury, and his reward by a further pension of £20. It is clear that Hardyng was well acquainted with Scotland, and James I. of Scotland is said to have offered him a bribe to surrender his papers. But the documents, which are still preserved in the Record Office, have been shown to be forgeries and were probably manufactured by Hardyng himself. Hardyng spent many years on the composition of a rhyming chronicle of England. The original edition ending in **1436** had a Lancastrian bias and was dedicated to Henry VI. Afterwards he prepared a version for Richard, duke of York (d. 1460), and the chronicle in its final form was presented to Edward IV. after his marriage to Elizabeth Woodville in **1464.**

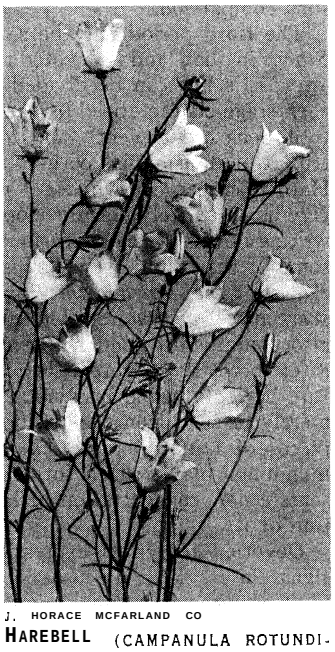
The version of **1436** is preserved in Lansdowne ms. 204, and the best of the later versions in Harley ms. **661,** both in the British Museum. Richard Grafton printed two editions in Jan. **1543,** which differ much from one another and from the now extant manuscripts. Sir Henry Ellis published the longer version of Grafton with some additions from the Harley ms. in **1812.**

See Ellis's preface to Hardyng's *Chronicle,* and Sir *F.* Palgrave's *Documents illustrating the History of Scotland* (for an account of Hardyng's forgeries).

HARE, SIR JOHN (JOHN FAIRS) (1844–1921), English actor-manager especially closely associated with the Garrick theatre, was born at Giggleswick, Yorkshire, on May **16, 1844** He appeared first in Liverpool in **1864,** and in London in 1865, where he was for ten years with the Bancrofts, succeeding in T. W. Robertson's comedies. In 1875 he became actor-manager at the Court theatre and from **1879** to **1888.** in association with the Kendals, brought success to the hitherto unlucky St. James's theatre. He became actor-manager of the Garrick theatre in **1889.** producing Sir Arthur Pinero's *The Profligate* and *The Notorious Mrs. Ebbsmith* and making a personal success in Sydney Grundy's *A Pair of Spectacles,* and later at the old Globe theatre in *Tlte* Gay *Lord Quex.* A fine character actor. Hare was popular in the United States, which he visited between 189j and 1901. Knighted in 1907, he appeared for the last time in 1917 in **A** *Pair of Spectacles.* He died in London on Dec. **28, 1921.** (W. J. M.-P.)

HARE, the name of the well-known English rodent now designated *Lepus europaeus.* The name includes all the numerous allied species which do not come under the designation of rabbits. *(See* RABBIT.) In parts of Europe, where the ordinary species does not occur, its place is taken by the closely allied blue. or mountain hare. the true *L. timidus* of Linnaeus, and the type of the genus *Lepus* and the family Leporidae. *(See* RODEWTIA.) The blue hare is a smaller animal with a more rounded and relatively smaller head. and the ears, hind legs and tail shorter. In southern Sweden it is permanently of a light fulvous gray, with black tips to the ears. but in more northerly districts the fur—except the black ear-tips—changes to white in winter, and still farther north the animal appears to be white at all seasons. In Ireland there is an allied species, *L. hibernicus,* distinguished by its more russet colouring, and the partial or complete absence of the white winter coat. The range of the common hare extends from England across southern and central Europe to the Caucasus; while that of the blue or mountain species reaches from Scotland and Scandinavia through northern Europe and Asia to Japan and Kamchatka. The North American varying hares are closely related to this form. These. the arctic hare (*L. arcticus*) and the Greenland hare (*L. groenlanicus*), turn white in winter.

The hare takes readily to the water. where it swims well; an instance having been recorded in which one was observed crossing an arm of the sea about a mile in width. Hares are remarkably prolific, pairing when scarcely a year old. and the female bringing forth several broods in the year. The young are born covered with hair and with the eyes open, and after being suckled for a month are able to look after themselves. In Europe this species has seldom bred in confinement: although an instance has recently been recorded. It will interbreed with the blue hare. Hares (and rabbits) have a cosmopolitan distribution with the exception of Madagascar and Australasia; and are now divided into numerous genera mentioned in the article RODENTIA. The most important of these groups is the typical genus which contains many different species, distributed over Europe, Asia, North America and Africa. In America several hares are wrongly called rabbits: the "jack rabbits" (*Lepus californicus* and *L townsendii*) and the "snow-shoe rabbits" (*L. americanus). Sylvilagus,* the cottontail, is called rabbit with more reason; it resembles the true rabbit, often lives in holes. and its young are helpless, nearly naked at birth. Several southern species, with less white on the tail, are also placed in this genus.



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HAREBELL (CAMPANULA ROTUNDIFOLIA)

HAREBELL or BLCEBELL is a)$ell-known perennial wild flouer, *Campanula rotundifolia,* a member of the bellflower family (Campanulaceae), found throughout boreal Eurasia and in North America from the

arctic to the mountains of Pennsylvania, the Rockies and Sierra Nevada. The harebell has a very slender slightly creeping rootstock, and a wiry, erect stem. The leaves at the base of the stem, to which the specific name rotundijolia refers, have long stalks, and are roundish or heart-shaped with a wavy or toothed margin; the lower stem leaves are ovate or lance-shaped, and the upper ones linear, almost stalkless, acute and entire. The flowers are slightly drooping, usually solitary or in sparse clusters, and have a smooth calyx. with narrow pointed erect segments, the corolla bell-shaped, with slightly recurved segments, and the capsule nodding, and opening by pores at the base. The plant is found on heaths and pastures throughout Great Britain and flowers in late summer and in autumn. It is there called bluebell of Scotland and witches thimbles, but as bluebell is also applied to a squill (*Scilla*), the vernaculars are often confused. Cultivated in gardens are the blue-flowered form, and double-flowered and white varieties. See CAMPANULA. (N. TR.)

HAREM (Arabic *harīm,* "forbidden"), a name applied to that part of a house in Moslem countries which is set apart for the women; it is also used collectively for the women themselves. Zenana (strictly *zanāna,* from Persian zan, "woman") is the term used in India; *andarūn* (Persian "inner part," *sc.* of a house) in Persia. The Indian harem system is also known as *pardah* or purdah, literally the name of the curtain used to separate the women's quarters from the rest of the house. In Mohammedan countries theoretically a woman must veil her face to all men except her father, her brother and her husband; but among certain Moslem communities (*e.g.,* in parts of Albania) women of the poorer classes may appear in public unveiled.

Turkish Harems.—The Turkish republic in 1926 made polygamy illegal; but even before that date it was not common, for, though the Koran permits four wives, the man of average possessions was perforce content with one wife and a small number of female servants.

The imperial seraglio was a unique institution, an elaborately organized community with a complete system of officers, disciplinary and administrative, and strict distinctions of status. The real ruler of this society was the sultan's mother, the *validé* sultan, who exercised her authority through a female superintendent, the kyahya *kadini.* She had also a large retinue of subordinate officials (kalfas) ranging downward from the *hasnadar* ousta (lady of the treasury) to the "mistress of the sherbets" and the "chief coffee server." Each of these officials had under her a number of pupil-slaves (alaik), whom she trained to succeed her if need be and from whom the service was recruited. After the validk sultan ranked the mother of the heir apparent, called the bash kadin effendi (her excellency the chief lady). Next came the ladies who had borne the younger children of the sultan, the hanum effendis, and after them the so-called odalisques (a perversion of odalik, from odah, "chamber"). Every odalisque who had been promoted to the royal couch received a *daïra,* consisting of an allowance of money, a suite of apartments and a retinue, in proportion to her status. Since all the harem women were slaves, the sultans, with practically no exceptions, never entered into legal marriage contracts.

The security of the harem was in the hands of a body of eunuchs both black and white. The chief of the white eunuchs, the kapu *aghasi* (master of the gates), had part control over the ecclesiastical possessions, and even the vizier could not enter the royal apartments without his permission. The chief of the black eunuchs, usually called the *kizlar* aghasi (master of the maidens), though his true title was darus *se'ādet* aga (chief of the abode of felicity), was an official of high importance. His secretary kept count of the revenues of the mosques built by the sultans. The number of eunuchs was always a large one. The validk sultan and the bash *kadin* effendi each had 50 at their service, and others were assigned to the favourite odalisques.

The ordinary middle-class household was naturally on a very different scale. The selamlik (or men's quarters) was on the ground floor with a separate entrance, and there the master of the house received his male guests; the rest of the ground floor was occupied by the kitchen and perhaps the stables. The *haremlik* (or women's quarters) was generally (in towns at least) on the upper floor fronting on and slightly overhanging the street; it had a separate entrance, courtyard and garden. Communication with the *haremlik* was effected by a locked door, of which the effendi kept the key, and also by a sort of revolving cupboard (*dulap*) for the conveyance of meals.

The presence of a second wife was the exception, and was generally attributable to the absence of children by the first wife. The expense of marrying a free woman led many Turks to prefer a slave woman who was much more likely to be an amenable partner. If a slave woman bore a child she was often set free and then the marriage ceremony was gone through.

The harem ladies frequently drove into the country and visited the shops and public baths. Their seclusion had very considerable compensations and from the moment when a woman, free or slave, entered into any kind of wifely relation with a man, she had a legally enforceable right against him both for her own and for her children's maintenance. She had absolute control over her personal property whether in money, slaves or goods; and, if divorce was far easier in Islam than in Christendom, still the marriage settlement had to be of such amount as would provide suitable maintenance in that event.

On the other hand, of course, the system was open to the gravest abuse, and in countries like Persia, Morocco and India the life of Moslem women and slaves was often far different from that of middle-class women of European Turkey, where law was strict and culture advanced.

After the middle of the 19th century familiarity with European customs and the direct influence of European administrators brought about a certain change in the attitude of orientals to the harem system, and in "progressive" circles those with more than one wife came to be spoken ill of; but Turkey was the only Mohammedan country that abolished polygamy altogether.

India.—In India various attempts were made by societies, missionary and other, as well as by private individuals, to improve the lot of the zenana women. *Zenana* schools and hospitals were founded, and a few women were trained as doctors and lawyers for the special purposes of protecting the women against their own ignorance and inertia. Similarly, trained medical women were introduced into zenanas by the Lady Dufferin association for medical aid to Indian women. In India, as in Egypt, the influence of western education had a considerable effect in relaxing the restrictions formerly placed upon women in the upper and middle classes, and feminist associations began to play a part in political life.

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(J. M. M.; X.)

HARFLEUR, a port of France in the *département* of Seine-Maritime, about 6 mi. E. of Le Havre by rail. Population (1954) 7,474. It lies in the valley of the Lézarde, near the estuary of the Seine.

Harfleur is identified with Caracotinum, the principal port of the ancient Calates. In the middle ages, when its name, Herosfloth, Harofluet or Hareflot, still indicated its Norman derivation, it was the principal seaport of northwestern France. In 1415 it was captured by Henry V of England, but in 1435 the people of the district of Caux rose against the English, and got rid of the foreign yoke. Between 1445 and 1449 the English were again in possession; but the town was recovered for the French by Jean, Comte de Dunois. In the 16th century the port began to dwindle in importance because of the silting up of the Seine estuary and the rise of Le Havre. In 1562 the Huguenots put Harfleur to pillage, and its registers and charters were destroyed; but its privileges were restored by Charles IX in 1568, and it was not till 1710 that it was subjected to the "taille." The port was improved on the opening of the Tancarville canal (1887) connecting it with the port of Le

Havre and with the Seine. Vessels drawing 18 ft. can moor alongside the quays of the new port, which is on a branch of the canal, has some trade in coal, timber and grain, and carries on fishing. The church of St. Martin with its lofty stone steeple forms a landmark for the pilots of the river. It dates from the 15th and 16th centuries. Of the old castle there are only insignificant ruins. The industries include distilling, metal founding, flour milling and the manufacture of oil and grease.

HARGEISA, the capital of former British Somaliland (from 1960 part of the Somali republic) in Hargeisa district, lies in a valley, 4.000 ft. above sea level, which runs from west to east and is enclosed by steep hills. Because of its altitude the climate is fairly equable. Pop. (1956 est.) 45,000. Originally the summer capital, Hargeisa became the permanent capital in 1941. Most of the houses are single storied, and there are areas in which nomadic hutments may be erected. Among the public buildings are the offices of the central and local governments. the meeting hall of the legislative council, schools, a broadcasting station and a power station. A network of roads connects Hargeisa with other towns in the former protectorate and with Berbera, the chief port, which lies on the Gulf of Aden, 117 mi. N.E. Frequent air services from Hargeisa airport to Aden and Nairobi link it to the rest of the world. There are no industries but the town is an important watering and trading centre for the nomadic stock herders who form the majority of the population.

The principal exports are fresh meat, sent by air to Aden, and livestock, skins and ghee (clarified butter), which are shipped from Berbera. Imports are mainly confined to tea, sugar. cotton cloth and other consumer goods. (J. A. BN.)

HARGREAVES, JAMES (1834–1915), prolific English inventor of industrial chemical processes, was born at Hoarstones, Lancashire. In 1856 an attempt to devise a method of recovering sulfur from alkali waste brought him in contact with W. Gossage, the soap manufacturer, who employed him until 1865; during this period he discovered a method of bleaching the brown soap in common use, invented blue mottled soap. and devised a method of recovering chromates from the fats and oils used in soap manufacture. Hargreaves also worked out a process for the recovery of phosphates from the slag of blast furnaces. In 1873 he erected works for the manufacture of hydrochloric acid by the action of the gases from pyrites burners on common salt; these works were eventually acquired by the United Alkali company. In conjunction with one of his employees, Bird. he invented the Hargreaves-Bird process for the manufacture of soda by the electrolytic decomposition of salt. This method was extensively adopted in Europe and the United States. In addition to his chemical investigations. Hargreaves invented an engine which ran on gas tar and was called the Hargreaves thermomotor; this was the forerunner of the diesel engine. Hargreaves died at Widnes, Lancashire. on April 4, 1915. (RT. S. C.)

HARINGTON, SIR JOHN (1562–1612), Elizabethan courtier, translator. author and wit. provides through his career and writings a unique insight into the life of the Elizabethan age. His father. John Harington of Stepney, enriched the family by marrying an illegitimate daughter of Henry VIII; his second wife was an attendant on Princess Elizabeth, who later stood as godmother for Sir John, born in 1562. Sir John was educated at Eton, Cambridge and Lincoln's Inn, London. In 1583 he married Mary Rogers, who bore him many children. Because he translated and circulated among the ladies a wanton tale from Ariosto, Elizabeth banished him from court until he should translate Ariosto's entire *Orlando Furioso.* Published in 1591, this remains one of the major translations of the age. more faithful to the spirit and style of the original than to accurate line-by-line reproduction. Probably while working on the Ariosto, Harington invented the flush lavatory (toilet') and installed one for the queen in her palace at Richmond, Surrey. In 1596 in *The Metamorphosis of Ajax* (a jakes, or privy) he described his invention in terms more Rabelaisian than mechanical. Again he was banished from court. In 1599 he accompanied the earl of Essex on his expedition to Ireland, where he won his knighthood. Harington was included in the queen's fury with Essex upon their return, hut he softened her anger with the account he had written of the expedition (published in *Nugae Antiquae,* 1769–7j).

Although active in his county of Somersetshire, Harington made his real career the court. The wantonness of his writings and the barbed wit of his personal epigrams won him a reputation as the queen's "saucy godson," a sort of jester about court, but he gained no advancement thereby. He met with even less success under James I, although he continued to write tracts and epigrams until he died at Kelston, Somerset, on Nov. 20. 1612.

His miscellaneous writings were collected by H. Harington in *Nugae Antiquae,* 2 vol. (1769–75). His *Letters and Epigrams* were edited by N. E. McClure (1930). For a study of the man and his work *see* T. Rich, *Harington and Ariosto* (1940). (T. RH.)

HARIRI, AL- (ABU MOHAMMED AL-QASIM AL-HARIRI) (1054–1122), Arab writer regarded as one of the supreme masters of style in Arabic literature, was born at Mahsan near Basra in 1054. His name denotes "the manufacturer or seller of silk." He is said to have held a government post, but devoted much of his life to studying the niceties of the Arabic language. On this subject he wrote a poem, *Mulhat al-'Irab* (French trans. by L. Pinto and A. Destrées, 1911); a work on the faults of the educated. *Durrat al-Ghawwas* (ed. by H. Thorbecke, 1871); and some smaller treatises (ed. by F. A. Arnold in *Chrestomathia Arabica,* pp. 202–209, 1853). His fame rests mainly on his 50 *maqamat* (ed. by F. Steingass, with English notes! 1896; Eng. trans. by T. Chenery, 1867, and by F. Steingass with valuable introduction. 1898).

The *maqamat* take the form of romances or anecdotes in rhymed prose and are of the same type as those of Hamadhani (*q.v.*), though far surpassing them in command of language. As a model of Arabic writing they came to rank next only to the Koran. They tell of the adventures of a fictional character, the rascally Abu Zayd, and are full of allusions to Arab history, poetry and tradition and to problems of grammar. The dialogue form adopted in them was the Arab's nearest approach to drama.

HARI RUD, the ancient Arius river of Afghanistan. It rises in the northern slopes of the Koh-i-Baba to the west of Kabul and finally loses itself in the Tejend oasis north of the Trans-Caspian railway and west of Merv. It runs a remarkably straight course westward through a narrow trough from Daolatyar to Obeh, amid the bleak wind-swept uplands of the highest central elevations in Afghanistan. From Obeh to Kuhsan, 50 mi. W. of Herat, it forms a valley of great fertility, densely populated and highly cultivated; practically all its waters are drawn off for purposes of irrigation. It is the contrast between the cultivated aspect of the valley of Herat and the surrounding desert that has given Herat its great reputation for fertility. It turns due north and breaks through the Paropamisan hills. Below Kuhsan it receives fresh tributaries from the west. Between Kuhsan and Zulfikar it forms the boundary between Afghanistan and Iran, and from Zulfikar to Sarakhs between Iran and the U.S.S.R. North of Sarakhs it diminishes rapidly till it is lost in the sands of the Turkman desert. The Hari Rud marks the only important break in the continuity of the central water parting of Asia.

HARITH IBN HILLIZA AL-YASHKURI, pre-Islamic Arab poet. was the author of one of the poems generally included among the *Mu'allaqat* (*q.v.*). He was a chieftain of the tribe of Bakr, but nothing is known of the details of his life.

HARIZI, JUDAH BEN SOLOMON (*c.* 1170–1235), a Spanish Hebrew man of letters. During a life of wanderings he translated several scientific works from the Arabic, including Maimonides' *Guide;* his rendering of the latter is more artistic than that of Ibn Tibbon. With his adaptation of the *Maqamat* of Hariri (*q.v.*), which he called *Mahberoth Ithi'el,* he was the only Hebrew writer to attempt translating Arabic poetry. He also produced original Hebrew *Maqamas,* the famous *Tahkemoni* (named after 2 Sam. xxiii, 8), partly translated by S. I. Kaempf in *Nicht-andalusische Poesie andalusischer Dichter* (1858).

See K. Albrecht, *Die . . . Angaben über Harîzîs Leben . . .,* (1890); J. Schirmann, *Die hebräischen Übersetzungen der Maqamen des Hariri* (1930). (C. RN.)

HARKER, ALFRED (1859–1939), British petrologist whose investigations of igneous rock complexes in the isles of Inverness-shire were pioneering achievements in igneous geology, was born at

Kingston-upon-Hull, Feb. 19, 1859. He was educated at St. John's college, Cambridge, where he was elected a fellow in 1885. In Yorkshire, where he spent part of his school days, he became interested in the geology of his native county; this interest in rocks grew at the university and led him to make petrology his life work at Cambridge, where he became, in 1918, reader in the subject.

His early work was on slaty cleavage in rocks, the result of these studies being published in a notable report to the British association (1886). Later, through his study of the mineral complex that girdles the Shap granites in Westmorland, he was able to offer a new interpretation of the thermal metamorphism of rocks. In 1895, at the instance of Sir Archibald Geikie. he was seconded to the Geological Survey of Scotland for summer work in Skye, where he made detailed geological maps of the Cuillins and the Red hills of central Skye.

His standard work, *The Natural History of Igneous Rocks* (1909), treating of the broad aspects of magmatic descent and the controlling influence of tectonic environment, had a strong influence on petrology and, with his later treatise *Metamorphism* (1932), fills an important place in the literature of petrology. He was elected a fellow of the Royal society in 1902 and was awarded its royal medal in 1933. He died at Cambridge, July 28, 1939.

(C. E. T.)

HARLAN, JOHN MARSHALL (1833–1911), associate justice of the U.S. supreme court, best known for his part in decisions involving amendments of the reconstruction period, was born in Boyle county, Ky., on June 1, 1833. He was the grandfather of John M. Harlan (1899–). also a member of the U.S. supreme court. The elder Harlan graduated from Centre college (Danville, Ky.) and studied law at Transylvania university (Lexington, Ky.). He served as county judge of Franklin county, Ky., in 1858–59. The following year he was a presidential elector for the Constitutional Union party. At the outbreak of the Civil War he recruited the 10th Kentucky U.S. volunteer infantry regiment and served as its colonel through numerous engagements. He resigned his commission in 1863 and in the same year was elected attorney general of Kentucky by the Union party. He was re-elected to the office in 1863. In the presidential campaign of 1864 Harlan emerged as a strong critic of the Lincoln administration and supported the candidacy of Gen. George B. McClellan. He later cast his lot with the Republican party and twice, in 1871 and 1875, was that party's unsuccessful candidate for governor. In 1877 he was appointed by Pres. Rutherford B. Hayes to a commission instructed to resolve the competing claims of two rival state governments in Louisiana. On Nov. 29 of the same year he was appointed to the U.S. supreme court by President Hayes. He remained a member of the court until his death almost 34 years later, a period of tenure exceeded by only two other justices in the court's history. In 1892 he was appointed by Pres. Benjamin Harrison to serve in the arbitration of the Bering Sea controversy with Great Britain. He died in Washington, D.C., on Oct. 14, 1911.

Although Harlan had opposed ratification of the 13th amendment. which prohibits slavery and involuntary servitude, as an undue infringement of state powers, as a judge he vigorously urged a broader interpretation of the amendments than any of his colleagues on the bench. His position is well illustrated by his notable dissent in the *Civil Rights Cases*, 109 U.S. 3 (1883). The majority of the court held that congress could not authorize punishment of private individuals who had discriminated against Negroes, since the 14th amendment applies only to "official" or "state" action. Harlan found congressional authority in both the 13th and 14th amendments and advanced a broader concept of "state action" than the court was or has since been willing to accept. In a series of cases involving state criminal procedures, Harlan. in dissent, urged that the 14th amendment imposed on the states the same limitations as are placed on the federal government by the first nine amendments of the U.S. constitution. This view, although never taken by the court, missed acceptance in 1947 by the narrow margin of one vote. The decision of *Plessy* v. *Ferguson*, 163 U.S. 537 (1896), upholding the validity of segregated seating on common carriers. inspired Harlan's eloquent protest and the assertion that "our constitution is colour-blind." His view was vindicated by the 1954 decision of the court in the school segregation cases. While rejecting the "natural rights" theories of Justice Stephen J. Field, Harlan nevertheless frequently voted to invalidate state regulation of economic activity. In *Adair* v. *United States*, 208 U.S. 161 (1908), his opinion for the court invalidated a congressional statute outlawing the so-called "yellow-dog" clause in labour contracts. Other notable opinions include his dissents in the Insular cases in which Harlan opposed withholding the federal bill of rights from unincorporated territories of the U.S. and argued that the constitution "follows the flag." One of his most famous dissents is his opinion in *Pollock* v. *Farmers' Loan and Trust Co.*, 158 U.S. 601 (1895), in which the court invalidated the federal income-tax and necessitated adoption of the 16th amendment.

Harlan's opinions are not distinguished by subtlety or fine discrimination. He was at his best in dissent, and many of these opinions are notable for their great power and conviction and their capacity to expose fundamental issues. He was not one to suppress his disagreements with the majority of the court, and the vigour of his language sometimes bordered on harshness. Harlan is one of the most distinctive figures in the history of the court. Many of his views, rejected by the court on which he sat, attained renewed importance in the years after his death. (F. A. A.)

HARLECH, ancient capital of Merionethshire, Wales, 38 mi. from Aberystwyth by rail. Population (1951) 1,206. (Parish of Llandanwg.) Ruins of a fortress crown the rock of Harlech, about half a mile from the sea. Roman coins have been discovered in the neighbourhood and there are associations with Bronwen, daughter of Bran Fendigaid, and the Mabinogion generally. In the 10th century, Harlech castle was, apparently, repaired by Colwyn, lord of Ardudwy, and thence called Caer Colwyn. The present structure dates from 1285 and is a good example of an Edwardian concentric castle. Edward made Harlech a free borough. Owain Glyn Dwr held it for four years. Dafydd ap Ieuan ap Einion held it for the Lancastrians, until famine made him surrender to Edward IV. From this time is said to date the air *Rhyfelgyrch gwyr Harlech*. The castle was the last to be held for the king in the civil war. The town is a tourist centre.

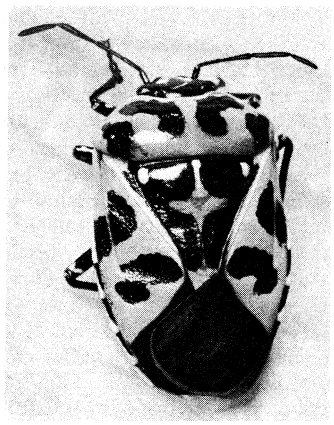
HARLEQUIN, the English name for one of the comic masks of the *commedia dell' arte*. The Italian name Arlecchino has been traced back to the medieval French Herlequin, which denoted a jester with devilish features who had found his way into the mystery plays. The Italian actor Tristano Martinelli (*c.* 1557–1630) is commonly regarded as the creator of the Arlecchino mask in improvised comedy. As a member of various traveling *commedia* companies he specialized as a witty comic servant under the stage name of Arlecchino. The standard Harlequin costume consisted of breeches and a jacket with multicoloured triangular patches sewn onto the garment. The actor carried a lath, the slapstick, which his English descendant in the 18th century used in the Harlequinades as a magic wand for the enactment of transformation scenes. As a rule, Harlequin (and Arlecchino before him) was in love with Columbine. *See* also CLOWN; PANTOMIME. (A. M. N.)

HARLEQUIN BUG, in North America, a hemipterous insect of tropical or subtropical origin, *Murgantia histrionica*, belonging to the stink bug family (Pentatomidae). It is about half an inch in length, shield-shaped and coloured brilliantly with red and black. First observed in Texas in 1864, it thereafter spread rapidly over the United States, reaching New Jersey in 1892 and Long Island in 1894. Now ranging from the Atlantic to the Pacific, the bug is rarely injurious north of about the 40th parallel.

It sucks sap from the leaves and veins of cabbage and other cruciferous crops, causing the plants to wilt and die. Fifty or sixty mature individuals may be found feeding on a large plant. The adult overwinters in sheltered sites. The barrel-shaped white eggs ringed with black are usually laid in double rows on the undersides of leaves. Within a month the eggs hatch, and the active young—wingless, but otherwise resembling the adults—molt five times before reaching full growth. In the south there may be four or five generations annually. Clean culture methods, especially thorough removal of host plants when a crop is harvested and the use of trap crops such as mustard on which the bug can concentrate in the spring and subsequently be killed by insecticides, will reduce losses

of cabbage, Brussels sprouts and others. In small plantings hand-picking is an effective means of control. Many insecticides are injurious to the plants or leave dangerous residues in the cabbage heads. A rotenone dust or spray applied according to manufacturer's directions will provide safe and eiiective control.

In South America the name has been used for a longhorn beetle (*Acrocinus longimanus*); and in Australia a hemipterous insect (*Dindymus versicolor*) injurious to apples and other fruits is called the harlequin fruit bug. (R. I. SR.)



ROSS E. HUTCHINS

HARLEQUIN BUG (MURGANTIA HISTRIONICA), PEST ON CABBAGES AND OTHER CRUCIFEROUS CROPS IN THE SOUTHERN U.S.

HARLEQUIN FLY, the popular name of small flies of the genus *Chironomus*. The larvae, known as bloodworms, are aquatic and live in foul or very deep water where there is little oxygen. To enable them to utilize fully the scant supply of oxygen, these larvae possess in their blood the same red pigment, hemoglobin, that is found in vertebrates. See DIPTERA; ANIMAL COLORATION; PIGMENT, ANIMAL; ANIMALS, DISTRIBUTION OF.

HARLINGEN, a city of Cameron county in southern Texas. U.S., is 28 mi. N.W. of Brownsville. It was founded in the early 1900s and was named for Harlingen. Netherlands. hy its pioneer settler. Lon C. Hill, Sr.. when it became a station (once known as Six-shooter Junction) of the St. Louis. Brownsville and Mexico railroad.

Harlingen was incorporated as a city in 1910, and adopted a city-manager form of local government in 1947.

The city, modern and well planned, is located in the centre of an intensively cultivated agricultural region. It has food-processing plants and is a major transportation and distribution hub of the Lower Rio Grande valley for citrus fruits and vegetables. Port Harlingen. with a grain elevator, oil terminals, chemical plants and other industries. is on a spur of the Intracoastal canal ancl is thus linked with more than 30,000 mi. of inland waterways. There is a Valley Mid-Winter fair. mainly for citrus fruits.

For comparative population figures *see* table in TEXAS: *Population.* (O. MO.)

HARLOW, an urban district created in 1955 after the development of the New Town (designated according to the New Towns act, 1946, to relieve the congestion in London) in the Epping parliamentary division of Essex (with a small part of the New Town in Hertfordshire), Eng., 25 mi. N.N.E. from Charing Cross. London, by road. The population of the area before development (1951) was 5,829; in 1961 it had reached 53,475 and its proposed final figure is 80.000. (See NEW TOWNS.)

Harlow village lies on the main London-Cambridge road and the New Town is to the west of it. A railway line runs through the north of the town. with a new station close to the east industrial estate and the town park, and beyond is the navigable river Stort, a tributary of the Lea. In 1955 a helicopter landing ground was opened.

Wheeled traffic is not allowed in the market square. where markets are held twice a week and which is one of several enclosed spaces for pedestrians only. There are special cycle tracks and footpaths with underpasses beneath main roads. Between the town centre and the residential areas is a belt of carparks and in the centre itself are two tower blocks of flats. Industries in Harlow New Town include the making of glass, surgical equipmen!. scientific apparatus, tools and furniture; printing and metallurgy.

HARMATTAN, a hot, dry wind over the southern Sahara desert that blows from the northeast, primarily in winter. It is a trade wind which is strengthened by the low-pressure area over the north coast of the Gulf of Guinea. The harmattan is accompanied by blowing sand in the desert. reducing visibility and making travel extremely uncomfortable. Suspensions of fine dust are noticeable along and off the west coast of North Africa, where aircraft operations are handicapped by lowered visibilities. At the height of the winter season. the harmattan reaches the Guinea coast. carrying with it clouds of red dust which form a dense haze and impede river navigation.

Locally, the wind is termed "the doctor" for, notwithstanding its disadvantages. it forms a welcome relief from the damp heat of the previous season. (E. M. Bs.)

HARMODIUS, a handsome Athenian youth, friend of Aristogiton. Hipparchus, the younger brother of the tyrant Hippias. endeavoured to supplant Xristogiton in the good graces of Harmodius. but. failing in the attempt, revenged himself by putting a public affront on Harmodius' sister at a solemn festival. Thereupon the two friends conspired with a few others to murder both Hipparchus and Hippias during the armed procession at the Panathenaic festival (514 B.C.). Seeing one of their accomplices speaking to Hippias, and imagining that they were being betrayed, they prematurely attacked and slew Hipparchus alone. Harmodius was cut down on the spot by the guards. and Xristogiton was soon captured and tortured to death. When Hippias was expelled (510), Harlnodius and Xristogiton became the most popular of Athenian heroes; their descendants were exempted from public burdens and had the right of public entertainment in the Prytaneum. The friends' names were celebrated in popular songs and scolia (after-dinner songs) as the deliverers of Athens. One of these songs, attributed to a certain Callistratus, is preserved in Athenaeus. Their statues by Antenor in the agora were carried off by Xerxes and replaced by new ones by Critius and Nesiotes. Alexander the Great afterward sent back the originals to Athens. It is not agreed which of these was the original of the marble tyrannicide group in the museum at Naples.

HARMON, MILLARD FILLMORE (1888–1945). U.S. army officer, military commander in Pacific theatres during World War II, was born on Jan. 19, 1888, at Fort Mason. Calif. In July 1942, after 30 years in the army — most of it as a flyer, staff officer and commander in the air corps — Harmon became commanding general of all U.S. army forces. both ground and air. in the South Pacific. He showed great skill and tact in co-ordinating his operations with those of the navy, which exercised over-all command of the area. A lieutenant general. he exercised supervision over army troops engaged in the air and ground campaigns that reconquered Guadalcanal and the other major islands in the Solomons from the Japanese. Harmon moved to the central Pacific in July 1944 as commanding general of the army air forces, Pacific ocean area. There he made an invaluable contribution to the war against Japan by pressing ahead vigorously with construction of air bases for B-29 bombers in the Marianas. After directing the launching of the strategic air war against Japan by the 20th air force in Nov. 1944, he was lost on a flight between Kwajalein and Johnston islands in the Pacific on Feb. 26–27: 1945. His plane n-as never found. (A. GG.)

HARMONIA, in Creek mythology, the daughter of Ares and Xphrodite. according to the Theban account; in Samothrace, daughter of Zeus and the Pleiad Electra. When Cadmus (*q.v.*) came to Samothrace in search of Europa. he carried off Harmonia; or, in Thebes. she was given him by the gods as his wife. In either case. all the gods honoured the wedding with their presence. Cadmus or one of the gods presented the bride n-ith a robe and necklace. the work of Hephaestus. This necklace brought misfortune to all nho possessed it: it led to the death of Amphiaraus (*q.v.*), of Eriphyle, of Alcmaeon (*q.v.*), of Phegeus ancl his sons. (Even in historic times its baleful influence continued. Phayllus, one of the Phocian leaders in the Sacred War, 352 B.C., carried it off and gave it to his mistress. After she had worn it for a time her son was seized with madness and set fire to the house, and she perished in the flames.) Both Harmonia and Cadmus were ultimately metamorphosed to snakes.

Harmonia is also the name given to the Greek personification of order and symmetry, and according to Euripides (*Medea,* 824) is daughter of the nine Muses. (T. V. B.)

HARMONICA, a generic term applied to musical instruments in which sound is produced by friction upon glass bells. The word is also used to designate instruments of percussion of the glockenspiel type, made of steel and struck by hammers (Ger. *Stahlharmonika*).

The origin of the glass-harmonica tribe is to be found in the fashionable 18th-century instrument known as musical glasses (Fr. *verrillon*), the principle of which was known already in the 17th century. The *verrillon* or *Glasspiel* consisted of 18 beer glasses arranged on a board covered with cloth, water being poured in whenever it was found necessary in order to alter the pitch, and the sound being produced by passing the moistened finger round the rims. (Or sometimes the sides of the glasses were struck instead by wooden sticks.) Gluck gave a concert at the "little theatre in the Haymarket" (London) in April 1746 at which he performed on musical glasses a concerto of his composition with full orchestral accompaniment.

When Benjamin Franklin visited London, in 1757, he was so much struck by the possibilities of the glasses as musical instruments that he set to work on a mechanical application of the principle involved, the result being the glass harmonica finished in 1762. The instrument was for many years in great vogue. Mozart, Beethoven, Naumann and Hasse composed music for it, while it had its celebrated virtuosos, such as Marianne Davies and Marianna Kirchgessner.

The curious vogue of the instrument, as sudden as it was ephemeral, produced emulation in a generation unsurpassed for zeal in the invention of musical instruments. The most notable of its offspring were Carl Leopold Rollig's improved harmonica with a keyboard in 1786, Chladni's euphon in 1791 and clavicylinder in 1799, Ruffelsen's melodicon in 1800 and 1803, Franz Leppich's panmelodicon in 1810. Most of these have long since completely disappeared.

The name, harmonica, is applied also to the aeolina, a small mouth organ, invented by Sir Charles Wheatstone in 1829. A few free reeds, each supplied with wind separately from the mouth of the player, are fastened in a small metal box. The tune is made by moving the instrument to and fro across the mouth, simple tunes being the result.

For the steel harmonica *see* GLOCKENSPIEL.

HARMONIC ANALYSIS is a mathematical procedure by which phenomena of a periodically recurrent nature can be subjected to measurement. Problems of great intricacy have been reduced to manageable terms by its technique of breaking complicated mathematical curves into comparatively simple components. Its applications range from analysis of the vibrations of machines to the study of sunspots.

A description of this versatile science was given by one of its pioneers. Jean Baptiste Joseph Fourier, in his classic thesis, *Analytical Theory of Heat* (1822):

> The analytical equations, unknown to the ancient geometers, which Descartes was the first to introduce into the study of curves and surfaces, are not restricted to the properties of figures . . . they extend to all general phenomena. . . . If matter escapes us, as that of air and light, by its extreme tenuity, if bodies are placed far from us by the immensity of space, if man wishes to know the aspect of the heavens at successive epochs separated by a great number of centuries, if the actions of gravity and of heat are exerted in the interior of the earth at depths which will be always inaccessible, mathematical analysis can yet lay hold of the laws of these phenomena. It makes them present and measurable.

Historical Background. — Much of the history of harmonic analysis is the story of the strange marriage of mysticism and mathematics.

In the 6th century B.C., Pythagoras taught that the essence of harmony was inherent in the miraculous power of numbers; but his mysticism was allied with keen observation and deduction. For example, he knew that the musical note produced by a string of fixed tension was converted into its octave when the length was reduced one-half, and its fifth when reduced two-thirds.

The great astronomer Johannes Kepler (*q.v.*) in the 16th and 17th centuries was imbued with the mysticism of Pythagoras, which was enjoying a revival in the centres of learning. particularly in the Italian universities. Kepler, while not accepting in a physical sense the "music of the spheres" of Pythagoras, believed it was possible to represent the motion of every planet in terms of musical notation. Stimulated by the quest for a basic harmony in arithmetic, geometry and music, Kepler opened a new era of mathematics with his discovery of the laws of planetary motion. Even in his lyrical moods, Kepler maintained the mathematician's quest for precision. For example, his staff notation of the tune appropriate to Mercury indicated, in strongly accented arpeggios, that its orbit is more elliptical than that of the other planets.

Another scientist who drew his inspiration from mysticism and his technique from mathematics was Isaac Newton. Newton, who was a disciple of the mystic Jakob Boehme, wrote in the *Principia,* published in 1687: "Nature is pleased with simplicity, and affects not the pomp of superfluous causes." But it is the hardheaded mathematician who is speaking in this excerpt from one of Newton's letters: "For the best and safest method of philosophizing seems to be, first diligently to investigate the properties of things, and establish them by experiment, and then to seek hypotheses to explain them."

Newton gave the first mathematical treatment of wave motion in the *Principia.* His calculations gave the ellipticity of the earth as 1/230; the figure accepted today is 1/297.

In connection with the study of the vibration of musical strings Daniel Bernoulli and Leonhard Euler laid the groundwork for Fourier's elaborate mathematical structure. The equations known as the Fourier series were first published by Bernoulli in 1728.

In keeping with the ancient traditions of harmonic analysis, James Clerk Maxwell in the 19th century pronounced Fourier's *Analytical Theory of Heat* "a great mathematical poem."

In *Science and the Modern World* (1925), Alfred North Whitehead notes that "we have in the end come back to a version of the doctrine of old Pythagoras, from whom mathematics, and mathematical physics: took their rise. He . . . directed attention to numbers as characterizing the periodicity of notes of music. . . . And now in the 20th century we find physicists largely engaged in analyzing the periodicities of atoms."

Basic Theory. — Many physical phenomena, such as sound waves, alternating electric currents, tides, machine motions, etc., may be periodic in character. Such motions can be measured at a number of successive values of the independent variable, usually the time; and these data, or a curve plotted from these data, will represent a function of that independent variable. Thus the ordinate of the curve at any point is $y=f(x)$. Generally the mathematical expression for f(x) will be unknown.

However, with the periodic functions found in nature, $f(x)$ can be expressed as the sum of a number of sine and cosine terms. Such a sum is known as a Fourier series (*q.v.*) and the determination of the coefficients of these terms is called harmonic analysis. The term harmonic analysis can also be used in the broader sense of the analysis into any kind of periodic components, such as spherical harmonics, cylindrical harmonics, tesseral harmonics. etc. However. this article shall be confined to the development into Fourier series, which development has found more extensive practical application than any of the others. One of the terms of such a series has a period equal to that of $f(x)$ and is called the fundamental. Other terms have shorter periods, which are integral submultiples of the fundamental. These are called harmonics.

Applications. — Harmonic analysis is of great value in mathematics. in physics and in engineering. A sound wave, for instance, can cause the vibration of a thin diaphragm, whose motion is photographed in the form of a continuous curve by the use of the Phonodeik of D. C. Miller, or by other methods such as the cathode ray oscilloscope. The shape of the resulting curve will depend on the quality of the sound and will generally be quite complicated. However, it can be analyzed into its fundamental and harmonics or overtones by use of Fourier series. It is the number and magnitude of these harmonics which determine the quality of the sound, and therefore such investigations are of great value in the scientific study of music and speech. Similar methods are used extensively by the electrical engineer in the study of alternating currents. In mechanical engineering they can be used

in the investigation of valve motion and other mechanical movements.

Harmonic analysis may be also used in the study of tidal records; and. by the use of such information as it affords, the prediction of tides is possible. (*See* TIDES.)

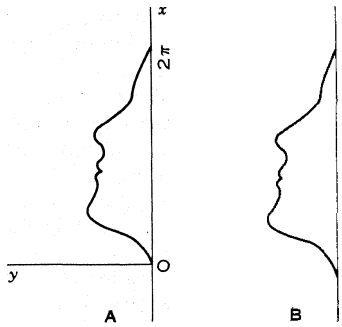


FIG. 1

All the above applications have been for cases where the movements are truly periodic. In a large class of other phenomena, such as the weather, sunspots, magnetic deviations, river flow, atmospheric strays in radio reception. etc.. the fundamental period is usually not evident and the periods of the harmonics are not simple submultiples of the fundamental. Even in such cases, however. modified methods can be used to some extent to give an analysis into a series of sine or cosine terms.

Any ordinary nonperiodic curve of finite length can also be analyzed by the harmonic method. the scale being changed in the x-direction so that the length is 2π units. An example taken from D. C. Miller's excellent book, The *Science* of *Musical Sounds*, is shown in fig. I(A), where a profile of a face is analyzed and found to have the equation:

$$\begin{aligned} y = {} & 49.6 \sin(\theta+302^\circ)+17.4 \sin(2\theta+298^\circ) \\ & +13.8 \sin(3\theta+195^\circ)+7.1 \sin(4\theta+215^\circ) \\ & +4.5 \sin(5\theta+80^\circ)+0.6 \sin(6\theta+171^\circ) \\ & +2.7 \sin(7\theta+34^\circ)+0.6 \sin(8\theta+242^\circ) \\ & +1.6 \sin(9\theta+331^\circ)+1.3 \sin(10\theta+208^\circ) \\ & +0.3 \sin(11\theta+89^\circ)+0.5 \sin(12\theta+229^\circ) \\ & +0.7 \sin(13\theta+103^\circ)+0.3 \sin(14\theta+305^\circ) \\ & +0.4 \sin(15\theta+169^\circ)+0.5 \sin(16\theta+230^\circ) \\ & +0.5 \sin(17\theta+207^\circ)+0.4 \sin(18\theta+64^\circ). \end{aligned}$$

These harmonics were then combined, giving the result shown in fig. I(B).

Numerical Methods. — In 1822 Fourier stated that a function $y=f(x)$ could be expressed between the limits of $x=0$ and $x=2\pi$ by the series:

$$y = a_1 \sin x + a_2 \sin 2x + a_3 \sin 3x + \cdots + b_0 + b_1 \cos x + b_2 \cos 2x + \cdots \quad (1)$$

provided the function is single-valued, finite and continuous except for a finite number of discontinuities. The coefficients are

$$\left.\begin{aligned} b_0 &= \frac{1}{2\pi}\int_0^{2\pi} y\,dx \\ b_k &= \frac{1}{\pi}\int_0^{2\pi} y \cos kx\,dx \\ a_k &= \frac{1}{\pi}\int_0^{2\pi} y \sin kx\,dx \end{aligned}\right\} \quad (2)$$

where $k=1, 2, 3, \cdots$

With the further restriction that there be only a finite number of maxima and minima, the theorem was proved by Lejeune Dirichlet in 1829.

Equation (1) can be written in the alternate form:

$$y = c_1 \sin(x+\phi_1)+c_2 \sin(2x+\phi_2)+c_3 \sin(3x+\phi_3)+\cdots, \quad (3)$$

where

$$c_k = \sqrt{(a_k^2+b_k^2)}, \qquad \phi_k = \tan^{-1}\frac{b_k}{a_k} \quad (4)$$

Assume that a record has been obtained of some periodic phenomenon expressed as a curve or as a set of data which can be plotted and called $f(x)$. Even although $f(x)$ cannot be expressed as a simple function. equation (1) can be used to approximate it, and the coefficients a, and b_k can be determined. It will be necessary first to find the period of the function; that is, the distance between corresponding points on successive waves. This distance will be called 2π radians or 360°, and can then be divided into any convenient number of parts, say n. The first n ordinates are measured and their values substituted in equation (1), giving n equations in the n undetermined coefficients. These equations can be solved to obtain a, and b_k. The n equations have the form:

$$y_k = b_0 + b_1 \cos x_k + b_2 \cos 2x_k + \cdots + a_1 \sin x_k + a_2 \sin 2x_k + \cdots,$$

where k = 0, 1, 2, 3, . . . (n−1) successively; y_k is the kth ordinate of the curve, and x_k is the corresponding abscissa expressed in degrees. From these it can be shown that

$$\left.\begin{aligned} b_0 &= \frac{1}{n}(y_0+y_1+y_2+\cdots+y_{n-1}), \\ b_k &= \frac{2}{n}(y_0 \cos kx_0+y_1 \cos kx_1+\cdots+y_{n-1} \cos kx_{n-1}), \\ a_k &= \frac{2}{n}(y_0 \sin kx_0+y_1 \sin kx_1+\cdots+y_{n-1} \sin kx_{n-1}). \end{aligned}\right\} \quad (5)$$

A curve plotted from (1) using the coefficients (5) will pass through all the values y_k exactly, but probably will not coincide with the experimental curve at other points. Obviously, the use of a larger number of terms will increase the accuracy. In some applications the function can be very closely approximated by a few terms. In other cases, particularly if the wave has sharp corners. a large number of terms is necessary to get a sufficiently accurate expression. It is often possible to tell something about the coefficients by inspection, thus simplifying the mathematical work of analysis. If positive and negative loops of the curve are the same, then even harmonics are absent. This is practically always the case with alternating currents. Also, if the curve for $x<0$ is the reflection in the y-axis of the curve for $x>0$, there will be no sine terms; while if the curve is symmetric about the origin, there are no cosine terms.

Schedule Methods. — The use of equation (5) is the basis of numerous so-called schedule methods of analysis. These are merely short cuts for solving this equation, many of the routine multiplications being combined and tabulated in a schedule. Of these, the best-known is probably that of C. Runge. It can best be explained by an example. For this a six-point schedule has been selected. Only odd harmonics are considered, and the zero is taken where the curve crosses the x-axis. Then the six equations are:

$$\begin{aligned} 3b_1 &= y_1 \cos 30^\circ + y_2 \cos 60^\circ + y_3 \cos 90^\circ + y_4 \cos 120^\circ + y_5 \cos 150^\circ, \\ 3b_3 &= y_1 \cos 90^\circ + y_2 \cos 180^\circ + y_3 \cos 270^\circ + y_4 \cos 360^\circ + y_5 \cos 450^\circ, \\ 3b_5 &= y_1 \cos 150^\circ + y_2 \cos 300^\circ + y_3 \cos 450^\circ + y_4 \cos 600^\circ + y_5 \cos 750^\circ, \\ 3a_1 &= y_1 \sin 30^\circ + y_2 \sin 60^\circ + y_3 \sin 90^\circ + y_4 \sin 120^\circ + y_5 \sin 150^\circ, \\ 3a_3 &= y_1 \sin 90^\circ + y_2 \sin 180^\circ + y_3 \sin 270^\circ + y_4 \sin 360^\circ + y_5 \sin 450^\circ, \\ 3a_5 &= y_1 \sin 150^\circ + y_2 \sin 300^\circ + y_3 \sin 450^\circ + y_4 \sin 600^\circ + y_5 \sin 750^\circ. \end{aligned}$$

All can be expressed as functions of 30°, 60° and 90°:

$$\begin{aligned} 3b_1 &= (y_2-y_4) \sin 30^\circ + (y_1-y_5) \sin 60^\circ, \\ 3b_3 &= -(y_2-y_4) \sin 90^\circ, \\ 3b_5 &= (y_2-y_4) \sin 30^\circ - (y_1-y_5) \sin 60^\circ, \\ 3a_1 &= (y_1+y_5) \sin 30^\circ + (y_2+y_4) \sin 60^\circ + y_3 \sin 90^\circ, \\ 3a_3 &= (y_1-y_3+y_5) \sin 90^\circ, \\ 3a_5 &= (y_1+y_5) \sin 30^\circ - (y_2+y_4) \sin 60^\circ + y_3 \sin 90^\circ. \end{aligned}$$

It will be noticed that, except for y_3, all the coefficients occur as sums or differences. In the schedule given above, y_0 has been added so that the curve does not have to cross the x-axis at $x=0$. If $f(x)=0$ when $x=0$, as in the previous equations, then of course y_0 disappears. The work can be tabulated as shown in Table I. Table II is a numerical example given by F. W. Grover. This has been plotted in fig. 2. The heavy curve is the one to be analyzed. The six points used in the above schedule are enclosed by circles. Since the wave is nearly sinusoidal, the analysis results in a large fundamental sine curve and very small higher harmonics. Synthesis gives the light curve of fig. 2. It will be noted that this passes through all six points, but does not exactly coincide with the original curve throughout. By taking a larger number of points and, therefore, a different schedule, a much closer approximation would be obtained.

TABLE I.—General Schedule

Measured ordinates	Sums	Differences		Sine terms: 1st and 5th	Sine terms: 3rd	Cosine terms: 1st and 5th	Cosine terms: 3rd
y_0		d_0					
y_1 y_5	S_1	d_1	sin 30°	S_1		d_2	
y_2 y_4	S_2	d_2	sin 60°	S_2		d_1	
y_3	S_3		sin 90°	S_3	S_1-S_3	d_0	d_0-d_2
				S_0 S_e	S	D_0 D_e	D
				$a_1=\frac{S_0+S_e}{3}$	$a_3=\frac{S}{3}$	$b_1=\frac{D_0+D_e}{3}$	$b_3=\frac{D}{3}$
				$a_5=\frac{S_0-S_e}{3}$		$b_5=\frac{D_0-D_e}{3}$	

A method of selected ordinates has been devised by J. Fischer-Hinnen. This appears to require slightly less computation than the Runge method, but has the disadvantage that a new set of equally spaced ordinates must be measured for each pair of coefficients. Other methods of computation of the coefficients have been worked out by C. P. Steinmetz. S. P. Thompson and others. Various graphical methods have also been devised. C. S. Slichter, for instance, uses a special graph paper which introduces the sine or cosine factor without computation. The area under the curve is measured with an ordinary planimeter. It requires the replotting of the curve for each coefficient, and it is doubtful if any time is saved over the schedule method. Other graphical methods have been used by W. K. Clifford, J. Perry, Harrison, Ashworth. Beattie and Rottenburg.

Mechanical Methods.— The above methods all require a large amount of labour, especially if many coefficients are to be determined. If much of the work is to be done, therefore, some machine method is advisable. Equation (2) is used in most of the mechanical analyzers.

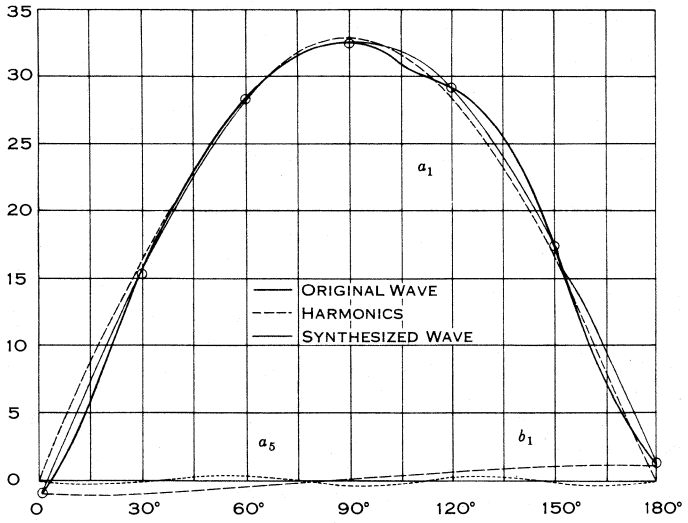


FIG. 2

If the curve $y=f(x)$ of fig. 3(A) is to be analyzed, it is merely necessary to multiply the ordinates by sin x (fig. 3[B]) and obtain the area under the resulting curve (fig. 3[C]). This gives

$$\int f(x) \sin x\, dx,$$

which is proportional to a_1. The other coefficients are obtained similarly. Most of the machines, therefore, consist of some means of multiplying the ordinates of the curve by sin kx or cos kx and integrating the product.

The first mechanical harmonic analyzer was invented in 1876 by Lord Kelvin. Another machine working on a similar principle is that invented in 1894 by O. Henrici and A. Sharp. For descriptions and illustrations of these early machines see MATHEMATICAL INSTRUMENTS. The Henrici machine was improved by G. Coradi. This very beautiful instrument makes use of a number of glass spheres which are moved an amount equal to the ordinate of the curve. The readings are obtained by two Amsler integrating wheels bearing on each sphere, one reading sine components, and the other cosine components. A five-sphere machine will thus give ten coefficients for one trace of the curve. The machine is speedy and accurate, but its expense and delicacy have limited its use to some extent. The Michelson and Stratton analyzer will handle up to 80 coefficients at once. It works equally well as a synthesizer and has been extensively used in tide prediction. The Chubb analyzer differs from all others in that it uses a polar graph instead of a rectangular one. The curve, in the form of a cardboard template, is fastened to the table of the machine. The table moves back and forth with a sinusoidal motion as it turns, and the result is integrated by an ordinary planimeter. The machine can evaluate only one coefficient at a time and is therefore slow. It is very rugged, and finds considerable use in connection with polar oscillograms.

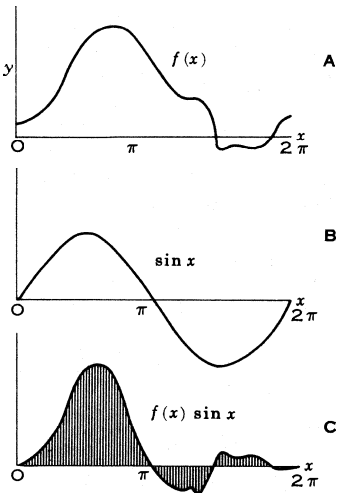


FIG. 3

A product integraph developed at the Massachusetts Institute of Technology can obtain the integral of the product of any two functions. Its primary use is in the mechanical solution of differential equations, but it can be used for harmonic analysis. In fact, it will develop curves in terms of various other series as well as the harmonic series of Fourier. Many other machines have been proposed, notably by O. Mader, Rowe, Wiechert and A. Sommerfeld, Bashforth, G. U. Yule, J. Le Conte, Terada. F. S. Dellenbaugh and D. O. Woodbury. Most of these machines work on the principle previously mentioned, though the Dellen-

TABLE II.—Schedule with Numerical Example

	Ordinates	Sums	Differences		Sine terms: 1st and 5th	Sine terms: 3rd	Cosine terms: 1st and 5th	Cosine terms: 3rd
0	−1·3 . . .		−1·3					
1	15·1 17·3 . . .	32·4	−2.2	0·50	+16·200		−0·425	
2	28·0 28·85 . . .	56·85	−0·85	0·86		−49·233		−1·905 −1·300
3	32·35	32·35		1·00	32·350	32·400	−1·300	0·850
				Sums	48·550	49·233	0·050	1·725 1·905 −0·450
				S_e	49·233			1·905
					97·783	−0·683		−3·630 0·180
				$a_1=$	32·594			$b_1=-1·210$ $b_3=-0·150$
					$a_5=-0·228$		$a_3=0·017$ $b_5=0·060$	

baugh uses the schedule method, while the Woodbury is based on the Fischer-Hinnen method.

Direct Analysis.— The above methods make use of an experimentally determined curve or set of data. In the case of electric currents or voltages. an entirely different method is possible. This direct method was suggested by M. I. Pupin in 1894. and was developed by the Bell System laboratories. Instead of first getting an oscillographic record of the voltage or current and analyzing it mathematically. the analysis is performed directly on the electric quantity by making a record of the response when the natural frequency of a tuned circuit is varied through a wide range.

A large number of methods are available for the harmonic analysis of complex waves. The direct mathematical method is unnecessarily long and arduous. This has been simplified by schedules which are fairly quick and are the methods generally used if only a small amount of such work is to be done, or if a punched card system or some other form of digital computer is available. If much harmonic analysis is required, it may be advisable to use a machine analyzer, such as the Henrici-Coradi, the Michelson and Stratton, or the Chubb. Of these the first appears to offer advantages if five or ten coefficients are sufficient. If a very large number of terms is required, the Michelson and Stratton is advisable.

The reverse process of synthesis is also used to a considerable extent. particularly in tide prediction. Various machines have been built for this purpose. the first being designed by Kelvin. An extremely compact form of Kelvin synthesizer was built by D. C. Miller for use in his work on the theory of musical sounds. The Michelson and Stratton machine is also very good for synthesis. In fact. any of the analyzers can be used for this purpose, though some are much more convenient than others. Some synthesizers display the sum of suitable voltages on an oscilloscope. See also FOURIER SERIES; SOUND; TIDES.

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(V. BU.; P. FN.)

HARMONICHORD, an ingenious kind of upright piano, in which the strings were set in vibration not by the blow of a hammer but by friction. One of the many attempts to fuse piano and violin, the harmonichord was invented by Johann Gottfried and Johann Friedrich Kaufmann (father and son) in Saxony at the beginning of the 19th century. The space under the keyboard was enclosed, a knee-hole being left in which were two pedals used to set in rotation a large wooden cylinder fixed just behind the keyboard over the levers. The cylinder (in some specimens covered with chamois leather) tapered towards the treble-end. When a key was depressed, a little tongue of wood, one end of which stopped the string, was pressed against the revolving cylinder, and the vibrations produced by friction were transmitted to the string and reinforced as in piano and violin by the soundboard. Carl Maria von Weber must have had some opinion of the possibilities of the harmonichord. since he composed for it a concerto with orchestral accompaniment.

HARMONIUM, a wind, keyboard instrument, otherwise a small organ without pipes, furnished with free reeds. Both the harmonium and its later development, the American organ, are known as free-reed instruments, the musical tones being produced by tongues of bra-s. technically termed "vibrators." The vibrator is fixed over an oblong, rectangular frame. through which it swings freely backwards and forwards like a pendulum while vibrating, whereas the beating reeds (similar to those of the clarinet family), used in church organs, cover the entire orifice, beating against the sides at each vibration. A reed or vibrator, set in periodic motion by impact of a current of air, produces a corresponding succession of air puffs, the rapidity of which determines the pitch of the musical note. There is an essential difference between the harmonium and the American organ in the direction of this current; in the former the wind apparatus forces the current upwards, and in the latter sucks it downwards, whence it becomes desirable to separate in description these varieties of free-reed instruments.

Harmonium.—This has a keyboard of five octaves compass when complete, and a simple action controlling the valves, etc. The necessary pressure of wind is generated by bellows worked by the feet of the performer upon foot-boards or treadles. The air is thus forced up the wind-trunks into an air-chamber called the wind-chest, the pressure of it being equalized by a reservoir, which receives the excess of wind through an aperture, and permits escape, when above a certain pressure, by a discharge valve or pallet. The aperture admitting air to the reservoir may be closed by a drawstop named "expression." The air being thus cut off, the performer depends for his supply entirely upon the management of the bellows worked by the treadles, whereby he regulates the compression of the wind. The character of the resulting tone is then entirely changed from a mechanical response to the player's touch to an expressive one, varying in correspondence with the increase or diminution of sound through the greater or less pressure of wind to which the reeds may be submitted. The drawstops bearing the names of the different registers in imitation of the organ, admit, when drawn, the wind from the wind-chest to the corresponding reed compartments, shutting them off when closed.

American Organ.—This acts by wind exhaustion. A vacuum is practically created in the air-chamber by the exhausting power of the footboards, and a current of air thus drawn downwards passes through any reeds that are left open, setting them in vibration. Valves in the board above the air-chamber give communication to reeds made more slender than those of the harmonium and more or less bent, while the frames in which they are fixed are also differently shaped, being hollowed rather in spoon fashion. The channels, the resonators above the reeds. are not varied in size or shape as in the harmonium; they exactly correspond with the reeds, and are collectively known as the "tubeboard." The American organ has a softer tone than the harmonium. The "automatic swell" in the instruments of Mason and Hamlin (of Boston. Mass.) is a contrivance which assists expression. Another very clever improvement introduced by these makers. who were the originators of the instrument itself. is the "vox humana." effected by a fan, made to revolve rapidly by a wind pressure; its rotation, disturbing the air near the reeds, causes interferences of vibration that produce a tremulous effect not unlike the beatings heard from combined voices, whence the name.

History. — The start in the instrument's invention was due to Prof. Christian Gottlieb Kratzenstein of Copenhagen. who, having had the opportunity of examining a Chinese cheng sent to his native city, invented about 1779 a small pneumatic organ fitted with free reeds which appears to have been the first instrument of its kind.

During the first half of the 19th century numerous efforts in France and Germany, and subsequently in England. were made to produce new keyboard instruments with free reeds, the most notable of these being the physharmonica of Anton Häckel. invented in Vienna in 1818. which, improved and enlarged, has retained its hold on the German people. The modern physharmonica is a harmonium without stops or percussion action; it does not therefore speak readily or clearly. It has a range of five or six octaves. Other instruments of similar type are the French melophone and the English seraphine. a keyboard harmonica with bellows but no channels for the tongues; for which a patent was granted to Myers and Storer in 1839; the aeoline or aelodicon of Eschenbach; the melodicon of Dietz: the melodica of Rieffelson; the apollonicon; the new cheng of Reichstein; the terpodion of Buschmann, etc. But none of these has survived.

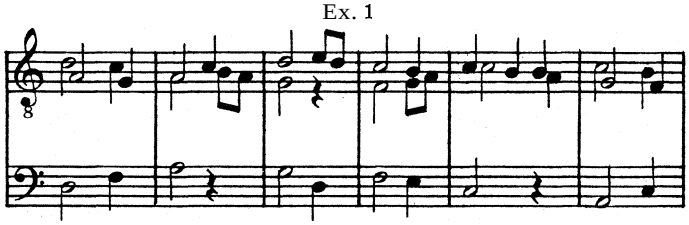
HARMONY, in broad musical terms, is the science of combined sounds. Theoretically. it is distinct from melody in that it is the result of the creation of a musical texture in at least two parts: from counterpoint in that these parts need have no melodic life of their own; and from rhythm in that harmony implies pitch. In practice, however. melody. counterpoint and rhythm each have a function in harmony. (In the course of this article the system of figured hass [*see* THOROUGH BASS] employed for *continuo* parts in the 17th and 18th centuries is used, since it is the best shorthand notation for harmony. The figures under any bass note show the intervals between each note of the parts above and the bass. The following conventions are employed: (1) Any unfigured hass note signifies $\overset{(8)}{5}$ (the octave is always understood); an accidental alone refers to the third. (2) Movement of parts is shown by intermediate figures)

In this article the letter name of a note is printed followed by a figure; the note so named is presumed to be the bass.

HARMONY BEFORE 1550

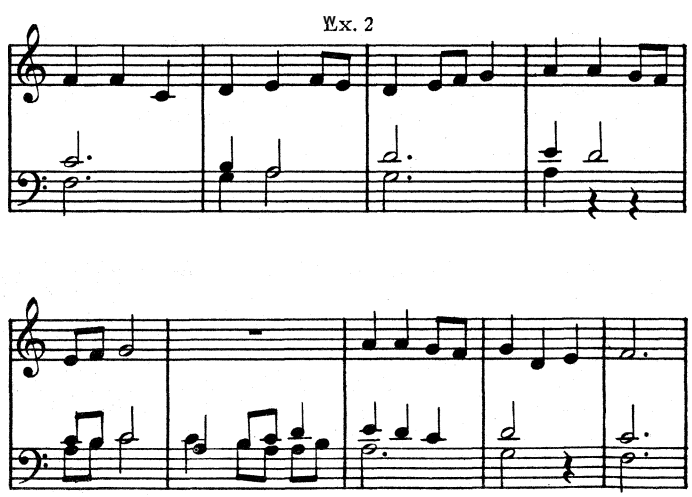
The earliest known harmony in western European music is called "parallel organum" (*see* ORGANUM) and dates from the 9th century. In this a plain chant melody was doubled at the octave, fifth or fourth below, and examples of organum occur in two, three or four parts. In England the interval of the third is recorded. In the 11th century a free organum style was introduced, so called because the chant was doubled at a variety of intervals. Although the voices sang note against note. the intervals varied so that contrary motion occurred as well as parallel movement. The plain chant was usually the lower part, In this style the ieeling of a cadence emerges since both parts end on the "final" of the mode. A new development occurs in the first half of the 12th century. In the added part two or more note; were sung to one note of the plain chant. At the same time the octave and the fifth emerge as characteristic intervals marking the beginning and end. In ex. 1 octaves and fifths occur at important points oi rest.

Ex. 1



The harmonic collisions in bars 2 and 5 in the above example were doubtless the result of methods of composition whereby each extra part was added to the original plain chant., as opposed to the much later methods of considering the parts as a whole. The counterpoint, however, was not entirely independent since the mode determined some sort of correlation between the parts. In ex. 2, irom a motet, c. 1250, decorated movement between fifths and octaves produce a $\frac{7}{3}$ $\frac{6}{3}$ progression on the last beat of bar 7, and the feeling of a cadential approach to the octave by contrary motion (bar 8). establishing a form of the cadence that persisted until the Renaissance and beyond (*see* CADENCE).

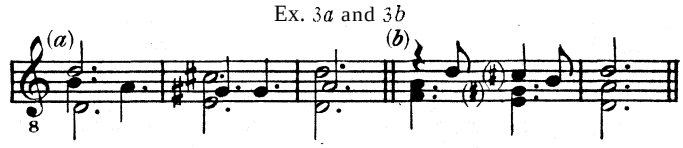
Ex. 2



This example shows the systematic movement of fifths and octaves as a harmonic basis of counterpoint. Polyphonic music of the immediately succeeding period differed little harmonically, though it developed greater rhythmic and melodic complexities. The interval of the third. however, was used more often, notably in the well-known rota (round) "Sumer Is icumen in" (*q.v.*).

The innovations of the Ars Nova (*q.v.*), concerned chiefly with form. melodic design and counterpoint, did not greatly affect the existing harmonic technique. Two related features are; however, connected with these innovations. To avoid the tritone (the inter\-a1 of three whole tones written as an augmented fourth. F-B, or, in the form of its inversion B-F, as a diminished fifth) the procedure in ex. 3*a* was evolved; and the cadence in ex. 3*b*, probably motivated bv the desire to resolve the sixth to what was held to be the more consonant fifth. became commoner a little later.

Ex. 3*a* and 3*b*



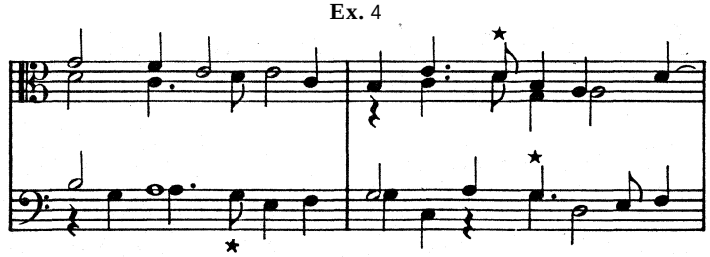
Ex. 3*b*, in which the cadence note D is preceded by notes a second and third below, is called the "Landini cadence," though it is not first found in. nor confined to. the work of Francesco Landini, being current all over Europe at this period.

The 15th-century practice of ia-burden. consisting of three-part harmony in which a melody is accompanied by two lower parts in parallel fourths and sixths, was a distinctly harmonic system. This was again a type of organum, deriving perhaps from the earlier English fondness for thirds. The English style at this period was in any case inclined to be harmonic — a *Kyrie* in the Old Hall manuscript consists almost entirely of $\frac{6}{3}$ chords — and these harmonic tendencies were incorporated in the work of John Dunstable (*q.v.*). Sot only do certain cadence progressions become systematic in Dunstable's work but the third ceases to be merely part of a chord of the fifth, becoming an important interval in its own right. The sixth becomes commoner and the seventh and fourth are often treated as dissonances by suspension. Pausing on one point or another of the mode with evident design, Dunstable appears to have differentiated between various forms of cadences, and he also anticipated a ieeling of tonality.

These features are also illustrated in the works of the Burgundians, Guillaume Dufay and Gilles Binchois. and in the later Flemish school of Jean d'Okeghem and Jakob Obrecht. Though their general style differs from that oi Dunstable the systematization of cadences in their work becomes more marked. The Landini cadence, though still appearing. was gradually replaced by one in which the sixth did not fall to the fifth before moving upward, and the $\frac{6}{3}$ chord became a commonly used feature of the musical language. A fuller harmony was obtained by the Flemish composers since they normally urote in four parts as opposed to the typical three-voice texture of Dunstable's time.

With Heinrich Isaak, Josyuin Desprès and Pierre de la Rue harmonic methods were established that were to remain. with iew changes, until the end of the 16th century. The treatment of dissonance by Josquin became more systematic. In the works of

Ex. 4



Okeghem leaps from dissonant notes were not uncommon, as ex. 4 shows. In Josquin only the first instance of such leaps (known as the *notu cambiata*) was normal. In fact. Josquin's treatment of dissonance differed only in detail from that of Palestrina.

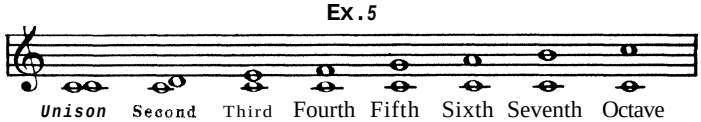
The most important changes of harmonic style in the century and a half culminating in Josquin were thus: (1) the replacement of parallel movement between perfect concords (fifths, octaves and fourths) by imperfect concord movement (thirds and sixths), though in Dunstable consecutive fourths are not uncommon and were even used, between upper parts, by Tomas Luis de Victoria a century later; (2) the systematization of dissonance treatment and cadences. From this system. with its delicate relation between dissonance and pulse, arose the whole conception of modern harmonic rhythm. See *Tonality* below.

HARMONY *c.* 1550-1900

Late 16th-Century Style. — From about 1550 onward the main elements of the harmonic method in use to the end of the 19th century are discernible. This method is based on the movement of parts and the intervals resulting from their relation to each other. After the modes were discarded, new chromatic possibilities of the diatonic system arose (*see* SCALE: *Diatonic Scale*). But the harmonic and contrapuntal method remained fundamentally unchanged. The main principles of this method are:

Harmony is reducible to the effect of intervals. Intervals from the note C are as follows:

Ex. 5



Unisons, fourths, fifths and octaves are perfect intervals and perfect concords. Since Dunstable the fourth, while remaining a perfect concord in theory, has been treated as dissonant when it occurs between the bass and another part and as concordant between upper parts.

Thirds and sixths are imperfect concords.

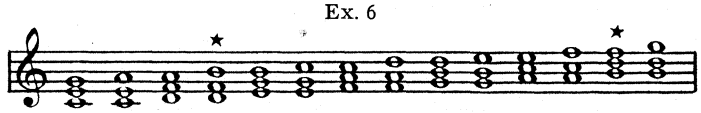
Seconds, fourths (*see* above) and sevenths are discords.

The properties of intervals are repeated in each octave, *i.e.,* a ninth has the harmonic properties of a second. etc.

Imperfect concords and discords, excepting the fourth, are further designated major or minor. In ex. 5, all are major and may be made minor by flattening the upper or sharpening the lower note. Minor and perfect intervals may similarly be diminished by flattening the upper or sharpening the lower note, and major and perfect intervals may be augmented by a reverse process. Whatever its quality, and interval's numerical name is derived from counting the number of note names, *i.e.,* C-G remains a fifth whatever accidentals are added. The change from major to minor does not affect consonance, but all augmented and diminished intervals are dissonant.

Hence the following three-note chords (in C major) are concordant, their constituent notes being concordant with each other. The chords marked * containing the tritone (F-B and B-F), a dissonant interval, were treated as essential discords in the 16th century and so in one sense are concordant. (See *Essential Discords* below.) As with octave multiples of intervals, inversion of the upper notes of triads (three-note chords) does not alter their harmonic significance.

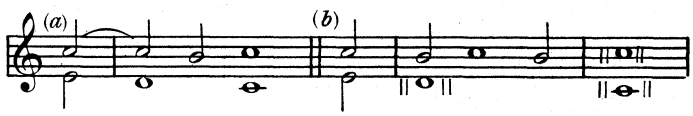
Ex. 6



Treatment of Dissonance. — Practice in the late 16th century confines dissonance treatment to the following:

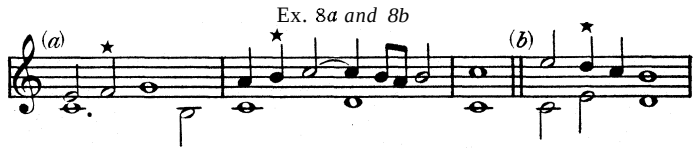
(1) Suspensions. Notes prepared as concords on weak beats are tied to dissonances on succeeding strong beats and resolved on the following weak beats to concords one note below (ex. 7*a*). The only exception to this treatment on a strong beat is the dissonant preparation called the consonant seventh or fourth, the latter being commoner in three- and four-part writing. The consonant seventh (D-C) occurs over a pedal (a held or reiterated note) bass in ex. 7b.

Ex. 7*a and 7b*



(2) Passing notes. Unaccented passing notes are discords "passing" between concords by step and between pulse beats (ex. 8*a*). Accented passing notes occur on weak beats and in this period are nearly always descending (ex. 8b).

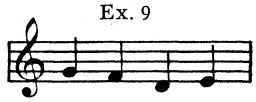
Ex. 8*a and 8b*



Ex. 8*a* shows, at the conclusion of bar 2, one of the common methods of decorating the resolution of a suspension.

Dissonances were quitted by step except in the following pattern where the second note is often dissonant:

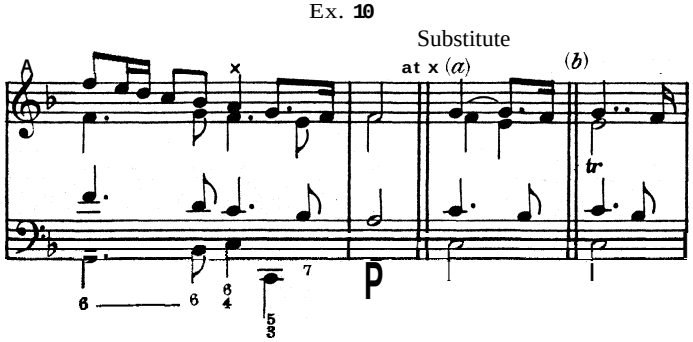
Ex. 9



These principles of 16th-century method are discussed fully in books concerning the style of the period, notably in those by Knud Jeppesen and Tillman Merritt, but perhaps most interestingly by the 16th-century composer, Thomas Morley, though he curiously omits mention, except by implication, of the relationship between dissonance and pulse. Particularly interesting to the modern reader is Morley's insistence on the interval structure of harmony, a conception that descends directly from the ancient methods of adding parts to an existing part.

Opposed to Morley's treatise was the inversion system of the 18th-century composer. Jean Rameau (*q.v.*). This system, widely used by pedagogues from the middle of the 19th century onward. is derived from Rameau's theory of the "fundamental bass." It teaches that all three-note and other chords are derived from fundamental triads; a $\frac{6}{3}$ chord having, for instance, an imaginary bass on the note figured as 6 and a $\frac{6}{4}$ chord on its fourth. Such a system fails to explain the augmented sixth, cannot effectively explain the diminished seventh as a fundamental discord and complicates the explanation of quite simple phenomena such as appoggiatura. Its explanation of the $\frac{6}{4}$ is perhaps its weakest point, since it argues that a $\frac{6}{4}$ on the dominant is the second inversion of the tonic chord. though usage always demonstrated this chord to be a dissonant version of the dominant chord. In the following example of a typical final cadence by Handel, the reduction of the

Ex. 10



cadential $\frac{6}{4}$ to its original dominant meaning is shown. It must be stressed that this passage is meaningless unless the bass note at that point is C (the dominant).

Neither does the system explain how $\frac{6}{3}$s on succeeding notes of the scale were held to be satisfactory while the fundamental triads of these same chords were prohibited. The system is mentioned here because of its almost universal dissemination up to the middle of the 20th century. Despite its fallacies, most 20th-century harmony textbooks were based on it.

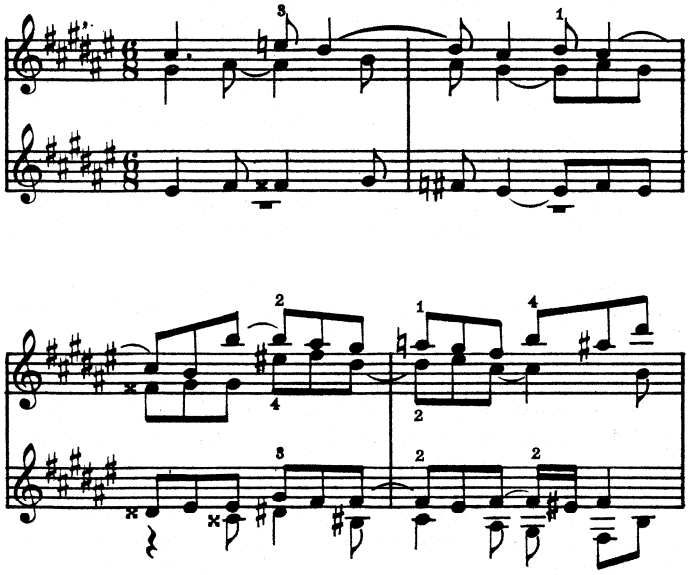
The Diatonic Age

Under this heading further developments, most of them dating from the 17th and early 18th centuries, may be approached. In this period concords remain as before. Though style changed greatly between 1650 and 1900 the fundamentals of harmonic method did not, though their application varied. The main features of this new application will now be classified.

Treatment of Dissonance. — As a general principle any dissonant note, however approached, resolves by falling or rising one note to a consonance, though there may be intervening notes decorating the resolution. Upward resolutions of accented discords are normally of a semitone, rarely a tone, although the resolution of a tone is common when moving in thirds or sixths. Different types of accented dissonance are given below. They are so called because of the nature of the approach to the dissonant note.

(1) Accented passing note. (2) Suspension. (3) Changing

Ex. 11

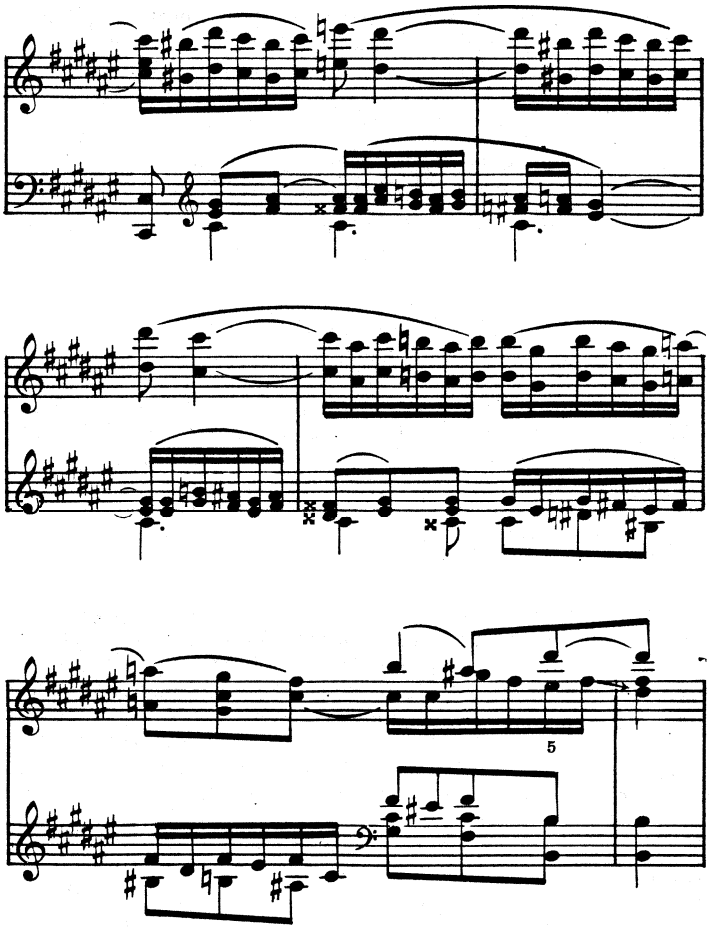


note (a harmony note approached through notes on each side). (4) Appoggiatura (a dissonance approached by leap).

The above example is a simplified skeleton, slightly altered to make certain dissonances appear more obvious, of a passage from Beethoven's "Hammerklavier" Sonata, Opus 106. This includes the fifth type of dissonance of fairly frequent occurrence, the note *échappée*, or changing note (5 in ex. 12), a two-note descending figure, which, usually leaping a third, is the only normal exception to the principle of quitting a dissonance by step (apart from decorated resolutions). Its dissonant note is always unaccented. Ex. 12 is altogether highly decorated and affords many examples of dissonance treatment, in particular of changing notes.

Essential Discords. — In modal usage the tritone was handled with care. Where its effect was ambiguous it was usually made into a perfect interval by an added accidental. Certain chords containing the tritone are known as essential discords. They are said to be essential when they can resolve to new harmony. An essential discord is therefore, a multiple discord requiring multiple resolutions. The tritone's ambiguity is shown in ex. 13*a*. In 13b are shown the three essential discords with their normal

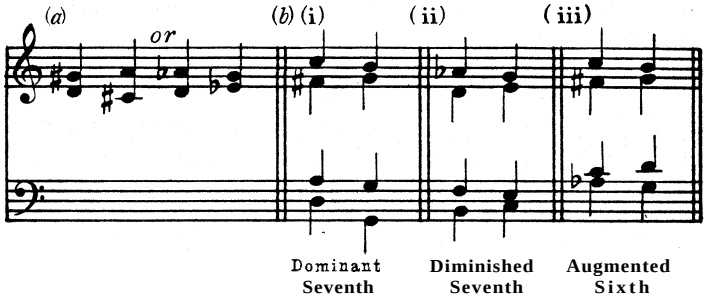
Ex. 12



resolutions. The augmented sixth often contains a fourth harmony note (which could be a D or an E♭ in ex. 13*b*, iii) which would not affect the essential harmonic and tonal meaning of the chord.

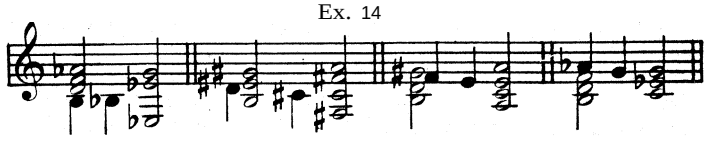
Kith the rise of diatonicism the strong leading properties of the tritone encouraged the use of it wherever a tonal sense was required. The term "leading note" is commonly used in a limited sense to mean the seventh note of the scale, the semitone leading to the tonic. But the fourth note also tends to lead down a semi-

Ex. 13*a* and *13b*



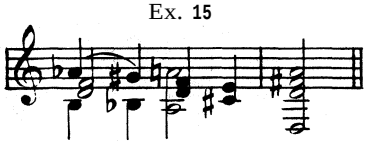
tone to the third. The tritone consists of both these notes, and this fact, coupled with its dissonant quality, gives it its motive power. As the tritone itself can be ambiguous, so the chords it contains can be altered enharmonically. Ex. 136, ii can be altered as follows:

Ex. 14



Furthermore, depending on the arrangement of the notes. the dominant seventh harmony on the second crotchet of all these may become an augmented sixth by enharmonic means (*i.e.*, A♭ = G♯) as shown in ex. 15.

Ex. 15

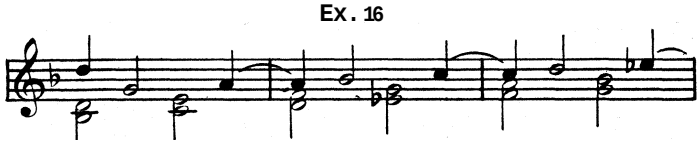


Part Writing. — Normally, simultaneous passing notes in different parts are concordant with each other but much depends on the texture of the harmonic progressions. on tempo and on whether the parts are in similar or contrary motion.

In similar motion, movement is by imperfect concord (thirds and sixths) and not by periect concord (unisons, fourths, fiiths and octaves) though similar movement of fourths between upper parts is usual; consecutive or parallel octaves and fiiths produce the effect of mixture stops on the organ, a doubling rather than the addition of parts, so that in part writing consecutives reduce the number of real parts, giving undue prominence to the parts so doubled. Deliberate doublings oi whole phrases at the octave are, of course, commonplace (they occur in ex. 12), and although such doubling was extended to fifths in the 20th century, it rarely occurred between 1650 and 1900. In Bach's *St. John Passion*, "If this man were not a malefactor" (no. 23), flutes doubling the vocal tenor line at the octave move in fifths with the first oboe and first violins in bar 3 of the chorus. The ear, horvever. perceives the tenor line in fourths below the upper voices. There are isolated examples of consecutives in the works of great masters in this period, but they are rare. and they usually are placed so that either their effect is inconsiderable or the harmony or figuration forces the ear to disregard them as contrapuntal progressions. More common types of consecutives can be found in Bach's chorale *Freuet euch, ihr Christen* (cantata no. 40) in four of the cadences between soprano and tenor; in Mozart's Violin Sonata in A, K. 526, in the opening notes of the last movement between top and bass; in Handel's Violin Sonata in E in the opening notes between violin and bass; and in Beethoven's Pianoiorte Sonata, Opus 31, no. 1 (second movement. bars 109, 111 and 113).

This discussion is made necessary by the fact that forbidden consecutives have long dominated the teaching of harmony. It is necessary ior students to distinguish between doublings that are a sign of impoverished part writing and those that are legitimately used for added sonority. As a rule parallel octaves are found less oiten than parallel fifths. The common syncopated avoidance of direct fiiths, as in ex. 16 irom Thomas Morley, is never found with octaves.

Ex. 16



Chromatic Harmony. — Chromatic harmony presents no difficulty once the harmonic principles of diatonic harmony have been grasped Ex 11 shows the use of chromatic dissonance and certain aspects of transitory modulation. Most chromatic chords are normal diatonic chords with one or more notes altered chromatically, very oiten in thia way producing a species of artificial leading note.

Tonality, Time Scale, Movement and Modulation. — The chief problem of composition has always been the problem of the extension of an idea. Renaissance composers discovered means of composing without using an existing *cantus firmus* (see COUNTERPOINT), and as a result various methods became standard: (1) canon and fugue; (2) *ostinato* methods including the device of isorhythm; (3) sectional vocal forms allied to the continuity of the text. All of these depended on the extension of an existing melodic or literary feature.

The monodists of the *nuove musiche* had to find other methods since imitative devices were hardly possible in truly monodic works. Hence the 17th-century predilection for forms of ground bass. This device was borrowed from dance music as bass and harmony patterns already existed for decorated repetitions in dance music; *e.g.*, the *passamezzo antico*. Such patterns were related to previous *ostinato* methods in that once a pattern was composed (like an isorhythmic talea) it was merely repeated.

But variation patterns alone could produce only one kind of extension. The other great factor that enabled composers to expand the time scale of music was the emergence of diatonic tonality. The modes ,provided a distinctive character and colour but little movement and few possibilities of extension. In the succeeding major and minor key system, horvever. the tonal centre or tonic became such a strong characteristic that any movement away from it forced continuation. since the piece was felt to be incomplete until it rested again on the tonic. This is. of course, a simplified view oi a process that took considerable time to evolve, especially as modal methods were in use until the 17th century; works by Dietrich Buxtehude and John Blow, for example, contain final cadences that 100 years later would not have been thought to establish tonics.

In spite oi the relation between dissonance and pulse (rhythmical beating) in 16th-century style, melodic rhythms themselves only partly depended upon the pulse; *i.e.*, insofar as they were related to other melodic parts. The rhythmic independence of various parts gradually disappeared with the development of tonality, and as a result the bass came into prominence as support of the harmonic structure. This led to the so-called "tyranny of the bar line." But this was no more tyrannical than the tyranny of modal thought or of pulse in 16th-century dissonance treatment. The real tyranny was one of a homophonic nature, namely that of the "top" and "bottom" parts with harmonic support in the inner parts.

By compensation there arose the delicate balance of movement, harmonic rhythm and time scale. Time scale may be illustrated in the fact that it is scarcely possible to tell from the first 20 bars of a madrigal or motet of the 16th century whether the whole piece will last two, five or ten minutes, but that this is usually possible after a few bars of a work by Beethoven.

Harmonic rhythm is the name given to the pulse rhythm of harmony changes. While the 16th-century treatment of accented discords was considerably widened in scope and became less rigidly applied, the principles remained, if only because dissonance produces accent and resolution repose. In addition, the tonal meaning of harmonies in the diatonic system enabled composers to use, instead of discords, other chords that had more or less motive power.

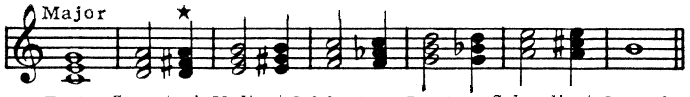
Extension of movement can be obtained in various ways, not all of them tonal. Among the non-tonal means extending movement are: (1) overlapping of melodic phrases, *i.e.*, one phrase starting at the point at which the previous one ends; (2) contrapuntal overlapping; (3j use of suspensions and other dissonances; the need of resolution, often delayed by further decoration, compels a forward movement; (4) use of non-final chords and progressions, such as interrupted cadences.

The most important voice in all harmonic progression is the bass. The bass must provide good counterpoint with the upper parts, and it also determines the tonal movement oi every phrase. At the end of a piece in C major, for example, a melody has as its last two notes B and C. A normal bass to these notes would be G C—the dominant followed by the tonic. This progression is called the periect cadence or full close. A bass that had D C, though periectly feasible (and indeed formed the basic final cadence long before the G C progression); would not sound so final. A bass E C would be distinctly unusual. Such considerations necessarily apply to the movement of the bass, especially regarding the approach to the aptly named dominant. In music that constantly moves dominant harmony is likely to be much commoner than tonic harmony, since the dominant always requires some movement at least to return to the tonic for finality.

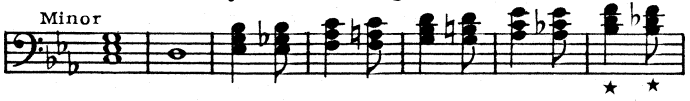
One of the phenomena of the diatonic style is that once a key is established, progressions involving directly related keys do not alter the tonic. Key relations to C major may be shown by the keys of the triads involving the perfect fifth on each degree of the scale. Direct relations are shown as minims (half notes); indirect relations are shown as crotchets (quarter notes); and doubly indirect relations as quavers (eighth notes). Relations to the minor tonic may be found by reversing the process; similarly, the direct relation to C minor is triads based on notes of the minor key. All relations are reciprocal. So relationships involve a third key; *e.g.*, in G major in a modulation to B♭ and E♭ minor the last key is the flat submediant of G major. It is not related through B♭.

Ex. 17

Direct and indirect through major scale



Indirect and doubly indirect through tonic minor



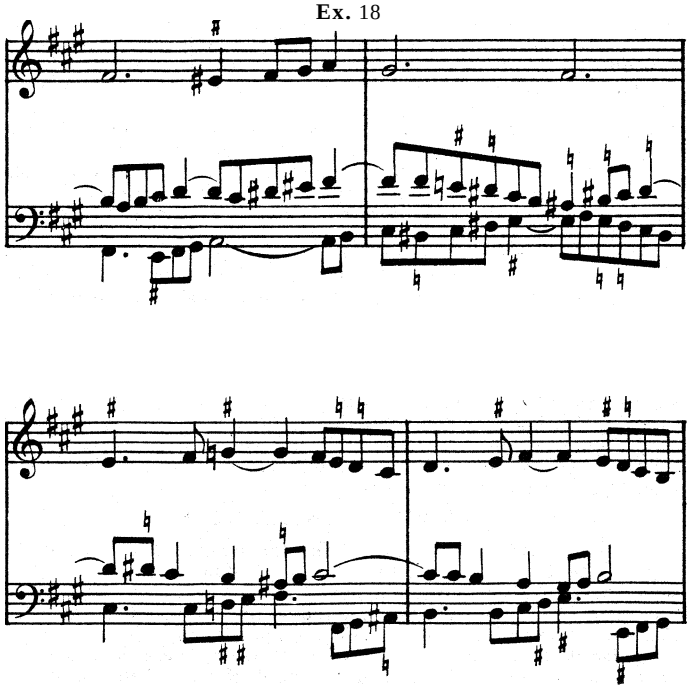
Keys marked* are ambiguous in effect; the chromatic supertonic insists on becoming the dominant of the dominant, and the seventh chords in the minor insist on leading to the minor mediants.

An understanding of the principles of tonal relations will make the apparent complesities of chromatic harmony clear. Hence in an analysis of Beethoven's First Symphony there is a transitory modulation to the supertonic of C in bar 7 of the allegro con brio of the first movement. It would be misleading to call this supertonic D minor because that would encourage the misbeliei that the D was a new tonic. This may be tested by adding as many perfect cadences in D minor as are desired and then stopping altogether. It will be iound that C is still the tonic. Such a test is useless, however, unless C is established as a tonic at the outset, as it is by Beethoven. If before playing those seven bars B♭ major were established then the D minor chord would be the mediant of B♭.

Thus transitory modulation differs from real modulation in that real modulation denotes movement to a new tonic, whereas transitory modulation moves to a tonal relation of the established tonic. Real modulation occurs in tn-o ways: (1) over a distance in time involving various modulations, as in the exposition of a sonata movement; and (2) where no properly established tonic exists, as in parts of development sections of sonata movements.

In the early 18th century nearly all modulation was transitory, except in movements on the largest scale like the first *Kyrie* of Bach's B minor Mass. A good illustration oi Bach's method in detail may be found in bar 11 onward of Fugue XIV of Book I of *Das Wohltemperierte* **Klavier** (ex. 18).

Ex. 18



If these bars are played omitting all accidentals except those specifically concerned with F ♯ minor (marked below and above) the tonal meaning of the whole passage is not altered, though from chord to chord the differences are huge. Oi course, some of the counterpoint becomes ugly, ii not nonsensical, showing that artificial leading notes produce their own melody and counterpoint. Nevertheless, the lesson is a tonal one; *i.e.*, Bach making artificial leading notes colour more strongly progressions to chords directly relative to F♯ minor.

The question of tonal and real answers in fugue (*q.v.*) was earlier bedeviled by pedagogues who iailed to distinguish between different kinds of modulation. The most real oi Bach's answers does not leave the tonic established by the subject. The episode between the second and third entries in Fugue XIV is not necessary for modulatory purposes, however vital it may be to the melodic extension and phrasing at that point; omission of bar 7 proves this.

The new style adopted by Bach's sons mas associated with a dramatic element in music rather than with melodic and contrapuntal development and ornamentation. The Viennese style of the late 18th century concentrates on changes oi key and texture rather than on extension of melody. The natural result of this change of style was the expansion of time scale. A movement lasting ten minutes will contain more real modulation than a piece lasting two minutes. Likewise, if there is much real modulation the time scale will be greater than in pieces with little or no real modulation. The reason for this is that the human ear normally refuses to listen to music without movement. From time to time a composer achieves the improbable by compelling interest in a deliberately static movement. But this is rare and is the nature of a tour de iorce. The second movement of Beethoven's Violin Concerto is a triumph of this kind. Of course many successiul sets of variations stay in the same key, or the listener's interest may be held by the composer's decorative skill, as in this particular movement. Larger sets of variations use the tonic minor, with a variety of transitory modulation, or a variety of basic progressions within the variations themselves. In the early baroque period, the great age of variation writing, composers normally used modulating ground basses ior longer movements and, even so, often took pains to conceal the final cadence of the ground bass pattern by unequal phrases, suspensions and so iorth.

The possibility of establishing a new tonic by real modulation led to the rise of the sonata iorm (*q.v.*). Sonata iorm sprang from simple binary iorms, such as are common in the dance movements oi Bach's suites ior keyboard. As soon as the time scale and modulatory scheme mas large enough to make the close at the double bar a full close in a new tonic, some sort of modulatory process was necessary to prepare ior the return to the original tonic—hence, the development section. Nineteenth-century textbooks obscured matters by inventing the term "shortened sonata form" to describe those movements where a development section is unnecessary. But the reason for its omission is the absence of real modulation to a new tonic. Thus, the exposition of the second movement of Beethoven's Piano Sonata, Opus 2, no. 1, ends with a dominant chord of F, not a tonic chord of C, and in this case the return to F presents no problem. The term "shortened sonata iorm" is misleading because binary form without a development section preceded full compound binary form. The latter is an expanded version of the former, and not vice versa.

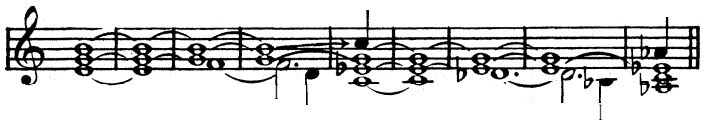
In movements in binary form without a development section the second group of subjects is usually shorter, and certainly not longer, than the first group. In a compound binary movement the reverse is true. the second group being usually at least twice as long as the first group. This is because it is difficult to establish a second key without preparation over a considerable time, whereas at the beginning of a piece a key can be established by a single chord.

The development sections of compound binary movements differ in detail. Some oi them are contrapuntal, some homophonic, some consist largely of passage work and some do not even use material from the exposition at all, while many introduce much new material. But they do not differ in their general tonal method, which is to avoid all sense of the new tonic reached at the end of the exposition by means of wide modulation. Many development sections are more complex in that they contain large episodes in some new tonic; *e.g.*, Beethoven's *Eroica Symphony*, first movement, and his *Appassionata* sonata. In cases like the first movement of Beethoven's Piano Sonata, Opus 14, no. 2, a new tonic is introduced as if it were the original tonic—a false recapitulation, so to speak; further modulation and very long dominant preparation occur beiore the real recapitulation starts in the original tonic.

Methods of modulation vary according to the scale of the work. In the exposition of compound binary movements, the enhanced dominant (the dominant of the dominant) is often used to herald the second group of subjects in the second key. This is not to say that the second key becomes an established tonic at the beginning of the second group. Rarely is such the case and, as Beethoven's style developed, the so-called transition section gradually becomes indistinguishable from the second group. If, indeed. the second group were to start in an already established new tonic, it would need to be a very short second group or it would become static. One of Beethoven's favourite devices in establishing a second key is to modulate widely just aiter the beginning of the second group, using the same methods as in the development section, only not so drastically, *e.g.*, the first movement oi his Piano Sonata, Opus 2, no. 2. Certain concepts are common to development modula-

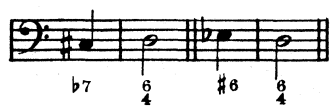
tion, namely, the use of tritone chords with their inherently ambiguous properties, and the principle that most chords will be compatible if they have a common note. The chord structure of Beethoven's Piano Sonata, Opus 57, first movement, bars 79–88, is as follows:

Ex. 19



This type of procedure can be described as a pedal link. Other methods of development modulation are the alteration of the quality of triads from major to minor or vice versa, producing different sets of relations, and, related to this procedure, the effect of certain notes on the aural imagination. If the note G is reiterated 20 times, the listener may still hear it as a tonic, but ii Ab s are introduced the G tends to become a dominant, an effect strengthened by the subsequent introduction oi an F♯ Whatever the explanation, such phenomena exist. Another example of this kind of note behaviour is shown in the alteration of a dominant chord from major to minor: the minor chord has less dominant and more tonic character than it had before, *e.g.,* the third bar of the introduction to the rondo of Beethoven's Piano Sonata, Opus 53. Such note behaviour is an important part of a composer's resources, since he is often concerned with modulation from dominant to dominant in the course oi development. Certain procedures establish new dominants fairly easily. The following progression

Ex. 20



shows how the function of certain notes together with a succeeding $\frac{6}{4}$ causes a strong presumption of a tonality of the dominant of G. In general it may be said that if, at a moment of no discernible tonality (as at the proionged diminished seventh chord just beiore the return to the tonic in the first movement of Beethoven's *Appassionata* sonata), a pedal or one of the dominant-ward progressions shown above is introduced, there is no difficulty in establishing a key. This procedure forms the tonal basis of many development sections that obliterate previous tonics with wide modulation, preparing for the return of the original tonic. Finally, there are types of motlulation that are repeated on different degrees; these types are common from the 17th century onward and are used in sonata developments throughout the period.

The 19th Century

Several factors combined, during the great romantic age, to alter some of the characteristic methods of diatonic harmony. First, since tonal principles were essentially abstract, forms arising from them became less common. Increasingly, themes symbolizing moods determined musical designs. An important factor in this development was the emergence of the solo song as a genre. Earlier developments of the solo song had sometimes been bound to specific musical forms or to lyrics designed for musical setting and therefore symmetrical or repetitive.

From the early middle ages to the Renaissance, songs used a structure containing a repeat, a refrain or an *envoi* in the iorm of paired lines, or forms of a ternary or rondo (*q.v.*) pattern. This was inevitable at periods when poets were closely identified with music. The early Italian cantata, however, mas built on a ground bass and on various rondo structures, the less formal sections being set in recitative, or arioso, and later in the form of the *da* capo aria. A pattern of libretto writing was evolved to conform to the demands of the musician, leading to the opera librettos of P. Metastasio (1698–1782).

The poems of the romantic period were generally literary achievements in their own right. The revolt against formal designs, as part of the romantic ideal, ensured a wide formal independence in the settings of these poems in the form of the German Lied (see Song: *German* Song). A Lied may begin in one key and end in another and it is even common to find quite short songs displaying bold changes of texture and tempo. Not surprisingly, Goethe preferred Carl Friedrich Zelter's settings of his poems to those by Schubert. Schubert recreated Goethe's poems, producing a new art iorm, while Zelter, whose settings seem stilted, merely served them.

The miniature scale of the typical song focused attention on the expressive rather than the functional qualities of harmony; hence the use of suspensions and appoggiaturas, single and multiple. with delayed resolutions, changing notes, chromatic decorations and the wide variety of romantic dissonance. It is not surprising that Bach was rediscovered in the early 19th century since his style, though disguised in contrapuntal forms, contained many features beloved by the romantics. It is interesting, since his chromatically colourful style was new to the romantics, that they regarded Bach as revolutionary. a view still widely held in the middle of the 20th century, though the chromaticisms and other contrapuntal decorations of Bach and, indeed, of Purcell were actually old-fashioned features of their style.

At the same time dramatic forms were adapted or enlarged to illustrate lyrical or poetic concepts. The symphonic field divides into the categories of abstract and program music. In the abstract field the procedures of Schubert and Brahms were typical. Their problem was to introduce (into forms based on the tonal schemes of Beethoven) longer and more lyrical melodic ideas in place of the shorter themes of the earlier Viennese composers. This resulted in the change of certain features of compound binary form but not of its essentials. By their very nature program symphonies and symphonic poems introduced new designs and, compensating for the partial absence of compound binary patterns, certain iormal features became prominent, among them the *Leitmotiv* (*q.v.*) and the metamorphosis of themes. Thus emphasis in design lay in melodic and textural variation and in repetition rather than on key structure.

As with the Lied the iunction of harmony became more decorative and impressionistic. With the development of the late 19th-century taste for fully saturated sound, harmonic colours became rich and complex and, while the basis of harmonic progression was still contrapuntal, the irequent doublings and complexities of texture tended to obscure this contrapuntal basis. Pedagogically, harmony was perceived more and more as the iunction oi vertical chords.

Nineteenth-century opera is dominated by the figures of Wagner and Verdi, whose conceptions of harmony were not dissimilar. They differed, of course, in their treatment of the voice, the orchestra, the time scale and in their conception of the theatre. But their forms and treatment of harmony and tonality were fundamentally melodic in outlook, Wagner placing emphasis on the orchestra and developing his concept of the Leitmotiv; Verdi giving prominence to the vocal line. It is significant that in his later, orchestrally richer operas Verdi used the Wagnerian Leitnzotiv technique. The harmonic detail of both composers was decorative and fluid, in Verdi's later work particularly, loosely based on the modulatory principle oi moving from dominant, or other related key, to dominant rather than from tonic to tonic. A well-known illustration of this harmonic fluidity is the opening oi Tristan und *Isolde* (ex. 21).

The key suggestions in the extract are as follows: bar 3, dominant of A minor; bar 7, dominant of C (major or minor); bar 11, dominant of E (the enhanced dominant of A in view of bars 1–3); bar 16–17, what looks like the eventual close in A minor is interrupted and steered through the dominant of C (18), the supertonic of C (20–21) becoming more like the subdominant oi A minor (D minor) in the last half of 21, and in 22 and 23 returning obliquely to the dominant of A minor (recognizable only from the effect of the previous A minor).

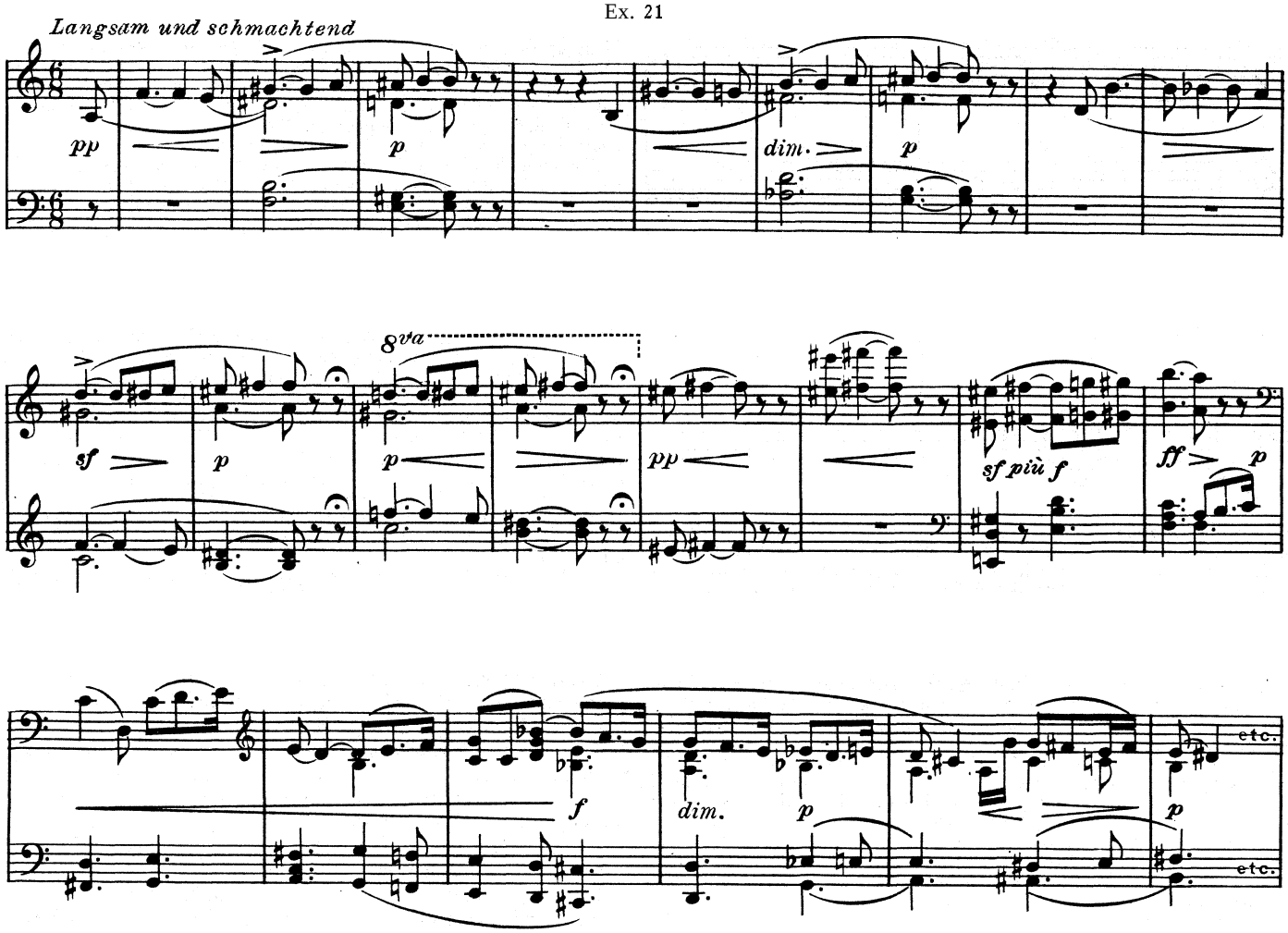
Wagner's complex harmonic counterpoint is well illustrated in this example. There was at one time much discussion of the first chord in *Tristan,* and Donald Tovey showed its origin in a well-known but overcomplex series of examples. This chord is simply an augmented sixth in a common enough form (the so-called French sixth), with an appoggiatura, G♯, resolving normally to A. The dissonance is unprepared but represents nothing new. The novelty of the opening of Tristan derives from the fact that, unlike the opening of Haydn's Creation, it has no tonic unison establishing tonality in the listener's mind. In this it does not differ fundamentally from the opening of Beethoven's First and Ninth Symphonies, both of which proclaim the nature of their opening chords after their first appearance. There are few chords in Wagner that cannot be explained in simple harmonic-contrapuntal terms, though his constant use of chromatic detail engendered the belief, widely held, that his harmonic methods were revolutionary.

The iunction oi tonality in opera is necessarily different from that in symphonic movements. The capacity for tonal memory over long periods is limited. Critics who postulate tonal theories depending on the possession of the iaculty of absolute pitch (a form of acute and permanent musical memory that, like other forms of memory, becomes less acute with age) assume that composers have written their music for enjoyment by the few possessed of this iaculty. The facts of history are otherwise. The very length of an opera, or even of one act of an opera, precludes the normal symphonic usage oi tonality, except on rare occasions. Instead, key is used for dramatic emphasis, bright and dark keys being contrasted to underline dramatic action. Act II of Tristan provides many instances of the methods of Wagner: the change from B♭ to C major at Tristan's arrival; the changes from A♭ to G♭, from A♭ to G major and to the much brighter B major at various stages in the love music; and particularly the use of the much darker D minor at King Mark's entrance, becoming D major at the words "Dies wundervolle Weib," a moving use of tonal word illustration.

POST-WAGNERIAN HARMONY

Widely different methods characterize the symphonic schools at the turn of the 19th century, although all of them used the harmonic resources of Wagner to some degree. Mahler stressed the lyrical aspects of the symphony, Sihelius, the architectural, while the Russian schools mere preoccupied with harmonic colour. The harmonic technique of these composers added little to Wagner's language despite their different applications. Richard Strauss, believed in his

Ex. 21

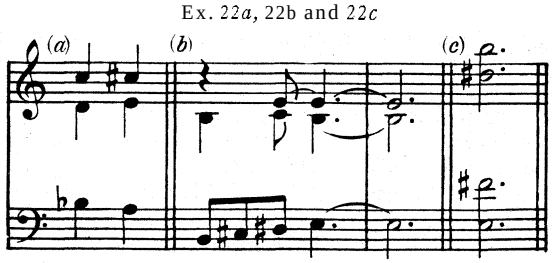


youth to be a revolutionary, was later seen as a complicator of Wagner's language.

The 19th–century harmonic language was particularly extended by Debussy. Much of Debussy's harmony may be analyzed as tritone discords with additional and altered notes, and its departure irom traditional methods was later seen to be less fundamental than was at first supposed. Certain new elements. however, were introduced: consecutive-fifth chord movement, a more common use of modal elements and, following the example of Liszt and others, the use of the augmented triad with added notes in the form of the whole-tone scale. Some of these elements blurred tonality and made movement more difficult. a consideration that sometimes caused Debussy to use more traditional methods, encouraging also the use of pedal figures. Pedals were also used freely by Sibelius and, indeed, became an increasingly important feature of 20th-century music.

Nationalist schools, developing their own variations of harmonic technique, produced a number of different styles. Often, consecutive triads. iourths and seconds were used, and novel scales and modes were introduced, resulting largely irom the study oi folk music. No system of harmony was, however, codified, except one by Hindemith based on a new view of traditional methods. Scriabin's system of chords quickly proved its limitations. Schönberg's system oi dodecaphony (*q.v.*) was designed to provide the composer with a method oi composing in place of the connecting thread of tonality. but it was not basically a harmonic system since the harmony of each piece differs according to its "row."

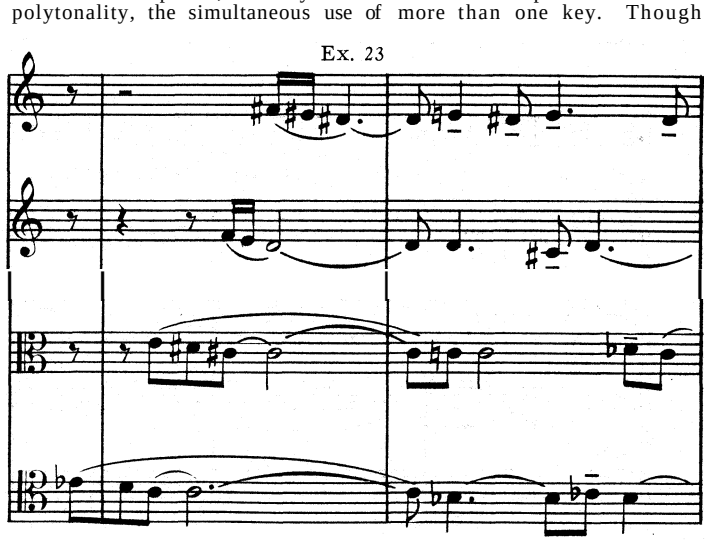
Ex. *22a,* 22b and *22c*



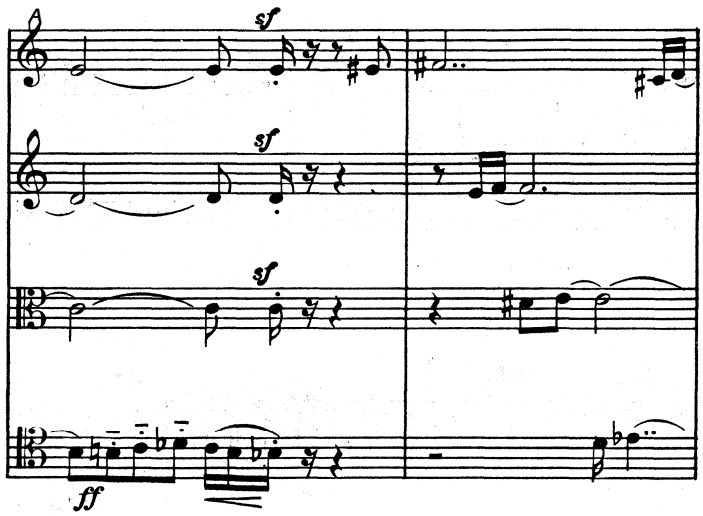
Nevertheless, certain methods were common to 20th-century composers whose music was based on tonality of some kind. In avoiding traditional cadences and progressions new uses were made of artificial leading notes such as in ex. *22a,* an instance as contrapuntal as the two-part cadence of the 16th century, and ex. *22b* irom Lennox Berkeley's String Trio. The combination of certain upper harmonies mas viewed as concordant; this view is the basis for the most probable explanation of Stravinsky's predilection for chords such as ex. *22c.* Another addition to the language was the doubling of melodic lines at various intervals to produce chordal polyphony. False relations mere used in increasing complexity and nonresolving acciaccature were used in the form of note clusters. The resolution of such acciaccature has the effect of a cadence.

Certain composers, notably Darius Milhaud. experimented with polytonality, the simultaneous use of more than one key. Though

Ex. 23



Ex. 23—contd.

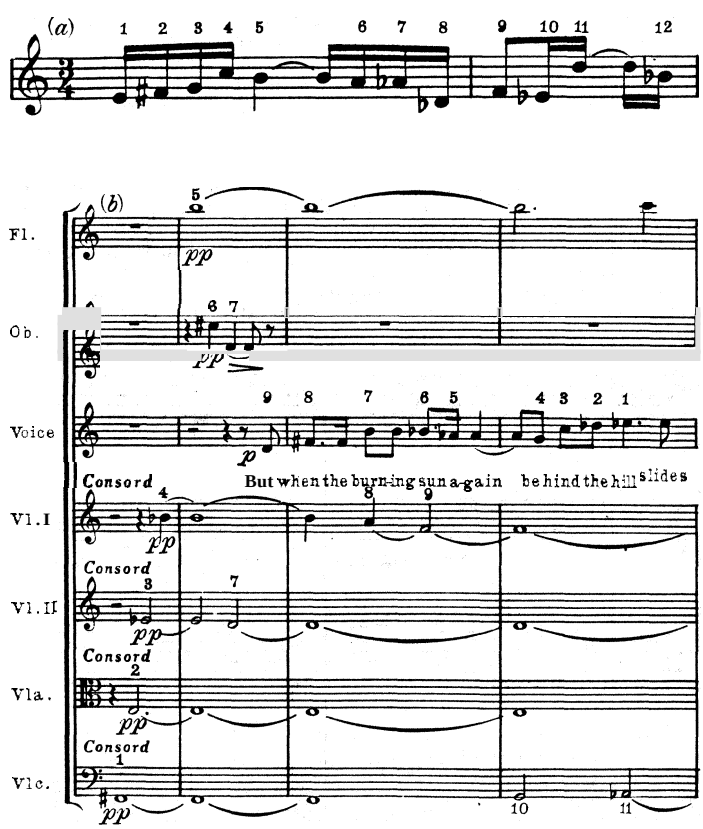


it produced interesting by-products, polytonality itself proved disappointing, possibly because of the limitations of the human ear.

Extensions of traditional methods of colour variation through harmony were used. In Béla Bartok's music harmonies are associated with intervals occurring in the thematic material. His fondness for seconds is generally attributable to a combination of contrapuntal cadence methods and highly rhythmic forms of harmony. This combination is used in conjunction with numerous scale patterns, sometimes derived from Balkan folk music. His Fourth String Quartet concentrates on the interval of the second not only thematically but also contrapuntally and harmonically. Ex. 23 demonstrates the thesis of this work.

The second movement of Bartók's *Concerto for Orchestra* affords a striking demonitration of his methods. Pairs of instruments enter using parallel motion as follows: (1) bassoons in sixths (supporting harmony traditional); (2) oboes in thirds (harmony traditional with much use of thirds; *e.g.*, bars 33–39); (3) clarinets in sevenths (harmony almost exclusively in sevenths); (4) flutes in fifths (many fifths in harmony); (5) trumpets in seconds (harmony largely combinations of seconds).

Ex. 24



Such harmony is, of course, contrapuntal in origin and thus has some resemblance to serial methods. An illustration of the serial technique appears in ex. 24, taken from Humphrey Searle's *Put Away the Flutes*. Here (a) is the opening melody (row); (b) is the start of the final section. The voice continues (from the previous section) with an inverted backward presentation of the row while the instrumental harmony is an inversion of the row. The figures show the relationship of the individual notes to the row.

The resemblance between Bartók's contrapuntal harmony and Schönberg's serial technique is, however, not more than superficial. Bartók's music is fundamentally tonal even though it is highly coloured by the use oi unusual scales. Moreover, contrapuntal methods oi harmonic structure, though characteristic of much modern tonal music, do not necessarily constitute the whole of its harmony. On the other hand, though contrapuntal possibilities exist in serialism, the serial technique is not, properly speaking, contrapuntal. In ex. 23 the harmony of seconds arises out of successive imitative entries at the second. not from the seconds in the thematic material. In contrast, Searle's harmony derives from the intervals occurring in a single melodic line. *See* also references under "Harmony" in the Index volume.

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(P. C. A. W.)

HARNACK, ADOLF VON (1851–1930). German theologian and church historian, the leading patristic scholar of his time, was born on May 7, 1851, at Dorpat. Estonia, where his father. Theodosius Harnack (1817–89), was professor of practical theology. Adolf studied at Dorpat and at Leipzig, becoming *Privatdozent* in church history in 1874 and professor *extraordinarius* in 1876. As full professor he occupied chairs at Giessen (1879–86), Marburg (1886–89) and the University of Berlin (1889–1921). Harnack was a member of the Prussian Academy of Science (of which he prepared a three-volume history in 1900), founder and president (1902–12) of the Evangelical-Social congress. director of the Royal library (1905–21) and president of the Kaiser Wilhelm Society for the Advancement of Science. He was ennobled in 1914 and died at Heidelberg on June 10, 1930.

Harnack's intellectual career led him through the orthodoxy of Dorpat and Erlangen and the historical-critical approach of the Tübingen school to the liberal position set forth bv Albrecht Ritschl (*q.v.*). The Ritschlians were primarily concerned to relate Christianity and culture, and Harnack believed this could be achieved only by a historical understanding of Christianity where the essence is separated from the dogma. This essence could be isolated by employing a scientific historical method that abjured all metaphysical speculation and included source study (hence his initiation, with O. von Gebhardt, of the important *Texte und Untersuchungen zur Geschichte der altchristlichen Literatur* series [Leipzig, 1882 *et seq.*], to which Harnack contributed 49 monographs); analysis of the cultural factors that help to shape historical events; the assessing of historical institutions and their relation to the *Geist* that produces them; and faithful representation of the facts.

Harnack's greatest work is his *Lehrbuch der Dogmengeschichte* (3 vol., 1886–89; Eng. trans. *History of* Dogma, 7 vol., 1894–99), universally acclaimed as brilliant in conception and a monument of liberal historiography. Christian dogma, by which Harnack means the authoritative doctrinal system of the 4th century, is traced in its origin and development through the Protestant Reformation. His thesis is that Christian dogma in its conception and development is a work of the Greek spirit on the ground of the Gospel. The process begun at the Reformation—viz., the overcoming of dogma by a recovery of the essence of the Gospel—should be completed, and it is the historical-critical approach that will achieve this. Harnack defended this value-judgment in his most famous work, *Das Wesen des Christentums* (1900 and many later eds.; Eng. trans., *What* Is *Christianity?,* 1901), which evoked

violent and prolonged opposition.

Harnack's other major works include *Geschichte der altchristlichen Literatzcr bis Eusebius* (3 vol., 1893–1904), incomplete; *Die Mission und Ausbreitung des Christentums in den ersten drei Jahrhunderten* (1902; Eng. trans., 2 vol., 1904–05; 2nd Ger. ed. 1924); a collection of papers, *Beiträge zur Einleitung in das Neue Testament* (7 parts, 1906–16; Eng. trans. of 6 parts. 1907–25); a collection of speeches and articles, *Reden und Aufsätze* (7 vol., 1904–30, vol. vii edited by Axel Harnack); *Marcion, das Evangelium vom fremden Gott* (1921). A complete bibliography of Harnack's writings, listing 1,611 items. was prepared by Friedrich Smend under the title *Adolf von Harnack: Verzeichnis seiner Schriften* (1931).

See *Adolj von Harnack,* a biography by his daughter, Agnes von Zahn-Harnack (1936). (G. W. GL.)

HARNESS AND SADDLERY, the equipment for any animal used for packing, traction or riding. Harness is the general term for the gear and tackle for such animals. Saddlery in the sense used in this article applies to articles produced by a saddler, a person who makes, repairs or sells saddles and related equipment, such as bridles, bits. stirrups and hames.

Bridles and Other Head Gear.—The bridle, a harness of horses and mules, is a set of straps that make the bit secure in the animal's mouth and thus ensure human control. The headstall portion of the bridle consists of the headpiece passing behind the ears and joining the head band over the forehead; the cheek straps run down the sides of the head to the bit, to which they are fastened; in the blind type of driving bridle the blinkers, rectangular or round leather flaps that prevent the animal from seeing anything except what lies in front, are attached to the cheek straps; the noseband passes around the front of the nose just above the nostrils; and the throatlatch extends from the top of the cheek straps underneath the head.

The martingale, sometimes used on riding horses, passes between the horse's forelegs with one end fastened to the saddle girth and the other to the head harness. It keeps the horse from throwing back its head.

The bit is the metal contrivance inserted in the mouth to which the reins are attached. There are three general types of bits: the straight bar, snaffle and curb. The snaffle has a jointed steel mouthpiece with straight cheek bars, the rings for the reins and cheekpieces of the headstall being fixed in the bars at the junction with the mouthpiece. The bars prevent the horse from pulling the bit through its mouth. The snaffle without bars is termed a bridoon. The curb bit is one to which a curb chain or strap is generally attached, fastened to hooks on the upper ends of the cheek bars of the bit and passing under the horse's lower jaw in the chin groove. The reins are attached to rings at the lower ends of the cheek bars, the leverage thus pressing the curb chain against the jam. The mouthpiece of the curb bit is unjointed and in the centre commonly has a port, *i.e.,* a raised curve, allowing liberty for the tongue and bringing the pressure on the base of the horse's jaw. The curb bit and the bridoon can be used together with separate headstalls and reins, and there are many combination bits.

Saddles. — The skeleton of the riding saddle is composed of the tree, or framework, the parts of which are the pommel or head. the projection that fits over the animal's withers, and the side bars that curve around to the back to form the cantle, or hind bow. The rigid parts are almost always covered with leather. To the tree are fastened the stirrup bars. On either side of the saddle are a leather skirt and hanging flaps to protect the rider from the mount's sweat. In saddles to be used with unbroken or unruly horses, knee rolls are often placed on either side behind the cantle.

The saddles of Asia, Africa and continental Europe tend to be heavy and high. But the English saddle, removed from all utilitarian purpose, has developed extreme lightness for sport, racing and fox hunting; the pommel and cantle are greatly reduced, and. provision is made for clinging with the knees in jumps.

The saddles of Latin America and of western North America are highly diversified but largely are derived from equipment developed in the cattle industry of Spain during the middle ages. On the pommel is a sturdy metal horn to which the lariat or lasso is tied when cattle are being roped. The cantle is high to prevent the rider from slipping off the seat when the horse sits back on its haunches at the moment of roping. The saddle is made secure by one or two surcingles called cinches, or girths; these are held to the tree rings by latigos, long leather straps. The sides and front of the stirrups are covered by leather taps (Sp. tapaderos), a casing that prevents them from snagging in brush.

Harness. — Many types of harness are used in different parts of the world for oxen. zebus. asses. reindeer, elephants, camels, water-buffaloes, yaks and dogs. In the basic occidental harness for horses and mules, a leather collar, heavily padded, passes over the head and rests firmly on the shoulders; two hames, rigid curved pieces of metal, rest on this collar and are fastened at top and bottom by hame straps. To the hames are attached the traces, straps that pass along the animal's sides and are connected to the ends of the whippletree (also called whiffletree, singletree or swingletree), a horizontal bar connected to the load by a centre link.

When the animal is harnessed between shafts, the shafts are usually supported by a back pad; the pad is a narrow leather cushion resting on the hack, attached to the shaft by straps and held in position by a girth or bellyband as well as by a backband and crupper. a loop strap passing under the tail. Reins pass through terrets, or rings. on the hames and pad. The other harness on the animal's hindquarters consists of the breeching. straps passing around behind the haunches to help in backing, braking and stopping the vehicle, and the hip strap fastened to the breeching and passing over the hindquarters.

The checkrein (bearing rein). a device sometimes used to add to the elegant arch of a horse's neck, consists of a separate bridoon bit with the reins passing through rings on the collar and then attached to a hook on the pad.

Historical **Sketch.**—With the possible exception of the sail, harness represents man's first attempt to employ nonhuman power fnr his purposes. In pre-Columbian times, the new world knew no harness except for llamas and dogs carrying packs, dogs pulling travois on the Torth American plains and dog sleds among the Eskimos. The Indian failure to develop much harness map be due both to the scarcity in America of animals anatomically suited to it and to the failure to observe systematically the effects of gelding.

The earliest old world form of harness, which presupposes gelding, is the yoke resting on the withers of two animals, first used in the near east perhaps by 4000 B.C. to attach a pair of oxen to a plow. By about 3000 B.C. the yoke was employed in Mesopotamia with onagers to draw light wagons and chariots, and by about 2000 B.C. it was applied to horses, then newly arrived from central Asia. Asses were used as pack animals in Egypt by 3000 B.C., but there is no evidence that any animal was ridden until about 1300 B.C.

The first use of the camel for labour is of very uncertain date. Presumably it is early. since the single-humped camel appears as a pack animal by 1000 B.C. in Mesopotamia. In the regioa north of the Altai mountains reindeer were used for traction earlier than horses, to judge from the fact that horses drawing the funeral sled of a chieftain buried at Pazirik about 400 B.C., which were sacrificed and buried with him, wore reindeer masks.

Bits. — Both oxen and onagers were controlled by rings through the nose. The horse, however, appears from the beginning to have been governed normally by a bridle and bit, sometimes of bone but generally of metal. At first this was a simple bar with a ring at each end for reins, although by 1400 B.C. the jointed snaffle was known throughout the near east. While there were many variations of both bar and snaffle bit, no basic innovation appeared for a thousand years; in the 4th century B.C. Xenophon speaks of the curb bit. During the European middle ages the development of mounted shock combat demanded that the knight have absolute control of his charger. with the result that heavy and very severe curbs were produced. But no basic new idea in bits has appeared for the past 23 centuries.

Spurs.—The simple prickspur appears in Celtic graves of about 400 B C. Although its use became habitual in Europe and eventually in the Americas, it seems not to have spread widely in the orient or Africa. Rowel spurs which replaced the single prick with a wheel of radiating points first were found in 9th-century Spain.

Saddles. — For at least 12 centuries after horses were first ridden there were no saddles but only saddle cloths attached by surcingles or bellybands. These cloths were gradually supplemented by cushions or rolls that improved the rider's comfort but did not add greatly to his stability. Saddles with rigid frames, pommels and cantles but without stirrups appear in China during the Han dynasty (206 B.C.–A D. 220) and are found in Roman Gaul in the 1st century AD., probably as an introduction from the barbarian world. The development of mounted shock combat in the middle ages required that the saddle become a large seat giving maximum support to the knight. In early modern times as shock combat in warfare and the tournament as sport went out of fashion, saddles steadily grew lighter. The decline of the saddle into the so-called English saddle of the late 19th and 20th century is a sign of the technological obsolescence of the horse among those using such saddles. Herdsmen continued to use very substantial saddles.

The sidesaddle developed from an ancient pack saddle with a pannier, a board suspended on one side upon which the woman rider could rest her feet for support. By Frankish times the term astreba referred specifically to the footrest of such a saddle, and the word conveniently labeled the stirrup when it came from central Asia.

During the middle ages and early modern times, the sidesaddle was varied in many ways from the basic device.

Stirrups.—The first stirrups appeared as big-toe stirrups in India in the late 2nd century B C. These were diffused nherever Hindu culture had contact with barefoot aristocracies, from Timor and the southern Philippines on the east to Ethiopia on the west. The wave of Indian culture that took Buddhism to China likewise carried the idea of the stirrup which the booted Chinese, in their chillier climate, expanded into the foot stirrup by the 5th century A.D.

The foot stirrup reached Korea in the 5th century and Japan and some of the central Asian countries in the 6th century. In A.D. 694 Moslem armies in northern Iran received the stirrup from Turkestan. Shortly afterward it was found in Byzantium. and by the early 730s it had arrived in the Frankish realm

Before the support of the stirrup supplemented that of pommel and cantle, a mounted warrior could thrust his spear only with the strength of his own arm. With stirrups he could lay the spear at rest under the upper arm while his hand guided the blow that was now delivered by the force of his charging horse. The increase of violence was immense. Since it made possible mounted shock combat, the stirrup is the most significant invention in the history of warfare prior to gunpowder. In the early 730s Charles Martel saw the military potentialities of the stirrup, seized great areas of church lands, distributed them to retainers as endoament on condition that they serve him by fighting in the new manner and thus instituted the feudal regime.

Modern Harness. — The Bronze Age transfer of the yoke from oxen to onagers, horses, etc., was not successful for anatomical reasons: a horse, ass or similar animal could be attached to such a yoke only by two straps running from the end of the yoke around the animal's neck and under its belly. The neck strap pressed on the windpipe and jugular vein in proportion to the pull of the animal, while the withers were so high a point of traction as to be mechanically inefficient. The modern harness, with its padded collar supporting rigid hames on the shoulders in a way that does not interfere with breathing or blood circulation, enables the animal to throw all its neight into pulling. It has been shown experimentally that a team of horses equipped with modern harness can pull a load between four and five times heavier than the same team can pull with the ancient yoke harness

Modern harness appears to have been introduced into Europe from Asia China under the Hans developed a type of single-horse chariot drawn by lateral shafts, and the modern harness is found in frescoes of about 500 A.D. in Kansu. The first modern harness in Europe was seen about 800 A.D

Animals and teams could not be harnessed tandem, or in sequence. until the 1st or 2nd century A D.. when suddenly the evidence of such harness is found in Gaul, Italy and China. When this was later combined with horse collar and traces, horsepower became available for plowing and heavy hauling. The first evidence of habitual plowing with horses comes from Norway toward the end of the 9th century. Two hundred years later plow horses nere common over much of northern Europe. from the Ukraine to Normandy. In the 11th century the nhippletree began to equalize the pull of traces on the load, and the pivoted front axle. knonn in Roman times. became common. By the 12th century the big four-wheeled wagon drawn by several teams of horses was revolutionizing land transport. It was the ancestor of all later European coaches and wagons, including the Conestoga wagons of the American frontier and the railroad coach.

See DRIVING AND COACHING; HORSEMANSHIP AND RIDING.

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HARNESS HORSE RACING: see HORSE RACING AND BREEDING.

HARNEY, GEORGE JULIAN (1817–1897), English socialist and Chartist agitator, was born at Deptford on Feb. 17, 1817. His education was rudimentary and as a youth he was several times imprisoned for selling unstamped radical newspapers. He became leader of the London Democratic association, the largest left-wing Chartist body in the capital, editor of the unstamped *Democrat* and a strong physical-force Chartist agitator (see CHARTISM). Although he saw that this agitation required an organized mass backing, he never secured it. Harney twice stood for parliament, for the West Riding of Yorkshire in 1841 and against Lord Palmerston at Tiverton in 1847. without success in either case. He edited *The Northern* Star from 1815 to 1850 and through it came to know Friedrich Engels and Karl Marx. sorne of whose ideas he shared. The ineffectiveness of the Chartist petition of 1848 convinced him that a successful working-class movement must be socialist as well as democratic. He helped Marx in the early days of the Communist International, but quarreled with him in 1851, for he was too independent-minded to follow hfarx's lead in everything. Thereafter Harney's influence waned. He moved to Jersey in 1855 and to Massachusetts in 1863, where he worked as a clerk. He returned to England in 1888 and died at Richmond, Surrey. on Dec. 9, 1897.

See A. R. Schoyen, *The Chartist Challenge* (1958). (M. R. D. **F.**)

HARO, LUIS DE (1598–1661), Spanish statesman. who governed Spain; as the favourite of Philip IV, during the critical years between the defeat of Rocroi (1643) and the peace of the Pyrénées (1659), was born at Valladolid, the son of Diego de Haro, marqués del Carpio (whose title he inherited in 1648), and of Francisca de Guzmán, sister of the conde-duque de Olivares. He went to court at an early age and quickly gained the friendship of Philip IV, whose amity Haro was able to reconcile with opposition to the king's minister Olivares, whom he succeeded in 1643. Less able and less ambitious than his uncle. Luis de Haro was unable to improve his country's situation: for most of his administration the war with France continued and the economic crisis worsened. When he led the Spanish delegation to negotiate the treaty of the Pyrénées he was no match for Mazarin, but for his services in arranging the peace his marquessate was raised to a dukedom. Haro died in Madrid in 1661.

HARO (CLAMEUR DE), the ancient Norman custom of "crying for justice," still surviving in the Channel islands. The wronged party must on his knees and before witnesses cry: "Haro! Haro! Haro! a l'aide, mon prince. on me fait tort." This appeal has to be respected. and the alleged trespass or tort must cease till the matter has been thrashed out in the courts. The "cry" thus acts as an interim injunction, and no inhabitant of the Channel islands would think of resisting it.

This method of appeal is said to be identical with the "Legatro of the Bavarians and the Thuringians," and the first mention of it in France is to be found in the "Grand coutumier de Normandie." A similar custom, only observed in criminal charges, was recognized by the Saxon lams under the name of "Clamor Violentiae." Thus there is reason to think that William the Conqueror on his arrival in England found the "cry" fully established as far as criminal matters were concerned. Later the "cry" was made applicable to civil wrongs; and, when the administration of justice became systematized, disappeared altogether in criminal cases. It was long retained in northwestern France in cases of disputed possession. and was not actually repealed until the close of the 18th century. See HUE AND CRY.

HAROLD I (HAREFOOT) (d. 1040), king of the English from 1037 to 1030. an illegitimate son of Canute by Aelfgifu of Northampton. He was made regent of England after his father's death in 1035, until the legitimate son, Hardicanute (*q.v.*), should arrive. Because the latter delayed in Denmark, Harold was made king in 1037, and banished Emma, Canute's widow. In 1036 he was responsible for the cruel treatment of a party brought from Normandy by a son of Aethelred II the Unready, Alfred, who was blinded and soon died.

A Welsh raid in 1039, when Earl Leofric's brother Edwin was killed. and an unsuccessful Scottish attack on Durham c. 1040 are the only other recorded events of this reign. Harold died at Oxford on March 17, 1040.

See F. M. Stenton, *Anglo-Saxon England,* 2nd ed. (1947). (D. WK.)

HAROLD II (1022?–1066), king of the English. the second son of Earl Godwine, was born about 1022. While still very young (before 1045) he was appointed. through his father's influence with Edward the Confessor, to the earldom of the East Angles. He shared his father's outlawry and banishment in 1051, but while Godwine went to Flanders, Harold with his brother Leofwine took refuge in Ireland. In 1052 the uneasiness felt at the visit to England of William, Duke of Normandy, who was known to covet the English throne, caused a reaction in favour of Godwine, who returned to England with his sons, under arms. The witan finally decreed that their lands should be restored. Harold therefore received his earldom of the East Angles, and on his father's death in 1053 succeeded him in the greater earldom of the West Saxons, Sweyn having died while on a pilgrimage to Jerusalem. Harold was now the chief man in the kingdom, and the latter part of Edward's reign was virtually the reign of Harold. On the death (1055) of Siward, earl of Yorthumbria. Edward. at the instigation of Harold. appointed his brother Tostig earl of Sorthumbria: Earl Aelfgar looked upon this appointment as a menace to the Mercian house. and his opposition led Harold to procure his outlawry by the witan. Aelfgar then joined Gruffydd. Prince of North Wales, in an attack on Hereford, as the result of which Aelfgar regained his position as earl of East Xnglia. In 1057. with the exception of Lfercia. Harold and his brothers held all the earldoms throughout England. Aelfgar, in order to secure a useful ally. married his daughter Ealdgyth to Gruffydd. Xelfgar died in 1062, and was succeeded by his son Edwin. In spite of the alliance between the hfercians and the Welsh, Harold and Tostig raided Wales in 1063. and forced Gruffydd, who was eventually killed by his own men, to flee. In 1063 Harold was shipwrecked on the French coast, and captured by the Normans. who only released him on his oath on sacred relics (though at the time he was unaware of their nature) to support William in any claim for the English throne. Probably on his return to England. though the date is uncertain. Harold married Ealdgyth (Edith), sister of Edwin, and widow of Gruffydd, thus conciliating the powerful earl of Mercia. His mistress. Eadgyth of the Swan-neck, the mother of his children. was still living. In 1065 the Northumbrians revolted against Tostig's rule. choosing Morkere, brother of Edwin of Mercia, in his place. Harold acted as mediator, but was compelled to agree to the banishment of Tostig, who was thenceforth his bitterest enemy.

On Jan. 6, 1066, Edward died, recommending Harold as his successor. He was accordingly elected at once and crowned. He won over the men of Northumbria. and prepared against the attacks which threatened on both sides. William challenged the crown, alleging both a bequest of Edward in his favour and Harold's oath, and prepared to invade England. From May to September: Harold kept men and ships in readiness on the south coast. but at last provisions failed and he returned to London. At this time Harald Hardrada of Norway, supported by Tostig in the north, invaded England. Together they sailed up the Humber, defeated Edwin and Morkere, and received the submission of York. Harold hurried northward, and on Sept. 25 won a complete victory over the Northmen at Stamford Bridge, in which Tostig and Harald Hardrada were slain. Two days later Harold received news that William had landed at Pevensey, and he marched southward as fast as possible. He gathered his army in London from all southern and eastern England, while Edwin and Morkere held the north. The king then marched into Sussex, and engaged the Normans (Oct. 14, 1066) on the hill of Senlac near Battle (see HASTINGS: The *Battle of Hastings*). After a fight lasting all day the Normans had the victory; Harold. wounded by an arrow in the eye, and his two brothers Gyrth and Leofwine, lay dead on the field.

Harold had three sons. Godwine, Edmund and Magnus, and two daughters. probably the children of Eadgyth of the Swan-neck. Another son mas named Ulf. By his wife Ealdgyth, who was sent for safety to Chester in 1066, he had a posthumous son. Harold, who took part in the expedition of Magnus Barefoot to the Scottish Isles in 1098. Harold's body is said to have been taken from the cairn of stones on the sea shore where it was originally buried to Waltham.

See E. A. Freeman, *History of the Norman Conquest of England* 6 vol. (1871–79), in which the existing sources are fully utilized; Lytton's *Harold* is a brilliant historical novel, though not an impartial record.

HARO STRAIT, a channel forming part of the international boundary between Canada and the United States, is located east of the southern end of Vancouver Island: B.C., and joins the straits of Juan de Fuca and Georgia. The San Juan islands of Washington state lie east of Haro strait. Depths in mid-channel average between 100 and 150 fathoms, but at its southern end where there are submerged islands the water is only about 10 to 50 fathoms deep. Deep-sea vessels approaching Vancouver usually follow the Haro strait through the islands in the gulf of Georgia.

Throughout the strait the ebb or south-going tidal stream has a much greater rate than the flood or north-going tide. Tide rips are common off headlands. The ebbing tides carry surface water from the Fraser river, which is warmer than the deeper water which comes from Juan de Fuca strait. (J. L. R.)

HARP, a plucked stringed instrument of great antiquity. Typically, the harp is either triangular or bow-shaped, with one string for each note and with a resonator to which the plane of the strings is perpendicular or nearly so. The gradation of string length from short to long corresponds to the gradation from high to low pitch. The word harp is often used inaccurately to describe instruments that are properly zithers or lyres.

The modern harp is a combination of the basic structure and method of sound production of the ancient harps, with a complex mechanism to obtain a full chromatic range.

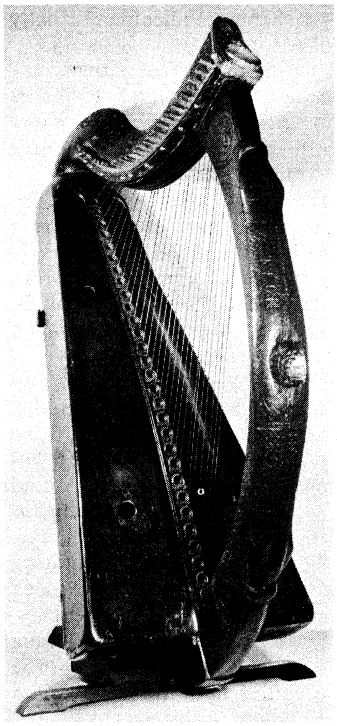
The modern double-action pedal harpcovers 63 octaves (3 below and $3\frac{1}{2}$ above middle Ci and consists of (1) a hollow sound box, rectangular or semicircular in section to which the belly, or sounding board is attached; (2) the harmonic curve, or neck, carrying the tuning pins, a set of wrest pins and two sets of rotating brass disks; (3) the forepillar. which joins the end of the neck to the base; (4) the strings, of gut or nylon and, in the bass, bound wire, which. at the upper end. are fixed through the tuning pins and, at the lower end, are pegged to holes in the belly; (5) the mechanism, concealed inside the forepillar and the deep metal plates that run along both sides of the neck. This mechanism is worked from seven pedals (one for each string in the harp's 7-note octave) set in the base of the harp; each of these pedals acts upon all the strings of a certain pitch name throughout the harp's compass. Depression of the pedal to the first notch (single ac-

tion) shortens the appropriate strings by a semitone; to the second notch (double action) by a whole tone; the shortening is effected by means of the rotating disks on the neck that grip the string at the appropriate point. This harp is normally tuned diatonically in C♭; thus, depression of all pedals to the first notch puts it into C, and to the second notch into C♯. Its technique demands skilled co-ordination between the hands, which pluck the strings with the fleshy part of the finger tips, and the feet, which, with the pedals, select the necessary pitch changes on the strings.

True harps of great size are depicted in the tomb of Ramses III (c. 1200 B.C.) and harps of various forms and sizes were much used in the ancient Mediterranean civilizations, the exceptions being Greece and Rome, where the lyre and cithara were more important. There are few extant specimens of these ancient harps. but their use ultimately spread to Africa and the far east and the form of the small Egyptian bow harp survives in the tribal harps of east Africa and the old Burmese harp. Ancient harps had no forepillar and, presumably. were strung at rather low tension.

The frame harp. with a forepillar joining the forward ends of neck and sound box. appears to have developed in northern Europe during the 10th and 11th centuries of the Christian era. From the 12th century two main forms are recognizable, one Irish and one European. The characteristic features of the Irish harp. or *clarsach*, were a huge sound box carved from a solid block of wood, a heavy neck and a deeply curved forepillar. It was designed to bear great tension from thick brass strings, which were plucked by long fingernails to produce a ringing, bell-like sound. It belonged to the world of strongly coloured medieval instruments, but, because of the static nature of the aristocratic Irish society into which it was integrated, it survived almost unchanged to the end of the 17th century. Its long resonance was out of keeping with the harmonic nature of 18th-century music! and by the end of that century it had disappeared.

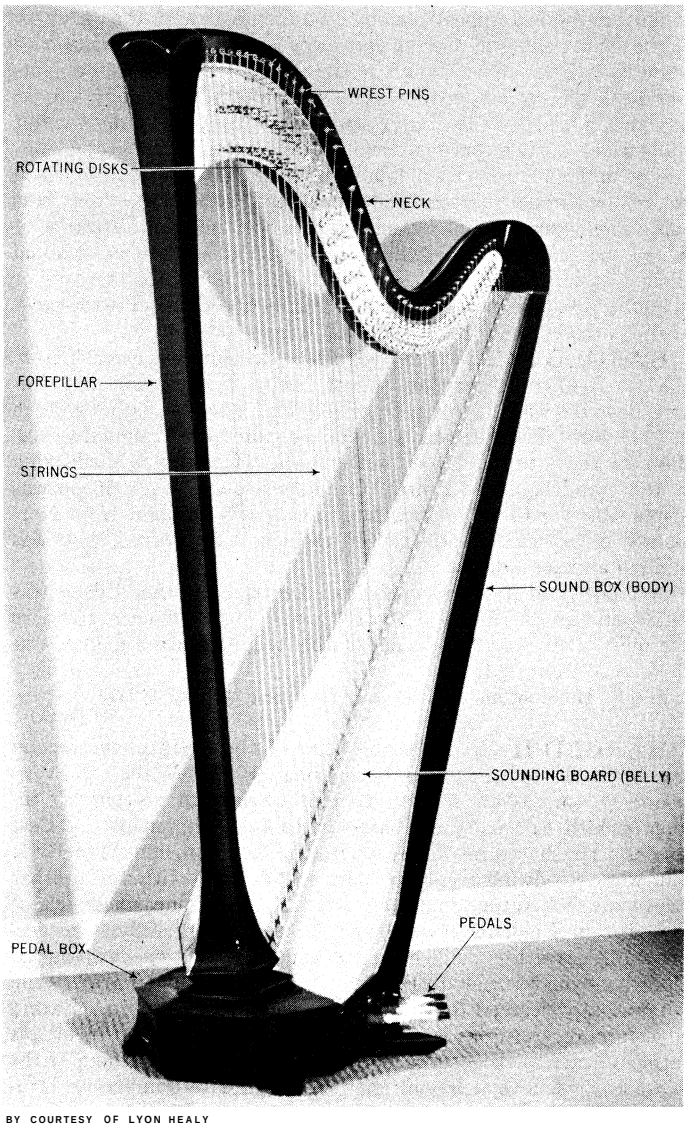
The modern harp is derived from the more delicate European harp, which differed from the Irish in having a thin, shallow sound box, slender neck and forepillar and, at least from the 16th century. gut strings plucked with the finger tips. The simple 16th century form is preserved in the rustic harps of Latin America, taken there by the Spaniards and adopted by the Indians, who still play vivacious dance music on them, together with drums, guitars and maracas.



BY COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM AND THE BOARD OF TRINITY COLLEGE, DUBLIN

FIG. I.— SMALL IRISH HARP. PROBABLY 14TH CENTURY

From the 17th century onward, the harp was progressively mechanized to give it the chromatic notes demanded by changing musical styles. The first attempt was made by Tirolean harp makers,, who placed a number of hooks on the neck close to the strings, to be turned by hand when required. Although this mechanism made it possible to sharpen the pitch by a semitone, it also pulled the hooked strings out of plane, and its operation left only one hand free to play. In 1720. Celestin Hochbrucker. a Bavarian. attached the hooks to a series of levers in the forepillar (which henceforth became hollow) controlled by seven pedals. In 17.50. Cousineau of Paris replaced the hooks by metal plates that gripped the strings while leaving them in plane. In 1792, Sébastien Érard substituted the rotating disk for the metal plate and in 1810 added a second disk for each string and produced the double action for the pedals; Érard's changes virtually established the modern form of the harp.



BY COURTESY OF LYON HEALY

FIG. 2.— DOUBLE-ACTION PEDAL HARP

The Welsh triple harp with three parallel ranks of strings, and the chromatic harp invented and improved by members of the Pleyel firm in Paris in the late 19th century. were attempts to chromaticize the harp without using mechanism. The so-called Irish harp of the 19th and 20th centuries is derived from the gut strung pedal harp and has little connection in construction or technique with the historic Irish harp.

In the absence of exact instrumentation, medieval harp music can only be inferred. Much 17th- and 18th-century solo music is alternatively for harp or keyboard instruments and is. with the exception of Mozart's concerto for flute and harp, unremarkable. The tonal and technical possibilities of the modern harp, particularly its sweeping glissandi and mysterious harmonics, make it most effective in impressionist or "atmosphere" music, and its. solo and ensemble repertoire is largely modern.

Parts specifically written for the harp are rare in early concerted music. Rlonteverdi's opera *Orfeo* (1607) and Handel's oratorio *Esther* (1730) being notable exceptions; the double-action pedal harp. however, became a standard part of the orchestra from 1830 onn ard.

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HARPENDEN, an urban district in the Hemel Hempstead parliamentary division of Hcrtfordshire. Eng., 3 mi. N.N.W. of St. Albans. Pop. (1951) 14,244. Area 4.9 sq.mi. It is a residential district from which many people travel daily to London. West of Harpenden common (238 ac.) is Rothamsted Experimental station (*q.v.*), a centre for agricultural research founded by J. B. Lawes and opened in 1843. It covers about 527 ac. and includes laboratories, an. experimental farm and the historic Rothamsted Manor house, now used as a hostel. Harpenden hall, dating from the 17th century, was acquired by the district council in 1932 for offices. About 4 mi. E. of Harpenden is Wheathampstead, where are the huge earthworks of Cassivellaunus' stand against Caesar.

HARPER, JAMES (1795–1869), founder of the U.S. publishing firm of Harper and Brothers, was born in Newton, Long Island, N.Y., on April 13, 1795. At the age of 16, after a country school education. he was apprenticed to a printer in New York city. In 1817. with his younger brother John, he established in New York a printing business that soon became a publishing firm. The business was successful and two younger brothers, Joseph Wesley and Fletcher, were brought into the firm. In 1833 Harper and Brothers was adopted as the name of the firm. The abilities of each of the brothers supplemented those of the others and the firm attained an eminent position in the publishing business. James was elected mayor of New York city in 1844 but declined offers thereafter to run for public office. He died in New York on March 27, 1869.

See J. *H.* Harper, *The House* of *Harper (1912).* (H. J. Sc.)

HARPER, ROBERT ALMER (1862–1946), U.S. botanist, whose early research on the cytology of reproduction in the fungi and later work on fundamental problems of morphogenesis came to be considered classic contributions to the understanding of living things. was born in Le Claire, Ia., Jan. 21, 1862. He was graduated from Oberlin (O.) college in 1886. From 1889 to 1898 he was at Lake Forest (Ill.) college, where he became professor of botany and geology. In 1898 he was appointed professor and head of the department of botany at the University of Wisconsin, Madison; he remained there until 1911, when he accepted the chair of Torrey professor of botany at Columbia university. He died on May 12. 1946. in Bedford, Va. (R. Bd.)

HARPER, WILLIAM RAINEY (1856–1906), U.S. Hebraist and first president of The University of Chicago, was born on July 26, 1856, at New Concord, O. His interest in Hebraic studies began in Muskingum college, New Concord, at which he graduated in 1870. In 1875, when only 19 years of age, he received his Ph.D. at Yale for studies in the Indo-Iranian and Semitic languages. In 1880. after several years of academy teaching, he was given a professorship in Hebrew at the Baptist Union Theological seminary in Chicago. There he founded *The Hebrew Student* and *Hebraica* and organized the American Institute of Hebrew. He published a number of textbooks and study helps for the teaching of Hebrew which found wide use. In 1886 he accepted a professorship in Semitic languages at Yale, and in 1889 was appointed also Woolsey professor of biblical literature, filling both positions simultaneously. In 1891 he became president of the nearly established University of Chicago (*q.v.*). His liberal aims and comprehensive plans for the new university attracted wide attention. Harper remained its president and head of the department of Semitic languages until his death on Jan. 10. 1906.

Among his more important books are *Religion and the Higher Life* (1904); *A Critical and Exegefical Commentary on Amos and Hosea* (1905); *The Prophetic Element in the Old Testament* (1905); *The Trend in Higher Education* (1905).

HARPERS FERRY, scene of John Brown's dramatic raid, Oct. 16–18, 1859, has become a quiet residential town in Jefferson county. W.Va., U.S., located at the confluence of the Potomac and Shcnandoah rivers where the states of West Virginia. Virginia and Maryland converge, about 60 mi. N.W. of Washington, D.C., and 70 mi. E. of Baltimore, Md. (For details of the raid *see* Brown, John [1800–1859].)

In 1747 Robert Harper established a ferry across the Potomac river and a grist mill on the bank of the Shenandoah river. The purchase of land from Harper's heirs in 1796 for the establishment of a federal armoury provided economic stimulus needed for the growth of the town. Pres. George Washington selected the site, recognizing the water-power potential of the rivers. The armoury attracted workmen whose need for goods resulted in the expansion of mercantile operations.

In the mid-1830s the Chesapeake and Ohio canal, Baltimore and Ohio railroad. and Winchester and Potomac railroad all were completed as far as Harpers Ferry. Gradually the town became a commercial. industrial and transportation centre for northern Virginia. Confederate forces under Gen. Thomas J. "Stonewall" Jackson captured the town, Sept. 13–15, 1862. and took more than 12,500 prisoners, the largest surrender of Union forces in the American Civil War. War-battered and flood-damaged Harpers Ferry never fully recovered and became a virtual ghost town.

Recognizing the scenic beauty and historical importance of Harpers Ferry. the national park service embarked on a program, authorized in 1944, of development and restoration. The old business section of the town and surrounding Civil War sites comprise Harpers Ferry National monument. *See* also Index references under "Harpers Ferry" in the Index volume. (H. H. K.)

HARPIES, the Greek *harpyiai,* or snatchers, were fabulous creatures, probably wind spirits. Their presence as tomb figures, however, as on the famous Harpy tomb of Xanthus in Lycia, makes it not impossible that they were ghosts; the two ideas are not wholly contradictory. In Homer's *Odyssey* they are plainly winds that carry people away; for example, they have carried off Odysseus (*i.e.,* he has been lost at sea). They are sometimes connected with the powers of the underworld; thus they carried off two orphan sisters whose marriage was being arranged by Aphrodite and gave them to the Erinyes, the deities of vengeance, as servants. Homer mentions one Harpy, Podarge (Swiftfoot), who seems to be of equine nature, since, according to the *Iliad,* she became by the West Wind the dam of Achilles' horses. Hesiod mentions two, Aello and Okypete (Stormwind and Swiftwing), daughters of Thaumas and of Electra, the daughter of Oceanus.

These harpies were in no way disgusting. Later, especially in the Argonautic saga, they were represented as birds with the faces of women, horribly foul and loathsome. They are sent to punish the Thracian king Phineus for his ill-treatment of his children, or for some other offense, and nearly starve him to death by carrying off most of his food and befouling the rest. Calais and Zetes, the sons of Boreas, deliver him and chase the harpies away. Virgil imitates the episode in the *Aeneid;* he calls the chief harpy Celaeno (Dark).

HARPIGNIES, HENRI (1819–1916), French landscape painter and engraver, was born at Valenciennes on June 28. 1819. He took to painting comparatively late in life, entering Achard's atelier in Paris at the age of 27. Between 1850 and 1865 he studied and painted in Italy and France, coming more and more under the influence of Corot. and the water colours executed during this period are among his finest work. Harpignies scored his first great success at the Salon. in 1861, with his "Lisière de bois sur les bords de l'Allier," and after that year he was a regular exhibitor at the old Salon. In 1886 he received his first medal for "Le Soir dans la campagne de Rome." which was acquired for the Luxembourg gallery. Many of his best works were painted at Hérisson in the Bourbonnais, as well as in the Nivernais and the Auvergne. He died on Aug. 28, 1916, at St. Privé (Yonne), where he had settled in 1878.

Harpignies's landscapes are distinguished for constructive drawing and breadth of treatment; a silvery tone pervades them. They may be seen in several galleries in the United State's, including the Toledo Museum of Art and the Boston Museum of Fine Arts.

HARPOCRATES, originally an Egyptian deity, adopted by the Greeks and worshiped in later times by both Greeks and Romans. In Egypt, Harpa-khruti, Horus the child. was one of the forms of Horus. the sun-god, the child of Osiris. He was supposed to carry on war against the powers of darkness, and hence Herodotus considers him the same as the Greek Apollo. He was represented in statues with his finger on his mouth, a symbol of childhood. The Greeks and Romans, not understanding the meaning of this attitude, made him the god of silence.

HARPOCRATION, VALERIUS (?2nd century A.D.), Greek grammarian, whose lexicon provides valuable information on a variety of subjects, was born in Alexandria. Two works were attributed to him, an anthology which has not survived. and the *Lexeis ton deca rhetoron* ("Lexicon of the Ten Orators") which survives in two forms—one virtually complete and an epitome made from an earlier and better version of the text which is now lost. The *Lexicon rhetoricum Cantabrigiense* edited by P. P. Dobree in 1834 contains a series of extra articles from the margin of a Cambridge manuscript of the fuller version. The lexicon of Harpocration explains words, phrases. names and events mainly from the works of the canonical ten Athenian orators and is arranged in alphabetical order. It is valuable both for its explanations of technical 'terms and Athenian institutions, and for the numerous quotations it preserves from tragic and comic poets, from the Atthidographers and other historical writers, and from Alexandrian scholars such as Didymus and Callimachus. It gives the fullest known explanation of many points in Xthenian law and has notes of great interest on religious and architectural matters.

See **edition** *by* W. **Dindorf,** 2 **vol. (1853)**; **J. E. Sandys,** *History of Classical Scholarship,* vol. *1, 3rd* **ed. (1921).** (G. B. KD.)

HARPOON, a barbed spear used mainly for spearing whales or large fish, and either thrown by hand or fired from a gun *(see* WHALE FISHERIES).

HARPSICHORD, a large keyboard instrument, belonging to the same family as the virginal and spinet, but having two, three or even four strings to each note, and a case of the harp or wing shape, afterward adopted for the grand pianoforte. J. S. Bach's harpsichord, in the museum of the Hochschule für Musik at Charlottenburg, has two manuals and four strings to each note, one 16 ft., two 8 ft. and one 4 ft. By means of stops the performer has a number of combinations for varying the tone and dynamic power. In all instruments of this family the strings, instead of being struck by tangents as in the clavichord, or by hammers as in the pianoforte, are plucked by means of a quill firmly embedded in' the centred tongue of a jack or upright placed on the back end of the keylever. This plucking of the string produces the incisive tone peculiar to the harpsichord family, What these instruments gain in brilliancy of tone, however, they lose in power of expression and of accent.

See also PIANOFORTE.

HARPY EAGLE, powerful eagles named after the mythological half-bird. half-woman monsters *(see* HARPIES). They are largely South American. and include the great harpy or Mexican imperial eagle (*Harpia harpyja*), most powerful of eagles, ranging to southern Brazil, and the crowned harpy (*Harpyhaliaetus*). Elsewhere are found the New Guinea harpy (*Harpyopsis*) and the large Philippine monkey-eating forest eagle (*Pithecophaga jefferyi*).

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HARPY EAGLE (HARPIA HARPYJA)

Most harpy eagles stand over three feet high and present a formidable appearance. Although slow of flight, they are powerfully armed with hooked beak and large talons. *See* also EAGLE.

HARQUEBUS: *see* ARQUEBUS.

HARRAN (HARAN; Rom. CARRHAE), a historic site of strategic importance on the Belikh river, is in modern times a small town 23 mi. S.S.E. of Urfa (Edessa) in the Urfa *il* of Turkey. The ancient town lay on the road that ran westward from Nineveh to the crossing of the Euphrates at Carchemish and was regarded as of considerable consequence by the Assyrian kings. Its chief cult in Assyrian times was that of the moon-god. As Haran, the town is frequently mentioned in the Bible. It was there that Abraham's father. Terah. settled with Abraham and all his family when they had left Ur of the Chaldeans (Gen. xi, 31–32). The story of this migration. and of Abraham's further migration from Haran after Terah's death. is told again in Acts vii, 2–4.

In Roman times Harran, as Carrhae. mas the scene of the disastrous defeat of Crassus by the Parthians (53 B.C.). Three and a half centuries later the emperor Galerius was defeated at Carrhae by the Persian king Narses (A.D. 296). Meanwhile the emperor Caracalla had been murdered there in 217 while preparing for a campaign against the Parthians.

Still a place of importance in the 12th century, Harran was again the scene of a battle when Bohemund, the Norman prince of Xntioch, was defeated there by the Turks in a decisive battle (0 Later in the century Harran formed part of the principality of the atabeg Zangi.

HARRATIN, black Berbers, dwelling In Tidikelt and other Saharan oases. Many, though blacker than the average Negro, are of the Berber type, with European features and well-proportioned bodies. They are the result of an early crossing with the Sudanese Negro. They have all the pride of the Berbers (*q.v.*) and do not live with or intermarry among Negroes.

HARRIER, any hawk (*q.v.*) in the genus *Circus,* subfamily Circinae, with face feathers arranged into a disc and oval nostrils. They are moderate in size (17–23 in., females larger and usually much different in colour) and. in most species! display a distinct white rump-patch. These predators. with wings somewhat angled up. fly low over open country) particularly marshes, in search of small mammals. reptiles, insects; frogs and sometimes birds. The nest is usually on the ground in marshes, or in tall grass, with four to six dull whitish or bluish eggs; the spotted harrier (*Circus assimilis*) oi .Australia and Celebes is remarkable for its tree-nesting habits.

The best knonn is the hen harrier (*C. cyaneus*). ranging across Europe and Asia from the arctic tundras-south to the Pyrenees, Italy, Turkestan and Tibet. An allied form, the marsh hawk (*C. c. hudsonius*) lives in North America. from Alaska and Newfoundland south to California, Texas, Ohio and Virginia; in winter it shifts southward. Females and young are brown; the bluish-ash males, whitish below, are known as blue hawks. Also common is the marsh harrier (C. *aeruginosus*), over most of Europe and the Mediterranean shores of north Africa to Mongolia, and Montagu's harrier (C. *pygargus*), having the same temperate range but with longer wings, more slender body and darker colours. The pallid harrier (*C. macrourus*) breeds from the Baltic to southeastern Europe and central Asia. Allied species are the cinereous harrier (*C. cinereus*), Peru to the Straits oi Magellan; long-winged harrier (*C. buffoni*), over all of South America, especially east of the .Andes ; South African marsh harrier (C. *ranivorus*), ranging north to Uganda on the east; pied harrier (C. *melanoleucus*), central eastern Asia from Lake Baikal to northeastern China; allied harrier (*C. approximans*), Australia, New Zealand. New Guinea, New Caledonia and the Fijis; eastern marsh harrier (*C. spilonotus*), central Asia and Madagascar; and black harrier (C. *maurus*), southern South Africa. (G. F. Ss.)

HARRPGAN, EDWARD (NED) (1845–1911), U.S. actor, producer and playwright, was born in New York city on Oct. 26, 1845. His theatrical career began in San Francisco, Calif.. where, in 1861, he was singing with Lotta Crabtree at the Bella Union. After developing his skill as a comedian, Harrigan formed a team with Sam Rickey and returned to New York. In 1872 he formed a new partnership with Tony Hart (original name Anthony Cannon), and Harrigan and Hart remained a team until 1885. In 1876 they became co-managers of the Theatre Comique, After a new theatre was destroyed by tire in 1884, Harrigan became sole manager or' Harrigan's Park theatre.

During his long career Harrigan wrote several hundred sketches and plays, mostly burlesques. His most popular creation was *The Mulligan Guard,* first produced in 1873. Harrigan died on June 6, 1911. (S. W. H.)

HARRIMAN, EDWARD HENRY (1848–1909), U.S. financier and railroad magnate, was born at Hempstead. N.Y.,

Feb. 25, 1848. He became a broker's clerk in New York at an early age. and in 1870 was able to buy a seat on the New York Stock exchange on his own account. Harriman's career in railroad management started with executive positions with the Illinois Central. In 1898, his career as a great railway organizer began with his formation, by the aid of the bankers, Kuhn. Loeb & Co., of a syndicate to acquire the Union Pacific line, which was then in the hands of a receiver. Having brought the Union Pacific out of bankruptcy into prosperity, he utilized his position to draw other lines within his control, notably the Southern Pacific in 1901. His abortive contest in 1901 with James J. Hill for the control of the Northern Pacific led to one of the most serious financial crises ever known on Wall Street. At his death. on Sept. 9, 1909, his influence was estimated to extend over 60,000 mi. of track. Harriman's methods excited the bitterest criticism, culminating in a stern denunciation from Pres. Theodore Roosevelt in 1907.

His son, WILLIAM AVERELL HARRIMAN (1891–), entered the employment of the Union Pacific in 1915 and was board chairman. 1932–46. Although he held numerous positions in the business world, Averell Harriman was best known for his governmental service: beginning with an administrative position with the N.R.A. in 1934. He was ambassador to the U.S.S.R. (1943–46) and to Great Britain (1946); secretary of commerce (1946–48); and director of the Mutual Security agency (1951–53). In 1954 he was elected governor of the state of New York; in 1958 he was defeated for re-election. (W. H. D.)

HARRINGTON, EARLS OF. The English title earl of Harrington was first created for the diplomatist and politician, WILLIAM STANHOPE (*c.* 1683–1756), a distant cousin of the more famous statesman James Stanhope (1673–1721), 1st Earl Stanhope. Educated at Eton, William Stanhope was British ambassador in Spain 1721–27, and 1729–30 and was created Baron Harrington in Jan. 1730. He was secretary of state for the northern department from 1730 to 1746 except for a short interval (1742–44), when he was president of the council. He was created earl of Harrington in 1742. He was lord lieutenant of Ireland (1746–50) and died in London on Dec. 8. 1756.

LEICESTER (1784–1862), 5th earl. was a soldier and a politician of advanced views, who worked with Lord Byron in the cause of Greek independence. although his later speeches in the house of lords displayed a much more conservative temper. WILLIAM (1922–). 11th earl. succeeded his father in 1929, and is also heir presumptive to the viscountcy of Stanhope.

HARRINGTON (HARINGTON), **JAMES** (1611–1677), English political philosopher, best known for his major work *Oceana,* a treatise on the ideal state mhich must be understood in terms of the political and economic conditions of 17th-century England, but which contains ideas that have gained importance far beyond their historical context. Harrington, a member of the English nohility. was born at Upton on Jan. 7, 1611. (He should not be confused with his cousin. Sir James Harrington, a member of the commission which tried Charles I.) He studied at Trinity college. Oxford. and traveled extensively in continental Europe. Although he was a devoted exponent of the ideas of republican government, he won the esteem of Charles I, whom he served and whose execution he deeply deplored. Moreover, Harrington's ideas initially failed to gain Cromwell's approval. *Oceana* was confiscated while it was being printed; only after the intervention of Cromwell's daughter was it published in 1656, dedicated to Cromwell.

Harrington's persistence in his republican views after the restoration of the monarchy led to his imprisonment in 1661, from which he was released after he had become physically and mentally ill. He died on Sept. 11, 1637 at Westminster.

"Oceana" is the name of the ideal state which Harrington envisaged for England. Olphaus Megaletor, a pseudonym for Oliver Cromwell, is its protector, who retires into private life after a republican government under a constitution has been firmly established. The treatise *Oceana* has been regarded as a Utopia. However. such developments in American political history as the adoption of written constitutions. the reliance on bicameral legislatures, rotation in office, the use of the secret ballot and the provision for indirect election of the president must be understood, in part, in terms of the influence of Harrington's ideas; his ideas did not remain confined to their Utopian context.

Of particular interest is Harrington's idea that political power follows economic power. This idea, which was extensively developed in *Oceana,* may be regarded as the first important restatement of Aristotle's theory of constitutional stability and revolution. In his *Politics,* Aristotle emphasized that constitutional stability in a polity is attained by a unification of political and economic power. The contemporary version of this aspect of Xristotle's theory is that democracy is most stable where there is a strong middle class. The other, corresponding aspect of Aristotle's theory is that whenever political and economic power are separated, a revolution is likely to occur. Through Harrington's influence this theory appears in American political thought in such diversified forms as Jefferson's defense of an agrarian democracy and the antitrust policies of Roosevelt and Wilson.

In 20th-century research in the social sciences, the Pareto-Davis theory of income distribution and political disturbances has provided a mathematical index for measuring the concentration of economic power and its relation to civil wars and revolutions. In terms of such a wide perspective, it may be suggested that Harrington's idea of the relation of political and economic power represents a fusing link between classical Greek thought, modern political history and contemporary research.

John Toland's edition of Harrington's *Works* was first published in 1700; subsequent editions appeared in 1747 and 1771. *Oceana* has been edited by Henry Morley (1887) and S. B. Liljegren (1924).

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For a discussion of the Pareto-Davis theory in relation to Aristotle's and Harrington's concepts of political and economic power, *see* F. Kort, "The Quantification of Aristotle's Theory of Revolution," *American Political Science Review,* vol. 46:486–493 (June 1952).
(F. KT.)

HARRIOT (HARRIOTT), **THOMAS** (1560–1621). English scientist, who specialized in mathematics and astronomy. was born and educated at Oxford. Sir Walter Raleigh made him scientific adviser on the expedition of 1585–86 to Roanoke, Va. Harriot's observations are found in A *Brief and True Report* (1588), often reprinted. *e.g.,* in Richard Hakluyt's *Voyages* (1600). He became the leading scientist of the circle around Raleigh and received a pension from the earl of Northumberland. In his algebra. *Artis analyticae praxis ad aequationes algebraicas resolvendas* (1631) he improved the theory of equations. noting the relation between coefficients and roots, and also improved notation, introducing the signs > (greater than) and < (less than). The book was influenced by François Vieta and. in turn, influenced John Wallis. Harriot constructed telescopes — the first one contemporaneously with Galileo—studied sunspots and comets and corresponded with Kepler on the refraction of light. He died July 2, 1621, in London.

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(D. J. S.)

HARRIS, SIR ARTHUR TRAVERS, 1ST BART. (1892–). British air marshal. best known for his outstanding work as air officer commander in chief, bomber command, was born at Cheltenham, Gloucestershire. on April 13, 1892, and was educated at Gore court. Sittingbourne. In World War I he first served with a Rhodesian regiment in German West Africa, and then, commissioned in the Royal Flying Corps, flew as a pilot in France and with the home defense command. Afterward he served in India and the middle east and on the planning staff in England before commanding a bomber group.

From 1940 to 1941 he was deputy chief of air staff, and in the latter year headed a delegation to the United States. He held the most important and arduous post of commander in chief of bomber

command with the greatest resolution between Feb. 1942 and Sept. 1945. During his command the bombing offensive against Germany was developed on an immense scale and is generally thought to have contributed greatly to the defeat of that country. Sir Arthur Harris was created a baronet in 1953. (E. B. BN.)

HARRIS, GEORGE, 1ST BARON. cr. 1815 (1746–1829), British general, was the son of the Rev. George Harris. curate of Brasted, Kent, and was born on March 18, 1746. Educated at Westminster school and at the Royal Military academy, Woolwich, he was commissioned to the royal artillery in 1760, transferring to an ensigncy in the 5th foot (Northumberland fusiliers) in 1762. His first active service was in the American War of Independence, his next under Major General Medows at Santa Lucia in 1778–1779, after which his regiment served as marines in Rodney's fleet. After commanding the 5th in Ireland for some years. he exchanged and went with General Medows to Bombay, and served in India until 1792. In 1794 he was again in India, and in 1796 became local lieutenant genera1 in Madras. Up to 1800 he commanded the troops in the presidency, and for a short time he exercised the civil government as well. In Dec. 1798 he was appointed by Lord Wellesley, the governor-general, to command the field army against Tipu Sahib (*q.v.*), and in a few months Harris reduced the Mysore country and stormed the great stronghold of Seringapatam. He returned home in 1800, and attained the rank of full general in 1812. Lord Harris died at Belmont in May 1829.

See Kt. Hon. S. Lushinpton, *Life of Lord Harris* (London, 1840).

HARRIS, GEORGE WASHINGTON (1814–1869). U.S. humorist. was born in Allegheny City. Pa.. on March 20. 1814, and lived most of his life at Knoxville. Tenn., and in the surrounding Great Smoky mountains. From the early 1840s until his death. Dec. 11. 1869, he wrote humorous tales for Tennessee newspapers. the New York *Spirit of the Times* and other publications which were reprinted widely over the entire country. The best of his tales. published in a hook. *Sut Lovingood's Yarns* (1867), surpasses.anything before Mark Twain, in the words of a leading critic. "for vivid imagination. comic plot. Rabelaisian touch, and sheer *fun.*" Harris achieves this high level of excellence by being an oral storyteller with a rare kind of dramatic imagination. He gets his tales going by introducing his comic narrator Sut Lovingood, a "long-legged. short-bodied. small-headed. hog-eyed. natral-born durn'd fool" who takes the reader into a wonderful world of fantasy where anything can happen—and does. There camp meetings. quiltings. frolics. horse races and even political gatherings spring to life in scent, sound, form, colour and motion that are hilariously comic. Mark Twain knew his work and was influenced by it. 'The manuscript of another hook. accepted by the publishers, was lost when Harris died on the train returning home. (D. DY.)

HARRIS, JAMES RENDEL (1852–1941), English scholar, was born at Plymouth in 1852 and studied at Clare college. Cambridge. From 1882 to 1892 he held professorships at Johns Hopkins university. Baltimore. Md., and Haverford (Pa.) college. He was professor of paleography (1893–1903) at Cambridge, spent a year at Leyden as professor of theology. and was director of studies at the Friends' Settlement at Woodbrooke. near Birmingham (1903–18). From 1918 to 1925 he was curator of manuscripts at the John Rylands library. Manchester. He died in Birmingham on March 1, 1941.

Harris wrote a long series of works dealing with textual criticism of the biblical and other sacred books. He also wrote on various Mediterranean cults. His works include *Biblical Fragments from Mount Sinai* (1890); *The Diatessaron* (1890); *Origin of the Cult of Dionysos* (1915); *Further Traces of Hittite Migration* (1927): *Josephus and His Testimony* (1931); *The Magi* (1932); *The Builders of Stonehenge* (1933): *Who Discovered North America?* (1934); *A Temple in Tennessee, Emendations to the Greek of the New Testament* (1935); *The Migration of Culture* (1936); and *An Egyptian Cat Goddess in Britain* (1938).

HARRIS, JOEL CHANDLER (1848–1908), U.S. author, creator of the American folk character. Uncle Remus. was born in Eatonton, Ga.. Dec. 9, 1848. As apprentice on a weekly plantation paper, *The Countryman*, he obtained the real basis for his later work. He established a reputation as a brilliant paragrapher, humorist and writer of dialect while employed on newspapers at Macon, Ga.. New Orleans. La., Forsyth and Savannah. Ga.. and finally on the staff of the *Atlanta* (Ga.) *Constitution* for 24 years. In 1879 the "Tar-Baby Story" appeared in the *Atlanta Constitution* and created a vogue for a distinctive type of dialect literature. This and successive Uncle Remus stories won for Harris a secure place in American literature. The pattern was new: Uncle Remus. the wise, genial old Negro tells animal stories to the little boy, son of a plantation owner, and inter\\-eaves his philosophy of the world about him. Harris recorded the speech of the plantation Negro faithfully. Speaking through Uncle Remus. he captured not only what the Negro said. but how he said it—the poetic impulse, gift for narrative and condensation, humour and pictorial language. *Uncle Remus: His Songs and Sayings* was published in hook form in 1880, followed by *Nights With Uncle Remus* (1883), *Daddy Jake, the Runaway* (1889), *Uncle Remus and His Friends* (1892), *The Tar Baby* (1904), *Uncle Remus and Brer Rabbit* (1906) and other volumes of a similar type. Included in a series of children's books were: *Little Mr. Thimblefinger and His Queer Country* (1894), *The Story of Aaron* (1896) and *Aaron in the Wildwoods* (1897). *Mingo, and Other Sketches in Black and White* (1884), *Free Joe and Other Georgian Sketches* (1887), *Sister Jane, Her Friends and Acquaintances* (1896) and *Gabriel Tolliver* (1902) reveal Harris' ability to vitalize other southern types. *On the Plantation* (1892) is valuable because of its autobiographic nature. From 1907 until his death in Atlanta. on July 3, 1908, he edited *Uncle Remus's Magazine.*

Harris' works are arnong the finest examples of the "local colour" literature that flourished in the 1870s and 80s. With an unerring instinct fur dialect and a firm grasp of character. he depicted the vanishing plantation life with charm and sympathy.

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HARRIS, JOHN (*c.* 1666–1719), English writer, best known as the editor of the *Lexicon technicum,* or *Dictionary of the Arts and Sciences* (1103), which is the earliest English encyclopaedia (*see* also ENCYCLOPAEDIA), and as the compiler of a *Collection of Voyages and Travels* (1705). Harris was a scholar of Trinity college, Oxford. and afterward took orders. In 1698, at St. Paul's cathedral, he delivered the seventh series oi the Boyle lectures—*Atheistical Objections Against the Being of God and His Attributes Fairly Considered and Fully Refuted.* Between 1702 and 1704 he gave st the Marine coffee house. Birchin lane, London. the mathematical lectures founded hy Sir Charles Cox. The friendship of Sir William Cowper, afterward lord chancellor, secured for him a series of church preferments. He showed himself an ardent supporter of the government and engaged in a bitter quarrel with the Rev. Charles Humphreys, afterward chaplain to Henry Sacheverell, who held him up to ridicule in *The Picture of a High-Flying Clergyman* (1716). Harris was one of the early members of the Royal society and for a time acted as vice-president. He died on Sept. 7, 1719.

HARRIS, ROY (1898–), U.S. composer who helped establish the distinctive features of the modern American school. He was born in Lincoln county. Okla.. on Feb. 12. 1898. His musical development came relatively late. After studying in California with Arthur Farwell, Arthur Bliss and others, he went to Paris in 1926 to study with Nadia Boulanger. His first significant work was a concerto for clarinet. piano and string quartet (1927). Returning to the U.S. in 1929, he accepted various teaching positions. and was also active as organizer of music festivals. In 1062 he was living in California.

Harris' works are marked by broad tonal melodies and asymmetrical rhythms. Some of his works reflect scenes of American life: *When Johnny Comes Marching Home,* a symphonic overture on a Civil War song (1935); *Folksong Symphony* with

chorus (1940); *Kentucky* **Spring** (1949). His Sixth Symphony (1944) bears the subtitle *Gettysburg Address*, its four movements inspired by Lincoln's ideals.

Of his seven symphonies, the best known is the third (1939), written in a single movement with contrasting sections of lyrical and dramatic nature. His Fifth Symphony (1943) has a vigorous proclamatory quality and his seventh, performed in 1952, shows his characteristic harmonic, melodic and rhythmic features to be further strengthened and developed.

In chamber music Harris follows classical models. He wrote three string quartets, a piano trio, a piano quintet and a string quintet. Particularly interesting is his third string quartet (1939) in the form of four preludes and fugues in modal harmony.

See N. Slonimsky, "Roy Harris," in ***The*** *Musical Quarterly*, Jan. 1947. (N. Sy.)

HARRIS, WILLIAM TORREY (1835–1909), U.S. educator, probably the most widely known public school educator and philosopher in the United States during the late 19th century, was born in North Killingley. Conn.. on Sept. 10, 1835. He attended Yale college and then worked as a teacher and later superintendent of schools in St. Louis. Mo. (1868–80). He served as U.S. commissioner of education from 1889 to 1906. As a practical school man, Harris was an effective administrator and innovator. He introduced into the curriculum such studies as art, music, science and manual arts, and he iavoured the professional study of education for teachers in training. He worked to extend the public high school and incorporated the kindergarten into the regular school system of St. Louis. As a philosopher and psychologist, Harris was conservative and synthetic rather than original, embracing German idealism, American transcendentalism. Christianity, phrenology and mental discipline. He lectured for several summers at the Concord School of Philosophy, but Hegelian idealism was retreating and Harris was not creative enough to stem the tide of Naturalism.

A prolific writer of several hundred philosophical and educational articles, Harris was also editor of the *Journal of Speculative Philosophy*, Appleton's International Education Series and Webster's *New International Dictionary*.

Harris died at I'rovidence, R.I., on Nov. 5, 1909.

See Kurt Leidecker, *Yankee Teacher* (1946). (R. F. Bs.)

HARRISBURG, capital city of Pennsylvania. U.S., and seat of Dauphin county, lies on the east bank of the Susquehanna river, 101 mi. W.N.W. of Philadelphia.

The population of the city proper was 79.697 in 1960; 69,544 in 1950; and 83.893 in 1940 by the federal census. Ringed by independent boroughs and townships. Harrisburg was unable to expand its boundaries, and the central city lost population. The national trend toward suburban living was aggravated in Harrisburg by slum clearance and public works projects that reduced housing in once thickly settled downtown sections. A truer picture of the community's growth is reflected in the population figures for the metropolitan area. The standard metropolitan statistical area comprising Dauphin and Cumberland counties had a population of 345.071 in 1960; 292,241 in 1950; and 252,219 in 1910.

Incorporated boroughs adjacent to the city include Steelton, Paxtang and Penbrook in Dauphin county; Camp Hill. Lemoyne, New Cumberland, Shiremanstown, West Fairview and Wormleysburg in Cumberland county. Other significant communities in the metropolitan area are Middletown, Hummelstown and Hershey in Dauphin county; and Mechanicsburg, Carlisle and Shippensburg in Cumberland county.

Located at the head of the Cumberland and Lebanon valleys and at the site of one of the best fords on the Susquehanna. the Harrisburg area has been a communications crossroads since Indian times. John Harris, an Englishman from Yorkshire, received a licence to trade with the Indians in 1705; and about 1715 he established a trading post on the site of Harrisburg and soon began to operate a ferry. The settlement. known as Harris' Ferry, grew and in 1785 when Dauphin county was created, a town mas laid out by John Harris. Jr., assisted by William Maclay, which for a time was called Louisbourg in honour of Louis XVI. This title was never widely used, being first set forth in commissions issued by the supreme executive council to justices of the peace for the town in 1786; the borough charter of 1791 used the name Harrisburg as did the city charter of 1860.

With the removal of the state capital to Harrisburg in 1812, it became a political and governmental centre as well as the hub of interior transportation. Among the notable political events in the city were the national tariff convention of 1827, the Buckshot War of 1838, and the first national Whig nominating convention in 1839, which named William Henry Harrison for U.S. president. In transportation. key events included the laying of the first lock in the famous Pennsylvania canal in 1827, the establishment of the first railroad in 1836, and the building in 1847 of the first link in the main line of the Pennsylvania railroad from Harrisburg to Pittsburgh.

Harrisburg's role as a governmental and communications centre made it the first major objective of the Confederate army when Gen. Robert E. Lee invaded Pennsylvania in June 1863. Confederate forces occupied Carlislc on June 27, and two days later a skirmish between Confederate and Union outposts was fought at a point about 3 mi. W. of Harrisburg in present Camp Hill. The invading forces then withdrew to concentrate at Gettysburg, where they were defeated in a three-day battle on July 1–3, 1863.

In the period aiter the Civil War. Harrisburg continued to be an important transportation centre and also enjoyed growing industrial development. Civic planning and improvement kept pace with 20th-century progress; and by mid-20th century the city had become the metropolis for an expanding group of industrial and residential suburbs.

Harrisburg has a diversified economy based upon manufacturing, transportation, wholesale and retail trade and governmental activities. The leading types of manufacture are steel and steel products, food products, airplane parts, clothing and shoes. Both the Reading and the Pennsylvania railroads maintain large freight classification yards. Many people in Harrisburg are employed by the stare government. while others work at the nearby Olmsted air force base at Middletown, the naval supply depot at Mechanicsburg, and the New Cumberland army general depot.

The city is dominated by the group of state capitol buildings, which occupy a 68-ac. park in the downtown section. The main capitoi. completed in 1906, was built to replace the first capitol which was completed in 1822 and destroyed by fire in 1697. The 272-ft. capitol dome, patterned after St. Peter's in Rome, is the most prominent feature of the Harrisburg landscape. The paintings, statuary and other decorative features of the capitol are justly famous. Eight other major buildings, including the Pennsylvania State museum, are in the capitol group.

Cultural facilities in the Harrisburg area are excellent and include a symphony orchestra, a community theatre, an art association, a historical society and the state library. Parks. golf courses and other recreational facilities are numerous in Harrisburg and vicinity. An outstanding scenic attraction is the five-mile-long parkway along the Susquehanna. (S. W. Hm.)

HARRISON, (THOMAS) ALEXANDER (1853–1930), U.S. painter. whose reputation rests primarily on his marine pictures, was born in Philadelphia, Pa., on Jan. 17, 1853, and studied at the Pennsylvania Academy of Fine Arts and the Ecole des Beaux Arts. Paris, where he went in 1873. Chafing under the restraints of the schools, he went into Brittany, and at Pont Aven and Concarneau turned his attention to marine painting and landscape. In 1882 he sent a figure piece to the Salon, a fisher boy on the beach. which he called "Châteaux en Espagne." This piece attracted much attention. He received many awards, including the Temple gold medal, Philadelphia (1887), first medal, Paris exhibition (1889) and medals in Munich, Brussels, Ghent, Vienna and elsewhere. Harrison died in Paris on Oct. 13, 1930.

Harrison's brother, (Lovell) Birge Harrison (1854–1929), was also a painter. He is identified especially with the Woodstock (N.Y.) art colony.

HARRISON, BENJAMIN (1833–1901), 23rd president of the United States, was born at North Bend, near Cincinnati, O., Aug. 20, 1833. His great-grandfather, Benjamin Harrison of Vir-

ginia, mas a signer of the Declaration of Independence and three times governor of Virginia (1781–84). His grandfather, William Henry Harrison (*q.v.*) (1773–1841), was the 9th president of the United States. His father, John Scott Harrison (1804–78), served as Whig congressman from the second Ohio district in the national house of representatives from *1853* to 1857.

Benjamin was born of his father's marriage to Elizabeth Irwin of Mercersburg, Pa., and was one of eight children by this marriage, only six of whom grew to maturity. He spent his youth on his father's farm at the junction of the Big Miami and Ohio rivers. He was prepared for college by private tutors, studied for three years at the Farmers' college in Walnut Hills near Cincinnati, and in *1852* graduated from Miami university at Oxford. O. He was a diligent student, leaning particularly to political science and history, and during his college life showed a marked talent for extemporaneous speaking. After graduation he devoted himself to the study of law and in *1854* was admitted to the Ohio bar.

At the age of *21,* Harrison moved from Ohio to Indianapolis, then a town of only *16.000* inhabitants but the fast-growing capital of Indiana. While engaged in building up his law practice he became active in the new Republican party and was elected city attorney of Indianapolis in *1857* and reporter of the supreme court of Indiana in *1860.* But both his legal and his political careers were interrupted by the Civil War. In *1862* he helped to recruit the 70th regiment of Indiana volunteers, becoming its colonel. For the next year and a half his regiment guarded railroads and engaged in minor skirmishes in Kentucky and Tennessee. It was then attached to Gen. William T. Sherman's command and participated in hard fighting in the Atlanta campaign. In recognition of his "ability and manifest energy and gallantry in command of a brigade" he was promoted to the brevet rank of brigadier general.

At the close of the Civil War, Harrison resumed the practice of law in Indianapolis. He also worked diligently to advance the interests of the Republican party, publicly castigating the Democratic party as the party of treason and supporting the program of the Radical Republicans toward the South. He opposed the Liberal Republican schism of *1872,* spoke out against the inflation advocated by the Greenback party (*q.v.*), and played a leading role in bringing about a peaceful solution of a strike in *1877* in Indianapolis. Becoming a candidate for the Republican nomination lor governor of Indiana in *1872* he failed of nomination, and when nominated in *1876* failed of election.

His energetic campaign for the governorship brought him national prominence. As chairman of the Indiana delegation to the Republican national convention in 1880 he swung his delegation to James A. Garfield (*q.v.*) and later campaigned for Garfield's election. In Jan. *1881* he was elected by the Indiana legislature as C.S. senator and chose to fulfill the duties of his new position rather than accept a cabinet post that was offered him. His influence with the White House waned after Garfield's assassination and his Indiana rival, Walter Q. Gresham (*q.v.*), was appointed to the cabinet of Pres. Chester A. Arthur (*q.v.*).

Senator Harrison favoured the merit system for federal appointments and supported the Pendleton act of *1883.* He served on committees dealing with military affairs, Indian affairs. transportation routes to the seaboard, foreign relations and territories. As chairman of the last-named committee he sponsored a hill establishing civil government in Alaska, worked to preserve and enlarge the national parks and took an active part in urging the admission of new states. Six states—North Dakota, South Dakota, Washington, Montana, Idaho and Wyoming—were later admitted during Harrison's term as president. He opposed President Cleveland's vetoes of pension bills, helped to enact the Interstate Commerce act in *1887* for the regulation of the nation's railroads, and throughout his senatorial term supported the protection principle in the tariff legislation of his party.

He failed of re-election by the Democratic state legislature in *1887* but became Indiana's "favourite son" for the Republican presidential nomination at the Chicago convention in the following year. Indiana's position as a doubtful state, the support of his devoted friends there and the endorsement of James G. Blaine (*q.v.*) gave him the nomination. In the ensuing election he defeated Cleveland, receiving *233* electoral votes to Cleveland's *168.*

Harrison's presidency (1889–93) was marked by new ventures in foreign policy and a deteriorating domestic situation. During his administration the United States participated in the first International Conference of American States (*see* PAN AMERICAN CONFERENCES) presided over by Secretary of State Blaine: was represented in the Berlin conference concerning the Samoan Islands; convoked an international monetary conference; concluded treaties of commercial reciprocity with many foreign countries; resolved peaceably a bitter controversy with Chile; and negotiated a convention for the arbitration of a troublesome dispute with Great Britain involving fur seals in the Bering sea. In domestic affairs enactment of the Sherman anti-trust act in 1890 was to have far-reaching results in the iuture. Of more immediate importance were the beneficial effects of the McKinley tariff bill on .American industry. but they were partly offset by the .inflationary results of the Sherman Silver Purchase act. The Democrats won a majority in the house of representatives in the election of 1890. The growing Populist discontent and the Homestead and other strikes that occurred after Harrison's renomination at the Minneapolis convention in *1892* largely accounted for his defeat for a second term by an electoral vote of *145* to *277* for Cleveland. (See also UNITED STATES (OF AMERICA) : History.)

After leaving the White House. Harrison returned to his law practice in Indianapolis. He contributed articles to magazines and wrote two books. This *Country* of *Ours (1397)* and *Views of an Ex-President* (1901). In 1898–99 he served as leading counsel for Venezuela in the arbitration of its boundary dispute with Great Britain at I'aris.

Harrison's outstanding traits displayed in his public career were his legal acumen. industry. high moral principles, devotion to duty and loyalty to the principles of the Republican party. As president he accepted the constitutional limitations of his office. Conceiving himself as the legal advocate of the American people he discharged his duties conscientiously and with dignity and ability but failed to provide magnetic leadership. After the war with Spain *11898)* he criticized the policy of denying full constitutional rights to the newly acquired territories.

Harrison was married twice. first in 1853 to Caroline Lavinia Scott. by whom he had a son and a daughter and who died in the White House in Oct. *1892.* and second to Mrs. Mary Scott Lord Dimmick in *1896,* by whom he had a daughter. He died at Indianapolis on blarch *13. 1901.*

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HARRISON, FREDERIC (1831–1923), English jurist and man of letters, one of the founders of the Sociological society in London and a leader of the positivist movement in England. was horn in London on Oct. *18. 1831.* He was educated at King's college school. London. and at Wadham college. Oxford. where, after taking classical first-class honours in 1853, he became a fellow. In 1855 in I'aris he talked with Auguste Comte and became a devoted follower of his thought and writings.

Harrison was called to the bar in 1858 and practised in equity. His interest in the betterment of the workers led to his appointment on the Royal Commission on Trade Unions. 1867–69, and through its reports he had a paramount influence on the shape of trade union law between *1868* and 1906. In *1369* he was secretary to the Royal Commission for Digesting the Law. From 1877 to 1889 he was professor of jurisprudence and international law under the Council of Legal Education. In 1889 he became an alderman of the newly formed London County council, resigning in 1893.

Harrison's life may best be understood. however, as an attempt to introduce the sociology of Auguste Comte into England. As president of the English Positivist committee from 1880 to 1905, he lectured and wrote extensively on these principles and on the religion of humanity. *The Positivist Review* carried his views beyond the audience of Newton hall, the London centre of the English positivists. In addition to this work he also took an active

part with Sir Patrick Geddes in the foundation of the Sociological society (later: the Institute of Sociology) in 1903; this society attempted to combine the philosophical and historical approach oi Comte with that of the practical held enquiry into social problems.

In mid-life he virtually retired from political life and legal practice to devote himself to writing. From 1900 onward books and essays flowed from his pen; he wrote on famous men, on history, on morals and on religion. as well as on the political issues of the day. He died at Bath. Somerset, on Jan. 14, 1923.

Harrison's principal works include *Oliver Cromwell* (1888); *Humanity: Religious Systems of the World* (1890); *Positivism: Its Position, Aims and Ideals* (1901); *Ruskin* (1902); *The Creed of a Layman* (1907); *National and Social Problems* (1908); *Autobiographical Memoirs,* 2 vol. (1911); *Tlze Positive Evolution of Religion: Its Moral and Social Reaction*(1913)

See Austin Harrison, *Frederic Harrison* (1927). (J. My.)

HARRISON, JANE ELLEN (1850–1928), English classical scholar whose view of the ritualistic origin of mythology has been endorsed by modern anthropologists. was horn at Cottingham, I'orkshire. Sept. 9, 1850. Overcoming the obstacles of a conventional upbringing, she went to Newnham college, Cambridge. to read classics. later studying Greek archaeology and art at London and Athens, and becoming a lecturer in Greek at Newnham. 1898-1914, and in Russian. which she learned during World War I, 191;-22. She died in London. April 15, 1928.

The Mythology and Monuments of Ancient Athens (1890) had won her recognition as a scholar, but her chief work is *Prolegomena to the Study of Greek Religion* (1903), which altered the approach to the subject. In it she investigated the actual ritual of Greek festivals. to discover what underlay the Olympic theogony. In *Themis* (1912) h e went further, using evidence from anthropology to illuminate the whole field of Greek religion. Her *Epilegomena* (1921) also considered modern religion in the light oi psychology.

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HARRISON, JOHN (1693–1776), British horologist, the inventor oi the hrst practical marine chronometer, was born at Foulby, near Pontefract. Yorkshire. He lived at Barrow-upon-Humber. Lincolnshire, from 1700 to 1736, when he settled permanently in London.

In 1714 the British government offered an award of £20,000 for a timekeeper which would enable longitude to be determined within an accuracy of half a degree at the end of a voyage to the West Indies. Harrison set himself to solve this difficult problem and by 1; 59 had constructed a large watch. In this. compensation lor the change of stiffness of the balance spring with temperature change, which affects the rate of the watch. was achieved with the aid of a bimetallic strip, the two metals enabling the effective length of the strip to vary. Harrison's expectations of accuracy were realized, for when tested at sea in 1761–62 his watch erred by only five seconds on arrival in Jamaica. corresponding to an error in longitude of only $1\frac{1}{4}'$. Harrison claimed the award of £20,000, but though he occasionally received sums on account it was not until 1773 that he was paid in full.

Earlier in his career Harrison made two other important inventions, since widely applied: his "gridiron" pendulum, devised about 1726, whose effective length does not vary with temperature. and a simple device which keeps a clock going while it is being wound up and the normal weight or spring drive is not in operation. He died in London on March 24. 1776.

See R. T. Gould, *The Marine Chronometer* (1923). (F. A. . W.)

HARRISON, ROSS GRANVILLE (1870–1959), U.S. biologist, was the first to employ tissue culture methods. In one important experiment he demonstrated the outgrowth of nerve fibers in culture medium thereby providing the foundation for modern nerve physiology and neurology. He also performed early experimental studies of embryological asymmetry. He was born in Germantown, Pa.. and after receiving his schooling in that area went to the Johns Hopkins university where he took his baccalaureate degree and began his zoological studies. He completed his nork for the degree of doctor of philosophy under the guidance of A'. K. Brooks. After teaching at Bryn Mawr college. he returned to the Johns Hopkins medical school where he taught anatomy. He went to Bonn where he worked with Moritz Nussbaum and took his degree in medicine in 1899. He came to Yale in 1907 and assumed the headship of the department of zoology which he held until his retirement in 1938.

Using amphibian material he was able to show that the three axes oi the limb become fixed at different times in development. During embryonic development, when material which normally would form a left limb is moved to the animal's right side but turned upside down, it will develop a right limb. From this and other experiments, Harrison was able to formulate the rules for the development of asymmetry which hold for all the vertebrate forms so far tested. The same material also provided the information that the middle germ layer is predominantly responsible for the formation of the limbs.

Upon retirement in 1938, Harrison became chairman of the National Research council, a position which he held throughout World War II. In association with Frank B. Jewett, then president of the National Academy of Sciences, the council and the academy were combined in essential services to the country. Harrison's work in administration was characterized by the extreme deliberation and logical analysis which he employed in his scientific approach. (J. S. Ns.)

HARRISON, THOMAS (1606–1660), English parliamentarian. a native of Newcastle-under-Lyme, Staffordshire, the son of a butcher and mayor of that town, enlisted in 1642 in Essex's lifeguards. became major in Fleetwood's regiment of horse under the earl of Manchester, was present at Marston Moor, at Naseby, Langport and at the taking of Winchester and Basing. as well as at the siege of Oxford. In 1646he was returned to parliament for Wendover, and served in Ireland in 1647 under Lord Lisle, returning to England in May, when he took the side of the army in the dispute with the parliament and obtained irom Fairiax a regiment of horse. In November he opposed the negotiations with the king, whom he styled "a man of blood" to be called to account, and he declaimed against the House of Lords. At the surprise of Lambert's quarters at Appleby on July 18.1648, in the second civil war, he was severely wounded. He showed a special zeal in bringing about the trial of the king. Charles was entrusted to his care on being brought up from Hurst Castle to London. Harrison was assiduous in his attendance at the trial, and signed the death-warrant. He took part in suppressing the royalist rising in the midlands in May 1649, and in July was appointed to the chief command in South Wales, where he is said to have exercised his powers with exceptional severity. On Feb. 20, 1651, he became a member of the council of state, and during Cromwell's absence in Scotland held the supreme military command in England. He failed to stop the march of the royalists into England at Knutsford on Aug. 16, 1651, but after the battle of Worcester he pursued the fugitives. Later he pressed on Cromwell the necessity of dismissing the Long Parliament, and it was he who at Cromwell's bidding, on April 20, 1653, laid hands on Speaker Lenthall and compelled him to vacate the chair. He was president of the council of thirteen which now exercised authority. Harrison belonged to the faction of Fifth Monarchy men, whose political ideals were entirely destroyed by Cromwell's assumption of the protectorate. He was deprived of his commission on Dec. 22, 1653, and on Feb. 3, 1654, was ordered to confine himself to his father's house in Staffordshire. He was imprisoned for a short time-in September, and on Feb. 1;, 1655, he was imprisoned in Carisbrooke Castie, being liberated in March 1656. At the Restoration, Harrison, who was excepted from the Act of Indemnity, refused to take any steps to save his life. to give any undertaking not to conspire against the government or to flee. He was arrested in Staffordshire in May 1660, and executed at Charing Cross on Oct. 13, 1660.

Richard Baxter. who was acquainted with him. describes Harrison as "a man of excellent natural parts for affection and oratory. but not well seen in the principles of his religion; of a sanguine complexion. naturally of such a vivacity, hilarity and

alacrity as another man hath when he hath drunken a cup too much, but naturally also so far from humble thoughts of himself that it was his ruin." Cromwell also complained of his excessive eagerness. "Harrison is an honest man and aims at good things, yet from the impatience of his spirit will not wait the Lord's leisure but hurries me on to that which he and all honest men will have cause to repent."

See C. H. Simpkinson, ***Life*** of ***Harrison*** (1905).

HARRISON, WILLIAM (1534-1593), English topographer and social historian, whose valuable and entertaining *Description of England* forms an important part of *The Chronicles of England* . . . of Raphael Holinshed (*q.v.*), was born, by his own account. in London on April 18. 1534. He was inducted early in 1559 to the rectory of Radwinter, Essex. on the presentation of Sir William Brooke. Lord Cobham, to whom he had formerly acted as chaplain; and from 1571 to 1581 he held the living of Wimbish in the same county. He became canon of Windsor in 1586, and died there in 1593.

His *Description of England* was undertaken for the queen's printer. Reginald Rolfe. who designed the publication of "an universall cosmographie of the whole world . . . with particular histories of every knowne nation." After Wolfe's death in 1576, this comprehensive plan was reduced to descriptions and histories of England, Scotland and Ireland. The historical section was to be supplied by Holinshed. the topographical by Harrison. The work was published in 1577 as *The Chronicles of England, Scotland and Ireland* . . . by Raphael Holinshed and others. Harrison's final share consisted of one book of topographical description of the island of Britain. two books of description of England's institutions and a translation from the Scots of John Bellenden's version of Hector Boece's Latin description of Scotland.

The *Description of England* is an exhaustive survey of the political, religious and social condition of Elizabethan England. Although Harrison was ill-qualified as a topographer, his insatiable spirit of inquiry enabled him to produce a vivid and detailed portrait of his countrymen and their institutions. His work throws particular light on the economic changes and consequent social upheavals of his time. His famous contemptuous account of "how gentlemen are made in England" reveals how rapidly the redistribution of wealth was altering the traditional structures of society. Harrison wrote in a voluhle and homely style; he apologized that his "foule frizeled treatise" was "scrambled up." but its very lack of literary polish enahles it to reflect not only current colloquial speech but also the pronounced individuality of its author.

The second and third hooks of Harrison's *Description of England* were edited by F. J. Furnivall for the New Shakespere society, with extracts from his unpublished "Chronologie" from the creation to Feb. 1593 and also from other contemporary writers. as *Shakespere's England* (4 vol., 1877-1908).

HARRISON, WILLIAM HENRY (1773-1841), 9th president of the United States. was born at the plantation of Berkeley in Charles City county. Va., on Feb. 9, 1773, the third son of Benjamin Harrison. His father. long prominent in Virginia politics. served his state in a number of capacities: as a member of the Virginia house of burgesses; as a delegate to the Continental Congress (1774–77); as a signer of the Declaration of Independence; and as governor of Virginia (1781–84). William Henry Harrison attended Hampden-Sidney college from 1787 to 1790, and later enrolled at the College of Physicians and Surgeons in Philadelphia. He withdrew in 1791 to enter the army as an ensign in the First Regiment at Ft. Washington, Cincinnati. Promoted to lieutenant the following year, he later acted as aide-de-camp to Gen. Anthony Wayne (*q.v.*) in the campaign against the Indians that ended in the battle of Fallen Timbers on Aug. 20. 1794. In 1797 Harrison received his captaincy but elected to resign his commission the next year. Soon afterward he was inade secretary oi the northwest territory. In 1799 the Jeffersonian party there sent him to congress as territorial delegate.

In May, 1800. Pres. John Adams appointed Harriron governor of the newly created Indiana territory. Sworn into office on Jan. 10. 1801. he served as governor until Sept. 1812. In 1803 he became a special commissioner to the Indians and in this role negotiated a number of treaties that opened new areas of land to white settlement. Greatly dissatisfied with these treaties. the Indians. led by Tecumseh (*q.v.*) and his brother. "The Prophet." and undoubtedly encouraged by the British, began the hostilities that terminated at the Tippecanoe river on Kov. 7. 1811. Here. Harrison, leading a force of regulars and militia, won the victory that not only established his military reputation but also gained for him the national prestige which made possible, in part, his subsequent election to the presidency.

When war broke out with Great Britain in the summer of 1812, Harrison was appointed a major general in the Kentucky militia. A few weeks later he was made a brigadier general in the regular army of the United States and placed in command of all the troops in the northwest. On Oct. 5. 1813. after reoccupying American territory previously surrendered to the enemy. troops under his command defeated the British at the battle of the Thames. *(See* WAR OF 1812.)

Harrison resigned his commission in 1814 and shortly afterward was appointed to negotiate a second treaty of Greenville with the Indians (July 22. 1814). Settling at this time in Ohio, Harrison quickly became important in the politics of his adopted state. He served in congress from 1816 to 1819 and in the Ohio senate from 1819 to 1821. From 1825 to 1828 he served in the U.S. senate. In 1828 he was appointed the first U.S. minister to Colombia. but retained this position for less than a year. For the next several years he lived in semiretirement at Korth Bend. Ohio.

Early in 1835 Harrison began to receive favourable mention as a candidate for president on the Whig ticket and was later "nominated" at large public meetings in Pennsylvania. New York and Maryland. In the election of 1836 he led the candidates running against Martin Van Buren (*q.v.*), but received only 73 electoral votes. while the "Little Magician" won 170 electoral votes. Harrison's military record and his noncommittal political views made him the most "available" candidate for the Rhig party nomination in the election of 1840. He received the Whig nomination at the party's convention in Harrisburg. Pa., in Dec. 1839. Largely to attract the votes of discontented and anti-Jacksonian Democrats, the Whigs nominated John Tyler, lately identified with the Democrats. for the vice-presidency. The campaign of 1840 was notable for the use of campaign songs, political slogans and party insignia. When the Democrats derisively referred to Harrison as the "log cabin and hard cider" candidate. the Whigs quickly adopted miniature log cabins and cider jugs as their major identifying symbols. The cry of "Tippecanoe and Tyler too!!" echoed throughout the land. In the November election Harrison overwhelmingly deieated his Democratic opponent, receiving 234 electoral votes to Van Buren's 60.

William Henry Harrison took his oath of office on March 4. 1841, and delivered a long inaugural address for the occasion. One month later. on April 4. 1841. he died, the first president to die in office. Vice-president John Tyler (*q.v.*) succeeded him. It is generally agreed that Harrison died of pneumonia. but his illness was complicated by the excitement and fatigue brought on by the innumerable demands of office seekers n-ho plagued him incessantly. His body was permanently interred at North Bend, O.

In 1795 Harrison married Anna Syinmes (1775–1864), daughter of John Cleves Symmes. Their grandson. Benjamin Harrison (*q.v.*), became the 23rd president of the United States (1889-93). *See* also UNITED STATES (OF AMERICA): *History.*

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HARRIS TWEED, a distinctive cloth originally handspun, warped, woven and finished by the inhabitants of Lewis-and-Harris. North and South Uist, Barra and other islands of the Outer Hebrides off the northwest coast oi Scotland, from the virgin fleece of native sheep.

Harris tweeds are relatively coarse and open in appearance but strongly characterized by a soft texture with excellent tailoring and wearing properties. Because of the steady increase in demand, most of them are now made from machine-spun yarns. Cloths spun and woven on the islands have an unmistakably peaty odour. The superiority claimed for the homespun and woven cloth is attributed to the incorporation of longer fibres in the yarn as compared with the shorter fibred machine-spun yarn employing more twist. The Harris tweed industry has been affected by the competition from cheaper imitation cloths manufactured on the mainland, in Europe and in the far east. These may be made from wool-cotton or wool-shoddy blends containing other fibres.

Two organizations—the Harris Tweed Association Ltd. and Independent Harris Tweed Producers Ltd.—watch over the interests of the trade. The first controls the "orb" mark. while the second employs arms that form the basic design for hanging tickets and woven labels. Both marks are affixed only to tweeds handwoven in the Outer Hebrides. (A. DR.)

HARROGATE, a municipal borough (1884) in the Harrogate parliamentary division of the West Riding of Yorkshire. Eng., 15½ mi. N. of Leeds and 21½ mi. W. of York by road. Pop. (1961) 56,332. It stands about 400 ft. above sea level, on the Pennine foothills. Harrogate is the principal inland watering place in the north of England, containing 88 known mineral springs. It owes its rise and development, which started in the 17th century (the Queen hotel was built in 1687), to the presence of these chalybeate and sulphur springs. There is some light industry but the chief employment is catering for visitors to the spa, delegates to conferences and tourists to the moorlands and dales of Yorkshire and to Knaresborough, Fountains abbey. Bolton abbey, etc. Harrogate consisted of two scattered townships. now united—Low Harrogate and High Harrogate. A common, the Stray. secured by act of parliament from ever being built upon, covers 200 ac in front of the main lines of houses. The chief of the many beautifully laid-out gardens is the Valley gardens (17½ ac.) adjoining the Royal Pump room (1842). There were 540 ac. of open spaces by the latter 1950s. At Harlow Car are the Northern Horticultural Trial grounds.

There were "holy wells" in Harrogate from early times, the best-known being that of St. Mungo. There are five main chalybeate springs: Tewit well, discovered in 1571 by William Slingsby and called the "English Spaw" by Timothy Bright; the Royal chalybeate spa or John's nell, discovered in 1631; Muspratt's chalybeate spring or the Chloride of Iron nell, discovered in 1819; Kissingen (Royal Baths Iron) wells; and the Pure Chalybeate spring. The chief sulphur springs are the Old Sulphur well, discovered about 1656; the Magnesia well; and the Montpellier or Royal Baths wells, the chief of which was discovered in 1822 on the grounds of the Crown hotel. The first account of the Harrogate springs was written by Edmund Deane of York in 1626 and called *Spadacrene Anglica or the English Spaw Fountain.* The Royal baths (1897, greatly extended in 1939) are owned by the corporation and are on the site of the old Victoria baths. The municipal offices were built in 1930 on the site of the new Victoria baths. The spa is equipped with apparatus for thermal, electrical and other kinds of treatment to supplement hydrological treatment. Harrogate also contains the Royal hall, opened in 1903, and the Royal Bath hospital. founded in 1824.

HARROW, a municipal borough (1954) in Middlesex. Eng., 11 mi. N.W. of Hyde Park corner, London, by road. Pop. (1961) 208.963. It includes Harrow-on-the-Hill. Wealdstone Pinner, Hatch End, Harrow Weald. Stanmore and parts of Edguare. Harrow-on-the-Hill, which stands on an isolated hill cap of Bagshot sands and gravels resting on the London Clay. rises to 408 ft. On the summit is the church of St. Mary, founded by Lanfranc, archbishop of Canterbury, and containing Norman work. Harrow is first mentioned in 7b7 and at Wealdstone is a moated house, a residence of the archbishops of Canterbury until 1545. Though a great extension of Harrow as a residential suburb of London has taken place north of the hill, the borough retains more than 1,100 ac. of open spaces which include Stanmore and Harrow Weald commons. Grim's dike runs across the northwest of the borough. There are photographic, optical. glass and printing works. The borough returns three members to parliament.

Harrow School.—The school was founded in 1571 by John Lyon (d. 1592). whose brass is in the church. A yeoman of the neighbouring village of Preston, he had yearly during his life set aside 20 marks for the education of poor children of Harrow. The charter was granted by Elizabeth I in 1571 and the statutes drawn up by Lyon in 1590, but it was not till 1611 that the first building was opened. In about 1660 the headmaster began to receive "foreigners," *i.e.,* boys from other parishes, who were to pay for their education. Control was originally vested in six persons of standing in the parish. but under the Public Schools act of 1868 the governing body consists of six members nho are elected respectively by the lord chancellor, the universities of Oxford, Cambridge and London, the Royal society and the assistant masters of the school. The principal buildings are of the 19th century but the fourth form room dates from 1611 and on its panels are cut the names of many eminent alumni among whom are Robert Peel, H. J. Temple (Lord Palmerston), R. B. Sheridan, Lord Byron and Henry Cardinal Manning. Other famous pupils include Lord Rodney, Anthony Trollope, Lord Shaftesbury and Sir Winston S. Churchill. The Vaughan library. named after the distinguished headmaster C. J. Vaughan (1844–59), was built by Sir George Gilbert Scott who also built the chapel. The war memorial building, near the chapel, is the nork of Sir Herbert Baker. Some features peculiar to the school are the Harrow songs illustrating its history and traditions; the ceremony of Bill (roll call) in the schoolyard; Harrow football, specially adapted to the heavy clay soil; and the Harrow hats, of straw uith shallow crowns and broad brims, worn all the year round. The Eton and Harrow cricket match takes place yearly at Lord's Cricket ground in London.

HARROWBY, DUDLEY RYDER, 1ST EARL OF (1762–1847), English statesman, was unobtrusively in office for most of the first quarter of the 19th century. The eldest son of Nathaniel Ryder, 1st Baron Harrowby, he was born on Dec. 22, 1762. and educated at St. John's college. Cambridge. Entering parliament in 1784, he held various minor offices: undersecretary for foreign affairs (1789–90); member of the India Board (1790); paymaster general (1791–1800); vice-president of the board of trade (1790–1801); treasurer of the navy (1800–01). He succeeded his father as 2nd Baron Harrow-by in 1803 and joined the Younger Pitt's second ministry in 1804 as foreign secretary. An accident compelled him to resign in 1805, but later in the year Pitt appointed him chancellor of the duchy of Lancaster. In the duke of Portland's ministry he was president of the board of control (July–Nov. 1809), and given an earldom and was subsequently in the cabinet without portfolio (1809–12). Like Lord Liverpool, under whom he served (1812–27) as lord president of the council, he was one of the least ambitious of politicians; three times he refused an offer of the premiership and never again held office after Aug. 1827. It was at Harrowby's London house that the cabinet was to have been assassinated by the Cato Street conspirators in Feb. 1820 (*see* THISTLEWOOD, ARTHUR). He died on Dec. 26, 1847. (A. AL.)

HARRY (OR HENRY) THE MINSTREL (BLIND HARRY) (fl. 1470–1495), author of the Scottish historical romance *The Actis and Deidis of the Illustere and Vailyeand Campioun Schir William Wallace Knicht of Ellerslie.* He has been traditionally identified with the Blind Harry named among the poets in William Dunbar's *Timor mortis conturbat me* and among recipients of the royal bounty in the treasurer's accounts for 1490–92. and with the blind minstrel described in John Major's famous *Hzstory* as a gatherer and itinerant reciter of legends about Wallace. He was no mere beggarly rhymer: his work shows his acquaintance with the poetry of John Barbour and Chaucer, and with Scots, Latin and French chronicles. He imitates Barbour's claim to historicity, citing as his main authority a Latin life of Wallace by Wallace's comrade-in-arms. John Blair; but Blair and his book have not been identified, and may be literary fictions.

The *Wallace,* ahich runs to 11 books and nearly 12,000 lines in decasyllabic couplets, is a historical novel in verse, fabricated from the events of the War of Independence, a mass of popular

legend about Wallace and earlier romances. It is not improbable that the poem in its present form is an edited and improved version of a series of *gestis* on the hero's exploits, gathered up by the minstrel into his repertoire; and the improver may have been John Ramsay, the Perth scribe who wrote the one surviving manuscript and also transcribed Barbour's *Bruce*. Judged simply as a romance, the *Wallace* is inferior to the *Bruce* in arrangement and literary finish. It has, however, great energy and patriotic spirit and its author is readier than Barbour both with tears and a rather grim laughter.

On external evidence the *Wallace* may be dated between *1474* and *1479;* the manuscript in the National Library of Scotland is dated *1488.* There seems to have been an edition printed at Edinburgh by W. Chepman and A. Myllar about *1508;* but the earliest surviving edition was printed by R. Lekprevik for Henry Charteris in 1570 Reprints are numerous. The poem was modernized by William Hamilton of Gilbertfield in *1722—the* version which provoked so much patriotic fervour in Burns. The first critical edition is J. Jamieson's *(1820);* the standard edition is by J. Moir for the Scottish Text society, *3* vol. *(1885-89).*

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HARSDÖRFER, GEORG PHILIPP *(1607–1658),* German poet, who, with Johann Klaj, founded in Niirnberg in *1644* the literary society of the *Pegnitzschäfer* ("Pegnitz Shepherds"), for the purification of the German language. He was born in Niirnberg, Nov. *1, 1607,* and died there, Sept. *22,* 1658. His best-known works are his *Frauenzimmer-gesprächspiele, 8* vol. *(1641-49).* a collection of entertaining anecdotes, and his *Poetischer Trichter, 3* vol. (1647–53), a treatise on poetry written in an euphuistic style. He also wrote religious and secular lyrics, numerous collections of stories and a novel, *Dianea (1634).* There is a selection of his poems in *Bibliothek deutscher Dichter des 17 Jahrhunderts,* vol. ix *(1826),* ed. by W. Müller.

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HARSHA (HARSHAVARDHANA) (reigned A.D. 606–647), emperor of northern India. Son of Prabhakaravardhana, king of Sthanvisvara (Thanesar, Punjab), he came to the throne at the age of *16,* after the assassination of his elder brother. Rajyavardhana. His accession occurred in the midst of a great war, in which the king of Magadha and Malwa and Sasanka, king of Bengal. were attacking Grahavarman, the Maukhari king of Kannauj with whom Harsha's line had a matrimonial alliance. Grahavarman was killed, and. as he left no heirs, Harsha became king of Kannauj, which was henceforth the capital of his empire.

For some years the young king waged war in many parts of India and succeeded in bringing most of the north under his hegemony. He appears to have made no attempt at building a centralized empire but ruled according to the traditional pattern, leaving conquered kings on their thrones and contenting himself with tribute and homage. His influence extended from Gujarat to Assam, but the area directly under his control probably comprised no more than the modern Uttar Pradesh, with parts of Punjab and Rajasthan. He attempted to conquer the Deccan (c. 620), but was driven back to the Narmada river by the Chalukya emperor Pulakesin II.

Harsha is known mainly through the works of Bana, whose *Harshaclzarita* describes his early career in flowery language, and of the Chinese pilgrim Hsuan Tsang (*q.v.*), who became a personal friend of the king. The pilgrim depicts Harsha as a convinced Buddhist, though in the earlier part of his reign he appears chiefly to have supported orthodox Hinduism. Hsuan Tsang describes Harsha as a model ruler, benevolent, energetic and just, and praises the efficiency and mildness of his administration and the prosperity of his empire.

In the pattern of Indian history Harsha's reign seems to mark a transition from the ancient to the medieval period, when decentralized regional empires continually struggled for hegemony. (*See* INDIA: *History.*) Like many other Indian kings, Harsha was a patron of literature and the arts and was himself an author. Three Sanskrit dramas attributed to his pen have survived. *See* SANSKRIT LANGUAGE AND LITERATURE.

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HART, ALBERT BUSHNELL *(1854-1943),* U.S. historian, who was the author. joint author or editor of about *100* volumes. was born at Clarksville, Pa., on July 1, *1854.* He graduated from Harvard college in *1880,* and studied in Europe at Paris, Berlin and Freiburg. After receiving a Ph.D. at Freiburg in *1883,* Hart taught at Harvard. where he was professor of history. 1897–*1910,* and of government, 1910–26. He edited the "American Nation" series. published in *28* volumes, *1904-18,* for which he wrote *Slavery and Abolition (1906)* and *National Ideals Historically Tvaced (1907).*

Of particular note are his studies of U.S. foreign policy: *The Monroe Doctrine: an Interpretation (1917),* and *The Foundations of American Foreign Policy (1901).* In addition, he wrote several biographies, among them *Salmon Portland Chase (1899). Abraham Lincoln (1914)* and *George Washington (1927).* Hart also edited numerous collections of documents giving contemporary data on historical events; they include *American History told by Contemporaries,* 5 vol. *(1897-1929);* *American Patriots and Statesmen from Washington to Lincoln, Revealed in . . . Letters, Addresses, State Papers, 5* vol. *(1916);* and *Source Book of American History (1899,* frequently revised). These, along with his *Introduction to the Study of Federal Government* (1891), were widely used as college texts, as was *Formation of the Union, 1750–1829 (1892).* Beginning in *1925* Hart edited the *American Year Book.* He participated in numerous studies and committees on reform in government and was historian from *1926* of the U.S. commission for the celebration *(1932)* of the *200th* anniversary of the birth of George Washington. He served as president of the American Historical association *(1909)* and of the American Political Science association *(1912).* He died June *16, 1943.*

HART, CHARLES (d. 1683), English actor, grandson of Shakespeare's sister Joan, is first heard of as playing women's parts at Blackfriars theatre, London, as an apprentice of the actor Richard Robinson. In the Civil War he was a lieutenant of horse in Prince Rupert's regiment, and after the king's defeat he played surreptitiously at the Cockpit and at Holland House and other noblemen's residences. After the Restoration he is known to have been in *1660* the original Dorante in *The Mistaken Beauty,* adapted from Corneille's *Le Menteur.* In *1663* he went to the Theatre Royal in Thomas Killigrew's company, with which he remained until *1682,* taking leading parts in plays by Dryden, Jonson, Beaumont and Fletcher. He is highly spoken of by contemporaries in such Shakespearean parts as Othello and Brutus. He is often mentioned by Samuel Pepys. Thomas Betterton praised him, and would not himself play the part of Hotspur until after Hart's retirement. Hart is said to have been the first lover of Nell Gwyn (*q.v.*) and to have trained her for the stage. He died at Stanmore, Middlesex, in Aug. *1683.*

HART, HEINRICH *(1855-1906)* and **JULIUS** *(1859–1930),* brothers, who collaborated in critical work leading to the development of naturalism in German literature. Heinrich was born on Dec. *30, 1855,* in Wesel, studied history, philosophy and modern languages at the universities of Halle, Munich and Münster, and died at Tecklenburg, Westphalia, on June *11, 1906.* His brother Julius was born at Miinster on April *9, 1859,* studied law at the university of Berlin, and died in Berlin on July *7, 1930.* Heinrich, in collaboration with his brother, edited a number of short-lived periodicals *(Deutsche Monatsblätter, 1878 et seq., Deutscher Literatur-Kalender,* 1879–82), which were followed by his *Kritisclze Waffengänge (1882-84).* The publication of this last periodical created a sensation and started the new literary

movement of naturalism. Gerhart Hauptmann and Arno Holz. in particular, were indebted to the Harts' critical work. The brothers had poems published in *Moderne Dichtercharaktere,* an anthology of lyrical poetry introducing social themes which was published by W. Arent in 1884. Later both brothers were active as theatre critics. but after the death of Heinrich. Julius opposed the literary trends he had helped to initiate and adopted a pantheistic philosophy.

See L. H. Wolf, *Die Kritische Waffengänge der Brüder Hart* (1922); K. Tillmann, *Die Zeitschriften der Gebrüder Hart* (1923).

(W. I. L.)

HART, MOSS (1904-61). playwright and stage director whose own life was a rags-to-riches drama. was born Oct. 24, 1904, in a New York city tenement. At the age of 17 he obtained a job as office boy for the theatrical producer Augustus Pitou. He wrote his first play at 18, and the critics found in it approximately that degree of maturity. He then worked as director of amateur theatre groups. spending his summers as entertainment director of vacation resorts in the Catskills that were known to the theatrical world as "the borscht circuit." In 1929 he wrote the first draft of *Once in a Lifetime,* a satire on Hollywood that became a hit the following year after its exuberant humor had been tempered by the sardonic skill of George S. Kaufman. He then wrote books for musicals for Irving Berlin and Cole Porter, but until 1941 he continued his collaboration with Kaufman. a collaboration that produced such popular comedies as *You Can't Take It With You* and *The Man Who Came to Dinner.* His affinity for success continued with his musical play *Lady in the Dark,* which he himself directed in 1941. Among the plays he directed was *My Fair Lady.* In 1959 he published *Act One,* the story of his theatrical apprenticeship. He died at Palm Springs, Calif.. Dec. 20, 1961. (J. Ay.)

HART, ERNEST ABRAHAM (1835–1898), English medical journalist. was born in London on June 26, 1835. Beginning on the *Lancet* in 1857, he was made editor of the *British Medical Journal* in 1866. He took a leading part in the exposures which led to the reform of the treatment of sick poor throughout England, and the Infant Life Protection act of 1872, aimed at the evils of baby farming, was largely the result of his efforts. The record of his public work covers nearly the whole field of sanitary legislation during the last 30 years of his life: the amendments of the Public Health and of the Medical acts, the measures relating to notification of infectious disease and to vaccination and the improvement of factory legislation, etc. From 1872 to 1897 he was chairman of the parliamentary bill committee of the British Medical association. Hart died on Jan. 7, 1898.

See Alienist and Neurologist, vol. xiv, pp. 488–493 (1893).

HART, SIR ROBERT, 1ST BARONET (1835–1911), who developed the imperial maritime customs service of China to its full stature, was born at Portadown. County Armagh, Ire., on Feb. 20, 1835. He graduated from Queen's college, Belfast, in 1853 and became a student interpreter in the consular service in China. In 1863 he succeeded H. N. Lay as inspector general of the customs. He founded the postal service that later passed to French control.

Hart was unique as an organizer, a diplomat and the confidant of both Chinese and foreign governments. In three serious crises (one in 1875 and two in 1885) Hart's skillful mediation restored peace. His loyalty to China was strikingly shown in his book, *These From the Land of Sinim* (1901), a scathing criticism of foreign dealings with China; he wrote it when a refugee in the British legation after the Boxers had burned down his house.

He was despotic; he had his favourites (nicknamed "the Royal Family"); but his appointments were always sound. Toward the end his influence declined with the Chinese government, which created the department of customs over his head in 1906. Hart showed no resentment, but in 1908 went home and remained nominally on leave until his death at Great Marlow, Buckinghamshire, Sept. 20, 1911. He was created baronet in 1893.

See Juliet Bredon, *Sir Robert Hart* (1909); S. F. Wright, *Hart and the Chinese Customs* (1950).

(O. M. G.)

HART, THOMAS CHARLES (1877–), U.S. naval officer of World War II, was born at Davidson, Mich., June 12, 1877, and graduated from the United States Naval academy in 1897. He became a rear admiral in 1929 and between that year and 1931 commanded the submarine force. Hart was superintendent of the Naval academy, 1931–34, a cruiser commander, 1934–36, and from 1936 to 1939 served as a member of the general board of the navy. Appointed commander in chief of the Asiatic fleet, with rank of admiral, in July 1939, he served in that post, acting for a brief period also as commander of the Allied naval forces in the far east. until June 1942, when he was retired. He was immediately recalled to active service. however, to serve again on the general board. from which he finally mas relieved in 1945. Appointed U.S. senator from Connecticut, he served until Dec. 1946, and was not a candidate for election. (J. B. HN.)

HART, WILLIAM S. (1870–1946), U.S. film and stage actor, the greatest of the early "western" heroes, was born Dec. 6, 1870, in Newburgh. N.Y., and was brought up in the Dakotas, where he lived until he was 16. He first appeared on the stage in 1889, and in 1905 his role in the play *The Squaw Man* made him a western hero. After playing in *The Virginian* and *The Trail of the Lonesome Pine* he went to Hollywood, where his portrayals of stern, taciturn westerners became enormously successful. Among his many films were *The Passing of Two-Gun Hicks, Hell's Hinds, The Captive God, The Dawnmaker, Truthful Tulliver, The Gunfighter, The Square Deal Man, Tumbleweeds* and *Desert Dust.* In 1923, after two years of retirement, he made nine pictures, including *Wild Bill Hickok, Singer McKee* and *A Lighter of Flames.* Later Hart turned to writing, producing several volumes of fiction and an autobiography, *My Life East and West* (1929). He died in Newhall, Calif.. June 24, 1946. (M. S. BY.)

HARTE, BRET (FRANCIS BRETT HARTE) (1836–1902), U.S. author. was the creator of a new genre in the short story and a new movement in American literature — the local colour school. Originally named Francis Brett Harte. he was born in Albany, N.Y., on Aug. 2j. 1836. His paternal grandfather was Jewish; his father was Roman Catholic; and his mother, low-church Episcopalian. The family lived a somewhat nomadic life until the death of the elder Harte in 1845, after which they settled in New Tork and Brooklyn. The education of young Frank. as he was then known, was spotty and' irregular. but he inherited a love of books and managed to get some juvenile verses published at the age of 11. Two years later he was forced to leave school and seek work.

In 1854 Harte left for California. where the previous year his mother had remarried. He taught one year in a rural school. made a brief trip into the mining country which legend has expanded into a lengthy participation in and intimate knowledge of camp life, and worked for a few days or weeks as a Wells Fargo expressman. In 1857 he went to Union, Calif.. on Humbolt bay, where for two years he was employed b y the *Northern Californian,* a weekly paper. There his support of minority groups. particularly Indians and Mexicans, proved unpopular; and after the massacre of Indians at Mad river, Feb. 26, 1860, which he editorially deplored, he found it advisable to leave town.

Returning to San Francisco. he married. worked in the office of the surveyor general. and began to write for the *Golden Era,* which soon published the first of his *Condensed Novels,* brilliant parodies of James Fenimore Cooper. Charles Dickens. Victor Hugo and others. which revealed him as one of the masters of that form. He then became clerk to the superintendent of the U.S. branch mint, a position which permitted a certain freedom to pursue his literary interests, including the editorship of the *Californian,* for which he engaged Mark Twain to write an article a week.

In 1868, after having written a series of Spanish legends like those used by Washington Irving in *The Alhambra,* he was virtually pushed into his rightful field when Anton Roman named him as first editor of the *Overland Monthly* and charged him with working up a group of local sketches. He wrote "The Luck of Roaring Camp," followed it with "The Outcasts of Poker Flat." and, as one of his idols. Byron. awoke one day to find himself world famous. His brisk reportorial style. his mastery of picturesque narrative, and his shrewd understanding of the universal appeal of an artful blending of sentiment and wit. proved to be a combination of qualities that won immediate praise. A further

fillip was given to his reputation by "Plain Language From Truthful James" (better known as "The Heathen Chinee"), a poem which attracted national attention.

Eastern publishers began to bid against one another for the literary services of the brilliant meteor out of the west; and, flushed with success, Harte signed a contract with the Atlantic Monthly calling for 12 monthly contributions at a stipend of $10,000, the highest figure until then ever offered an American r t e r Resigning a professorship at the newly founded University of California. Harte left for the east, never to return. In New England he was greeted as an equal by Henry Wadsmorth Longfellow, James Russell Lowell. Oliver Wendell Holmes and William Dean Howells, and in the best social circles he was lionized and toasted to the point of spiritual and moral breakdown. Moreover, he was soon to learn that the vein he had discovered was a shallow one. It was with difficulty that he tardily fulfilled his contract, which mas not renewed. Personality difficulties developed. the domestic scene was not quiet, and his work slumped further. After several years of indifferent success on the lecture circuit. Harte took the advice of friends and in 1878 accepted a consulship in Crefeld. Ger. Two years later he was moved to Glasgow, Scot.. where he served as consul for five years. In 1885 he retired to London. where he continued to live for 17 busy but uneventful writing years. His wife and family. whom he always supported generously, joined him for reunions at wide intervals, but he never returned to the U.S. Harte died on Nay 5, 1902.

During his London years Bret Harte was something of an anachronism. telling and retelling stories of a California which did not then exist and which perhaps had never existed. But he found in England a ready audience long after American readers had tired of his formula. It is inaccurate. however, to say that Harte burned himself out in a few sensational years and did no first-rate work thereafter. His "An Ingénue of the Sierras" and "A Protégée of Jack Hamlin's," both written in 1893, are perhaps better than his earlier stories, for they are dryly and ironically humorous, avoiding the emotional dilution and the sentimentality that mar so many of his more familiar stories.

Harte was driven all his life by hard economic necessity and never had the leisure to do the work of which he was capable. This is unfortunate because his talent, though limited in range, was susceptible of high artistic polish. He had a remarkably discerning journalistic eye for mannerisms and a usually reliable ear for habits of speech, and he was clever enough to pour old wine into new bottles, to take conventional story formulas and give them the aura of novelty that goes with an unusual setting. He was a master of small effects in narrative technique; his style, richly humorous, is ever graceful, ever charming. If his world is a fairyland of make-believe. the illusion is well sustained.

Harte's most successful books were The Luck *of* Roaring Camp, and *Other Sketches* (1570) and Tales of the *Argonauts* (1875). His best play was *Ah* Sin (1877), which was written in collaboration with Mark Twain. and was based on his famous poem, "Plain Language From Truthful James" (1870).

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HARTEBEEST, a large South African antelope. *Alcelaphus caama,* characterized by its red colour. long face with naked muzzle, and sharply angulated lyrate horns. present in both sexes. This graceful animal. one of the swiftest of African antelopes, but grotesque appearing. formerly occurred in great herds from Cape Colony to Rhodesia. but is now comparatively rare and restricted to remote districts. It stands about 4 ft. high at the withers, with heavy forequarters. which are much higher than the narrow and drooping hindquarters. The name is usually extended to include all members of the genus. *See* ANTELOPE.

HARTFORD, a city and the capital of Connecticut; U.S., in Hartford county is a port of entry at the head of navigation on the Connecticut river, 38 mi. from Long Island sound and 100 mi. N.E. of New York city.

The city is well-planned with many parks and squares, and a planning commission has functioned since 1907. The state capitol, which stands on a hill in centrally located Bushnell park. is a handsome building of marble and granite, designed by R. M. Upjohn. Completed in 1879, it contains many objects of historic interest, including the tombstone of Israel Putnam and a carved chair made for the senate chamber from wood of the Charter Oak (see belo). In the park is the Corning Memorial fountain (1899), designed by J. Massey Rhind, and the memorial arch and bridge erected by the city in 1884 in tribute to the Civil War dead. Facing the capitol on the south is the supreme court and state library building (1910), and across the west lawn is the state armoury and arsenal, and Bushnell Memorial hall. Between the capitol and the Connecticut river stands the old three-story brick statehouse (1796), a gem of colonial architecture. designed by Charles Bulfinch. This was turned over to the city, and for a generation was used as a city hall, but after 1915 it was restored as a historic shrine. The city stands at 40 ft. above sea level. and an extensive system of dikes along the lower meadows form a protection against flood hazards.

Insurance, the outstanding business of Hartford and an outgrowth of its banks. dates from Feb. 8, 1794, when the first fire insurance policy was issued. Principal industries are the manufacture of brushes: mechanical counters, electrical equipment. tools, automatic machines, automobile parts, precision machines, chucks. firearms, plastics. marine engines. typewriters and glass-making machinery.

Hartford is the seat of Trinity college (Episcopalian) founded in 1823 as Washington college, and the Hartford Seminary foundation (Congregational), founded at East Windsor Hill in 1834 and moved to Hartford in 1865. Also located in the city are La Salette Missionary college and St. Mary's seminary (Roman Catholic), the University of Connecticut's schools of law, social work and college of insurance and the University of Hartford (Hartford Art school. Hartt College of Music and Hillyer college). The *Hartford Courant*, established in 1763. is one of the oldest surviving newspapers published in the United States. The Hartford Times, edited by Gideon Welles from 1826 to 1836, mas once one of the nation's most influential Democratic newspapers. The city has many literary associations, such as those with Lemuel Hopkins, John Trumbull, Timothy Dwight. Joel Barlow and David Humphrey~known as the Hartford Wits (see AMERICAN LITERATURE: Eighteenth Century). It is the birthplace of Noah Webster and was at one time the home of Harriet Beecher Stowe. Charles Dudley Warner and Samuel L. Clemens (Mark Twain).

History. — The first settlement was made by Dutch from New Amsterdam. who built a fort in 1633 at the mouth of Park river. a narrow and muddy branch of the Connecticut, which they held until 1654. In 1635, 60 English settlers came from New Towne (now Cambridge), Massachusetts. In 1636 the First Church of Christ (Centre Congregational), which was organized in New Towne (1632) moved to Hartford with most of its congregation under the leadership of Thomas Hooker (*q.v.*) and Samuel Stone. (The present building [1807] stands near the site of the original meetinghouse, and adjoins the graveyard where Hooker. William Leete, John Haynes and their contemporaries were buried.) In 1637 the settlement adopted its present name from Hertford. England, the birthplace of Stone.

Of interest is the monument marking the site of an oak tree on Charter Oak avenue. where, according to tradition. Capt. Joseph Wadsworth secreted the royal charter when New England colonial Gov. Sir Edmund Andros attempted to seize it in 1687. The city was chartered in 1784 and the town and city were consolidated in 1881. Hartford was the scene of the famous convention of 1814–15 called by New England Federalists to protest against the war policies of Pres. James Madison. (See UNITED STATES [OF AMERICA]: History.) Shipping reached a peak in the 18th century but never recovered from the depression caused by the War of 1812. After the American Civil War, the city prospered through better transport facilities and industries rapidly developed in the late 19th century.

Hartford adopted the city-manager form of government in 1948. The nature of the community was profoundly altered by

mid-20th century at which time Hartford had become the focus of a large and growing metropolitan district, completely surrounded by suburban towns and an even larger urbanized area. The chaotic condition of local government produced by this development is suggested by the fact that there are 32 local governments in the metropolitan district. Pop. (1960) 162,178; metropolitan population, 522,735. (E. E. Sr.)

HARTLAND, EDWIN SIDNEY (1848–1927), British anthropologist, was born at Islington, a borough of London, on July 23, 1848. He was a solicitor at Swansea from 1871 to 1890, and a charter member of the Folk-lore society, which he served as president in 1899. He was mayor of Gloucester in 1902. In 1922 he gave the first Frazer lecture at Oxford. His interest in folk tales and mythology (he was chairman of the folktale section of the International Folklore congress in 1891) led him to undertake research into primitive culture. He served as head of many British anthropological organizations and died on June 19, 1927.

He wrote *English Fairy and Other Folk Tales* (1890); *The Science of Fairy Tales* (1891); *The Legend of Perseus,* 3 vol. (1894–96); *Primitive Paternity* (1910); *Ritual and Belief* (1914); *Primitive Society* (1921); and *Primitive Law* (1924).

HARTLEBEN, OTTO ERICH (1864–1905), German poet, dramatist and short-story writer, was born in Clausthal, Hanover, on June 3, 1864. He studied law at the University of Berlin and later at the University of Tübingen. Hartleben soon abandoned the study of law, however.

Hartleben, who followed Nietzsche in rejecting morality, led a bohemian life and wrote intermittently between drinking bouts with friends. After his health failed, he retired to Salò, It., where he lived on a large country estate on the shores of Lake Garda which he named Halkyone and where he hoped to found a poetry centre. He died at Salò at the age of 41, on Feb. 11, 1905.

His writings are filled with humour and satire; he delighted in taunting the *bourgeoisie* and presenting militarism in a ridiculous light. Because of his storytelling genius he has been likened to Guy de Maupassant (*q.v.*); his verses are lyrical and excellent in form. He wrote: *Der Frosch, Familiendrama nach Henrik Ipse* (1891); *Der Geschichte vom abgerissenen Knopf* (1893); *Meine Verse* (1895); *Vom gastfreien Pastor* (1895); *Meiner Verse Zweiter Teil* (1904); *Hanna Jagert* (1892); *Rosenmontag* (1900; Eng. trans., "Love's Carnival," 1904), a play about the Prussian military system; *Das Ehefest* (1906); *Tagebuch* (1906). His *Collected Works* were published in three volumes (1909).

See W. Mahrholz, *Deutsche Literatur der Gegenwart* (1930); J. Bithell, *Modern German Literature, 1880–1938,* 2nd ed. (1946); H. Lücke, *Otto Erich Hartleben* (1941).

HARTLEPOOL, a municipal borough in the Hartlepools parliamentary division of County Durham, Eng., on a peninsula at the northern point of Hartlepool bay, 2 mi. N.N.W. of West Hartlepool (*q.v.*) and 18 mi. E.S.E. of Durham by road. Pop. (1951) 17,219. Area 2.3 sq.mi. This ancient market town and port, to which John gave a charter in 1201, is now an industrial centre, mainly for shipbuilding, marine engineering and fishing, and also a residential and holiday town with miles of sandy beach. On Heugh point is a lighthouse and along the coast to the northwest is a lifeboat station. The large parish church of St. Hilda was begun in the late 12th century and restored in 1925–30.

HARTLEY, DAVID (1705–1757), English physician and philosopher, known for his advocacy of a physiological psychology in place of a psychology based on the concept of a soul, was born on Aug. 30, 1705. Educated at Bradford grammar school and Jesus college, Cambridge, he practised medicine at Newark, London and Bath, where he died on Aug. 28, 1757.

Hartley's chief work, *Observations on Man, His Frame, His Duty, and His Expectations* (2 vol., 1749), aimed to overcome "the great difficulty of supposing that the Soul, an immaterial Substance, exerts and receives a physical influence upon and from the Body." The preface states that he had been "informed that the Rev. Mr. Gay had asserted the possibility of deducing our intellectual pleasures and pains from Association." From Isaac Newton's *Opticks* (1704) he derived the idea that sensory stimuli might operate by producing "vibrations," propagated through the nerves, like "the trembling of particles in sounding bodies": in the brain the occurrence of vibrations in a certain order sets up a readiness for similar vibrations to recur in the same order. Part II explains how the more complex processes—imagination, memory, reasoning—may thus be analyzed into clusters or sequences of elementary sense impressions formed by individual experience, so that all mental phenomena can be explained by a single law of association. Part III seeks to show how the idea of God develops in the human mind. Hartley's theory had little influence until the early 19th century, when it was taken up and elaborated by James Mill and other members of the associationist school.

Bibliography.—The *Observations* were published by his son with a life of Hartley, 3 vol. (1801). *See* also G. S. Bower, *Hartley and James Mill* (1881) and B. Schönlank, *Hartley and Priestley die Begründer des Assoziationismus in England* (1882). (Cy. B.)

HARTLEY, DAVID, the younger (1731–1813), parliamentarian, pamphleteer and inventor, son of the philosopher David Hartley (*q.v.*), was a fellow of Merton college, Oxford, and member of parliament for Hull (Kingston-upon-Hull), 1774–80 and 1782–84. He gained fame about 1776 by a discovery intended to protect buildings against fire, and attracted gatherings to his experimental house on Putney common where an obelisk stands in his honour. He was the friend and correspondent of Benjamin Franklin, with whom he shared many interests; he devoted a great part of his political career to opposing the American War, speaking frequently in the commons and publishing in 1778 his vigorous *Letters on the American War.* He was appointed by the Fox-North ministry as plenipotentiary to treat with the Americans in 1783, and signed the definitive treaty in Paris.

See G. H. Guttridge, *David Hartley, M.P.,* with bibliography (1926).

HARTLIB, SAMUEL (*c.* 1599–*c.* 1662), educational reformer and agriculturalist, was born at Elbing (then a Hanseatic city under Polish protection). His father was a refugee merchant from Poland, but his mother was English. He was at Cambridge before 1625, and when in 1628 he settled in England he associated himself with the reforming ideas of John Dury. He was an admirer of J. A. Comenius, many of whose works he translated, including *A Reformation of Schools* (1642). He wrote more than 30 tracts and treatises among which were *Macaria* (1641), a description of the ideal state, and *A True and Readie Way to Learn the Latine Tongue* (1654). In 1651, in *An Essay for Advancement of Husbandry-Learning,* he advocated the foundation of an agricultural college. Milton dedicated his tractate *On Education* to Hartlib. He was also concerned with the educational legislation of the Long parliament and the visit to England of Comenius (1641). For his services Cromwell awarded him a pension of £300 a year which ended with the Restoration. It is supposed that Hartlib died in poverty and, according to J. W. Adamson, was buried at St. Martin-in-the-Fields, London, on March 12, 1662.

Bibliography.—H. A. Dircks, *Biographical Memoir of Samuel Hartlib* (1865); J. W. Adamson, *Pioneers of Modern Education 1600–1700* (reprint, 1921); G. H. Turnbull, *Hartlib, Dury and Comenius* (1947); W. A. L. Vincent, *The State and School Education, 1640–1660* (1950); S. J. Curtis and M. E. A. Boultwood, *A Short History of Educational Ideas,* 2nd ed. (1956). (S. J. C.)

HARTMANN, JOHANNES FRANZ (1865–1936), German astronomer and inventor of scientific instruments, was born at Erfurt on Jan. 11, 1865. From 1886 to 1891 he studied mathematics at Tübingen, Berlin and Leipzig. In 1891 he was appointed assistant in Leipzig observatory. In 1909 he became professor of astronomy and director of the observatory in Göttingen, and in 1921 director of the university observatory at La Plata, Arg. He worked on spectrographs and dispersion curves and wrote numerous papers on his spectral observations. He edited the volume on astronomy in the series *Die Kultur der Gegenwart* (1921). Hartmann invented the microphotometer (1899), and the spectrocomparator (1904). With John Plaskett and Otto Struve, he discovered and investigated the calcium clouds in space.

HARTMANN, KARL ROBERT EDUARD VON (1842–1906), German philosopher who based his metaphysical system on the unconscious, was born at Berlin on Feb. 23, 1842. Educated for the army, he turned to philosophy after an injury

to his knee in 1865.

In 1867 the university of Rostock conferred on him the degree of Ph.D. He subsequently returned to Berlin and died at Grosslichterfelde on June 5, 1906.

Eduard von Hartmann's reputation was established by his second book, Die Philosophie des *Unbewussten,* 3 vol. (Berlin, 1869; 12th ed., with supp. texts, 1923; Eng. trans., The Philosophy of the *Unconscious,* London, 1884). Its success was due to the diversity of its contents (Hartmann professing to obtain his speculative results by the methods of inductive science and using many concrete illustrations), to its apparent pessimism and to the vigour and lucidity of its style. The unconscious is both reason and will and the absolute all-embracing ground of all existence, the spiritual principle required by nature. At the fall of man, will and reason were separated, and the former, as blind impulse, determines the melancholy career of the unconscious in the world process.

Reason is in constant strife against will; and only when it is emancipated from this strife in the conscious reason of the enlightened pessimist can the world be redeemed. When the greater part of the will in existence is so far enlightened by reason as to perceive the inevitable misery of existence, a collective effort to will nonexistence will be made, and the world will relapse into nothingness, the unconscious into quiescence. Civilization, like the happiness of the individual, means the annulment of the will to live and the gradual releasing of the unconscious from its sufferings.

Meanwhile mankind must provisionally affirm life and devote itself to social evolution, instead of striving after a happiness which is impossible; in so doing man will find that morality renders life less unhappy. Suicide, and all other forms of selfishness, are highly reprehensible.

BIBLIOGRAPHY.—Eduard von Hartmann's numerous other works include *Neukantianismus, Schopenhauerianismus und Hegelianismus* (1877); *Phanomenologie des sittlichen Bewusstseins* (1879); *Zur Geschichte und Begrundung des Pessimismus* (1880); *Das religiose Bewusstsein der Menschheit* (1882); *Moderne Probleme* (1886); *Zwei Jahrzehnte deutscher Politik* (1889); *Das Grundproblem der Erkenntnistheorie* (1889); *Die soziale Kernfragen* (1894); *Kants Erkenntnistheorie und Metaphysik* (1894); *Kategorienlehre* (1896); *Geschichte der Metaphysik,* 2 vol. (1899–1900); *Die moderne Psychologie* (1901); *Das Problem des Lebens* (1906); and *System der Philosophie im Grundriss,* 8 vol. (1906–09). Under the pseudonym Karl Robert he published *Dramatische Dichtungen: Tristan und Isolde, David und Bathseba* (1871).

HARTMANN, NICOLAI (1882–1950), one of the dominant figures of German philosophy between World Wars I and II, was born in Riga, Latvia. on Feb. 20, 1882. Educated at St. Petersburg, Dorpat and Marburg, he served in World War I and was successively appointed professor at Marburg (1920), at Cologne (1925), at Berlin (1931) and at Gottingen (1945), where he died on Oct. 9, 1950.

Originally a disciple of Marburg Neo-Kantianism, Hartmann reversed the Kantian conception of the object as a construct of the mind and developed what he himself called "a new ontology" (cf. his Neue *Wege* der Ontologie, 1942; Eng. trans. by R. C. Kuhn, *New* Ways of Ontology, Chicago, Ill., 1953), a theory of unitary though diversified being which is in and by itself. Intelligent beings have the privilege of taking cognizance, within the narrow compass of their faculties, of things existing. But this awareness of reality must in its turn be regarded primarily as forming part and parcel of reality, as an event among other events, and by no means as fundamental to being or to reality as such. According to Hartmann it is an error to hold that the basic forms of human thought, the "subjective categories," are identical with the basic structure of reality, the "objective categories." All that scientists or philosophers can hope to achieve is a partial assimilation of their subjective categories to those of the object. The element of the irrational will always loom large in their field of vision, and the restricted circle of light in which they move will be forever encompassed by the vast expanse of unobjectifiable being.

In conceiving his realist ontology Hartmann was influenced by Edmund Husserl's phenomenology, but whereas Husserl supplemented the intuitive grasp of essential forms by a reflexive study of the mental acts which give rise to the realm of intuited essences, Hartmann insisted on viewing philosophy as an object-centred research, a prolongation, as it were, of the scientist's approach to reality.

Reality, for him, revealed a hierarchy of layers, each of them structured in accordance with certain regional "categories," the bottom layer, the region of inanimate matter, supporting the rest, the top layer, the mind, forming a superstructure in no way anticipated by realities further below. Hartmann's conception of the scale of being differed radically from the hierarchical vision of classical metaphysics. He adopted Max Scheler's thesis of the relative weakness of the higher categories. Reality, though orderly and partly rational, is for him void of meaning, and man has to perform the heroic feat of living a human life in a world entirely alien from his human aspirations. In this he is assisted by an intuition of values which are believed to form an imposing firmament of ideal entities. In developing this "material" ethics, so styled in contradistinction to Kant's formalism, Hartmann again followed Scheler's example.

His work, remarkable for its scope and for the consistency with which ontological principles are brought to bear upon all areas of philosophical thought, shows a genius for systematic synopsis rather than for original vision or for disclosure of hidden traits of reality.

BIBLIOGRAPHY.—Hartmann's chief writings are *Grundzüge einer Metaphysik der Erkenntnis* (1921; 2nd ed., 1925); *Die Philosophie des deutschen Idealismus,* 2 vol. (1923–29); *Ethik* (1926; 2nd ed., 1935; Eng. trans., *Ethics,* 3 vol., 1932); *Zur Grundlegung der Ontologie* (1935); *Moglichkeit und Wirklichkeit* (1938); *Der Aufbau der realen Welt* (1940); *Philosophie und Natur* (1950); *Asthetik* (1953). *See* further *Nicolai Hartmann, der Denker und das Werk,* ed. by H. Heimsoeth and R. Heiss (1952); H. Kuhn, "Nicolai Hartmann's Ontology," *The Philosophical Quarterly,* vol. i, iv (1951); O. Samuels, *Foundation of Ontology: A Critical Analysis of Nicolai Hartmann,* Eng. trans. (1954). (HT. K.)

HARTMANN VON AUE (*fl.* 1190–1210), Middle High German poet, was one of the masters of the courtly epic. There are no documentary references to him, but it emerges from his works that he received a learned education at a monastery school, that he was a ministerialis at a Swabian court and that he took part in Henry VI's ill-fated crusade of 1197. There are in existence by Hartmann four extended narrative poems (Erec, Gregorius, Der *arme* Heinrich, Iwein), two shorter allegorical love poems (Biichlein I and 11) and 16 lyrics (13 love songs and three crusading songs). The lyrical poems and the two Biichlein appear to have been written first, followed by the narrative poems—his most important works—in the above order. Gregorius and *Der* arme *Heinrich* are religious works with an openly didactic purpose. The former is a version of the Oedipan legend of Pope Gregory, a popular medieval theme. The latter, Hartmann's most perfect poem, tells the story of a leper who is healed by the readiness of a pure young girl to sacrifice her life for him. The two secular epics Erec and Iwein, both based on works by Chrétien de Troyes and belonging to the Arthurian cycle, enshrine Hartmann's ethical ideal of restraint and moderation (*mâze*) in human conduct, and are complementary in that they depict the return to grace of knights who have defected from this ideal—Erec by subordinating the duties of the man of action to those of the chivalrous servant of woman, Iwein by neglecting the claims of family life for the pursuit of heroism and adventure.

Hartmann regarded his works as instruments of a moral purpose. Edifying content mattered more to him than elegance of style, and his narratives are characterized by clarity and directness, and by the avoidance of rhetorical devices and displays of poetic virtuosity.

The best short account of Hartmann and his works is in the introduction to F. Neumann's edition of *Der arme Heinrich* and *Gregorius* (1958). *See* also G Ehrismann, *Geschichte der deutschen Literatur bis zum Ausgang des Mittelalters* II, 2, 1, pp. 141–212 (1954), which contains detailed bibliographies on specific topics. (RD. J. T.)

HART'S-TONGUE (Phyllitis) is the name given to a genus of ferns, formerly known as *Scolopendrium,* meaning "like a centipede," from the numerous lines of fructification on the leaves.

Typical P. *scolopendrium* (S. *vulgare)* is common in Europe, including Great Britain, and in eastern Asia. Variety *americana* grows in the U.S. and southern Canada but is very rare, occurring only locally in central New York. Tennessee, Ontario and New Brunswick. Var. *Lindeni* grows in Chiapas, Mexico. The thick, leathery, glossy fronds reach a length of 18 in. There are eight species of *Phyllitis,* mainly tropical and subtropical. *See* PTERIDOPHYTA.

HARTY, SIR HERBERT HAMILTON (1880–1941), Irish conductor and composer, was born at Hillsborough, County Down, Ireland, on Dec. 4, 1880. He was an organist in Belfast and in Dublin before he went to London in 1900. As an accompanist he was soon in great demand and his compositions also received recognition. His *Comedy Overture* was played at a promenade concert at Queen's Hall in 1907 and in the same year his *Ode to a Nightingale* was produced at the Cardiff festival with Madame Agnes Nicholls, his wife, in the solo part. In 1920, after gaining considerable experience by conducting the London Symphony orchestra, he was appointed permanent conductor of the Halle orchestra in Manchester.

In 1925 Harty was knighted and also received the degree of Mus.D. from Dublin university. In January 1927 he visited London with the Halle orchestra and chorus and gave a notable performance of Berlioz's *Requiem* at a British Broadcasting Corporation's Albert Hall concert.

Harty's compositions include a violin concerto; *With the Wild Geese,* tone poem for orchestra; *The Mystic Trumpeter* for voices and orchestra; an "Irish" symphony; songs and settings of folk-songs. In 1931 and again in 1934 he conducted orchestras in the United States. Harty died on Feb. 19, 1941, at Brighton, Eng.

HARTZENBUSCH, JUAN EUGENIO (1806–1880), one of the most successful of the Spanish romantic dramatists, editor of standard editions of Spanish classics and author of fanciful poetry in a traditional style, was born in Madrid. Sept. 6, 1806, the son of a German cabinetmaker. Early tribulations ended with the production of *Los amantes de Teruel* (1837), a vivid dramatization of a legend, followed by successes with *comedias de magia* (*e.g., Los polvos de la madre Celestina,* 1840) and adaptations of Golden Age plays. He entered the Spanish Academy (1847) and became director of the national library (1862). He died in Madrid. Aug. 2, 1880. (R. F. B.)

HARUN AL-RASHID (766–809), fifth Abbasid caliph, who reigned from 786 to 809, when the caliphate (*q.v.*) was at its zenith. Son of the caliph al-Mahdi and the princess Khaizuran, he was born at Rayy (beside modern Teheran) in Feb. 766. From the age of 14 he was given military commands, subject to the advice of his guardian, Yahya the Barmecide, in the wars against the Byzantine empire. His efficiency in these gained him the honorific name of al-Rashid, "the rightly guided," and nomination as second in succession to the throne. After his father's death in 785 his brother al-Hadi tried to alter the succession, to the dismay of Yahya the Barmecide and Khaizuran, but in Sept. 786, before he had taken any definite steps, al-Hadi died under suspicious circumstances and Harun was at once proclaimed caliph. Frankish historians say that he and his contemporary Charlemagne were on friendly terms and exchanged embassies on several occasions. His reign marked the flowering of culture in the new social and political structure created by the Abbasids. The merging of Arab and non-Arab elements and the consequent growth of industry and commerce set free some of the energies of the caliphate for the pursuit of intellectual culture, and Harun proved an enthusiastic and discerning patron. *The Arabian Nights (see* THOUSAND AND ONE NIGHTS) gives impressions, perhaps somewhat romanticized, of the brilliance of the court at Baghdad at that period. Despite expenditure on luxury, however, the affairs of the caliphate were prudently administered by Harun's viziers, Yahya the Barmecide and his son Fadl, who greatly increased administrative efficiency. Nevertheless the strains of the vast empire were not eliminated. It was probably the rivalry of different groups at court supporting different policies that. led to the fall of the Barmecides (*q.v.*) in 803; but a change of administration did not improve matters, and troubles increased during the remainder of Harun's reign. He died at Tus (near modern Meshed) on March 24, 809, on his way to quell a rebellion in Transoxiana. The war between his sons. which broke out in 811, is an indication of the strength of the unresolved tensions.

BIBLIOGRAPHY.—F. W. Buckler, *Harunu 'l-Rashid and Charles the Great* (1931); Nabia Abbott, ***Two*** *Queens of Baghdad, Mother and Wife of Harun al-Rashid* (1946). *See* also CALIPHATE: *Bzbliography.* (W. M. WT.)

HARUSPICES, ancient Etruscan diviners, "entrail observers" whose art (*disciplina*) consisted especially in deducing the will of the gods from the appearance presented by the entrails of the slain victim. They also interpreted all portents or unusual phenomena of nature, especially thunder and lightning, and prescribed the expiatory ceremonies after such events. This formed a most complicated pseudo science. in sharp contrast to native Italian divination, which consisted of asking the approval of the gods for a proposed action and deducing a "yes" or "no" from such omens as the flight of birds *(see* AUGURS; DIVINATION; ORACLE) and in simple inspection of the entrails of a victim to see if the beast were normal and therefore acceptable. The Etruscans were said to have learned it from a being named Tages (*q.v.*). Instructions were contained in certain books called *libri haruspicini fulgurales, rituales.* The art was practised in Rome chiefly by Etruscans, occasionally by native-born Romans who had studied in the priestly schools of Etruria. Though of great importance under the early republic, it never became a part of the state religion. In this respect the haruspices contrast with the augurs, who were an ancient and purely Roman institution, and were a most important element in the political organization of the city. In later times the art fell into disrepute. Gnder the empire, however, there existed a collegium of 60 haruspices; however, it was never a state priesthood but a body of salaried expert advisers.

HARVARD UNIVERSITY, the oldest and one of the foremost U.S. educational institutions, situated chiefly in Cambridge, Mass., but also in Boston and other places. Of its student body, drawn from all parts of the Cnited States and from many other countries, somewhat less than one half are undergraduates in Harvard college; the rest study in the graduate schools of arts and sciences (which includes engineering and applied physics) business administration. dental medicine, design, divinity, education, law, medicine, public administration and public health.

In 1636 the general court of the Colony voted £400 toward "a schoale or colledge," which in the next year was ordered to be at "Newetowne." In memory of the English university where many (probably some 70) of the leading men of the Colony had been educated. the township was named Cambridge in 1638 In the same year John Harvard (1607–38), an immigrant Puritan minister to America, a bachelor and master of arts of Emmanuel college, Cambridge, dying in Charlestown. Mass.. bequeathed to the wilderness seminary £780 (half his estate) and 260 books; and the college, until then unorganized. was named Harvard college (1639) in his honour.

The history of Harvard is unbroken from 1640, and its first commencement was held in 1642. The spirit of the founders is beautifully expressed in the words taken from *New England's First Fruits* (1643) and carved on the college gates: "After God had carried us safe to *New-England,* and wee had builded our houses, provided necessaries for our liveli-hood. rear'd convenient places for Gods worship and settled the Civill Government; One of the next things we longed for, and looked after was to advance *Learning* and perpetuate it to Posterity; dreading to leave an illiterate Ministry to the Churches, when our present Ministers shall lie in the Dust." The charter of 1650 dedicated the college to "the advancement of all good literature, arts, and sciences." and "the education of the English and Indian youth . . . in knowledge and godlynes." The second building (1654) on the college grounds was called the "Indian College." In it was set up the college press, which since 1638 had been in the president's house, and there, it is believed, was printed the translation of the Bible (1661–63) by John Eliot into the language of the natives, with his primer, catechisms, grammars, tracts, etc. A fair number of Indians were students, but only one, Caleb Cheeshahteaumuck, took a bachelor's degree (1665). By generous aid received from abroad for this spe-

cial object. the college was greatly helped in its infancy.

The charter of 16jo has been in the main, and uninterruptedly since 1707, the fundamental source of authority in administration. It created a self-perpetuating corporation consisting of the president, the treasurer and five fellows, who formally initiate administrative measures, control the college funds, and appoint officers of instruction and government, subject, however, to confirmation by the board of overseers (established in 1642), which has a revisory power over all acts of the corporation. Circumstances gradually necessitated ordinary government by the resident teachers; and today the various faculties. elaborately organized, exercise immediate government and discipline over all the students. The board of overseers was at first jointly representative of state and church. The former, as founder and patron, long regarded Harvard as a state institution; but the controversies and embarrassments incident to legislative action proved prejudicial to the best interests of the college, and an act of 1865 severed the connection with the state. Financial aid and practical dependence had ceased some time earlier; indeed, from the very beginning, and with steadily increasing preponderance, Harvard has been sustained and fostered by private munificence. The last direct subsidy from the state terminated in 1824, although state aid was afterward given to the Agassiz museum, later united with the university.

The church was naturally sponsor for the early college. The changing composition of its board of overseers marked its liberation first from clerical and later from political control; since 186j the board has been chosen by the alumni who therefore really control the university. When in the first half of the 17th century the unity of Puritanism, in religion and in politics, gave way to a variety of intense sectarianisms, this, as also the incoming of Anglican churchmen, made the old iaith of the college insecure. The conservatives, who clung to pristine and undiluted Calvinism, sought to entrench themselves in the board of overseers. The history of the college from about 1673 to 1725 was exceedingly troubled. One episode in the struggle was the foundation of Yale college by the conservatives of New England as a truer "school of the prophets" after they had failed to secure control of the government of Harvard. In 1792 the first layman mas chosen to the corporation; in 1805 a Unitarian became professor of theology; in 1843 the board of overseers was opened to cle gymen of all denominations; in 1886 attendance on prayers ceased to be compulsory. Thus Harvard, in response to changing conditions. grew away from the ideas of its founders.

Harvard and its alumni and faculty have been closely associated with the intellectual development of the United States in many spheres. Especially in the field of letters, its influence was felt in colonial times through Increase Mather, Cotton Mather, Samuel Sewall and others, and in the revolutionary and early national epoch through men such as the Adamses and Robert 'Treat Paine. Henry Wadsworth Longfellow taught there and the graduates included such men as Ralph Waldo Emerson, Oliver Wendell Holmes, Henry Thoreau, James Russell Lowell, Henry James, Henry Adams, and, later, Robert Frost (who was a special student for two years and taught at Harvard. 1939–43), T. S. Eliot, E. A. Robinson, Walter Lippmann and J. P. Marquand.

The first course in American history was introduced in 1838 by Jared Sparks. The writing of history, given impetus by George Bancroft. William Prescott, John L. Motley, Francis Parkman, John Fiske and others, continued through the works of such teachers and graduates as Albert B. Hart, James Ford Rhodes, Theodore Roosevelt, Frederick J. Turner and Vernon L. Parrington. By the 1960s, Harvard had provided six presidents of the United States—John Adams, John Quincy Adams, Rutherford B. Hayes, Theodore Roosevelt, Franklin D. Roosevelt and John F. Kennedy—and a number of justices, cabinet officers and congressional leaders, as well as business and financial figures of importance. Science was taught at Harvard in the 18th century (astronomy almost from the beginning of the college) but the modern growth of investigation was led by such men as Benjamin Pierce in astronomy, Wolcott Gibbs and Theodore W. Richards in chemistry, and Nathaniel S. Shaler in geology. In the debate of the 1860s over Darwin's theories, the botanist Asa Gray was ranged against the anti-Darwinian naturalist Louis Agassiz. At Harvard, William James introduced the experimental study of psychology into the United States in the 1870s. In other fields, too—the ministry, the law, medicine, music, philosophy—Harvard teachers and graduates took a leading role.

In organization and scope of effort Harvard became, especially after 1869. in the highest sense a university; but the "college" proper, whose end is the liberal culture of undergraduates. continues to be the centre of university life, as it is the embodiment of university traditions. In this period of development the university was led by three outstanding presidents—Charles W. Eliot (1869–1909), A. Lawrence Lowell (1909–1933) and James B. Conant (1933–1953). Another forceful leader, Nathan M. Pusey, became president in 1953. The medical school (in Boston) dates from 1782, the law school from 1817, the divinity school (although instruction in theology was of course given from the foundation of the college) from 1819; but in all of these schools the selection and instruction of students had been lax. Under Eliot these schools were raised to the graduate level in admissions and instruction, the laboratory investigation of disease was added to the clinical practice of medicine, the historical study of religions was provided for the ministry, and the case method of studying the law was introduced. (The graduate school of business administration was formed in 1908. and after 1920 teaching by discussion of actual cases was applied to training for business as well.) The graduate school of arts and sciences was formed in 1872. After 1949 it included the fields of engineering and applied physics, which had first been offered in 1847 in the Lawrence scientific school, and later in a school of engineering. Graduate schools also were developed in dental medicine, design, education, public administration and public health. In addition to its laboratories, museums and research groups in Cambridge and Boston, such as the Museum of Comparative Zoology founded by Louis Agassiz in 1859, the Gray herbarium (1864), the Peabody Museum of Archaeology and Ethnology (1866), the Arnold arboretum (1872), the Semitic museum (1889), the William Hayes Fogg Art museum (1895) and the Busch-Reisinger Museum of Germanic Culture (1902), the university maintained several institutions distant from Cambridge. These included an institute of Italian art and culture at the villa I Tatti in Florence; the Dumbarton Oaks Research library and collection in Byzantine and medieval humanities at Washington, D.C.; astronomical and seismographic observatories at Harvard, Mass. and an additional radio-telescope at Ft. Davis, Tex. The Harvard forest of about 2,300 ac. is at Petersham, Mass., and the Black Rock forest of 3,700 ac. at Cornwall, N.Y.

At the outset: Harvard students were given the classical tongues—Greek, Latin and Hebrew. In the early 19th century, a young graduate, George Ticknor, returned from Germany to urge the modern languages. and after 1825 instruction was offered in French, Spanish, German and Italian. Longfellow was the first Smith professor of French and Spanish languages, and he was followed by James Russell Lowell. Other languages were added from time to time—Russian in 1896, for instance, and in the 20th century Chinese. Japanese and the Indic languages. After World War II research centres on various regions of the world were established. Combining language skills and social science methods, they included the Russian research center (1948), the center for middle eastern studies (1954) and the center for east Asian studies (195j). In the law school, where international law had been taught for several decades, an international legal studies program was also established after World War II. In addition, the university created a center for international affairs (1957).

Harvard's library is the largest university library in the United States, if not in the world. Among all libraries of the United States it is the oldest and one of the foremost. Three adjoining buildings house nearly half the collection: advanced study and research centres in the Harry Elkins Widener Memorial library (1915); rare books and manuscripts are kept in the Houghton library (1942); and the Lamont library (1949) serves undergraduates. The New England Deposit library in Boston provides storage for little-used materials. The other half of the university's books are in scores of departmental and special libraries, of which

the most outstanding are those covering law, business, biological sciences, Chinese and Japanese, astronomy, anthropology and ethnology. The Houghton library houses remarkable collections of books and manuscripts by John Keats and Emily Dickinson, Emerson, Lowell, Holmes and others; the Theatre collection is unique in 18th- and 19th-century British and American materials. In Widener there is a special Theodore Roosevelt collection, and other particularly strong areas include the Italian Risorgimento, Celtic, the fine arts, the French Revolution, Hebraica, linguistics, and Portuguese language and literature. The university publishes, mainly through the Harvard University Press, a distinguished series of scholarly studies and journals in a variety of fields.

The central faculty of arts and sciences and seven separate professional faculties control admissions, set curricula and prescribe educational policy. Teaching fellows, instructors and assistant professors are appointed for a term, but associate professors and professors are appointed for life. To assure the highest quality in these posts, a system of ad *hoc* committees was instituted in 1941 with, typically, a special committee of scholars drawn both from Harvard and from other institutions, led by the president, sitting to review each appointment. The office of university professor was created in 1935 to free a few outstanding scholars for work "on the frontiers of knowledge" without commitment to any single school or faculty.

Among the students are a number of mature men established in their careers who come to the university for background study under programs developed since 1935—the Littauer fellows in public administration, the Nieman fellows in journalism, fellows in international affairs, post-doctoral fellows in the sciences, medicine, dental medicine and public health, conservation fellows, members of the trade union program, and the advanced management group (about 140 business executives twice yearly). Beginning in 1933 the Society of Fellows provided an opportunity for a limited number of outstanding young scholars, on three-year appointment as junior fellows, to pursue research and study in fields of their own choosing without academic limitations. Women students, who were first admitted to the school of education in 1920, by the mid-1950s were accepted in all divisions of the university not provided through Radcliffe college.

A strong development toward the university ideal marked the last half of the 19th century. especially in the widening of courses, the betterment of instruction and the progress of university freedom; and this was consolidated in the 20th century, bringing Harvard to the forefront among higher institutions of learning. This had its effect on the undergraduate college as well as in the developing graduate schools, and Harvard became a leader both in setting high standards for admission and in seeking change in the rigid, traditional curriculum. In the search for a college curriculum to meet the needs both of general education and specialized learning, Harvard has been bold in experiment and innovation. The ideas of recognizing special students and introducing the elective system were suggested in 1824, attaining establishment even for freshmen by 1885, the movement characterizing particularly the years 1865–85. The basis of the elective system is freedom in choice of studies within liberal limits. This freedom was modified in 1910 by requiring each student to choose enough courses in one field to enable him to gain considerable knowledge of that subject, and by distributing a certain number of courses among other fundamental subjects to round out his view of the world. Dissatisfaction with the distribution requirement as a means to a well-rounded education, however, led in 1946 to the report of a special faculty committee, under the chairmanship of Paul H. Buck, on "General Education in a Free Society." After several years of trial the general education program was put into full effect in the fall of 1951. This provided that each student should take, during his first two years, one course in each of the three great fields of learning—the natural sciences, the social sciences and the humanities. Rather than offer a single "core" course, however. the faculty gave the student a choice among four or five offerings in each of these fields, each prepared by outstanding scholars especially for the instruction of nonspecialists. Optional advanced courses also were offered under the same program. In this way, it was felt, all students would gain a common appreciation of the western heritage. In 1910 the degree with distinction was established for high attainment in general, coupled with distinguished success in the subject to which the student had given most attention. Beginning with 1916, general final examinations on the student's field of concentration were introduced; the plan was later extended to almost all departments.

In the years following 1916 a system of tutors was developed to direct the private reading of the students. The tutor met his men individually each week and advised as to their private study. In later years, especially after World War II. this tutoring became limited in the larger departments to the abler students. Feeling that tutorial instruction had value for all students, the faculty introduced in the fall of 1952 a system of tutoring in groups of six or less to cover all students in these larger departments, while continuing individual tutoring as before. First-year students in Harvard college live in dormitories in the Harvard Yard, and since 1931 students in the three upper classes have lived under the house plan. The several houses, each with about 400 students with tutors, a senior tutor and a master, became the centres of undergraduate life, each house having its own library, common rooms, social and intellectual activities and athletic teams. It is believed that in this way any advantage that a small college may have is united with those of the university college. In 1950 a somewhat similar arrangement for communal living mas provided for graduate students in Cambridge.

With an increase in the number of persons of college age and an increasing demand for college and university education in the United States after mid-century, Harvard sought to make its special contribution by maintaining quality and by providing increasing numbers of well-equipped college and university teachers in several fields through its graduate programs.

RADCLIFFE COLLEGE, an institution of higher education for women, dates from the beginning of instruction of women by members of the Harvard faculty in 1879. the Society for the Collegiate Instruction of Women being formally organized in 1882. The present name was adopted in 1894 in honour of Ann Radcliffe, Lady Mowlson (d. *c.* 1661), widow of Sir Thomas Mowlson, alderman and (1634) lord mayor of London. She was the founder (1643) of the first scholarship in Harvard college. From 1394 also dates the present official connection of Radcliffe with Harvard. The requirements for admission and for degrees are the same as in Harvard. and all diplomas are countersigned by an authorized official of Harvard and bear the university seal. Instruction has always been given by members of the Harvard faculty, and after World War II Radcliffe students were introduced into Harvard classes. Although instruction was joined, Radcliffe maintained its own deans and administration, continued its own student activities and maintained its own library, recreational facilities and tutorial hall. Radcliffe. with the Harvard graduate school of business administration, maintains a one-year graduate management training program for women intending a career in business.

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HARVEST, the season of the ingathering of crops (A.S. *haerfest* "autumn." O.H. Ger. *herbist*). Harvest has been a season of rejoicing from the remotest ages. The Romans had their Cerealia or feasts in honour of Ceres. The Druids celebrated their harvest on Nov. 1. In pre-Reformation England Lammas day (Aug. 1, O.S.) was observed as the beginning of the harvest festival. Throughout the world harvest has always been the occasion for many queer customs which all have their origin in the animistic belief in the corn spirit or corn mother. This per-

sonification of the crops has left its impress upon the harvest customs of modern Europe. In West Russia, for example, the figure made out of the last sheaf of corn is called the bastard, and a boy is wrapped up in it. The woman who binds this sheaf represents the "corn-mother," and an elaborate simulation of childbirth takes place, the boy in the sheaf squalling like a newborn child, and being, on his liberation, wrapped in swaddling bands. Even in England vestiges of sympathetic magic can be detected. In Northumberland, an image formed of a wheatsheaf, and dressed in a white frock and coloured ribbons, is hoisted on a pole. This is the "kern-baby" or harvest-queen, and is set up in a prominent place during the harvest supper. In Scotland, the last sheaf, if cut before Hallowmas, is called the "maiden," and the youngest girl in the harvest-field is given the privilege of cutting it.

Throughout the world. as Sir J. G. Frazer shows, the semi-worship of the last sheaf is or has been the great feature of the harvest-home. Among harvest customs none is more interesting than harvest cries; the Devonshire reapers go through a ceremony which in its main features is a counterpart of pagan worship. "After the wheat is cut they . . . pick out a bundle of the best ears . . . ; this bundle is called 'the neck'; the harvest hands then stand round in a ring, an old man holding 'the neck' in the centre. At a signal from him they take off their hats, then all together they utter in a prolonged cry 'the neck!' three times, raising themselves upright with their hats held above their heads. Then they change their cry to 'Wee yen! way yen!' or, as some report, 'we haven!'" On a fine, still autumn evening "crying the neck" has a wonderful effect at a distance.

For a very full discussion of harvest customs see Sir J. G. Frazer, *The Golden* ***Bough.***

HARVEST BUG, the familiar name for mites of the family *Trombidiidae*. belonging to the order Acari of the class Arachnida. Harvest bugs are the six-legged larval forms of several species of *Trombicula.* They are minute, rusty-brown organisms, barely visible to the naked eye, which swarm in grass and low herbage in the summer and early autumn, and cause considerable irritation by piercing the skin, often lodging themselves in some part where the clothing is tight. They may be destroyed, and the irritation allayed, by rubbing the affected area with some insecticide like turpentine or benzine. They are not permanently parasitic, and if left alone will leave their temporary host to assume the active life characteristic of the adult mite, which preys upon minute animal organisms. In the United States they are called "chiggers."

HARVESTER. HARVEST SPIDER or HARVESTMAN, names given to arachnids'of the order Opiliones. Harvest spiders or harvestmen, so-called on account of their abundance in the late summer and early autumn, may be distinguished from all true spiders by the extreme length and thinness of their legs, and by the small size and spherical or oval shape of the body, which is not divided into two regions by a constriction. The French name *faucheurs* given to these arachnids alludes to the ability of detached legs to contract and extend in a fashion reminiscent of the mower swinging the scythe. They may be met with in a great variety of situations. They are predacious, feeding upon small insects, mites, and spiders. The males are smaller than the females, and often differ markedly from them. The male is furnished with a long protrusible penis. The sexes pair in the autumn, and the female, by means of her long, protrusible ovipositor, lays her eggs in some cleft or hole in the soil. After breeding, the parents die. The eggs hatch with the warmth of spring. The adults are provided with a pair of glands, situated one on each side of the carapace, which secrete an evil-smelling fluid believed to be protective. Harvestmen are very widely distributed and are abundant in temperate countries of both hemispheres. They are also common in the tropics. The long legs of harvestmen serve them not only as organs of rapid locomotion, but also as props to raise the body well off the ground, thus enabling the animals to stalk unmolested from the midst of an army of raiding ants. Harvester is sometimes, but erroneously, used as a synonym for harvest bug (*q.v.*). (See ARACHNIDA.)

HARVESTING MACHINERY. Each machine on the farm has its important purpose, but harvesting machines have a special place in the over-all picture because the farmer depends upon them to get his crops safely in after they have survived the hazards of drought, flood, hail, frost and pests. For the history of harvesting machinery, see FARM MACHINERY. For other types of agricultural machinery, see PLANTING MACHINERY; TILLAGE MACHINERY; CROP-PROCESSING MACHINERY. *See* also CROP DRYING AND PROCESSING.

Haymaking Machinery.—The variety of machines used is limited only by the diversity of crops grown, but many farmers grow some hay and this is usually the first harvest of the season. The first operation in making hay is to cut the grass (or legume) which will be made into hay by drying so it will keep for many months without spoiling. The grass is cut off, close to the ground, usually with a mower.

The *Mower.*—The cutting mechanism consists of a cutter bar, a long flat bar of strong steel to which slotted fingers or guards are attached to point forward, and a reciprocating knife, a thin strip of steel to which triangular steel blades or knife sections are riveted. The cutter bar runs close to the ground and the guards comb through the grass, which is cut off by the knife sections working against ledger (*i.e.*, stationary) plates mounted in the guards. The action is very similar to having many pairs of scissors mounted along the front of the cutter bar. The guards provide the scissors' action with the reciprocating knife sections and they also give some protection to the knife against stones.

The cutter bar is fastened to a frame which may be carried directly on a tractor or may be mounted on wheels and pulled by a tractor or by horses, mules, oxen or water buffalo. The reciprocating knife is usually driven by a crank and connecting rod (pitman). The crank of a horse-drawn mower is normally driven through gears from the wheels, but tractor mowers are driven by the tractor engine through a flexible drive system which permits the mower to follow the ground independently of the tractor. This drive is more satisfactory than one through the wheels, because there is no slippage and cutting can be done more rapidly.

The width of cut for horse mowers may vary from three and one-half to five feet while tractor mowers are usually six or seven feet except for a few narrower ones designed for very small tractors. As the crop is cut by the mower, it falls in a continuous swath on the ground, where it is usually left to cure until dry enough to rake for stacking or baling.

Dump Rake.—The next machine to be used depends upon whether the hay is to be stored as loose hay in a stack, stored in a haymow as loose chopped hay. or baled. If to be stacked as loose hay, the grass will be allowed to dry almost to the safe storage point in the swath and then it will be raked into windrows and bunches with a dump rake. This machine consists of a number of long, semicircular spring teeth spaced across the entire machine. They are carried at the upper end in a beam nhich, in turn, is supported by a wheel at each end. The teeth form a basket into which the hay is raked by the forward motion of the machine and which can be dumped by rotating the beam which carries the teeth.

Hay Chopper.—If the hay is to be stored loose for mow curing, the grass is raked into windrows and then picked up and chopped by a hay chopper soon after cutting. The advantage of this system is that a very fine quality hay is secured by avoiding the loss of leaves and certain food elements through field drying. The hay chopper is a form of forage harvester which will be described later under forage harvesting machines.

Side-Delivery Rake.--Often hay is baled to make it more compact and economical to handle. When this is to be done, the hay is raked from the swath into a windrow by a side-delivery rake while the moisture content is still quite high so that the leaves will not fall off too badly. The windrow is kept sufficiently loose for air circulation to continue the drying process to the point where the hay can be baled safely.

The side-delivery rake consists essentially of a rotating cylinder with spring teeth which, because of the oblique position of the cylinder in reiation to the direction of travel, rakes or rolls the hay forward and laterally until it escapes from the rake to form

a windrow. The cylinder is counterbalanced so that it can follow the contour of the ground.

Sweep Rake.—For loose hay. side-delivery rakes together with sweep rakes are sometimes used. The latter are used to gather up the windrowed hay and carry it to the stackar. The sweep rake consists essentially of a number of wooden teeth, several feet long. carried at the rear on wheels or directly by a tractor or truck. As the rake moves forward, the hay slides back onto, and collects on, the teeth, nhich are then lifted at the front for transport to the stack when the rake is full.

Loaders *and Stackers.*—For handling loose hay, loaders and stackers are also used. By means of toothed pick-up cylinders, the loader picks up the hay from the windrow and delivers it to the wagon or truck body by means of a slat-and-rope carrier or a raker-bar mechanism. Most stackers are of the overshot type. The hay is placed by a sweep rake onto a large "floor" of wooden teeth mounted on the end of a boom which is pivoted at the opposite end. A winch rotates the boom and its load of hay upward, past the vertical, and "shoots" the hay over onto the stack. The boom is then returned to its position flat on the ground for the next load.

Hay Conditioners.—These are used to accelerate the rate of drying when field curing. The machines consist of pairs of smooth rolls ahich may be of steel or rubber (to split the stems) or meshing fluted rolls (to crimp the stems) between which the swath of cut crop is passed. Splitting or breaking stems of leguminous crops allows moisture to escape quickly so that leaves and stems dry at more nearly the same rate. and drying time is cut about half.

Pick-Up Balers—Used to bale hay directly from the windrow in the field when it has been allowed to dry to safe storage moisture content, the baler has a rotary toothed pick-up mechanism. This lifts the windrow and delivers it to an auger or other feeding device which, nith the help of packer fingers or a "wadboard packer." places a charge of hay in the bale chamber on each stroke of the compressing plunger. Two twines or wires are automatically tied around a length of hay compressed into the bale chamber to form a bale. The density and length of the bale can be adjusted. Some balers are driven by power-take-off (PTO) shaft while those of greater capacity, used for custom baling. are usually driven by a gasoline engine mounted on the baler. Twine is tied in a conventional knot. "Wire-tie" machines usually twist the ends of the wires together, but both twine and wire are joined mechanically and automatically.

Hay *Pelleters.*—The next step beyond hay baling is hay pelleting in which the hay is compacted approximately eight times in place of about two and one-half times as in baling. In the late 1950s this system appeared to offer promise from the standpoint of feeding and handling efficiency but only stationary machines for the commercial pelleting of ground alfalfa were generally available.

Forage Harvesting Machines.—Grass, legumes, corn (maize) and other crops are often ensiled to keep them in a succulent and fermented state rather than in the dry condition in which they are called hay. To make silage, they must be cut up so as to permit packing in the silo sufficiently well to expel most of the air and so produce anaerobic fermentation and prevent mold formation. (See ENSILAGE.)

Almost all silage crops are now cut in the field with a forage harvester nhich cuts the crop and chops it immediately or picks up and chops a windrow which has been cut and raked earlier. Forage harvesters have a basic cutting or chopping unit consisting of rotating knives which shear the crop against a cutter bar or shear plate. The length of cut is adjusted by varying the feed speed or by changing the number of knives. The knife holder, whether it be flywheel or cylinder type, includes impeller devices which fling the chopped hay through a pipe into a wagon hauled behind the machine. In some cases the knives are shaped so as to provide the impelling action to transport the chopped material. These machines. like balers, may have a separate engine or be driven by a tractor through a PTO shaft. They usually handle one row of corn or up to seven feet of grass or legume crop.

Forage harvesters can be equipped with alternate attachments. They may have a cutter bar similar to that of a mower or combine, in nhich case the crop is chopped immediately. They may be equipped with a pick-up mechanism like that of a baler. This is used where it is wished to allow the crop to wilt or dry a little before it is chopped for ensilage or placement in the mow for curing as hay. The third attachment is a row-crop device making it suitable for harvesting corn for silage. A knife cuts the stalks close to the ground while gathering chains grasp them and carry them to the feed rolls or apron which delivers the material to the cutter wheel and meters it.

So-called economy-type forage harvesters which perform both the cutting and chopping operations are also used where acreages to be harvested are small. They consist of a stalk beater or shredder to which is fitted a blower to deliver the chopped fodder to a wagon. Beaters which have their axis of rotation parallel to the ground often use an auger to collect the chopped material from the rotor knives or hammers and carry it to the blower.

Grain Harvesting Machinery.—Grain or cereal crops are harvested when their seeds have reached maturity and have dried to some degree. The crop may be threshed as it is harvested (by a combine or reaper-thresher), in which case the grain is usually allowed to dry to a safe storage level of moisture before harvesting. If the crop is not threshed as cut it is harvested with a grain binder and left to dry in bundles, with a windrower or swather, in which case it is dried in the windrow, or with a mower with dropper or buncher attachment, to be dried in hand-tied bundles.

Grain Binder.—This is used to harvest small grains in localities where the combine harvester-thresher is unsuitable or not available. It cuts the grain, binds it and drops the bundles or sheaves on the ground singly or in bunches to be shocked or hauled for stacking or storing in the barn until threshing. The cutting mechanism is very similar to that of the mower. A slatted cylindrical reel mounted parallel to and above the knife pushes the cut grain back onto a canvas conveyer which moves it laterally to and between a pair of counter-rotating inclined canvas conveyers or elevators. These deliver the grain to the binding deck where a butter evens the butts of the cut straw, and a set of packer fingers in the binding attachment compresses the straw to form a bundle of the required size and density. A trip mechanism engages the pouer to operate the binding attachment and the knotter ties a loop of twine around the bundle before it is ejected.

When pulled by horses or other draft animals, binders secure their mechanical motions and power from a large lugged traction wheel, and cut a swath from four and one-half to eight feet wide. When pulled by tractors, they are usually PTO driven and cut from six to ten feet. Binders with special drive wheels are sometimes used for rice harvesting but have been largely replaced by combines.

Buncher.—On very small farms, grain may be harvested with a mower using a dropper attachment or buncher, a slat device mounted behind the cutter bar and permitting the operator to collect the grain in bunches for later hand tying.

Combine.—As early as 1950 practically all of the small grains, soybeans and similar crops in the western hemisphere and Great Britain were harvested by means of the combine or combined harvester-thresher. This machine cuts, threshes and cleans the grain as it moves over the field. In design, it is essentially a regular binder-type cutting device with a gathering-conveying mechanism that delivers the cut grain to a conventional thresher that has been modified to make it work satisfactorily when in motion over the fields. In combine harvesting the aim is usually to take the heads of grain with a minimum of straw. Hence, the cutting-gathering device is sometimes called the header. However, if the crop is lodged. that is, bent down, or if the straw is to be saved, the crop is cut close to the ground.

From the threshing cylinder, which rubs the grain out of the heads against a curved "concave," some of the grain and chaff goes directly to the cleaning "shoe" where sieves and a blast of air are used to separate and clean the grain. Some of the grain and chaff go with the straw to the straw deck or to walkers which serve to shake the grain from the straw. This grain too is delivered to the cleaning shoe and thence, after passing through the air blast, it drops into the clean-grain auger which conveys it to an

elevator and on into the storage tank or to the bags as the case may be. The straw drops out the back of the machine and is left in a windrow for later baling, is baled directly by a baling attachment or press, or is scattered over the ground by means of a fan-like straw spreader.

While combines were used as early as about 1875 in California and the Pacific northwest of the United States, it was not really until the 1920s and 1930s that they made themselves generally felt. They were then shown to be the only practical way to harvest soybeans and this impetus together with the introduction of the small (five and six foot cut) PTO-driven combine made them popular throughout almost the entire United States. The self-propelled combine, introduced in 1940, with its own traction power made the large combine a much more flexible unit and for large farms this machine became standard equipment. Combines became established in Great Britain during World War II when labour shortage forced their adoption and justified the auxiliary drying equipment needed in that climate. After World War II, several European combines were produced to embody cleaning and separating principles peculiar to those countries and, above all, to provide means for saving the straw, which is valued highly.

Power-take-off-driven combines cut from j to 7 ft. wide while self-propelled and pull-type machines with auxiliary engine range in size from 8 to 18 ft. On self-propelled and other large models the cut grain is gathered behind the cutter bar by a large auger which replaces the canvas conveyer used on earlier models. A chain-type conveyer carries the grain to the threshing cylinder except on some "straight-through" pull-type combines where a canvas conveyer moves the material directly from cutter bar to cylinder. V-belt and roller-chain drives are used to power the various elements of the machine and a generous use of sealed-for-life ball bearings on models appearing in the late 1950s typified the trend of the farm machinery industry toward higher standards of materials and workmanship. Combines are made with means for regulating the speed of the threshing cylinder to suit the various crops to be harvested, and self-propelled machines are usually equipped with means for fine adjustment of the travel speed to suit field and crop conditions.

Hillside combines of the self-propelled type are available for use on steeply rolling land. The body of the machine is supported in the frame by hydraulic cylinders which are automatically adjusted to keep the body level.

Pick-Up Attachments.—Combines may be fitted with pick-up attachments that mount ahead of the cutter bar. These are used to pick up, for threshing, windrows of grain that have been cut and allowed to dry for several days.

Windrow-Harvesters, *Windrowers* or Swathers.—These are used in some sections of the U.S. and Canada where weather and crop conditions at harvest time are unfavourable for direct combining of the grain. Uneven ripening of the grain. and heavy, green weed conditions both favour windrow harvesting. Green patches and green weeds both dry out in the windrow and permit satisiactory threshing, whereas if left standing until green spots and weeds were ripe, the crop might all be lost by storms and windy conditions.

Windrowers.—These consist essentially of a cutter bar with a canvas-type conveyer behind it to move the cut grain to one point and to deposit it gently on the top of the stubble so the air can circulate beneath and through it. A reel is used to push the cut grain back onto the canvas. Most windrowers are pulled by a tractor, cut a swath width up to 16 ft. and are PTO driven, but in the second half of the 20th century there appeared to be an increasing preference for self-propelled models.

Pick-Up Reels.—Used on combines and windrowers when the crop is very badly lodged or flattened by wind or due to straw weakness, these reels have rows of spring teeth in place of the usual bats. The teeth are eccentrically controlled to get under and lift the crop before it is cut, but to retract smoothly after the grain is into the header. This action is necessary to prevent the straw from wrapping on the reel.

Combines may also be fitted with corn harvesting attachments (see below).

Corn (Maize) Harvesting Machinery.—When corn is grown for grain it may be cut with a corn binder and stored in shocks while the grain dries to shelling and storing moisture. However, the usual practice is to use a mechanical corn picker which jerks or "snaps" the ears from the stalks so that only the grain and cobs are harvested. The standing stalks are guided by two shields or snouts to pass between two counterrotating rollers which pull the stalks down and through very sharply. The ears strike either a snapping bar located above the rolls or the rolls themselves and this breaks the shanks which attach the ears to the stalk. The ears then travel by means of an elevator to the husking mechanism, consisting of closely spaced, counterrotating rollers which tear the husks away. The ears are carried by means of a chain-type elevator to a trailed wagon.

Some pickers are pulled behind a tractor and are PTO driven, but most are mounted directly on a tractor, one unit on each side, to form a two-row harvester.

Picker-Shellers.—Pickers may be fitted with shelling units (see FARM MACHINERY) and are then known as picker-shellers. By shelling the corn as it is harvested, a separate operation is eliminated. Cob hauling and storage are avoided with considerable saving and the corn may be harvested early to reduce field losses. Similar advantages can be secured by equipping a combine with a corn attachment. In t is case, the combine shells and cleans the corn. The attachment consists of a two-row snapping unit similar to a picker. or of a two-row cut-off and conveying unit which delivers the whole corn plant to the combine. See also CORN.

Mechanical Cotton Harvesters.—The hand harvesting of cotton is an excessively laborious operation, which has stimulated the development of many patents on machines to do the job. In the U.S. more and more cotton was being picked mechanically in the second half of the 20th century.

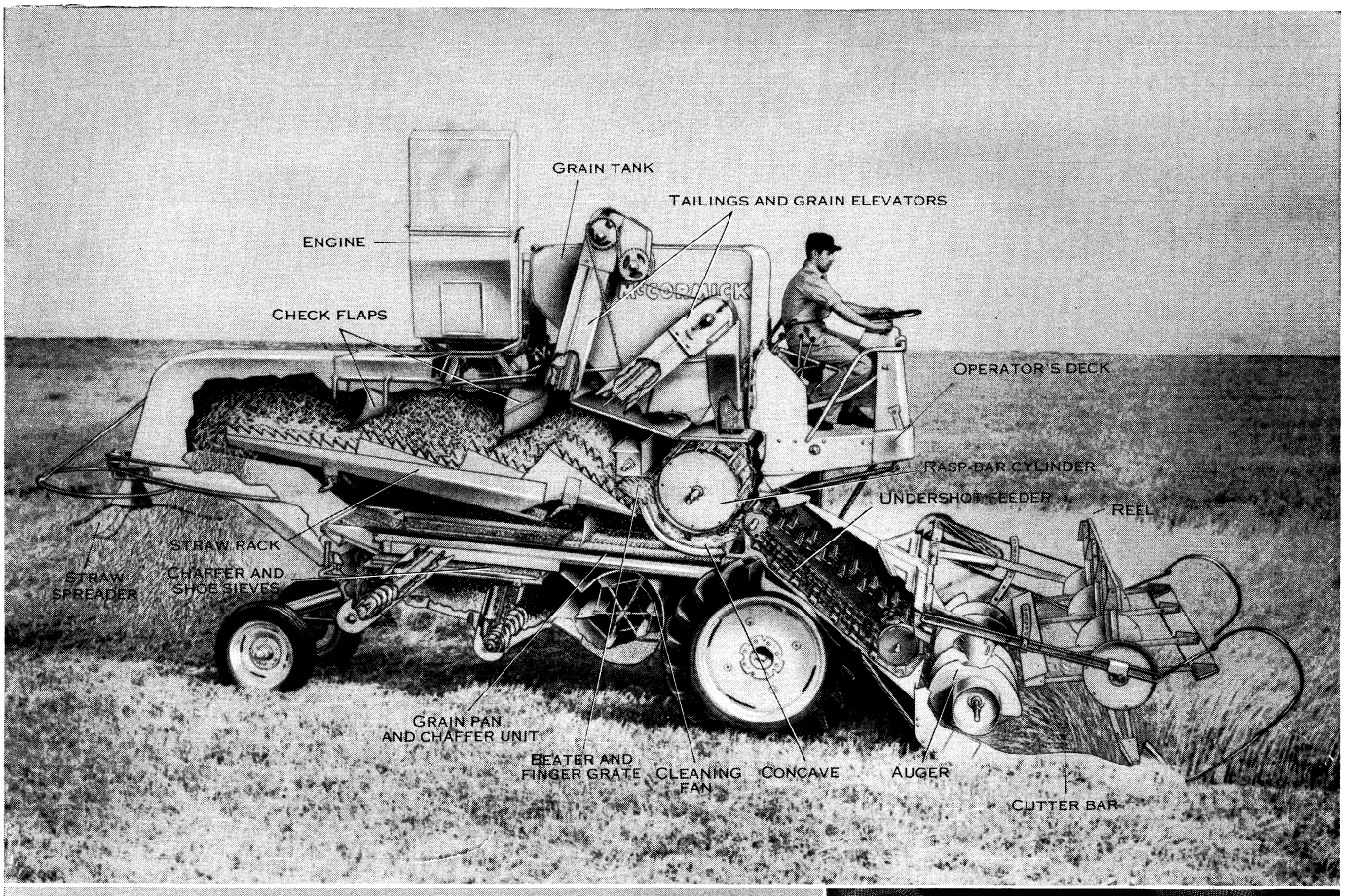
Regular open-boll cotton is commonly harvested by machines which utilize rotating moistened spindles. The plants are guided between banks or drums of rapidly rotating, automatically cleaned and dampened spindles. The cotton is wrapped around the moistened spindles, to which the fibres tend to adhere, and then doffed or stripped by a special device. When barbed spindles are used a doffing wheel unrolls the cotton to get it free of the spindle. From the strippers or doffers the cotton is delivered by conveyer or suction to a large basket carried above the machine.

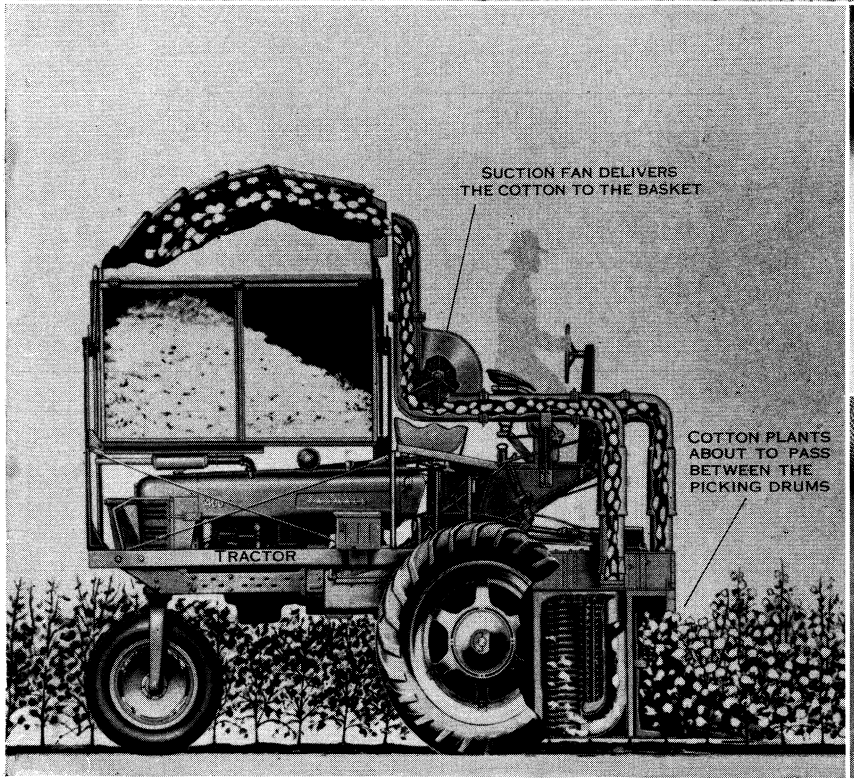
In some areas such as the high plains of Texas a stormproof cotton, in which the cotton is kept close within the protective boll, is grown. Strippers are used to harvest this type of cotton. The plants pass between stationary strippers or counterrotating rollers or brushes which tear the bolls from the stalks. Both cotton strippers and pickers are usually mounted on tractors. A few are self-propelled. See also COTTON AND THE COTTON INDUSTRY: Cotton Cultivation.

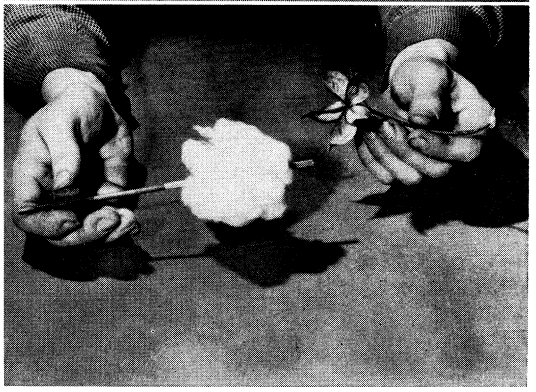
Potato Harvesting Machinery.—One of the simplest mechanical devices for lifting potatoes is the potato plow provided with a share to which are attached a series of rods for raising the tubers as the implement is drawn through the ground. A middle buster, or double plow with right- and left-hand bottom mounted back to back, fitted with rods as above is another simple device for this purpose. Still another consists of a flat diamond-shaped plow, for lifting the potatoes, and an agitated pivoted grate, actuated by a small star wheel underneath, which shakes off most of the earth, leaving clean potatoes lying on the surface of the ground.

More elaborate machines, designed to both raise and separate the tubers from the soil, are of two distinct types, the spinner and the elevator. The spinner type is carried on two wheels and has a broad scoop share which runs under the ridge and loosens the earth around the tubers. Immediately behind the share is the spinner, consisting of a series of forks rotating at right angles to the path of the machine. The forks, set to work at about the same depths as the share, throw the potatoes to one side, leaving them more or less in compact rows. This type is commonly used in Great Britain and Europe.

The elevator type comprises a broad share with an agitating rod-link conveyer directly behind it to carry the earth and potatoes upward and backward. As they are moved the agitation shakes a







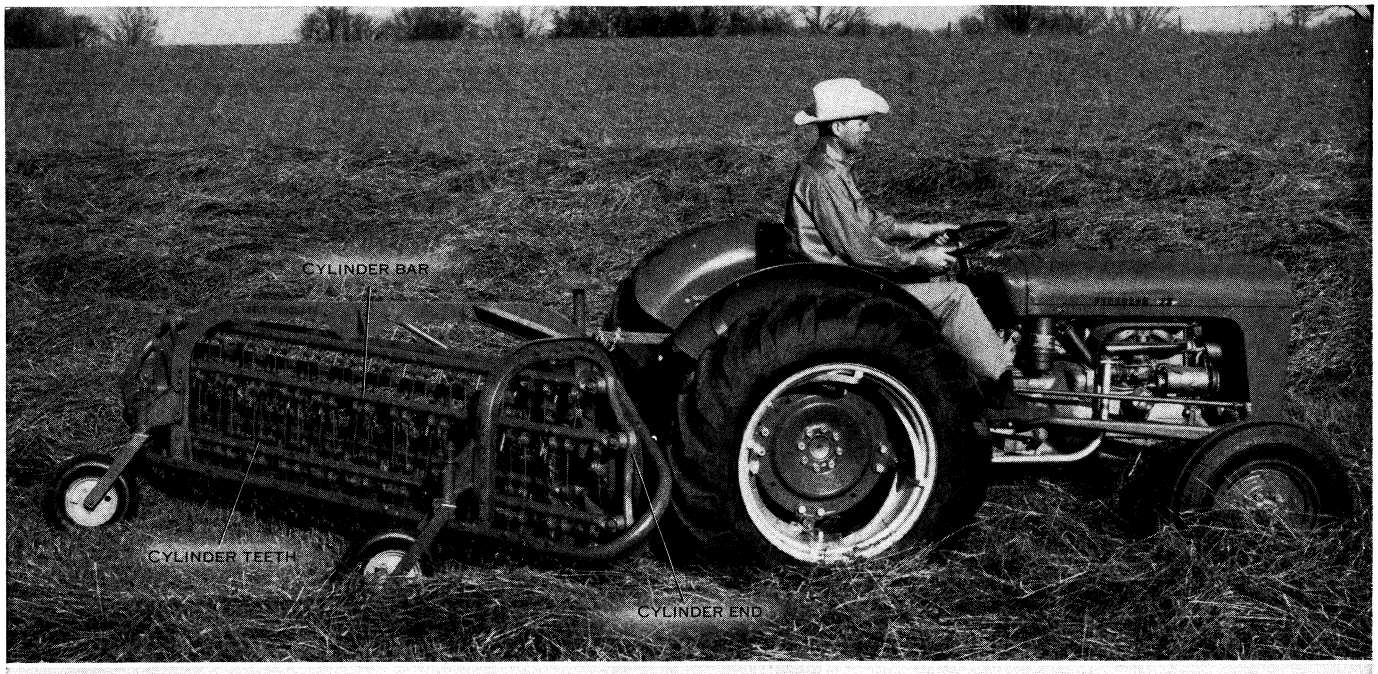
BY COURTESY OF (TOP, BOTTOM LEFT) INTERNATIONAL HARVESTER CO., (CENTRE RIGHT, BOTTOM RIGHT) ALLIS-CHALMERS MFG. CO.

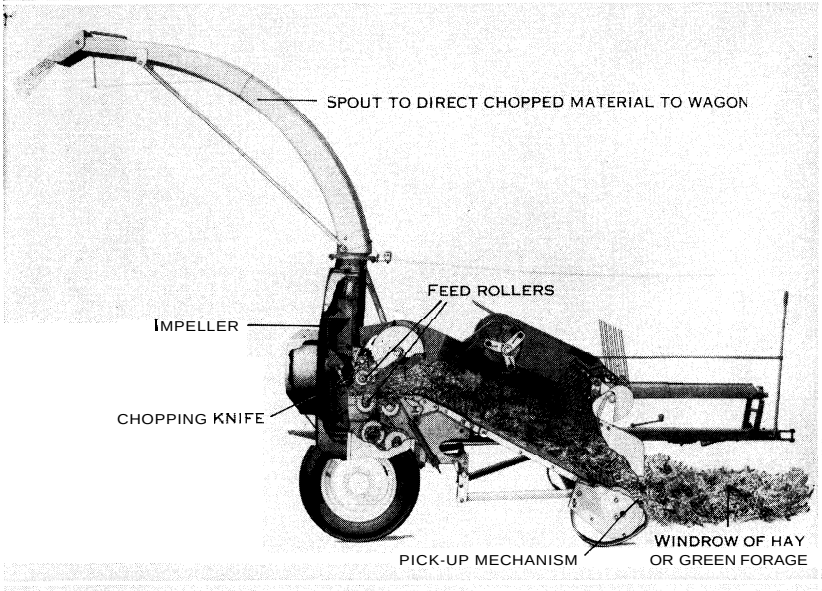
MODERN HARVESTING EQUIPMENT

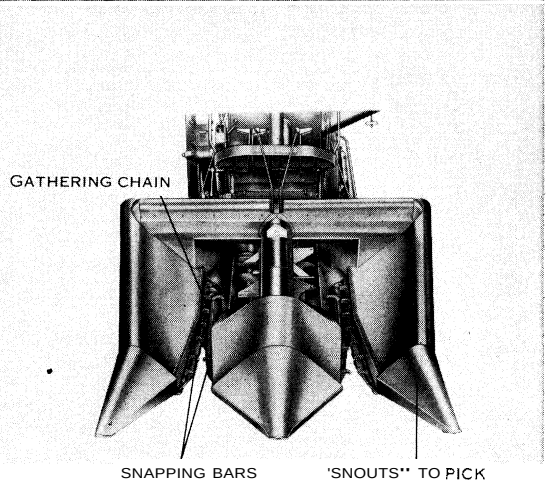
Top: Combine, or combined harvesting-threshing machine, saves labour and greatly reduces grain harvesting losses

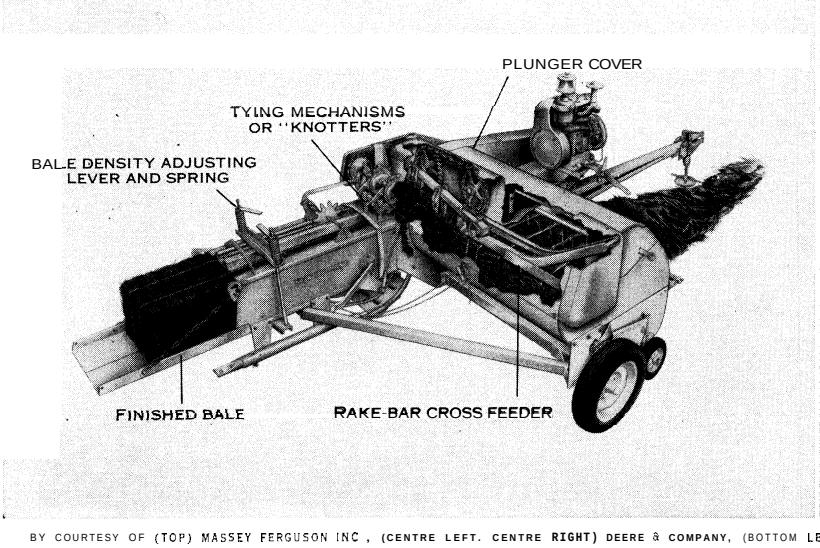
Bottom left: Cotton picker. Seed cotton fibres are removed from the plant by their tendency to adhere to revolving spindles as shown in the pictures *centre right* and bottom *right*

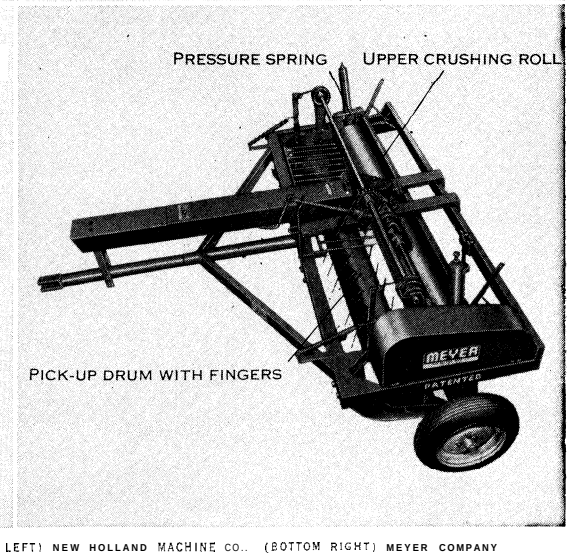
HARVESTING MACHINERY











BY COURTESY OF (TOP) MASSEY FERGUSON INC , (CENTRE LEFT. CENTRE RIGHT) DEERE & COMPANY, (BOTTOM LEFT) NEW HOLLAND MACHINE CO.. (BOTTOM RIGHT) MEYER COMPANY

Top: Side-delivery rake. Rotating teeth move the mown, cured hay to form a windrow for pick up by baler or forage harvester
Centre left: Forage harvester. Used to chop hay for drying or green forage for immediate feeding or ensiling
Centre right: Corn harvesting attachment for combine
Bottom left: Hay baler. Used to compress and package hay for storage
Bottom right: Hay crusher or conditioner. High quality hay may be made by reducing field curing or drying time

large part of the earth free and it drops through the conveyer. At the end of this conveyer the potatoes may be dropped off onto the ground. In some they are delivered to cleaning devices and sorting tables. In these more complicated machines various mechanisms are used to prepare the potatoes for direct sacking. Rods and deflectors are used to separate the vines. Rollers may be used to move the potatoes and remove earth and small stones. Finally the potatoes move onto moving picking tables where men. riding on the machine. pick out rocks and other foreign objects before the potatoes are delivered to bags or bulk transportation. Most diggers are PTO driven and are made in one- and two-row models. The digging depth is regulated from a forward truck or gauge wheel that runs on the row.

Beet Harvesting Machinery. — In sugar beet harvesting the object is to lift the whole root from the ground, clean the earth off it and deliver it to a wagon accompanying the machine. In the process the tops, together with a small portion of the root itself. must be removed and separated from the root as it travels to the wagon. Some machines have stationary blades that lift the beets together with some earth onto a kicker-wheel cleaner-conveyer; others perform the lifting by means of two tilted wheels whose action, rolling together, lifts the beets out of the soil.

In these machines the beets are first topped by a revolving inclined disk, the cutting height of which is regulated by a finder wheel or shoe. These machines are semimounted on a tractor and lift one row at a time.

Other types of beet harvesters top the beets after they have been lifted. One of these actually lifts the beets by their tops. The second type employs a two-blade lifter to do the lifting. At the same time a large spiked wheel rolling over the beets impales them on the spikes and subsequently elevates them to a rod-chain conveyer. They are removed from the spikes by strippers after being topped by rotary disk-type knives.

A part of the U.S. beet crop and much in other beet-growing countries is lifted by hand after mechanical loosening. A subsoiler type of standard with a blade or small share projecting under the row is sometimes used. Others employ the two-blade design which straddles and lifts the beet, the device used on some complete harvesters. Some are single-row units drawn by horses; others drawn by tractors loosen several rows at a time. *See* also BEET.

Peanut Harvesting Machines. — Peanuts are an important crop and mechanical harvesting is considered essential. The tubers are usually lifted and allowed to dry for three to ten days before picking or removal from the vines. They are lifted. vines and all. with units similar to potato diggers. Side-delivery rakes may be used to windrow the vines for drying, but special shaker-windrowers that clean and windrow the vines more loosely and gently are more generally used. After drying, the threshing is done with a combine or a special peanut harvester. These employ intermeshing spike tooth cylinders or similar devices to comb the peanuts out of the vines. All peanut harvesters require stemmer saws to remove the piece of stem that remains on the peanut when it is broken from the vine. *See* also PEANUT.

Sugar Cane Harvesting Machinery. — Sugar cane is harvested by hand in those parts of the world where labour costs are very low, hut in the mainland U.S. and Hawaii it has been necessary to mechanize. Harvest of the one-year cane grown in Louisiana is not excessively difficult. The specially designed cane harvester which straddles one row cuts the cane off close to the ground, removes the useless leafy top and conveys the cut stalk or cane to an accompanying truck or wagon.

The much heavier two-year cane grown in Hawaii is far more difficult to mechanize since at harvest time it is completely lodged and tangled. .Although much effort was made in the late 1950s to develop harvesters to cut. detrash and deliver two-year cane to an accompanying truck. most such cane was harvested by means of push rakes mounted on crawler tractors which push the cane into piles to be grab-loaded onto trucks for hauling to the mill. In being pushed into piles many canes are torn up by the roots, necessitating replanting for the following crop. Much of the balance of Hawaiian cane is grab harvested. A grab. similar to a clamshell bucket, is used literally to tear the cane loose from the ground, two or three tons at a time, and load it directly into trucks. This method, too, damages the stools. or stumps, badly. Some unirrigated cane. which therefore does not grow in furrows. is harvested with a V-cutter which consists of a modified snow plow having sharp knives along the lower edges to shear off the cane, which is then pushed into windrows and bunched for grab loading. *See* also SUGAR.

BIBLIOGRAPHY.—R. Bainer, R. A. Kepner and E. L. Barger, *Principles of Farm Machinery* (1955); *A. A.* Stone and H. E. Gulvin, *Machines for Power Farming* (1957). *See* also bibliography at end of FARM MACHINERY. (G. E. PD.)

HARVEY, GABRIEL (1550?–1630), English writer and a friend of Edmund Spenser, was the eldest son of John Harvey, a yeoman of considerable means and a ropemaker. In 1566 Harvey matriculated at Christ's college, Cambridge, and in 1570 received his B.A. and became. through the influence of Sir Thomas Smith, a fellow of Pembroke hall (later Pembroke college). When in 1573 he was ready to take his M.A., some students protested that he was arrogant, overcritical and inclined to defend paradoxes. The degree was conferred only after the intervention of John Young. master of Pembroke hall. The next year Harvey was appointed praelector or professor of rhetoric. and in this capacity delivered annual lectures, two of which were published. *Ciceronianus* (1577) and *Rhetor* (1577). Both works revealed the scope of Harvey's learning. his thorough knowledge of classical authors and his admiration of writings in the vernacular. On the death of Sir Thomas Smith in 1577, Harvey composed a series of Latin elegies, published as *Smithus: vel Musarum lachrymae* (1578). On July 26. 1578 Harvey disputed before Queen Elizabeth I when she visited at Audley End, Essex. There is a biased but entertaining account of this in Thomas Nashe's *Haoe With You to Saffron-Walden* (1596). Harvey himself celebrated this significant event in his career with another collection of facile Latin verse. *Gratulationes Valdinenses* (1578). His fellonship at Pembroke was not renewed, but he was elected on Dec. 18, 1578, to a new fellowship at Trinity hall. Cambridge. where he began the study of civil law.

At Pembroke Harvey had become an intimate friend of Edmund Spenser. Spenser celebrated this friendship in *Thr Shepheards Calender* (1579) through the characters of Colin Clout (Spenserj and Hobbinol (Harvey). The June eclogue in particular expresses the deep affection between them. In 1j80 appeared *Three Proper, and Wittie, Familiar Letters* containing two letters by Spenser and three by Harvey. The letters revealed that Spenser had temporarily succumbed to Harvey's advocacy of classical metres, but that authorship was not Harvey's main aim. Unfortunately for Harvey's ambitious plans. his epistles caused trouble. Cambridge demanded and received a retraction of the criticism that the university failed to honour learning and granted preferential treatment to wealthy students. Edward de Vere. earl of Oxford, at the instigation of John Lyly, interpreted personally Harvey's satire of an Italianate Englishman in "Speculum Tuscanismi." Harvey denied that the poem was an attack upon the ear!. and that he went.. as Nashe alleged, to the Fleet prison. Further humiliation was heaped on Harvey in the Latin comedy *Pedantius*, performed at Trinity college in 1581, which satirized him as. in Nashe's words, "the concise and firking finicaldo fine Schoole-master."

In 1585 he failed to be elected master of Trinity hall, and though he had completed his study of civil law, he was not admitted to the doctor's degree. In 1585, however, he became doctor of civil law at Oxford. Except for Lyly's criticism in *Pap With a Hatchet* (1589), nothing is known of Harvey's activities until 1592, when he published *Foure Letters, and Certaine Sonnets*. This pamphlet detailed accurately, but mercilessiy, the pathetic death of Robert Greene and replied to the indictment of himself and his brothers John and Richard in Greene's *A Quip for an Upstart Courtier* (1592) and Nashe's *Pierce Penilesse* (1592). The origins of this dispute are hidden in mysterious animosities, undoubtedly including the attack on "Speculum Tuscanismi" and the personal associations of the antagonists at Cambridge. Richard Harvey in *Lamb of God* (1590) had abused Nashe as a "piperly makeplay or makebate." but unaccountably the latter did not reply for two

years. Then Harvey and he carried on a lengthy fliting, in Nashe's *Strange Newes* (1592) and *Have With You to Saffron-Walden* and in Harvey's *Pierces Supererogation* (1593) to ivhich he appended a reply to Lyly written four years earlier. Both writers were evidently at the time in the employ of stationers, Nashe with John Danter and Harvey with John Wolfe; and since neither appeared enthusiastic to prolong the feud, it is plausible that the controversy was artificially stimulated by printers interested in sales. It was officially terminated in 1599 when the archbishop of Canterbury ordered the satires of the two men burned.

In 1598 Harvey petitioned Sir Robert Cecil to be elected master of Trinity hall; once again he was not appointed. About this time, or earlier, he retired to Saffron Walden. In 1608 his sister, Mary Collins, instituted a legal suit against him. On his mother's death in 1613 he evidently succeeded to his inheritance, and died in Saffron Walden in 1630. The picture posterity has of Harvey is based on Nashe's devastating burlesque, and on his malicious account of Greene's death. Though Harvey was sometimes tasteless and certainly pompous, he should be judged neither by his books, since he came into print reluctantly, nor by his desire to introduce hexameters into English. His marginalia in the books he read, many of which are extant, demonstrate that rather than a pedant, he was, like Francis Bacon, a man who made all learning his province.

Harvey's English works were edited by A. B. Grosart (1884–85); *Ciceronianus* was edited by H. S. Wilson and translated by C. A. Forbes (1945). Autobiographical material appears in *The Letter Book of Gabriel Harvey,* edited by E. J. L. Scott (1884), and Harvey's *Marginalia,* edited by G. C. Moore Smith (1913), which also contains the best biography. (E. H. MR.)

HARVEY, GEORGE BRINTON McCLELLAN (1864–1928), U.S. editor and diplomat, was born in Peacham, Vt., Feb. 16, 1864. At 18 he became a reporter on the *Springfield* (Mass.) *Republican,* and later on the *Chicago News* and the *New York World.* He was insurance commissioner of New Jersey in 1890–91 and managing editor of the *New York World,* 1891–93. In 1899 he purchased the *North American Review,* which he thereafter edited. During 1900–15 he was president of the publishing house of Harper & Bros., and during 1902–13 was editor of *Harper's Weekly.* In 1903 he purchased the *Metropolitan Magazine.*

Harvey was said to have been the first to suggest, in 1906, Woodrow Wilson, then president of Princeton, as a presidential possibility. In the campaign of 1912 he gave Wilson strong support, but after the latter's nomination an estrangement developed. In 1916 Harvey urged the election of Charles E. Hughes, the Republican candidate for president. He was strongly opposed to the League of Nations on the ground that it involved the yielding of national sovereignty. In 1918 he established the *North American Review's War Weekly,* later called *Harvey's Weekly,* which bitterly denounced the Wilson administration. In 1921 he mas appointed ambassador to England by President Harding, a position which he held till Dec. 1923. He was editorial director of the *Washington Post* in 1924–25. He died at Dublin, N.H., Aug. 20, 1928.

HARVEY, SIR JOHN MARTIN (1863–1944), English actor, producer and theatre manager, who came to be associated with his outstanding success as Sydney Carton in *The Only Way* (an adaptation of Charles Dickens' *A Tale of Two Cities),* mas born at Wivenhoe, Essex, on June 22, 1863. He was educated at King's College school, London, and was intended for a naval architect. However, he chose the stage, making his first public appearance at the Court theatre, London, in 1881, while still a boy. He joined Sir Henry Irving's Lyceum company in 1882 and remained there for 14 years. He married Angelita Helena de Silva, who became his leading lady when he entered management.

A man of scholarly refinement, and an actor of power and sensitivity, Harvey maintained the Irving standard and method. His finest performance was as Oedipus Rex in Max Reinhardt's production of that play at Covent Garden theatre, London. in 1912. Martin Harvey was knighted in 1921 and was made an honorary LL.D. of Glasgow university in 1938.

He died on May 14, 1944.

See *The* Autobiography of *J.M.H.* (1933) and M. Willson Disher, *The Last Romantic* (1948). (W. J. M.-P.)

HARVEY, WILLIAM (1578–1657), English physician, the discoverer of the circulation of the blood. was born at Folkestone, Kent. on April 1, 1578. He was educated at Caius college, Cambridge, and then proceeded to Padua to study medicine under Hieronymus Fabricius ab Aquapendente and became doctor of medicine in April 1602. Returning to England, he settled in London. He was admitted (June 1607) fellow of the Royal College of Physicians, and in 1609 obtained the reversion of the post of physician to St. Bartholomew's hospital. and in the same year he succeeded to the post.

In 1616 he began a course of lectures at the College of Physicians in which he first brought forward his views upon the movements of the heart and blood. Meantime his practice increased, and he had the lord chancellor, Francis Bacon, and the earl of Arundel among his patients. He was physician extraordinary to James I and physician in ordinary to Charles I. In 1628 he published the *Exercitatio anatomica de motu cordis et sanguinis in animalibus,* in which he announced his discovery of the circulation of the blood. Between 1629 and 1632 he traveled on the continent, principally in Italy with James Stuart. afterward duke of Richmond. Four years later he accompanied the earl of Arundel on his embassy to the emperor Ferdinand II. He returned to his practice in London at the close of the year 1636, and accompanied Charles I in one of his journeys to Scotland (1639 or 1641), and was in attendance on the king at the battle of Edgehill (Oct. 1642), and then followed Charles I to Oxford.

While with the king at Oxford he was made warden of Merton college, but a year later, in 1646, that city surrendered to Lord Fairfax, and Harvey returned to London. He was now 68 years old, and, having resigned his appointments and relinquished the cares of practice, lived in learned retirement with one or other of his brothers. The work on mhich he had been chiefly engaged at Oxford, and indeed since the publication of his treatise on the circulation in 1628, was an investigation into the subject of generation. Charles I had put the royal deer parks at Windsor and Hampton Court at Harvey's disposal, and had watched his demonstration of the growth of the chick with no less interest than he had watched the movements of the living heart. Harvey had collected a large number of observations, and George Ent succeeded in obtaining the manuscripts, with authority to print them or not. The result was the publication of the *Exercitationes de generatione animalium* (1651).

This was the last of Harvey's labours. He had now reached the age of 73. His theory of the circulation was generally accepted by the most eminent anatomists both in his own country and abroad, and he was known and honoured throughout Europe. In 1654 he nas elected president of the College of Physicians but declined the honour, though he enriched the college with many gifts.

Harvey died on June 3, 1657, and was buried at Hempstead, Essex; in 1883 his remains were placed in the Harvey chapel in the church there.

John Aubrey says: "In person he was not tall, but of the lowest stature; round faced, olivaster complexion, little eyes, round, very black, full of spirits; his hair black as a raven, but quite white 20 years before he died." The best-known portrait of him extant is by Cornelius Jansen in the library of the College of Physicians.

Harvey's Work on the Circulation. — In estimating the character and value of the discovery announced in the *Exercitatio anatomica de motu cordir et sanguinis in animalibus,* it is necessary to bear in mind the previous state of knowledge. Aristotle taught that the blood was elaborated from the food in the liver, thence carried to the heart, and sent through the veins over the body. The Alexandrian physicians Erasistratus and Herophilus taught that, while the veins carried blood from the heart to the members, the arteries carried a subtle kind of air or spirit. Galen discovered that the arteries were not, as their name implies, mere air pipes, but that they contained blood as well as vital air or spirit, and he believed that the nerves arose from the brain and conveyed "animal spirits" to the body. The views of Galen re-

mained current till the 16th century. The physicians of that period had developed certain doctrines concerning the vascular system which may be summarized thus: (1) The blood is not stagnant, but moves in the body. But no one had a conception of a continuous stream returning to its source (a circulation in the true sense of the word) either in the system or in the lungs. If they used the word *circulatio*, as did Andreas Caesalpinus, it was as vaguely as the French policeman cries "*Circulez*." The movements of the blood were in fact thought to be slow and irregular in direction as well as in speed, like the circulation of air in a house, or of a crowd in the streets. (2) They supposed that one kind of blood flowed from the liver to the right ventricle of the heart, and thence to the lungs and the general system by the veins, and that another flowed from the left ventricle to the general system by the arteries. (3) They supposed that the septum of the heart was pervious and allowed blood to pass directly from the right to the left ventricle. (4) They had no conception of the functions of the heart as the motor power of the movement of the blood. They doubted whether its substance was muscular; they supposed its pulsation, like that of the arteries, to be due to expansion of the contained vital spirits.

Of the great anatomists of the 16th century, Andreas Vesalius in 1543 ascertained that the septum between the right and left ventricles is complete, though he could not bring himself to deny the invisible pores which Galen's system demanded. Michael Servetus, in his *Christianismi restitutio* (1553), went somewhat farther, and, from the anatomical fact of the complete septum and the large size of the pulmonary arteries he concluded that there is a communication in the lungs by which blood passes from the pulmonary artery to the pulmonary vein. It seems doubtful whether even Servetus rightly conceived of the entire mass of the blood passing through the pulmonary artery and the lungs. Indeed, a true conception of the lesser circulation as a transference of the whole blood of the right side to the left was impossible until the corresponding transference in the greater or systematic circulation was discovered. Lastly, the system of valves in the veins had been elaborately set forth and illustrated by Harvey's own teacher Fabricius. The way then to Harvey's great work had been paved by the discovery of the valves in the veins, and by that of the lesser circulation, but the significance of the valves mas unsuspected and the fact of even the pulmonary circulation was not generally admitted.

In his treatise Harvey proved (1) that it is the contraction, not the dilatation, of the heart mhich coincides with the pulse, and that the ventricles, as true muscular sacs. squeeze the blood which they contain into the aorta and pulmonary artery; (2) that the pulse is produced by the arteries being filled with blood; (3) that there are no pores in the septum of the heart, so that the whole blood in the right ventricle is sent to the lungs and round by the pulmonary veins to the left ventricle. and also that the whole blood in the left ventricle is again sent into the arteries, round by the smaller veins into the *venae cavae*, and by them to the right ventricle again—thus making a complete circulation; (4) that the blood in the arteries and that in the veins is the same blood; (5) that the action of the right and left sides of the heart, auricles, ventricles and valves, is the same. the mechanism in both being for reception and propulsion of liquid and not of air; (6) that the blood propelled through the arteries to the tissues is not all used, but that most of it runs through into the veins; (7) that there is no to-and-fro undulation in the veins. but a constant stream from the distant parts toward the heart; (8) that the dynamic starting point of the blood is the heart and not the liver.

The method by which Harvey arrived at his solution of the most fundamental and difficult problem in physiology is well worthy of attention. He had not only furnished himself with all the knowledge that books and the instructions of the best anatomists of Italy could give, but, by a long series of dissections, had gained a far more complete knowledge of the comparative anatomy of the heart and vessels than any contemporary had. Thus equipped. he began his investigations into the movements of the heart and blood by seeing their action in living animals. He minutely describes what he saw in dogs, pigs, serpents, frogs and fishes, and even in slugs, oysters, lobsters and insects, in the transparent shrimp, and lastly in the chick while still in the shell. He particularly describes his observations and experiments on the ventricles, the auricles, the arteries and the veins He shows how the arrangement of the vessels in the fetus supports his theory. He adduces facts observed in disease as well as in health to prove the rapidity of the circulation. He explains how the mechanism of the valves in the veins is adapted to favour the flow of the blood to the heart. He estimates the capacity of each ventricle, and reckons the rate at which the whole mass of blood passes through it. He elaborately and clearly demonstrates the effect of obstruction of the bloodstream in arteries or in veins, by the forceps in the case of a snake, by a ligature on the arm of a man, and illustrates his argument by figures. These results can be explained only by the constant circulation of the same blood. Lastly, in the 15th, 16th and 17th chapters of his great work, he adds certain confirmatory evidence as to the effect of position on the circulation, the absorption of animal poisons and of medicines applied externally, the muscular structure of the heart and the necessary working of its valves. The whole treatise, which occupies only 52 pages of print, is a model of accurate observation, patient accumulation of facts, ingenious experimentation, cautious hypothesis and logical deduction.

In one point only was the demonstration of the circulation incomplete. Harvey did not see the capillary channels by which the blood passes from the arteries to the veins. This gap in the circulation was filled 30 years later by the great anatomist Marcello Malpighi, who described the capillary circulation four years after Harvey's death. But the existence of the channels first seen by Malpighi was already clearly pointed to by Harvey's reasoning.

Harvey's Work on Generation.— The *Exercitationes de generatione animalium* is between five and six times as long as the work on circulation, and is followed by excursus *De partu, de uteri membranis, de conceptione;* but, though the fruit of observations as patient and extensive, its value is far inferior. The subject was more abstruse, and was inaccessible to proper investigation without the aid of the microscope. Hieronymus Fabricius, Harvey's master, in his work *De formatione ovi et pulli* (1621), and another pupil of Fabricius, Volcher Coiter of Nürnberg, were among the few in modern times who had preceded Harvey in this study. The 72 chapters which form Harvey's book lack the coordination so conspicuous in the earlier treatise, and some of them seem almost like detached chapters of a system which was never completed or finally revised.

Aristotle had believed that the male parent determined the form of the future embryo. while the female only nourished and nursed the seed. Galen taught that each parent contributes seeds, the union of which produced the young animal. Harvey, after speaking with due honour of Aristotle and Fabricius, begins ab *ovo,* for he says, "almost all animals, even those mhich bring forth their young alive, and man himself, are produced from eggs." This dictum, usually quoted as *omne vivum ex ovo,* was a prevision of genius, and was not proved until K. E. von Baer discovered the mammalian ovum in 1827. Harvey proceeds with a careful anatomical description of the ovary and oviduct of the hen, describes the new-laid egg, and then gives an account of the appearance seen on the successive days of incubation. Commenting on Aristotle and Fabricius, he declares against spontaneous generation, proves that there is no *semen foemineum,* that the chalazas of the hen's eggs are not the *semen galli,* and that both parents contribute to the formation of the egg. He describes accurately the first appearance of the ovarian ova as mere specks, their assumption of yolk and afterward of albumen. He describes two methods of production of the embryo from the ovum: one is metamorphosis, or the direct transformation of pre-existing material, as a worm from an egg, or a butterfly from an aurelia (chrysalis); the other is epigenesis, or development with addition of parts, the true generation observed in all higher animals. Chapters xlvi–l are devoted to the abstruse question of the efficient cause of generation, which, after much discussion of the opinions of Aristotle and of Sennertus, Harvey refers to the action of both parents as the efficient instru-

ments of the first great cause.

He then goes on to describe the order in which the several parts appear in the chick. He states that the fetal heart is the first organ to be seen, and explains that the nutrition of the chick is effected not only by yolk conveyed directly into the midgut, as Aristotle taught, but also by absorption from yolk and white by the umbilical veins; on the fourth day of incubation appear two masses (which he oddly names *vermiculus*), one of which develops into three vesicles, to form the cerebrum, cerebellum and eyes, the other into the breastbone and thorax; on the sixth or seventh day come the viscera; and lastly the feathers and other external parts.

Harvey points out how nearly this order of development in the chick agrees with what he had observed in mammalian and particularly in human embryos. He notes the bifid apex of the fetal heart in man and the equal thickness of the ventricles, the soft cartilages which represent the future bones, the large amount of amniotic fluid and absence of placenta which characterize the fetus in the third month; in the fourth the position of the testes in the abdomen, and the uterus with its Fallopian tubes resembling the bicornuate uterus of the sheep; the large thymus; the caecum, small as in the adult, not forming a second stomach as in the pig, the horse and the hare; the lobulated kidneys, like those of the seal and porpoise, and the large suprarenal veins, not much smaller than those of the kidneys. He failed, however, to trace the connection of the urachus with the bladder. In the following chapters he describes the process of generation in the fallow deer or the roe. Much of Harvey's work on generation was superseded during the next 25 years by that of Malpighi. The remaining writings of Harvey are unimportant.

Harvey as Physician.—Of Harvey as a practising physician very little is known. Aubrey says that "he paid his visits on horseback with a footcloth, his man following on foot, as the fashion then was." He adds, "Though all of his profession would allow him to be an excellent anatomist, I never heard any that admired his therapeutic way. I knew several practitioners that would not have given threepence for one of his bills" (the apothecaries used to collect physicians' prescriptions and sell or publish them to their own profit). "and that a man could hardly tell by his bill what he did aim at." However this may have been, and rational therapeutics was impossible when the foundation stone of physiology had only just been laid, Harvey was an active practitioner, performing such important surgical operations as the removal of a breast, and he turned his obstetric experience to account in his book on generation. Some good practical precepts as to the conduct of labour are quoted by Percivall Willughby (1596–1685). He also took notes of the anatomy of disease, which unfortunately perished with his other manuscripts. He may be regarded as a forerunner of G. B. Morgagni (*q.v.*), for Harvey saw that pathology is but a branch of physiology, and like it must depend on accurate anatomy. The only remaining specimen of his observations in morbid anatomy is his account of the post-mortem examination made by order of the king on the body of the famous Thomas Parr, who died in 1635, at the reputed age of 152. Harvey insists on the value of physiological truths for their own sake, independent of their immediate utility. but he himself provides an interesting example of the practical application of his theory of the circulation, in the cure of a large tumour by tying the arteries which supplied it with blood.

The following is believed to be a complete list of all the known writings of Harvey, published and unpublished: *Exercitatio anatomica de motu cordis et sanguinis in animalibus* (1628); *Exercitatio anatomica de circulatione sanguinis: ad Johannem Riolanum* (1649); *Exercitationes de generatione animalium* (1651); *Anatomia Thomae Parr,* first published in the treatise of John Betts, *De ortu et natura sanguinis* (1669). Letters. to Caspar Horimann of Nürnberg, May 1636; to Schlegel of Hamburg, April 1651; three to Giovanni Nardi of Florence. July 1651, Dec. 1653 and Nov. 1655; two to Morison of Paris, May 1652; two to Horst of Darmstadt, Feb. 1654–55 and July 1655; to Vlackveld of Haarlem, May 1657. His letters to Hoffmann and Schlegel are on the circulation; those to Morison, Horst and Vlackveld refer to the discovery of the lacteals; the two to Nardi are short letters of friendship. All these letters were published by Sir George Ent in his collected works (1687). Of two manuscript letters, one on official business to the secretary, Dorchester. was printed by Aveling, with a facsimile of the crabbed handwriting (*Memorials of Harvey,* 1875), and the other, about a patient, appears in Robert Willis' *Life of Harvey* (1878). *Pralectiones anatomiae universalis* (1616)—manuscript notes of his Lumleian lectures in Latin—are in the British museum library; an autotype reproduction was issued by the College of Physicians in 1886. An account of a second manuscript in the British museum, entitled *Gulielmus Harveius* de *musculis, motu locali,* etc.. was published by Sir G. E. Paget (*Notice of an Unpublished Manuscript of Harvey,* 1850).

The following treatises, or notes toward them, were lost either in the pillaging of Harvey's house, or perhaps in the Great Fire of London, which destroyed the old College of Physicians: *A Treatise on Respiration,* promised and probably at least in part completed (pp. 82, 550, ed. 1766); *Observationes de usu lienis; Observationes de motu locali,* perhaps identical nith the above-mentioned manuscript; *Tractatum physiologicum; Anatomia medicalis* (apparently notes of morbid anatomy); *De generatione insectorum.*

The fine edition of Harvey's works published by the Royal College of Physicians in 1766 was superintended by Mark Akenside; it contains the two treatises, the account of the post-mortem examination of old Parr, and the six letters enumerated above. A translation of this volume by Robert Willis, with Harvey's will, was published by the Sydenham society (1847).

There is a convenient photographic facsimile of the work on the circulation issued by G. illoreton (1894). The standard translation of his collected works is still that of Robert Willis (1847). A convenient reprint of the translation by Willis of the work on the circulation is available (1906).

BIBLIOGRAPHY.—The literature that has arisen on Harvey and his great discovery would fill a library. A bibliography by Geoffrey Keynes was published (1928), and a further account of the works of Harvey on the occasion of the celebration of the tercentenary of the publication of the work on the circulation by the Royal College of Physicians, London (1928). Of later writings on Harvey mention may be made of the biography by D'Arcy Power (1897); the facsimile of Harvey's Paduan diploma issued by the Royal College of Physicians, with pamphlet by J. F. Payne (1908); the volume of *Portraits of Dr. William Harvey* published by the Historical section of the Royal Society of Medicine (1913).

The Harveian oration at the Royal College oi Physicians is devoted to an annual exposition of some part of his work. Among the orations are those by W. Osler, *The Growth of Truth as Illustrated in the Discovery of the Circulation of the Blood* (1906); H. R. Spencer, *William Harvey, Obstetric Physician and Gynaecologist* (1921); A. Chaplin, *Medicine in the Century Before Harvey* (1922); C. Singer, *The Discovery of the Circulation of the Blood* (1922) gives an exposition of the history of this event. (P. H. P.-S.; C. SI.)

HARVEY, a city of Cook county. Ill.. U.S.. is 20 mi. S. of the Chicago loop. The city was from the first both an industrial and residential suburb of Chicago. The area was originally platted as South Lawn by a syndicate of land speculators in 1873. Rapid growth began in 1889 when Turlington W. Harvey, a Chicago capitalist, purchased some of the land. which was then swamp and prairie. The following year he organized the Harvey Land association. The population. negligible when the settlement was incorporated as a village in 1891. had increased to 5.000 by 1895 when Harvey was organized as a city. Engineering. machine-shop and metalworking industries mere attracted there in the 1890s and have since dominated the industrial life of the community. For comparative population figures *see* table in ILLINOIS: *Population.*

(S. L. J.)

HARVEY STEEL PROCESS. Named after the inventor, H. A. Harvey, an American metallurgist, this is a process of hardening the surface of steel, used in the production of armour plate. The essence of the process is that the plate is face-hardened by cementation of its surface. The plate is exposed in a furnace to great heat for a considerable period, about a fortnight, and covered with finely pulverized carbon. The surface of the steel is thus penetrated and carburized to a considerable depth, the front of the plate becoming of a different composition from that of the back. After thus being exposed to cementation, the plate

is withdrawn and cooled slowly to a dull red, when it is suddenly chilled by a water spray. (See IRON AND STEEL; ARMOUR PLATES; METALLURGY.)

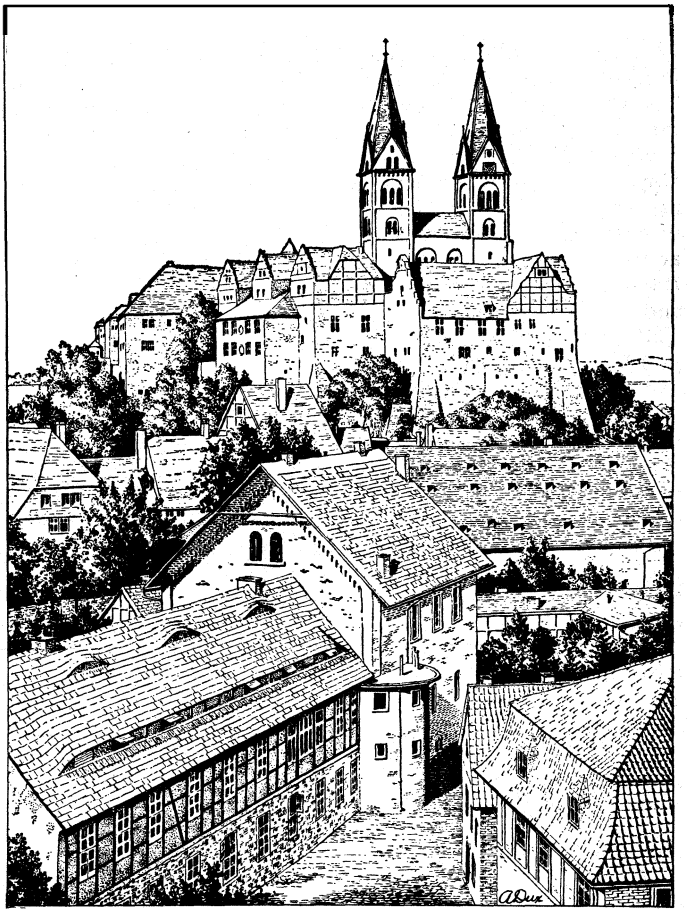
HARWICH, a municipal borough and seaport in the Harwich parliamentary division of Essex, Eng., on the extremity of a small peninsula projecting into the estuary of the Stour and Orwell, 70 mi. N.E. of London by road. Pop. (1951) 14,069. Area 2.4 sq.mi.

Harwich (Herewica, Herewyck) formed part of the manor of Dovercourt. Ring Alfred in 885 defeated 16 Danish ships in the harbour. It became a borough in 1319 by a charter of Edward II. In 1604 James I gave it a charter which provided a new constitution, and from this date began regular parliamentary representation. though two burgesses had attended parliament in 1344. In 1885 the borough was disfranchised. In 1253 Henry III granted to Roger Bigod a market there every Tuesday and a fair on Ascension day and eight days after. James I granted a Friday market and two fairs. The fair and markets died out. Town wall defenses were begun in 1337 and finished after a French raid in 1450. In the 14th century merchants came even from Spain and there was much trade in wheat and wool with Flanders; the passenger traffic appears to have been as important in the 14th century as it is now. In 1578 Sir Martin Frobisher embarked at Harwich on his arctic expedition. Shipbuilding was a large industry in the 17th century. Several Martello towers survive from Napoleonic times.

The town of Harwich occupies an elevated situation, and a wide view is obtained from Beacon hill at the southern end of the esplanade. Many of the streets are ancient and there are several old houses. The nave of All Saints church is of the 12th century and the chancel is of the 14th century. The harbour is one of the best on the east coast of England, and in stormy weather is largely used for shelter; the minimum water alongside Parkeston quay at dead low water is 17 ft. A breakwater and sea wall prevent the blocking of the harbour entrance and encroachments of the sea; and there is another breakwater at Landguard point on the opposite (Suffolk) shore of the estuary. A varied assortment of goods is exported and imports include dairy produce from Denmark, vegetables from Holland and fruit from Italy. Harwich is one of the principal English ports for continental passenger traffic. steamers regularly serving the Hook of Holland, Antwerp and Esbjerg. There are summer services to Zeebrugge, Esbjerg and Goteborg. A train ferry to Zeebrugge was inaugurated in 1924. The continental trains of the Eastern region railway run to Parkeston quay, 1 mi. from Harwich up the Stour, where the passenger steamers start. Besides shipping the chief industries are tailoring, light engineering and fishing. Between the Parkeston quay and Town railway stations is that of Dovercourt (*q.v.*), a popular watering place now united with Harwich. Harwich is an important naval base. A depot of Trinity House, the lighthouse and pilotage authority, was opened in 1953.

HARZBURG, a town of Germany, in the Land of Lower Saxony, situated at the northern foot of the Harz mountains, at the terminus of the railway from Brunswick, 5 mi. E.S.E. from Goslar and 18 mi. S. from Wolfenbiittel. Population 6.198. The town is a spa and possesses brine and carbonated springs. 4 mile and a half south from the town lies the Burgberg, 1,500 ft. above sea level, with remains of an old castle and, according to tradition, formerly an altar to the heathen god Krodo, still to be seen in the Ulrich chapel at Goslar.

HARZ MOUNTAINS, the most northerly mountain-system of Germany, situated between the rivers Weser and Elbe, occupy an area of 784 sq.mi. Their greatest length extends in a south-east and north-west direction for 57 mi. and their maximum breadth is about zo mi. An irregular series of terraced plateaus rises here and there into rounded summits, and is intersected by narrow, deep valleys. The north-western and higher part is Ober or Upper Harz; the south-eastern and more extensive part. Unter or Lower Harz; while the north-west and south-west slopes of the Upper Harz form the Vorharz. The Brocken group, dividing the Upper and Lower Harz, is generally classed with the Upper. The Upper Harz includes the Brocken (3,747 ft.), the Heinrichshohe (3,425 ft.), the Konigsberg (3,376 ft.) and the Wurmberg (3,176 ft.); the Lower Harz, the Josephshohe 'in the Auerberg group and the Viktorshohe in the Ramberg, each 1,887 ft. The Brocken (*q.v.*) is celebrated in legends immortalized in Goethe's *Faust*. While useful in working the numerous mines of the district, at other parts of their course the many streams present most picturesque scenery. The finest valley is the rocky Bodethal, with the Rosstrappe, the Hexentanzplatz, the Baumannshohle and the Bielshohle.



BY COURTESY OF THE GERMAN RAILROAD INFORMATION BUREAU

QUEDLINBURG CASTLE NEAR THE HARZ MOUNTAINS, FOR MANY CENTURIES THE RESIDENCE OF THE ABBESSES OF **QUEDLINBURG**

The Harz is a mass of Palaeozoic rock rising through the Mesozoic strata of north Germany, and bounded on all sides by faults. Slates, schists, quartzites and limestones form the greater part but the Brocken and Viktorshohe are intrusive granite, and diabases and diabase tuffs are interstratified with sediments. Silurian, Devonian and Carboniferous are represented—the Silurian and Devonian forming the greater part of the hills south-east of a line drawn from Lauterberg to Wernigerode, while north-west of this line the Lower Carboniferous predominates. A few patches of Upper Carboniferous on the borders of the hills near Ilfeld, Ballenstedt, etc., are unconformable upon the Devonian. The general strike of the folds, especially in Oberharz is about north-east. The mass belongs to the Hercynian chain of Europe (which derives its name from the Harz), and continues north-eastwards the Ardennes and Eifel. The folding took place at the close of the Palaeozoic; but the faulting to which they owe their present position was probably Tertiary. Metalliferous veins are common, amongst the best-known being the silver-bearing lead veins of Klausthal, which occur in the Culm or Lower Carboniferous.

Owing to its position as the first range which the northerly winds strike after crossing the north German plain, the climate on the summit of the Harz is generally raw and damp, even in summer. In 1895 an observatory was opened on the top of the Brocken, and the results of the first five years (1896–1900) showed a July mean of 50° Fahr., a February mean of 24·7°, and a yearly

mean of 36.6". During the same five years the rainfall averaged 64½ in. annually. But while the hilltop summer is thus ungenial, the summer heat of the lower-lying valleys is greatly tempered and cooled; so that, adding this to the scenery, forests and legendary and romantic associations, the Harz is a favourite summer resort. Among the more popular places of resort are Harzburg, Thale and the Bodethal; Blankenburg, with the Teufelsmauer and the Hermannshohle; Wernigerode, Ilsenburg, Grund, Lauterberg, Hubertusbad, Alexisbad and Suderode. Some places also have mineral springs and baths, pine-needle baths, whey cures, etc. The Harz is penetrated by several railways, among them a mountain railway up the Brocken, opened in 1898.

The northern summits are bare, but the lower slopes of the Upper Harz are rich in pines and firs. Between the forests stretch numerous peat mosses, the spongy reservoirs of which are sources of many small streams. On the Brocken are found one or two arctic and several alpine plants. In the Lower Harz the forests contain a great variety of timber. The beech attains unusual size and beauty, and the walnut tree grows in the eastern districts. The last bear was killed in the Harz in 1705, and the last lynx in 1817, and since then the wolf has become extinct; but deer, foxes, wild cats and badgers are still found.

Mining has been carried on since the middle of the 10th century, especially for rich argentiferous lead, but gold in small quantities, copper, iron, sulphur, alum and arsenic are also found. Klausthal and St. Andreasberg in the Upper Harz are the chief centres. Near the latter the Samson shaft goes down 2,790 ft. or 720 ft. below sea level. For obviating flooding of deep workings, large drainage works have been built. In 1777–99 the Georgsstollen was cut through the mountains from the east of Klausthal westward to Grund, a distance of 4 mi.; the Emst-Auguststollen, no less than 14 mi. in length, was made from the same neighbourhood to Gittelde, at the west side of the Harz, in 1851–64. Marble, granite and gypsum are worked; and vitriol is manufactured. Much wood is exported for building and other purposes, and it is used locally as fuel. The sawdust of numerous mills is collected for use in papermaking. Turf cutting, coarse lacemaking and the breeding of canaries and native songbirds also occupy many of the people. Agriculture is carried on chiefly on the plateaus of the Lower Harz; but there is excellent pasturage both in the north and in the south. In the Lower Harz, as in Switzerland, the cows, which carry bells, are driven up into the heights in early summer, returning to the sheltered regions in late autumn.

Upper and Lower Saxon, Thuringian and Frankish stocks have all contributed to form the present people, and their respective influences are still to be traced in the varieties of dialect. The boundary line between High and Low German passes through the Harz.

The Harz was the last stronghold of paganism in Germany, and to that fact are due its legends and fanciful names.

See G. Braun, *Deutschland* (Berlin, 1926).

HASA (Arabic al-Ḥasā'), the easternmost province of the kingdom of Saudi Arabia, extends S. along the west coast of the Persian gulf, with an average width of 100 to 200 mi. from the frontier of the Kuwait enclave to Jabrin on the north edge of the Empty Quarter. Pop. 150,000. The coast is low and flat, with a deep barrier of sand dunes between it and the hard desert. Along it are the five ports of Jubail, Qatif, 'Uqair (ancient Gerrha), Ras Tannura and al-Khaubar. The fort of Qatīf is a strongly-built structure attributed to the Carmathian prince, Abu-Tāhir. Ras Tannura, a port developed by the California Arabian Standard Oil Co., is the terminus of its 50-mi. pipe line from the Dhahran oil fields. Al-Khaubar, also developed by this company, lies 6 mi. easterly from Dhahran.

About 150 mi. N. lies the main oasis, which gives its name to the province and is famous for its many springs, both hot and cold; its prosperous palm groves producing the excellent *khalās* variety of date; its Shi'a population; its peculiar breed of large white donkeys; and its many settlements, of which the chief are Hufuf (30,000, elevation 600 ft.) and Mubarraz (20,000). The Kiit or fort of Hufuf is attributed to the Carmathians, and its chief architectural feature is the great mosque of Ibrāhīm Pasha, so named after a Turkish governor of the province during the early 19th century. The great market place, or Sūq al-Khamis, is the scene of great activity every Thursday, when a good business is done in the produce of the oasis and the *'abas* (mantles) and leather-work, which are the main features of local industry. 'Ain al-Hārra, near Mubarraz, and Umm-al-Siba' are the most remarkable of the numerous spring-fed pools, from which perennial streams issue for the irrigation of the oasis.

Before the Wahhabi movement of the 18th century, Hasa was ruled by princes of a dynasty called 'Urair. In due course it was absorbed by the Wahhabi empire and, on the destruction of the latter, it came within the orbit of Turkey. Relapsing again under the Wahhabi rule of Faisal Ibn-Sa'ud, it was reoccupied in 1875 by Midhat Pasha and remained part of the Turkish province of Nejd until 1914, when 'Abd-al-'Aziz Ibn-Sa'ud captured it by a bold *coup-de-main* and ejected the Turkish garrisons from Hufuf, Qatif and 'Uqair. In 1933 the Standard Oil Co. of California acquired an oil concession covering the entire sedimentary area in Saudi Arabia, which included almost all but the westernmost third of the kingdom. In 1936 this concession was shared on an equal basis with the Texas Co. The merger (known as the California Arabian Standard Oil Co.) explored and mapped either by precision triangulation or aerial methods almost the entire area under Ibn-Sa'ud's rule. In 1938, engineers mapped the formerly unexplored east coast line of Hasa. The peninsula of Qatar, closing the Gulf of Bahrein on the south, forms geographically part of Hasa, but is administered semi-independently by its Sheikhly family of Ibn-Thānī under British protection. Its boundary with Hasa was still unsettled during World War II; Ibn-Sa'ud had claims on the whole territory. The area is of importance because of the discovery of oil there. Part of the prosperity of Hasa is due to its share in the pearl fisheries along its coast.

(H. St. J. B. P.; P.K.H.)

HASAN and HUSAIN (or HOSAIN), sons of the fourth Mohammedan caliph 'Ali by his wife Fatima, daughter of Mohammed. On 'Ali's death Hasan was proclaimed caliph; but the strength of Mu'awiya, who had rebelled against 'Ali, was such that he resigned his claim on condition that he should have the disposal of the treasure stored at Kufa, with the revenues of Darabjird. This secret negotiation came to the ears of Hasan's supporters, a mutiny broke out and Hasan was wounded. He retired to Medina where he died about 669. The story that he was poisoned at Mu'awiya's instigation is generally discredited *(see* CALIPHATE). Subsequently his brother Husain revolted against Mu'awiya's successor Yazid, but was defeated and killed at Karbala on Oct. 10, 680. Husain is the hero of the religious drama performed annually *(e.g.,* at Karbala) on the anniversary of his death by the Shi'ites of Persia and India, to whom the family of 'Ali are the only true heirs of Mohammed.

See Sir W. Muir, *The Caliphate,* rev. ed (Edinburgh, 1915); Sir Lewis Pelly, *The Miracle Play* of *Hasan and Hosein* (1879).

HASAN UL-BASRI (Abū Sa'ūd ul-Ḥasan ibn Abī-l-Ḥasan Yassār ul-Baṣrī) (642–728 or 737), Arabian theologian, was born at Medina, the son of a freedman of Zaid ibn Thābit, one of the *Anṣār* (Helpers of the Prophet). He became a teacher of Basra and founded a school there, where among his pupils was Wāṣil ibn 'Atā, the founder of the Mo'tazilites. He himself was a great supporter of orthodoxy and practised ascetism. With him fear is the basis of morality, and sadness the characteristic of his religion. In politics he adhered to the earliest principles of Islam, being strictly opposed to the inherited caliphate of the Omayyads and a believer in the election of the caliph.

His life is given in Nawāwī's *Biographical Dictionary* (ed. F. Wüstenfeld, Göttingen, 1842–47). Cf. R. DOZY, *Essai sur l'histoire de l'islamisme* (1879); A. von Kremer, *Cztlturgeschichtliche Streifzüge* (1873); R. A. Nicholson, *A Literary History of the Arabs* (1907).

HASBEYA, a small Druse town of the Beka', Lebanon, at the foot of Mt. Hermon, 36 mi. W. of Damascus and set in the midst of olives, vines and other fruit trees. Its castle was held by the crusaders but recaptured by the Druses (1171).

In the immediate neighbourhood is the chief sanctuary of the Druses and the place where the founder of the sect dwelt. A large

number of Christians were massacred here in 1860. In the course of the punitive expedition the sacred and secret books of the Druses were discovered. The ground around Hasbeya is volcanic, and there are bitumen pits in the neighbourhood. An identification of the site with the Baal-Gad or Baal-Hermon of the Bible has been suggested. (E. Ro.)

HASDAI IBN SHAPRUT (*c.* 915–970/90), the founder of the new culture of the Jews in Moorish Spain in the 10th century, was born at Jaen and died at Córdoba. He was both physician and minister to Caliph Abd ar-Rahman III in Córdoba. A man of wide learning and culture, he encouraged the settlement of Jewish scholars in Andalusia, and promoted the Jewish renaissance in Europe.

See article in *Jewish Encyclopedia.*

HASDEU or HĂJDEU, **BOGDAN PETRICEICU** (1836–1907), Rumanian philologist, was born at Khotin, Bessarabia, and studied at the University of Kharkov. In 1858 he first settled in Jassy as professor of the high school and librarian. He may be considered as the pioneer in many branches of Rumanian philology and history. At Jassy he started his *Archiva historica a Romaniei* (1865–67), in which a large number of old documents in Slavonic and Rumanian were published for the first time. In 1870 he inaugurated *Columna lui Traian,* the best philological review of the time in Rumania. In his *Cuvente den Bătrâni* (2 vol., 1878–81) he was the first to contribute to the history of apocryphal literature in Rumania. His *Historia critica a Romanilor* (18; 5), though incomplete. marks the beginning of critical investigation into the history of Rumania. Hasdeu edited the ancient Psalter of Coresi of 1577 (*Psaltirea lui Coresi,* 1881). In 1876 he was appointed director of the state archives in Bucharest and in 1878 professor of philology at the University of Bucharest. His works include one drama. *Rasvan şi Vidra.*

After the death of his only child Julia in 1888 Hasdeu became a mystic and a strong believer in spiritualism. He died at Campina on Sept. 7, 1907. (M. G.)

HASDRUBAL, the name of several Carthaginian generals, the most important being:

1. The son-in-law of Hamilcar Barca (*q.v.*), whom he followed in his campaign against the governing aristocracy at Carthage at the close of the First Punic War and in his subsequent wars in Spain. After Hamilcar's death (228 B.C.), Hasdrubal. who succeeded him in the command, extended the new province by diplomacy and consolidated it by the foundation of New Carthage (Cartagena) as its capital and by a treaty with Rome which fixed the frontier on the Ebro. In 221 he was killed by an assassin.

Polybius ii. 1; Livy xxi, 2; Appian, *Hispanica,* 4–8.

2. The second son of Hamilcar Barca. Left in command of Spain when his brother Hannibal went to Italy (218 B.C.). he fought for seven years against Publius Cornelius Scipio and his brother Gnaeus. A defeat on the Ebro in 215 prevented him from joining Hannibal in Italy at a critical moment. but in 211 he completely routed his opponents. He nas subsequently outgeneralled at Baecula bv the younger P. Cornelius Scipio. Nevertheless, by a retreat he evaded Scipio and broke into central Italy (207). He was ultimately defeated on the banks of the Metaurus (*q.v.*), his head being thrown into Hannibal's camp by order of the Roman general C. Claudius Nero.

3. The son of Gisgo. who commanded Carthaginian armies in Spain (214–206 B.C.) and in Africa (205–203).

Polybius x, 34–xi, 3; Livy xxvii, 1–51; Appian, *Bellum Hannibalicum,* ch. lii *sqq.;* C. Lehmann, *Die Angriffe der drei Barkiden auf Italien* (Leipzig, 1905). *See* also PUNIC WARS. (H. H. Sd.)

HASE, CARL BENEDICT (1780–1864), French Hellenist. of German extraction. was born at Sulza near Naumburg on May 11. 1780, and died in Paris on March 21. 1864. He made his way to Paris on foot in 1801. and from being employed to edit Johannes Lydus by Choiseul-Gouffier. devoted himself to Byzantine studies. In addition to various professorships, in 1812 he nas chosen to supervise the studies of Louis Napoleon and his brother. His most important works are the editions of Leo Diaconus and other Byzantine nriters (1819), and of Johannes Lydus. *De ostentis* (1823), *a* masterpiece of textual restoration, the difficulties of which were aggravated by the fact that the manuscript had for a long time been stowed away in a wine barrel in a monastery.

See J. D. Guigniaut, *Notice historique sur la vie et les travaux de Carl Benedict Hase* (186;) ; articles in *Nouvelle Biographie générale* and *Allgemeine deutsche Biographie;* and a collection of autobiographical letters, *Brieje von der Wandetung una aus Paris,* edited by O. Heine (1894), containing a vivid account of Hase's journey, his enthusiastic impressions oi Paris and the hardships of his early life.

HASE, KARL AUGUST VON (1800–1890), German Protestant theologian and church historian, was born at Steinbach, Saxony on Aug. 25, 1800. He studied at Leipzig and Erlangen, and was professor of theology at Jena from 1829 to 1883. He died at Jena on Jan. 3, 1890. Hase's aim was to reconcile modern culture with historical Christianity in a scientific way. His views are presented scientifically in his *Evangelisch-protestantische Dogmatik* (1826; 6th ed., 1870), the value of which "lies partly in the full and judiciously chosen historical materials prefixed to each dogma. and partly in the skill, caution and tact with which the permanent religious significance of various dogmas is discussed" (Otto Pfleiderer).

More popular in style is his *Gnosis oder prot.-evang. Glaubenslehre* (3 vol., 1827–29; 2nd ed., 1869–70). But his reputation rests chiefly on his treatment of church history in his *Kirchengeschichte, Lehrbuch zunächst fur akadenzische Vorlesungen* (1834, 12th ed., 1900).

For his life *see* his *Ideale und Irrtümer* (1872; 5th ed., 1894) and *Annalen meines Lebens* (1891); *R.* Bürkner, *Karl von Hase* (1900). *See* also O. Pfleiderer, *Development of Theology* (1890); *F.* Lichtenberger, *Hist. of German Theology* (1889).

HASHEMITE KINGDOM OF THE JORDAN: *see* JORDAN.

HASHISH or HASHEESH, the Arabic name, meaning literally "dried herb," for the various preparations of the Indian hemp plant *(Cannabis indica),* used as a narcotic or intoxicant in the East. and either smoked, chewed, or drunk *(see* HEMP). From the Arabic hashishin. *i.e.,* "hemp-eaters," comes the English "assassin" (see ASSASSIN).

HASKOVO, Bulgaria: *see* KHASKOVO.

HASLEMERE, an urban district (1933) in the Farnham parliamentary division of Surrey. Eng.. 41 mi. S.W. of London by road. Pop. (1951) 12.003. Area 9.0 sq.mi. It is a residential area near the Sussex border in an elevated valley between the ridges of Hindhead (Gibbet hill. 895 ft.) and Blackdown (918 ft.). These summits are open heath, but their flanks are wooded and deeply scored by steep valleys. of which the most remarkable is the Devil's Punch Bowl. on the west flank of Hindhead. On Blackdown is Aldworth. built for Alfred. Lord Tennyson. Both hill areas are largely National Trust property.

Haslemere was a borough from 1596 until 1831. There is an Educational and Natural History museum founded in 1895 by Sir Jonathan Hutchinson.

HASLER or HASSLER, **HANS LEO (VON)** (1564–1612), German composer. was born at Nürnberg. Ger.. on Oct. 2 j. 1564. He was taught by his father. Isaac Hasler, a musician of some standing in Nürnberg, and afterward became a pupil of Andrea Gabrieli in Venice. Italy. In 1585 he became organist to Octavian Fupger at Augsburg and in 1600 was appointed musical director in that city. He next became organist of the Frauenkirche at Nürnberg (1601) and in 1608 entered the service of Augustus I of Saxony, continuing with his successor John George. He died on June 8, 1612. at Frankfurt, whence he had accompanied John George to the imperial election.

Hasler is considered the greatest German representative of the Venetian school, and he had a deep influence in turning German music toward Italy and away from the Netherlands. A fine contrapuntalist. he wrote church music (masses. motets. psalms, etc.) of great beauty, but his fame rests on the charm of his secular songs. which are essentially German in spirit. One of the melodies in his *Lustgarten neuer teutscher Gesäng,* "Mein G'muth ist mir verwirret" was adapted to the chorale "O Haupt voll Blut und Wunden" and was used by J. S. Bach in his Passion according to St. Matthew.

JACOB HASLER (1569–after 1618), younger brother of Hans Leo, was also an organist and composer. He was organist to Christoph Fugger at Augsburg from 1593, to Count Eitel Fritz of Hohenzollern at Hechingen from 1597, and to the imperial court at Prague from 1602 to 1612. He published organ and church music and also madrigals.

KASPAR HASLER (1562–1618), elder brother of Hans Leo. was organist at the Lorenz-Kirche, Niirnberg, and edited several collections of Italian motets.

HASLINGDEN, a market town and municipal borough (1891) in the Rossendale parliamentary division of Lancashire, Eng., 17 mi. N.N.W. of Manchester by road. Pop. (1951) 14,513. Area 12.8 sq.mi. The old town stood on a slope on the border of the ancient Rossendale forest, but the modern part has extended about its base.

The parish church of St. James (rebuilt 1780) retains a 16th-century tower. Woolen manufactures have largely given place to the making of cotton goods, rubber, footwear, poultry equipment (pedigree poultry are bred), chemicals and engineering; stone is quarried nearby. There is a weekly cattle market. To the northwest is Haslingden moor and Thirteen Stones hill, once an ancient stone circle.

HASSAM, (FREDERICK) CHILDE (1859–1935), U.S. painter and etcher, an important exponent of Impressionism in American art, was born in Dorchester, now part of the city of Boston: Mass., on Oct. 17, 1859 and studied in Boston and Paris. He soon fell under the influence of the Impressionists, and took to painting in a style of his own, in brilliant colour, with effective touches of pure pigment. He settled in New York city on his return from Paris, where he became a member of the group of U.S. Impressionists known as the Ten American Painters. Scenes of New York life remained his favourite subject matter, though he also did New England and rural New York landscapes. Hassam received many medals and awards. He died on Aug. 27, 1935.

HASSAN, a town and district of Mysore, India. The town, 61 mi. N.W. of Mysore city, had a population in 1951 of 24,869. It was founded in the 11th century.

HASSAN DISTRICT divides naturally into the Malnad, or hill country, including some of the highest ranges of the Western Ghats, and the Maidan or plain country, sloping toward the south. The Hemavati, which flows into the Cauvery in the extreme south, is the most important river. The upper slopes of the Western Ghats are clothed with forests, and wild animals abound. Minerals found are gold, magnesite, mica, corundum and asbestos. The soil of the valleys is rich red loam. The area is 2,638 sq.mi. The population in 1951 was 715,135.

The district contains remarkable monuments! such as the colossal Jain image at Sravana Belgola (a monolith 57 ft. high on the summit of a hill) and the great temple at Halebid (*q.v.*). Coffee is extensively cultivated. The Southern railway traverses the northeast of the district, and Hassan has a station on the line from Arsikere to Mysore.

The history of Hassan begins with the Hoysala dynasty, which lasted from the 11th until the 14th century. The capital was at Dwarasamundra (Dorasamudra or Dwaravati-pura), the ruins of which are scattered. around the village of Halebid. The earlier kings professed the Jain faith, but the finest temples were erected to Siva by later monarchs. At their zenith all south India owned their sway.

HASSAN IBN THABIT (*c.* 563–*c.* 674), Arab poet, best known for his poems in defense of Mohammed. He was born in Medina. a member of the tribe of Khazraj. In his youth he traveled to Hira and Damascus, then settled in Medina, where, after the advent of Mohammed, he accepted Islam and became the new religion's first poet, using in his verse many phrases from the Koran. He is said to have lived to be over 110 years old. He was an able satirist. but his poetry is regarded as lacking in distinction. His works were edited by H. Hirschfeld, with introduction (1910).

HASSE, JOHANN ADOLPH (1699–1783), German musical composer, was born at Bergedorf near Hamburg. on March 25. 1699. After singing in a travelling operatic cdmpany and at the court theatre of Brunswick, he made his début as a composer at that theatre with the opera *Antigonus.* Afterward he went to Italy to complete his studies under Porpora, with whom, however, he seems to have disagreed both as a man and as an artist. But he gained the friendship of Alessandro Scarlatti, to whom he owed his first commission for a serenade for two voices, sung by two of the greatest singers of Italy. Farinelli and Signora Tesi. Subsequently his opera *Sesostrato,* written for the Royal opera at Naples in 1726. made his name known all over Italy. He then spent some years in Venice. where he married (1730) the soprano singer Faustina Bordogni (1693–1783) with whom he was invited to Dresden by the splendour-loving elector of Saxony, Augustus II. In 1733 Hasse was invited to London by the aristocratic clique inimical to Handel. But he modestly and wisely declined to become the great master's rival, remaining in London only long enough to superintend the rehearsals for his opera *Artaserse* (first produced at Venice, 1730). Meanwhile Faustina had remained at Dresden, the declared favourite of the public and unfortunately also of the elector; her husband, who remained attached to her was only allowed to see her at long intervals. In 1739, after the death of Augustus II, Hasse settled permanently at Dresden till 1763, when he and his wife retired from court service. Later! however, he went with his family to Vienna: and added several operas to the great number of his works already in existence. His last work for the stage was the opera *Ruggiero* (1771), written for the wedding of Archduke Ferdinand at Milan. On the same occasion a work by Mozart, then 14 years old, was performed. and Hasse observed "this youngster will surpass us all." Hasse died at Venice on Dec. 23. 1783. His compositions, many of which were popular during his lifetime but were soon forgotten, include 120 operas, besides oratorios, cantatas, masses and many instrumental works.

HASSELT, ANDRÉ HENRI CONSTANT VAN (1806–1874), Belgian Romantic poet who exercised a strong influence on French literature in Belgium before the revival inspired by the founding of the literary periodical *La Jeune Belgique* (1881). He was born in Maastricht, Holland, on Jan. 5, 1806, and obtained Belgian nationality in 1833, settling in Brussels, where he was employed at the Bibliotheque de Bourgogne before becoming an inspector of schools. He knew Victor Hugo. Alexandre Dumas and other French Romantic writers, but was also influenced by the German lyric poets. His first book of poems, *Primevères* (1834) was followed by the patriotic *La Belgique* (1842) and by poems on a variety of themes. His chief work, *Les Quatre Incarnations du Christ,* appeared first in 1863, and was augmented in 1867 and re-edited in 1908. He also wrote novels for young people. and a few historical studies. He died in Brussels, Dec. 1, 1874.

In spite of imperfections of form and a declamatory style, Van Hasselt's work remains one of the highest achievements in Belgian poetry during the greater part of the 19th century. Romantic in conception and austerely spiritual, it displays great literary beauty. His chief contribution, however, consists in his introduction into French prosody of rhythms and metrical devices from German poetry, nhich he knew by heart.

Van Hasselt's masterpiece is his epic, *Les Quatre Incarnations du Christ,* in which he presents great historical events as marking the progress of society under the influence of Christianity toward a final establishment of Christ's kingdom upon earth. The poem is admirably constructed and is often extremely moving.

His works were published in ten volumes (1876–77).

See M. Reichert, *Les Sources Allemandes des oeuvres poétiques d'André van Hasselt* (1933). (J.-E.-M.-G. D.)

HASSELT, the capital of the Belgian province of Limburg. Pop. (1955 est.) 33.564. It stands at the junction of several important roads and railways from Maaseyck. Maastricht and Liège. It has many breweries and distilleries, and makes coarse gin called Hasselt spirit. On Aug. 6, 1831, the Dutch troops obtained there their chief success over the Belgian nationalists during the War of Independence. A septennial fete is held on the day of Assumption. Aug. 15, in honour of the Virgin under the name of Virga Jesse. Fir trees and branches are planted in front of the houses. The figure of the giant who is supposed to have once held the

Hazelbosch under his terror is paraded on this occasion as the "lounge man." Originally this celebration was held annually, but in the 18th century it was restricted to once in seven years. Hasselt in the 20th century began to grow as the industrial capital of the new Kempen coalfield.

HASSENPFLUG, HANS DANIEL LUDWIG FRIEDRICH (1794–1862), German statesman, was born at Hanau, Hesse, on Feb. 26, 1794. He studied law at Gottingen, graduated in 1816, and took his seat as Assessor in the judicial chamber of the board of government (*Regierungskollegium*) at Cassel, of which his father Johann Hassenpflug was also a member. He rose rapidly, and in May 1832 was appointed successively minister of justice and of the interior. He now became conspicuous in the constitutional struggles of Germany. He deliberately set to work to reverse the Hessian constitution of 1831. The story of the constitutional deadlock that resulted belongs to the history of Hesse-Cassel and Germany; so far as Hassenpflug himself was concerned, it made him, more even than Metternich, the Mephistopheles of the Reaction to the German people. In the summer of 1837 he was suddenly removed from his post as minister of the interior and he thereupon left the elector's service.

In 1838–39 he was head of the administration of the little principality of Hohenzollern-Sigmaringen, and in 1839–40 civil governor of the grand-duchy of Luxemburg. From 1841 to 1850 he was in the Prussian judicial service. In 1850 he was tried for peculation and convicted; and, though this judgment was reversed on appeal, he left the service of Prussia.

He was now recalled by the elector of Hesse, and immediately threw himself again with zeal into the struggle against the constitution. Finding the opinion of all classes, including the army, solidly against him, he decided to risk all on an alliance with the reviving fortunes of Austria, which was steadily working for the restoration of the status quo overthrown by the revolution of 1848. On his advice the elector seceded from the Northern Union established by Prussia and, on Sept. 13 fled from Hesse with his minister. They went to Frankfort, where the federal diet had been re-established, and on the 21st persuaded the diet to decree armed intervention in Hesse. This decree, carried out by Austrian troops, all but led to war with Prussia, but the unreadiness of the Berlin government led to the triumph of Austria and of Hassenpflug, who at the end of the year was installed at Cassel as minister of finance. He was loathed and despised by all, and disliked even by his master. In November 1853, he was publicly horse-whipped by the count of Isenburg-Wachtersbach, the elector's son-in-law. The count was pronounced insane; but Hassenpflug tendered his resignation. It was not accepted; and it was not till Oct. 16, 1855 that he was finally relieved of his offices. He died at Marburg on Oct. 16, 1862. He lived just long enough to hear of the restoration of the Hesse constitution of 1831 (June 21, 1862), which it had been his life's mission to destroy. Of his publications the most important is Actenstucke, die landstiindischen Anklagen *wider* den *Kurfürstlichen* hessischen *Staatsminister Hassenpflug.* Ein *Beitrag zur* Zeitgeschichte *und zum* neueren deutschen *Staatsrechte,* anonym. (Stuttgart and Tiibingen, 1836.) He was twice married, his first wife being the sister of the brothers Grimm.

See the biography by Wippermann in *Allgemeine* deutsche *Biographie,* with authorities.

HASTINAPUR, an ancient city of India, in the Meerut district of the Uttar Pradesh (formerly United Provinces), lying on the banks of a former bed of the Ganges, 22 mi. N.E. of Meerut. It formed the capital of the great Pandava kingdom, celebrated in the Mahabharata, and probably one of the earliest Aryan settlements outside the Punjab. Tradition points to a group of shapeless mounds as the residence of the Lunar princes of the house of Bharata whose deeds are commemorated in the great national epic. The town was finally swept away by a flood of the Ganges, and the capital was transferred to Kausambi.

HASTINGS, a famous English family. Sir Henry de Hastings (d. 1268), was summoned to parliament as a baron by Simon de Montfort in 1264. Having joined Montfort's party Sir Henry led the Londoners at the battle of Lewes and was taken prisoner at Evesham. He was among those who resisted the king at Kenilworth, and after the issue of the Dictum de Kenilworth he commanded the remnants of the baronial party when they made their last stand in the isle of Ely, submitting to Henry in July 1267.

His son JOHN, BARON HASTINGS (c. 1262–c. 1313), married Isabella (d. 1305), daughter of William de Valence, earl of Pembroke, a half-brother of Henry III. His paternal grandmother, Ada, was a younger daughter of David, earl of Huntingdon, and a niece of the Scottish king, William the Lion; and in 1290 when Margaret, the maid of Norway, died, Hastings came forward, unsuccessfully, as a claimant for the vacant throne. He fought constantly either in France or in Scotland; he led the bishop of Durham's men at the celebrated siege of Carlaverock castle in 1300; and with his brother Edmund he signed the letter which in 1301 the English barons sent to Pope Boniface VIII, repudiating papal interference in the affairs of Scotland; on two occasions he represented the king in Aquitaine.

LAURENCE HASTINGS (1318?–1348), son of John, 3rd baron, was created earl of Pembroke in 1339. (See PEMBROKE, EARLS OF.)

HASTINGS, FRANCIS RAWDON-HASTINGS, 1ST MARQUESS OF (1754–1826), British soldier and governor general of India, born on Dec. g, 1754, was the son of Sir John Rawdon of Moira, County Down, 4th baronet, who was created Baron Rawdon of Moira and afterward earl of Moira, in the Irish peerage. Lord Rawdon, as he was then called, was educated at Harrow and Oxford and joined the army in 1771 as ensign in the 15th foot. His life may be divided into four periods: from 1775 to 1782 he was engaged with much distinction in the American war; from 1783 to 1813 he held various high appointments at home and took an active part in the business of the house of lords; from 1813 to 1823 was the period of his labours in India; after retiring from which, in the last years of his life (1824–26), he was governor of Malta. He was created an English peer, Baron Rawdon, in 1783 and succeeded his father as earl of Moira in 1793.

In 1812 he was appointed governor general of Bengal and commander in chief of the forces in India. He landed at Calcutta and assumed office in succession to Lord Minto in Oct. 1813. One of the chief questions which awaited him was that of relations with the Gurkha state of Nepal. Lord Moira, after travelling through the northern provinces to study the question, declared war against Nepal (Nov. 1814). The enemy's frontier was 600 mi. long, and Lord Moira, who directed the plan of the campaign, resolved to act offensively along the whole line. In 1816 the Gurkhas abandoned the disputed districts, ceded some territory to the British and agreed to receive a British resident. This affair brought Lord Moira the marquessate of Hastings (1817).

He had now to deal with a combination of Maratha powers. In 1816 the Pindaris entered British territory in the Northern Circars, where they destroyed 339 villages. Before the end of 1817 the preparations of Lord Hastings were completed, when the peshwa suddenly broke into war, and the British were opposed at once to the Maratha and Pindari powers, estimated at 200.000 men and 500 guns. Both were utterly shattered in a brief campaign of four months (1817–18). The peshwa's dominions were annexed; and those of Sindhia, Holkar and the raja of Berar lay at the mercy of the governor general and were saved only by his moderation. Thus, 60 years after the battle of Plassey, the supremacy of British power in India was effectively established.

While Lord Hastings' achievements were appreciated in India, the court of directors of the East India company grumbled at his having extended British territory. They also disliked his measures for introducing education among the natives and his encouraging the freedom of the press. In 1819 he obtained the cession by purchase of the island of Singapore. In finance his administration was very successful, as, in spite of his wars, he showed an annual surplus of £2,000,000 sterling. Lord Hastings did not escape unjust detraction. His last years of office were embittered by the discussions on the affairs of the banking-house of W. Palmer and company. Annoyed by the insinuations made against him. he tendered his resignation in 1821, though he did not leave India till the first day of 1823. He was much exhausted by his nine years

of labour in India, and his fortune was gone. In 1824 he received the comparatively small post of governor of Malta. He died on Nov. 28, 1826, leaving a request that his right hand should be cut off and preserved till the death of the marchioness of Hastings and then be interred in her coffin.

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HASTINGS, FRANK ABNEY (1794–1828), British naval officer and philhellene, was son of Lieut. Gen. Sir Charles Hastings, a natural son of Francis Hastings, 10th earl of Huntingdon. He served in the navy from 1805 to 1820. In 1822 he joined the Greek service. For two years he took part in the naval operations in the Gulf of Smyrna and elsewhere. He saw that the light squadrons of the Greeks must in the end be overpowered by the heavier Turkish navy, clumsy as it was; and in 1823 he drew up and presented to Lord Byron an able memorandum which was laid before the Greek government in 1824. This paper contains the germs of the great revolution afterward effected in naval gunnery and tactics. In substance the memorandum advocated the use of steamers in preference to sailing ships, and of direct fire with shells and hot shot, as a more trustworthy means of destroying the Turkish fleet than fire ships.

The application of Hastings' ideas led necessarily to the disuse of sailing ships, and the introduction of armour. Largely by the use of his own money, of which he is said to have spent £7,000, he was able to some extent to carry out his bold plans. In 1824 he came to England to obtain a steamer, and in 1825 he had fitted out a small steamer named the "Karteria" (Perseverance), manned by Englishmen, Swedes and Greeks, and provided with apparatus for the discharge of shell and hot shot. The effect produced by his shells in an attack on the sea line of communication of the Turkish army, then besieging Athens at Oropus and Volo in March and April 1827, proved the truth of his contention. After the defeat of the Greeks round Athens, Hastings, in co-operation with Gen. Sir R. Church (*q.v.*), shifted the scene of the attack to western Greece. There his destruction of a small Turkish squadron at Salona bay in the Gulf of Corinth (Sept. 29, 1827) provoked Ibrahim Pasha into the aggressive movements which led to the destruction of his fleet by the allies at Navarino (*q.v.*) on Oct. 20, 1827. On May 25, 1828, Hastings was wounded in an attack on Anatolikon, and he died in the harbour of Zante on June 1.

See T. Gordon, *History of the Greek Revolution* (1832); G. Finlay, *History of the Greek Revolution* (Edinburgh, 1861).

HASTINGS, WARREN (1732–1818), the first governor general of British India, was born on Dec. 6, 1732, in the hamlet of Churchill, near Daylesford, of an old Oxfordshire family which had fallen into poverty. His mother died a few days after his birth; his father, Pynaston Hastings, drifted away to die obscurely in the West Indies. Young Hastings attended a charity school in his native village until, at eight, he was taken in charge by an uncle, Howard Hastings, who held a post in the customs. After two years at a private school at Newington Butts, he was sent to Westminster, where Edward Thurlow, Lord Shelburne, Elijah Impey and the poets William Cowper and Charles Churchill were among his contemporaries. In 1749 his uncle died, leaving him to the care of a distant kinsman, Creswicke, who sent his ward to seek his fortune as a writer in Bengal.

When Hastings landed at Calcutta in Oct. 1750 the affairs of the East India com'pany were at a low ebb. In southern India French influence was predominant. Bengal, however, was under the able government of Ali Vardi Khan, who peremptorily forbade the foreign settlers at Calcutta and Chandernagore to introduce feuds from Europe. Hastings was placed in charge of an *aurang* or factory in the interior, where his duties would be to superintend the weaving of silk and cotton goods under a system of money advances. In 1753 he was transferred to Cossimbazar, the river port of the native capital of Murshidabad. In 1756 the old nawab died, and was succeeded by his grandson Suraj ud-Daula, a young madman of 19, whose name is indelibly associated with the tragedy of the Black Hole. When Suraj ud-Daula resolved to drive the English out of Bengal, his first step was to occupy the fortified factory at Cossimbazar and to imprison Hastings and his companions. Hastings was soon released at the intercession of the Dutch resident and made use of his position at Murshidabad to open negotiations with the English fugitives at Falta, the site of a Dutch factory near the mouth of the Hooghly. After a while he fled from the Mohammedan court to join the main body of the English at Falta.

When the relieving force arrived from Madras under Col. Robert Clive and Adm. Charles Watson, Hastings enrolled as a volunteer and took part in the action which led to the recovery of Calcutta. Clive appointed him in 1758 resident at the court of Murshidabad. There he first came into collision with the Bengali Brahman, Nuncomar. During his three years of office as resident he served the company well, but his name nowhere occurs in the official lists of those who derived pecuniary profit from the necessities and weakness of the native court. In 1761 he was promoted to be member of council, under the presidency of Henry Vansittart, who had been introduced by Clive from Madras. The period of Vansittart's government has been truly described as "the most revolting page of our [British] Indian history." The administration was left in the hands of the nawab, while a few irresponsible English traders had drawn to themselves all real power. The members of council, the commanders of the troops and the commercial residents plundered on a grand scale. The youngest servant of the company claimed the right of trading on his own account, free from taxation and from local jurisdiction, not only for himself but also for every native subordinate whom he might permit to use his name.

This exemption, threatening the very foundations of the Moslem government, finally led to a rupture with the nawab. Sometimes in conjunction only with Vansittart, sometimes absolutely alone, Hastings protested unceasingly against the policy and practices of his colleagues. On one occasion he was stigmatized in a minute by Stanlake Batson with "having espoused the nawab's cause, and as a hired solicitor defended all his actions, however dishonourable and detrimental to the Company." An altercation ensued. Batson gave him the lie and struck him in the council chamber. When war was actually begun, Hastings officially recorded his previous resolution to resign, in order to repudiate responsibility for measures which he had always opposed. After the decisive victory of Buxar over the allied forces of Bengal and Oudh, he resigned and sailed for England in Nov. 1764.

Fourteen years' residence in Bengal had not made Hastings a rich man, estimated by the opportunities of his position. According to the custom of the time he had augmented his slender salary by private trade. At a later date he was charged by Edmund Burke with having taken up profitable contracts for supplying bullocks for the use of the company's troops. It is admitted that he conducted by means of agents a large business in timber in the Gangetic Sundarbans. When at Falta he had married Mrs. John Buchanan, the widow of an officer. She bore him two children: one of them died in infancy at Murshidabad and was shortly followed by her mother (1759); the other child, a son, was sent to England and died shortly before his father's return. While at home Hastings made the personal acquaintance of Samuel Johnson and Lord Mansfield. In 1766 he was called upon to give evidence before a committee of the house of commons upon the affairs of Bengal.

In the winter of 1768, Hastings received the appointment of second in council at Madras. Among his companions on his voyage round the Cape were the Baron Imhoff, a speculative portrait painter, and his wife Maria, a lady of some personal attractions and great social charm, who was destined henceforth to be Hastings' lifelong companion. At Madras he won the good will of his employers by devoting himself to the improvement of their manufacturing business; and he kept his hands clean from the prevalent taint of pecuniary transactions with the nawab of the Carnatic. He drew up a scheme for the construction of a pier

at Madras, to avoid the dangers of landing through the surf, and instructed his brother-in-law in England to obtain estimates from the engineers James Brindley and John Smeaton.

In 1772 he was nominated to the second place in council in Bengal with a promise of the reversion of the governorship when John Cartier should retire. The second governorship of Clive was marked by the transfer of the *diwani* or financial administration from the Mogul emperor to the company and by the enforcement of stringent regulations against the besetting sin of peculation. But Clive was followed by two inefficient successors; and in 1770 occurred the most terrible Indian famine on record, which is credibly estimated to have swept away one-third of the population. In April 1772 Warren Hastings took his seat as president of the council at Fort William. His first care was to effect a radical reform in the system of government. Clive's plan of governing through the agency of the native court had proved a failure. The directors were determined "to stand forth as *diwan* and take upon themselves by their own servants the entire management of the revenues." All the officers of administration were transferred from Murshidabad to Calcutta, which Hastings boasted he would make the first city in Asia.

This reform involved the ruin of many native reputations and brought Hastings for a second time into collision with Nuncomar. At the same time a settlement of the land revenue on leases for five years was begun, and the police and military systems of the country were placed upon a new footing. Hastings was a man of immense industry, with an insatiable appetite for detail. The whole of this large series of reforms was conducted under his own personal supervision. As a measure of economy, the stipend paid to the titular nawab of Bengal, who was then a minor, was reduced by one-half—to 16 *lakhs* a year (about £160,000). Thomas Macaulay imputes this reduction to Hastings as a characteristic act of financial immorality; but it had been expressly enjoined by the court of directors, in a dispatch dated six months before Hastings took up office. His bargains with Shuja ud-Daula, the nawab wazir of Oudh, stand on a different basis.

The Marathas had got possession of the person of the Mogul emperor, Shah Alam, from whom Clive obtained the grant of the *diwani* of Bengal, Bihar and Orissa in 1765 and to whom he assigned for the upkeep of his dignity and expenses the districts of Kora and Allahabad and a tribute of £325,000.

With the emperor in their camp, the Marathas were threatening the province of Oudh. Hastings, as a deliberate measure of policy, withheld the tribute due to the emperor and resold Allahabad and Kora to the wazir of Oudh. The Marathas retreated, and danger for the time was dissipated by the death of their principal leader. The wazir now determined to satisfy an old quarrel against the adjoining tribe of Rohillas, who had established themselves for some generations in a fertile tract west of Oudh. They were not so much the occupiers of the soil as a dominant caste of warriors and freebooters. But in those troubled days their title was as good as any to be found in India. After some hesitation, Hastings allowed the company's troops to be used to further the designs of his Oudh ally, in consideration of a payment to the Bengal treasury. The Rohillas were defeated. Some of them fled the country, and so far as possible Hastings obtained terms for those who remained. The fighting, no doubt, on the part of the wazir was conducted with all the savagery of oriental warfare; but there is no evidence that it was a war of extermination.

Meanwhile the Regulating act, passed by Lord North's ministry in 1773, changed the constitution of the Bengal government. The council was reduced to four members with a governor general, with certain indefinite powers of control over the presidencies of Madras and Bombay. Hastings was named in the act as governor general for a term of five years. The council consisted of Gen. Sir John Clavering and Col. George Monson, two third-rate politicians of considerable parliamentary influence; Philip Francis (*q.v.*), then known only as an able permanent official; and Richard Barwell, of the Bengal civil service. At the same time a supreme court of judicature was appointed, composed of a chief and three puisne judges, to exercise an indeterminate jurisdiction at Calcutta. The chief justice was Sir Elijah Impey, already mentioned as a schoolfellow of Hastings at Westminster. The tendency of the Regulating act was to establish for the first time the influence of the crown, or rather of parliament, in Indian affairs. The new members of council disembarked at Calcutta on Oct. 19, 1774; and on the following day commenced the long feud which scarcely terminated 21 years later with the acquittal of Warren Hastings by the house of lords. Taking advantage of an ambiguous clause in their commission, the majority of the council (for Barwell uniformly sided with Hastings) reviewed the recent measures of the governor general. All that he had done they condemned; all that they could they reversed. Hastings was reduced to the position of a cipher at their meetings. They listened to detailed allegations of corruption brought against him by Nuncomar.

Hastings disdained to reply and referred his accuser to the supreme court. The majority of the council, in their executive capacity, resolved that the governor general had been guilty of peculation and ordered him to refund. A few days later Nuncomar was thrown into prison on a charge of forgery preferred by a private prosecutor, tried before the supreme court sitting in bar, found guilty by a jury of Englishmen and sentenced to be hanged. Hastings always maintained that he did not cause the charge to be instituted, and the legality of Nuncomar's trial is thoroughly proved by Sir James Stephen. The majority of the council abandoned their supporter, who was executed in due course. He had forwarded a petition for reprieve to the council, which Clavering took care should not be presented in time and which was subsequently burned by the common hangman on the motion of Francis. Meanwhile, Hastings had sent an agent to England with a general authority to place his resignation in the hands of the company under certain conditions. The resignation was promptly accepted, and one of the directors was appointed to the vacancy. But in the meantime Colonel Monson had died, and Hastings was thus restored, by virtue of his casting vote, to the supreme management of affairs. He refused to ratify his resignation; and when Clavering attempted to seize the governor generalship, he obtained an opinion from the judges of the supreme court in his favour. Hastings was never again subjected to gross insult, and his general policy prevailed.

A crisis was now approaching in foreign affairs. Bengal was prosperous and free from external enemies on every quarter. But the government of Bombay had hurried on a rupture with the Maratha confederacy at a time when France was on the point of declaring war against England and when England was faced with revolt in America. Hastings shouldered the whole responsibility of military affairs. The French settlements in India were promptly occupied. On the part of Bombay, the Maratha war was conducted with procrastination and disgrace. But Hastings avenged the capitulation of Wargaon by the complete success of his own plan of operations. Thomas Goddard with a Bengal army marched across India and achieved almost without a blow the conquest of Gujarat. William Popham stormed the rock fortress of Gwalior, then deemed impregnable and the key of central India; and by this feat held in check Sindhia, the most formidable of the Maratha chiefs. The Bhonsla Maratha rajah of Nagpur, whose dominions bordered on Bengal, was won over by the diplomacy of an emissary of Hastings.

But while these events were taking place, a new source of embarrassment had arisen at Calcutta. The supreme court assumed a jurisdiction of first instance over the entire province of Bengal. The English common law was arbitrarily extended to an alien system of society. *Zamindars*, or government renters, were arrested on mesne process; the sanctity of the *zenana* was violated by the sheriff's officer; the deepest feelings of the people and the entire fabric of revenue administration were alike disregarded. On this point the entire council acted in harmony. Hastings and Francis went joint bail for imprisoned natives of distinction. At last, after the dispute between the judges and the executive threatened to become a trial of armed force, Hastings set it at rest by a characteristic stroke of policy. A new judicial office was created in the name of the company, to which Impey was appointed. The understanding between Hastings and Francis was

for a short period extended to genera1 policy. Francis received patronage for his friends, while Hastings was to be unimpeded in the control of foreign affairs. But a difference of interpretation arose. Hastings recorded in an officialminute that he had found Francis' private and public conduct to be "void of truth and honour." They met as duellists. Francis fell wounded and soon afterward returned to England.

The Maratha war was not yet terminated when a more formidable danger threatened the English in India. The Madras authorities had irritated beyond endurance the two greatest Mussulman powers in the peninsula, the nizam of the Deccan and Hyder Ali, the usurper of Mysore, who began to negotiate an alliance with the Marathas. A second time the genius of Hastings saved the situation. On the arrival of the news that Hyder had descended from the highlands of Mysore, cut to pieces the only British army in the field and swept the Carnatic up to the gates of Madras, he adopted a daring policy. He signed a blank treaty of peace with the Marathas, who were still in arms, reversed the action of the Madras goyernment toward the nizam and concentrated all the resources of Bengal against Hyder Ali. Sir Eyre Coote was sent by sea to Madras with all the troops and treasure available; and reinforcements marched southward under Col. Thomas Pearse along the coast line of Orissa. The landing of Coote preserved Madras from destruction, though the war lasted through many campaigns and terminated only with the death of Hyder. Pearse's detachment was decimated by an epidemic of cholera (perhaps the first mention of this disease by name in Indian history) ; but the survivors penetrated to Madras, held Bhonsla and the nizam in check and corroborated the lesson taught by Goddard — that the company's sepoys could march anywhere, when boldly led.

Hastings had to provide the ways and means for this exhausting war. He reformed the collection of the land tax, and the government monopolies of opium and salt were placed upon a remunerative basis. Pressing demands were met by loans and in at least one case from the private purse of the governor general. Hastings' fertile mind at once turned to the hoards of the native princes and zamindars. Chait Singh, the zamindar of Benares, who had grown rich under British protection, lay under suspicion of disloyalty. The wazir of Oudh had fallen into arrears for the maintenance of the company's garrison posted in his dominions, and his administration was in disorder. In his case the ancestral hoards were under the control of his mother, the begum of Oudh, into whose hands they had passed when Hastings was powerless in council.

Hastings decided to go to Oudh and Benares to enforce administrative and financial reforms. When he reached Benares and presented his demands, the rajah rose in insurrection, and the governor general barely escaped with his life. But Popham rallied a force for his defense. The insurgents were defeated, Chait Singh took to flight. and an augmented revenue demand was imposed upon his successor. The wazir of Oudh consented to everything demanded of him. The begum was charged with having abetted Chait Singh in his rebellion, and after severe pressure applied to herself and her attendant eunuchs, was deprived of her treasure and of her rich jagir lands. But Hastings appears to have been uneasy about the incidents of this expedition and to have anticipated censure in England. He therefore procured documentary evidence of the rebellious intentions of the rajah and begum, to the validity of which Impey obligingly lent his extrajudicial sanction.

The remainder of Hastings' term of office in India was passed in comparative tranquillity. But in England the long struggle between the company and the ministers of the crown for supreme control of Indian affairs and the attendant patronage reached its climax. The success of Hastings' administration alone postponed the solution. His original term of five years would have expired in 1778; but it was annually prolonged by special act of parliament until his voluntary resignation. Indian affairs formed the hinge on which party politics turned. On one occasion Henry Dundas carried a motion in the house of commons, censuring Hastings and demanding his recall. The directors of the company were disposed to agree; but in the court of proprietors Hastings always possessed a sufficient majority. Charles Fox's India bill led to the downfall of the coalition ministry in 1783. The act which William Pitt carried in 1784 introduced a new constitution, in which Hastings felt that he had no place. In Feb. 1785 he sailed from Calcutta, after a dignified ceremony of resignation and amid enthusiastic farewells from all classes.

On his arrival in England, after a second absence of 16 years, he was well received. Pitt had never taken a side against him, while Thurlow was his pronounced friend. But Francis, whom he had discomfited in the council chamber at Calcutta, was more than his match in the parliamentary arena. Burke had taken the subject races of India under the protection of his eloquence. Francis, who had been the early friend of Burke, supplied him with the animus against Hastings and with the knowledge of detail which he might otherwise have lacked. The Whig party followed Burke's lead. Dundas, Pitt's favourite subordinate, had already committed himself by his earlier resolution of censure; and Pitt was induced by motives which are still obscure to incline the ministerial majority to the same side. To meet the oratory of Burke and Richard Sheridan and Fox, Hastings wrote an elaborate minute with which he wearied the ears of the house for two successive nights; and he subsidized a swarm of pamphleteers. The impeachment was decided upon in 1786, but the actual trial did not commence until 1788. For seven long years Hastings was upon his defense on the charge of "high crimes and misdemeanours." During this anxious period he bore himself with characteristic dignity.

At last, in 1795, the house of lords gave a verdict of not guilty on all charges laid against him; and he left the bar at which he had so frequently appeared with his reputation clear, but ruined in fortune. The wealth he brought back from India was swallowed up in the expenses of his trial. He forwarded a petition to Pitt praying that he might be reimbursed his costs from the public funds. This petition, of course, was rejected. At last, when he was reduced to actual destitution, it was arranged that the East India company should grant him an annuity of £4,000 for a term of years, with £90,000 paid down in advance. This annuity expired before his death; and he was compelled to make more than one fresh appeal to the bounty of the company, which was never withheld. Shortly before his acquittal he had fulfilled the dream of his childhood by buying back the ancestral manor of Daylesford, where the remainder of his life was passed in honourable retirement. In 1813 he was called on to give evidence upon Indian affairs before the two houses of parliament, which received him with exceptional marks of respect; and Oxford university conferred on him the honorary degree of D.C.L. In 1814 he was sworn to the privy council. He died on Aug. 22, 1818, in his 86th year, and lies buried behind the chancel of the parish church, which he had recently restored at his own charges.

In physical appearance, Hastings "looked like a great man, and not like a bad man." The body was wholly subjugated to the mind. A frame naturally slight had been further attenuated by rigorous habits of temperance and thus rendered proof against the diseases of the tropics. Against his private character not even calumny has breathed a reproach. As brother, as husband and as friend, his affections were as steadfast as they were warm. A classical education and the instincts of family pride saved him from the greed and the vulgar display which marked the typical "nabob." Concerning his second marriage, it suffices to say that the Baroness Imhoff was nearly 40 years of age, with a family of grown-up children, when the law of her native land allowed her to become Mrs. Hastings. She survived her husband, who cherished toward her to the last the sentiments of a lover. Her children he adopted as his own; and it was chiefly for her sake that he desired the peerage which was twice held out to him.

Hastings' public career will probably never cease to be a subject of controversy. He was the scapegoat upon whose head parliament laid the accumulated sins, real and imaginary, of the East India company. If the acquisition of the Indian empire can be supported on ethical grounds, Hastings needs no defense. No one who reads his private correspondence will admit that even

his least defensible acts were dictated by dishonourable motives. On certain of his public measures no difference of opinion can arise. He was the first to attempt to open a trade route with Tibet and to organize a survey of Bengal and of the eastern seas. He persuaded the *pundits* of Bengal to disclose the treasures of Sanskrit to European scholars. He founded the Madrasa or college for Mohammedan education at Calcutta, primarily out of his own funds: and he projected the foundation of an Indian institute in England. The Bengal Asiatic society was established under his auspices, though he yielded the post of president to Sir William Jones. No Englishman ever understood the Indian character so well as Hastings; none ever devoted himself more heartily to the promotion of every scheme. great and small. that could advance the prosperity of India. Indians and Anglo-Indians alike venerated his name, the former as their first beneficent administrator. the latter as the most able and most enlightened of their own class. If Clive's sword conquered the Indian empire. it was the brain of Hastings that planned the system of civil administration and his genius that saved the empire in a dark hour.

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(J. S. Co.; X.)

HASTINGS, WILLIAM, BARON (*c.* 1430–1483), a son of Sir Leonard Hastings (d. 1455). was master of the mint and chamberlain of the royal household under Edward IV. Crested a baron in 1461. he married Catherine, daughter of Richard Neville, earl of Salisbury. He was faithful to Edward IV during the king's exile in the n-inter of 1470–71. After the king's return Hastings fought for him at Barnet and at Tewkesbury, thereafter retaining Edward'~confidence for the remainder of the reign despite the hostility of the queen and her kinsmen. He was made captain of Calais in 1471 and was with Edward IV when he met Louis XI of France at Picquigny in 147j, on which occasion he received gifts from Louis and from Charles the Bold of Burgundy. After Edward IV's death Hastings refused to ally himself with Richard, duke of Gloucester, afterward King Richard III. During a meeting of the council on June 13, 1483, he was seized and at once put to death. This dramatic incident is related by Sir Thomas More in his *History of Richard III,* and was worked by Shakespeare into his play *Richard III.*

HASTINGS, a municipal, county and parliamentary borough and seaside town of Sussex, Eng., one of the Cinque Ports, 64 mi. S.S.E. of London by road. Pop. (1951) 65,522. Area 11.4 sq.mi. Hastings stands where an outlier of the chalk downs reaches the coast. and the shore line is backed by cliffs. Two converging valleys running seaward contain much of the town. which has spread up the steep slopes as well as westward along the shore at the foot of the cliffs, and since 1872 the borough has included the town of St. Leonards, built (1828) by James Burton, father of the more famous Decimus. At the eastward end of the foreshore is the old fishing village. Hastings has some light industries. but its main occupation is catering for visitors who, because of its genial climate and sandy beaches, are attracted the year round. Romantically placed on the cliff overlooking the old town are the ruins of Hastings castle, and below it are the remains of a harbour begun in 1893 but never finished.

Rock shelters on Castle hill and numerous flint implements suggest an extensive early population: and there are earthworks and a promontory camp probably of the early Iron Age or Romano-British date. In 700, the name tells us, it was the residence of the Haestingas tribe (*i.e.,* "Haesta's people"). Hastings was not a Roman settlement, but it mas a place of some importance in the Anglo-Saxon period. In the reign of Aethelstan (928) it was important enough to have a mint. The battle of Bastings (*see* below) in 1066 was fought near the present Battle abbey, about 6 mi. N. After the Conquest, William I made the earthworks of the castle and by 1086 Hastings had given its name to the rape (*q.v.*) of Sussex in which it lay. The town at that time had a harbour and a market. but although it became the chief town of the Cinque Ports (*q.v.*) it was not mentioned in *Domesday Book.* Its charter shows. however, that it had greater liberties than Dover in return for the same services. It was represented in the parliament of 1265 and was incorporated by Elizabeth I in a charter of 1588.

The fragments of the castle stand on the brink of the West cliff, together with the ruins, excavated in 1824, of the castle chapel, a transitional Norman structure 110 ft. long, with a nave, chancel and aisles. Besides the chapel there was formerly a college, both being under the control of a dean and secular canons. The deanery was held by Thomas Becket. and one of the canonries by William of Wykeham. Titus Oates, whose father was rector of the parish, was baptized in 1649 in the church of All Saints, a 15th-century Perpendicular building. The parish church of St. Clement replaced (about 1380) an earlier structure which in turn had replaced a church washed away by the sea. (X.)

The Battle of Hastings (1066).—The battle of Hastings (Oct. 14, 1066) between Harold, king of England, and William, duke of Normandy. was "one of those battles which at rare intervals have decided the fate of nations" (Sir F. M. Stenton, *Anglo-Saxon England,* Oxford University Press). By 1066 William controlled, directly or by alliance. every harbour from the Scheldt to Brest; his wife's father, Baldwin of Flanders. was regent of France. and the count of Anjou, his only other dangerous neighbour, was distracted by rebellion. With a solemn papal blessing and the emperor's approval, William prepared to enforce his claim to the English crown. He persuaded the Norman barons to promise support. and recruited thousands of volunteers from Brittany, Maine, France, Flanders, Spain and Italy, mostly adventurers attracted by prospects of conquest. The organization of supplies and transport for this miscellaneous host of about 5,000 knights, and the imposition of disciplined Norman cohesion upon them, were probably William's supreme military achievements.

Harold mobilized his fleet and army in May, repelled his outlawed brother Tostig's raids on the south and east coasts. and concentrated his large fleet off Spithead and his militia along the Hampshire, Sussex and Kentish coasts. Ready to move early in August, William's transports were kept in port by north winds for eight weeks, first in the Dives estuary until Sept. 12, then at St. Valéry-sur-Somme. Meanwhile the English militia, short of supplies after four months' fruitless waiting, lost morale and on Sept. 8 were dismissed; the ships were brought back to the Thames, many being lost en route. The channel was thus left open, and the best chance of destroying William's army was lost. At this moment Harald III Hardrada, king of Norway, another claimant of the English crown. supported by Tostig, entered the Humber with 300 ships, defeating the forces of Edwin, earl of Mercia, and his brother Morcar, earl of Northumbria, in a heavy battle at Gate Fulford, outside York (Sept. 20). This battle crippled Hardrada's forces, but also left the two earls incapable of raising another army that year. King Harold, hearing of this invasion, left London immediately with his housecarls and such thegns and shire militia as he could muster, and by forced marches surprised the invaders at Stamfordbridge on Sept. 25, utterly destroying them and killing Karald and Tostig.

On Sept. 27 the wind changed, and after nightfall William crossed the channel unopposed and disembarked quietly at Pevensey next morning. He quickly transferred his forces to Hastings, built a castle and began to explore and ravage the neighbourhood, determined not to lose touch with his ships until he had defeated Harold's main army. Harold, at Pork, learned on about Oct. 2 of William's landing. summoned all thegns and shire militia to follow, and set off by forced marches, gathering reinforcements as he went. and by Oct. 13 he was approaching Hastings with about 7.000 men, including his housecarls. some thegns and shire levies and many half-armed. untrained peasants. He had mobilized barely half of England's trained soldiers, yet he advanced against

William instead of making William come to meet him in a chosen defensive position. a bad strategical decision probably explained by his eagerness to defend his own men and lands. which William. was hnrrying, and to thrust the Normans back into the sea.

William, warned of Harold's approach. determined to force battle immediately. At dawn on Oct. 14 he advanced. sighting Harold's army on the ridge 10 mi. N.W. of Hastings. William arrayed his army for attack, his archers and crossbowmen in the front line. his heavy infantry in the second, his knights in three divisions in the rear. Normans in the centre, Bretons and French on left and right respectively. The English. lacking archers and cavalry (though they used horses for movement from place to place) could not hamper these manoeuvres, but prepared to resist. Their position was not wholly favourable; William's advance was unexpected, and Harold had to fight where he stood or retreat. He placed himself. his housecarls and his other trained troops around his standard at the summit of the ridge (where the high altar of Battle abbey was later placed), grouping his other men along the crest for about 400 yd. westward and about 200 yd. eastward, at which points the slope became steep enough to protect both flanks. The front was too small: some men, finding no fighting room. withdrew: the rest. in too close order, made a perfect target for arrows. In front the easy slope (jo ft. in 400 yd.) allowed William's knights an open approach, against which Harold relied on the close "shield wall" formation of his trained troops to hurl back and dishearten the enemy. The idea that Harold prepared a palisade is incorrect; but the disparity of English and Norman equipment and tactics was smaller than is often supposed. The heavily armoured knight, riding a powerful charger and holding couched a heavy thrusting lance, was still 100 years away: Norman armour was flimsy, the horses light and unprotected. and the knights, using javelins: maces and swords. had to engage hand to hand, where the great two-handed English battle-axes would work terrible havoc. Harold's hopes depended on keeping his line unbroken. his casualties light, and so exhausting and demoralizing the Normans.

William's archers opened at close range. inflicting many casualties but suffering heavily from the English slings and spears; William therefore threw in his cavalry. which was so badly mauled by the English battle-axes that it panicked and fled. William himself checked and turned them. counterattacking a large body of Englishmen who had broken ranks in pursuit. William pressed his cavalry charges throughout the day. interspersing them with flights of arrows. an'd annihilating considerable numbers of Englishmen whom he drew from their positions by two feigned flights. The defense. hard-pressed. depleted and tiring. was worn down and slowly outnumbered: Harold's brothers. Gyrth and Leofwine. fell, and late in the afternoon a chance arrow killed Harold. The leaderless English fought on till dusk and then broke: a last rally in the gloom caused the Normans further casualties and endangered William himself. But as darkness fell the English scattered, leaving William the winner of one of the most daring gambles in history. (R. F. T.)

HASTINGS, a town in the North Island of New Zealand. in the Hawke's Bay province, 12 mi. S. of Napier by rail. Pop. (1961) 23.383. It is the centre of a rich agricultural. pastoral and fruit-growing district. Hastings was formerly known as Heretaunga and is named after Warren Hastings (*q.v.*).

HASTINGS, a city in Nebraska, U.S., about 90 mi. W. of Lincoln, is the seat of Adams county. It was founded in 1872 as the western terminus of the St. Joseph and Denver railroad on Walter Micklen's homestead and named after a surveyor who graded the final section of the railroad into the village. It was incorporated in 1874.

Located in irrigated farm land it is a wholesale and distributing. centre with large grain storage facilities. Its industries include the manufacture of agricultural implements, irrigation equipment. air conditioning machinery. sheet metal and millwork and the processing of food. A natural gas company has its regional headquarters there. Water and electricity plants are municipally on ned

Educational institutions include Hastings college (Presbyterian), founded in 1882; Mary Lanning School of Nursing: and Immaculate Conception monastery. The House of Yesterday. a municipal museum. emphasizes the Great Plains in its historical. geological and biological collections: the J. M. McDonald planetarium is operated in conjunction with the museum. Good Samaritan Village (Lutheran) offers low cost housing and nursing care for the aged. Hastings State hospital and Mary Lanning hospital also serve the community. A nearby artificial lake provides facilities for water sports. For comparative population figures *see* table in *NEBRASKA:* Population. (R. S. V. M.)

HAT: *see* HAT MANUFACTURE; HEADDRESS.

HATAY, the southernmost *il* (province) of Turkey. on the Mediterranean coast. is bounded west by the Gulf of Iskenderun (Alexandretta). south and east by Syrian territory. Pop. (1960) 441,198. Area 2.139 sq.mi. Formerly part of the Turkish empire, coextensive with the former sanjak of Alexandretta. Hatay came under French mandatory control after World War I but. after a period from Jan. 1937 as a separate entity under Syrian responsibility. it was returned to Turkey by a Turko-French agreement in June 1939. Between the Amanus mountains or Nur Daglari (6.000 ft.) in the west and the rim of the Syrian plateau on the eastern border is a large plain watered by the Asi (Orontes) river. partly occupied by a shallow lake. Climate and agriculture are typically Mediterranean. Main roads connect Hatay with Syria and with the rest of Turkey. The chief towns are Xntioch (Antakya), the capital, and Iskenderun. See also TURKEY: *History.* (N. TU.; S. ER.; E. TU.)

HATCHMENT or ACHIEVEMENT, in heraldry, the setting out of armorial bearings. with all that belongs to them: shield, helm and crest, supporters and motto or word. The term "hatchment" is now usually applied to armorial bearings enclosed in a black lozenge-shaped frame suspended against the wall of a deceased person's house. It remains for from 6 to 12 months, when it is removed to the parish church. This custom is falling into disuse, though a hatchment was shown in a London street in 1928. It is usual to hang the hatchment of a head of a house at Oxford and Cambridge universities over the entrance to his lodge or residence.

If for a bachelor, the hatchment has a black ground: if for a single woman, her arms are represented upon a lozenge. bordered with knotted ribbons, also on a black ground. If the hatchment is for a married man. his arms upon a shield impale those of his surviving wife; or if she is an heiress they are placed upon a scutcheon or pretence, and crest and other appendages are added. The dexter half of the ground is black. the sinister white. For a wife whose husband is alive the same arrangement is used, but only the sinister ground is black. For a widower the same is used as for a married man, but the whole ground is black; for a widow the husband's arms are given with her own, but upon a lozenge. with ribbons. without crest or appendages, and the whole ground is black. When there have been two wives or two husbands the ground is divided into three parts per pale, and the division behind the arms of the survivor is white. It is thus easy to discern from the hatchment the sex, condition and quality and possibly the name of the deceased. In Scottish hatchments it is not unusual to place the arms of the father and mother of the deceased in the two lateral angles of the lozenge.

HATFIELD, a town in Hertfordshire, Eng.. 20 mi. N. of Hyde Park corner. London, on the Great North road. Pop. (1951) 13,834. The church of St. Etheldreda contains an Early English round arch; the chancel and transepts are also of the 13th century. In the Salisbury chapel (1618) are monuments to Robert Cecil, 1st earl of Salisbury. and Robert Cecil, the 3rd marquess. Hatfield house stands close to the site of a palace of the bishops of Ely erected in the 11th century; hence the true name of the town, Bishop's Hatfield. Of the red brick palace, built round a large quadrangle, only one side remains. and it contains the banqueting hall, used as a restaurant for visitors. After the Dissolution Henry VIII kept the palace mainly as a residence for his children. and it was there that Elizabeth I received the news of her accession. James I exchanged Hatfield in 160; for Theobalds, near Cheshunt, an estate of the 1st earl of Salisbury. who immediately pulled down three sides of the old palace to build the present

Hatfield house. which remained in the Cecil family thereafter. It is built in the shape of an E. Large gardens were laid out by James I and altered through the centuries. The west wing of the house was severely damaged by fire in 1835 when the eccentric widow of the 1st marquess of Salisbury was burned. The 3rd marquess installed electric lighting in 1881. During World War II it was used as a hospital. Hatfield house is rich in portraits of and by well-known persons. among which are three of Elizabeth I.

When Hatfield New Town (to cover 3.7 sq.mi. between the Barnet bypass and Hatfield park) was designated in 1948. there was already enough industry in the district to employ nearly all its 25,000 inhabitants. The chief works are those of the de Havilland Aircraft company. Others include engineering, cardboard boxes, etc. In 1952 a technical college was opened.

HATHERLEY, WILLIAM PAGE WOOD, 1ST BARON, (1801–1881), lord chancellor of Great Britain. was born in London on Nov. 29. 1801. The son of Sir Matthew Wood, a London alderman and lord mayor who became famous for befriending Queen Caroline and braving George IV. he was educated at Winchester, Geneva university and at Trinity college. Cambridge. of which he became a fellow in 1824. He entered Lincoln's Inn. and was called to the bar in 1823. He practised as an equity draftsman and before parliamentary committees. In 1845 he became Q.C., and in 1847 became M.P. for the city of Oxford. In 1849 he 77-35 appointed vice-chancellor of the county palatine of Lancaster. and was solicitor general in 1851–52. When the Liberal party returned to power in 1853, he was raised to the bench as a vice-chancellor.

In 1868 he was made a lord justice of appeal. but before the end of the year was selected by Gladstone to be lord chancellor. He retired in 1872. but sat occasionally as a law lord. He died in London on July 10, 1881.

HATHQR, Egyptian goddess. was originally a personification of the sky. as the meaning of her name; "Castle of (the sky-god) Horus." shows. In the sun temples built by six kings of the 5th dynasty (c. 2560–2450 B.C.) near Memphis, Egy., her worship was. therefore. associated with that of another sun-god. Ra of Heliopolis. In the old centre of her cult, at Dendera, in upper Egypt. however. she was considered as the wife of Horus and as the goddess of festivity. dance and love.

From Dendera her worship spread elsewhere, and she was consequently identified with a number of local tree. lion and cow goddesses. as at Deir el-Bahri (Dayr al-Bahri). There. however. owing to the proximity of the necropolis of Thehes. she became "Lady of the West" and patroness of the region of the dead. quite contrary to her earlier nature. The Greeks identified Hathor with their Aphrodite. (J. CY.)

HAT MANUFACTURE. The hat. a covering for the head worn by both sexes, is distinguished from the cap or bonnet by the possession of a brim. The history of the hat as part of the apparel of both sexes. with the various changes in shape which it has undergone, is treated in the article HEADDRESS.

At the present day the hat trade is divided into four sections. The first is concerned with the manufacture of hats made from fur: the second. with those made from wool. The productions from these two sections are known as fur felt hats and wool felt hats respectively. The third section engages itself in the manufacture of hats made from materials plaited or woven from straw or vegetable products of a fibrous nature such as palm leaf. hemp, bamboo, rush, etc. This section is known as the straw hat section of the industry (see STRAW). The fourth has to do with hats made from silk plush and is termed silk hatting.

Fur Felt Hats.—The manufacture of fur felt hats under modern conditions entails a series of processes in which highly skilled labour must be employed. The furs used in the industry are coney (rabbit), hare, muskrat, nutria and beaver. The three latter are aquatic and before they can be utilised, have to be washed thoroughly in a strong solution of whale oil soap and water to remove the scum and dirt with which the fur fibres are encrusted. Hare and coney do not require this preliminary washing. All long coarse guard hairs are plucked from the skin, leaving only the smooth soft fur.

After plucking, the remaining fur is treated with a solution of nitrate of mercury; process known as *carroting*, its object being to open out the minute branches or *barbs* with which each fur fibre is covered. Carroted skins are fed into a machine which cuts the hide into short shreds, the fur fibre emerges on an endless belt, the hide, now denuded of fur and useless for hat manufacturing purposes being discarded. Fur fibre having been sorted according to its quality value, now undergoes an operation known as *blowing* by which the fibres are fed into a machine whose mechanism contains numerous revolving cylinders bearing .thousands of steel teeth or pickers. The action of this machine separates from the individual fur fibres the *kemp* or colouring matter useless for hat manufacturing purposes, and the *down* of the fibre the portion from which fur felt hats are made.

The accumulation of millions of fur fibres into a *hood* from which a finished hat is made is known as *forming;* this, as having reference to the manufacture of fur felt hats, is the process by which fur fibres are knit closely together to form a fabric which shall have the requisite configuration, thickness, homogeneity and stability. For this purpose, a quantity of fur, varying according to the weight and dimensions of hood that is to be made, is fed into a machine and projected into a chamber containing a minutely perforated copper cone. This cone revolves, and to its damp outer side are drawn by suction the myriads of mist-like fur particles; thus the cone rapidly becomes covered with a film of fur. The cone, with its coating of fur, is wrapper1 round with flannel and, protected further with a metal cover, is immersed in hot water after which the formed hood is removed from the cone.

Each fur fibre has a number of minute branches or barbs and when a mass of such fibres is subjected to heat, moisture and motion with the addition of pressure, the fibres become firmly interlocked. Repetitions of this treatment result in fur felt the shape of which is relatively much the same as that of the original mass, but decreased in size through the working together of fibres and the consequent shrinkage. It is usual to form the hat body or "hood" (the unit which. after many processes, finally emerges as a completed hat) as a cone about 29 in. in height and about 20 in. in diameter. As the hood is handled, not as a cone but in the flat, the diameter of the cone is not considered in the terminology. Thus, the size of the hood above mentioned would be referred to as 29×31, the latter figure being the width of the flat hood across the corners at the base.

After a hood has been formed, the fabric has little cohesion and has to be hardened or shrunk, the object being to interlock or knit together the individual hair fibres so closely that they become inseparable. In the hardening operation, the formed hoods, saturated with water, are stacked together in lots of six to ten. rolled up in a wet cloth and manipulated by hand. Some shrinkage occurs. During this process, the operator must he careful not to tear the hood or treat the delicate fabric so roughly as to cause a "shove" or other damage.

The universal method is to divide the hardening process into four successive shrinking operations known as *(a) hardening, (b) starting, (c) planking, (d) second or final planking.*

These operations are not closely defined, and the extent to which each is carried varies with different manufacturers and with special requirements. To indicate the progressive steps, a hood 29 in.×31 in. (height 29 in., width across base 31 in.) after hardening will be considered as an example and the following table will show the approximate relative dimensions:

Operation	Dimensions inches
A. After hardening	29 × 31
B. „ starting	18 × 24
C. „ planking	11 × 16½
D. „ second planking	10¼ × 15¾

Briefly the following is a description of operations B., C. and D.

Starting is a shrinking operation employing an open kettle of boiling water and a machine with three deeply corrugated revolving rollers. The operator takes four to six hoods. wets them in boiling water, piles them one on the other, rolls them up, wraps

a canvas cloth round them and tosses the bundle between the rollers of the machine. After a time, the bundle is taken out, unwrapped, unrolled and the hats immersed in boiling water. Each hood is then subjected to hand manipulation. The same hoods are then stacked up again, this time however, their relative positions are changed. They are rolled up again but the rolling is started from another corner or side, the canvas is wrapped on and the bundle tossed between the rollers. These operations are repeated until the operator finds that the shrinking has been carried far enough.

Planking is an operation similar to "starting" employing a three-roller machine over an open hot water bath. The pressure used is somewhat greater, more manipulation is performed and the hoods are put through the machine a greater number of times.

Second planking is another shrinking operation employing similar equipment but requiring still greater pressure and increased manipulation.

The operations by which fur fibre is converted into a fur felt hood comprise what is known as the wet side of hat manufacturing: the processes by which the hood is converted into a finished hat being termed the dry side of the industry. In this regard no general methods are adopted. so much depending on the particular shape or style of headwear it is purposed to produce. Usually, before a hood is converted into a hat, a certain amount of stiffening or proofing is applied In this operation the hooa is treated with a solution composed of shellac and methylated spirit. The hood after this application is placed in a hot oven or kiln the spirit in the solution tending to slightly open the "pores" of the fabric, the heat whilst evaporating the spirit, driving the shellac into the opened "pores" and there solidifying The object of this process is to weld the fur fibres so closely together that they cannot be separated during subsequent operations.

The operation of *blocking* or *shaping* is that whereby the hood is converted into its ultimate shape. As a rule. the hood is saturated with dry steam and whilst in this condition pulled over a wooden block the shape of the hat to be produced The dry steam softens the shellac or "proofing" in the hood allowing the whole to become malleable The wooden block with its felt covering is now allowed to dry and in drying the shellac again hardens, thus once more tightening up the fur fibres so that the whole fabric has moulded itself to the configuration of the block on which it has been placed. When quite dry, the hood, now converted into a definite shape, is removed from the block and can be regarded as a hat, the trimming of which is merely a matter of fashion requirements.

Wool Felt Hats.—In the manufacture of these articles the wool used is technically known as *noils*, being the short fibre separated by *stapling* from the *tops* or longer wool fibres used in the weaving of cloth The *noil* is carded through a machine carrying a number of cylinders clothed with wire card. This has a cleaning and strengthening effect and the wool noil emerges in a continuous web rather like a lace curtain. This web is wrapped round a double cone which is cut through the middle giving two half cones of carded wool known technically as *formes*.

A forme varies in size and in weight according to the type of hat for which it is intended, but before it can be made into a hat it has to be reduced to a hood, as in fur felt hat production. This process known as hardening is conducted by means of steam and rotary rubbing, the action serving to shrink and consolidate the wool, the final hardening being obtained by means of machine rolling whilst the formes are immersed in boiling water. The forme. having been reduced to a hood, is thoroughly dried.

In the shrinking processes, various surface inequalities become apparent on the hood and in order to remove the same and get a perfectly even face to the fabric and to obtain a degree of lustre the hoods are passed through a machine containing a wheel or bob coated with fine sand paper and revolving at a high speed. This is termed pouncing or buffing.

Wool felt hat production from the hood stage proceeds very closely on the lines adopted in the manufacture of fur felt hats.

The operation of dyeing both fur and wool hats is conducted whilst they are in the hood stage and prior to their being stiffened or proofed.

The continent of Europe supplies approximately 90% of the world's fur and wool hoods for hat manufacturing.

Silk Hats.—The silk hat was invented in Florence about 1760, but it was not until the beginning of the 19th century that it was worn to any extent.

A silk hat consists of a light stiff body covered with a plush of silk, the manufacture of which in a brilliant glossy condition is the most important element in the industry. Originally the bodies were made of felt and various other materials, but now calico is chiefly used. The calico is first stiffened with a varnish of shellac, and then cut into pieces sufficient for crown, side and brim. The side-piece is wound round a wooden hat block, its edges are joined by hot ironing, and the crown-piece is put on and similarly attached to the side. The brim, consisting of three thicknesses of calico cemented together, is now slipped over and brought to its position, and thereafter a second side-piece and another crown are cemented on. The whole of the body, thus prepared, now receives a coat of size; subsequently it is varnished, and thus made ready for the operation of covering. In covering this body, the under brim, generally of merino, is first attached, then the upper brim, and lastly the crown and side sewn together are drawn over. All these by hot ironing and stretching are drawn smooth and tight, and as the varnish of the body softens with the heat, body and cover adhere all over to each other without wrinkle or pucker. Dressing and polishing by means of damping, brushing and ironing come next, after which the hat is "velured" in a revolving machine by the application of haircloth and velvet velures, which cleans the nap and gives it a smooth and glossy surface. The brim has only then to be bound, the linings inserted, and the brim finally curled, when the hat is ready for use.

HATSHEPSET or **HATASU** (*fl.* 1500 B.C.), Egyptian queen, daughter of Thotmes I., sister and queen of the short-reigned Thotmes II., after whose death she secured the crown in spite of opposition from the future Thotmes III., who was the son either of Thotmes I. or of Thotmes II. She acquired fame by her magnificent terrace-temple at Dēr el-Bahri and by her obelisks at Thebes, the expenses of which were partly met by the treasure-hunting expeditions which she sent to South Arabia. The long military inactivity of her reign, during which State affairs were in the hands of her partisans, shook Egyptian power in Asia. In 1841 her tomb was discovered on a cliff behind the Valley of the King's Tomb. Her successor, Thotmes III., had her name and figure cut off from the sculptures in her temple and treated the remains of her partisans in a similar manner.

See *Cambridge Ancient Hi-tory,* vol. ii (1924).

HATTIESBURG, a city of southeastern Mississippi, U.S.. and the seat of Forrest county, is located on the Leaf and Bowie rivers. 65 mi. from the Gulf of Mexico and about 85 mi. S.E. of Jackson. The town was founded in 1881 by Capt. William Harris Hardy. Confederate soldier, statesman and engineer, and named for his wife. It was incorporated in 1884. Early settlers were attracted to the area by the large acreage of virgin pine timberland n-hich constituted the major source of wealth for many years. Adequately served by an excellent system of highways and railways, and also by a trade area consisting of ten surrounding counties. Hattiesburg is referred to locally as the "Hub of South Mississippi." Industrial plants produce timber products and building materials and a variety of other items. including metal goods, clothing, fertilizers, mattresses. food products, naval stores and boilers.

Hattiesburg is known for its medical and recreational facilities. as well as for its culture and hospitality. It is the seat of Mississippi Southern college (1910), a state institution; and William Carey college (1906), owned and operated by the Mississippi Baptist convention. Camp Shelby. a U.S. army training centre. is nearby. For comparatix-e population figures *see* table in MISSISSIPPI: *Population.* (J. T. D.)

HATTO I (850?–913), archbishop of Mainz, belonged to a Swabian family. and was probably educated at the monastery of Reichenau. of n-hich he became abhot in 888. The German king Arnulf appointed him archbishop of Mainz in 891. He presided

over the synod of Tribur in 895. accompanied the king to Italy in 854 and 895, and in 899, when Arnulf died, became regent of Germany, and guardian of the young king, Louis the Child. He compelled Zwentibold, king of Lorraine, an illegitimate son of Arnulf, to recognize Louis. In 896 he secured for himself the abbey of Ellwangen and in 898 that of Lorsch. He assisted the Franconian family of the Conradines in its feud with the Babenbergs, and was accused of betraying Adalbert, count of Babenberg, to death. He retained his influence during the whole of the reign of Louis, and on the king's death in 911 helped to secure the election of Conrad; duke of Franconia, to the vacant throne. When trouble arose between Conrad and Henry. duke of Saxony, afterward King Henry the Fowler. the attitude of Conrad was ascribed by the Saxons to the influence of Hatto, who wished to prevent Henry from securing authority in Thuringia, where the see of Mainz had extensive possessions. He was accused of complicity in a plot to murder Duke Henry. who in turn ravaged the archiepiscopal lands in Saxony and Thuringia. He died on May 1j, 913. Stories of cruelty and treachery gathered round his name.

HATTON, SIR CHRISTOPHER (1540–1591), lord chancellor of England, was a son of William Hatton of Holdenby, Northamptonshire. He was educated at St. Mary hall. Oxford; admitted to the Inner Temple in May 1560; and enrolled as one of the queen's gentleman pensioners in 1564. A handsome and accomplished man and a good dancer, he soon became a prime favourite of Elizabeth I. In 1572 he was made captain of her bodyguard; in Nov. 1577 vice-chamberlain of her household and a privy councillor; and in December of the same year a knight. Regularly elected to parliament from 1571, he soon became a leading government spokesman in the house of commons. In foreign affairs he sided with the earl of Leicester and Sir Francis Walsingham rather than with the more cautious Lord Burghley. He was a promoter of Sir Francis Drake's great voyage (1577–80), and Drake renamed his flagship "Golden Hind" in honour of Hatton, whose cognizance was "a hind statant Or." At this time Hatton though not himself in favour of the queen's proposed marriage to Francis, duke of Alençon, was active in the prosecution of the Puritan John Stubbe for printing a violent pamphlet against it. Later he took a prominent part in the examinations of various Catholic plotters. notably William Parry (1585) and Anthony Babington(1586). He was a commissioner lor the trial of Mary, queen of Scots, at Fotheringay and afterward advised William Davison (*q.v.*) to dispatch the warrant for her execution. He strongly supported archbishop John Whitgift's efforts to discipline the Puritans, and this may well explain his appointment as lord chancellor in 1587. He lacked any great knowledge of the law, but seems to have been a sensible and businesslike chancellor. In 1588 he was made knight of the garter and chancellor of Oxford university. He died in London on Nov. 20, 1591, and was buried in St. Paul's cathedral. His name is perpetuated in Hatton garden, part of Ely place. Holborn. of which Elizabeth forced the bishop of Ely to grant him the virtual freehold. Hatton also built the magnificent Holdenby (or Holmby) house in Northamptonshire. He wrote the fourth act of a tragedy. *Tancred and Gismund*, and was a patron of men of letters such as Thomas Churchyard. John Dee and Barnaby Rich. Edmund Spenser addressed a sonnet to him. and William Byrd a musical work, and his death occasioned several panegyrics in both prose and verse.

See E. St. J. Rrooks, *Sir Christopher Hatton* (London, 1946); Sir N. H. Nicholas, *Life aad Times of Sir C. Hatton* (London, 1847).

(R. B. WM.)

HATTON, JOHN LIPTROT (1809–1886), English musical composer, was born at Liverpool on Oct. 12, 1809. He was virtually a self-taught musician, and found his way to London as a member of Macready's company at Drury Lane in 1832. Ten years after this he was appointed conductor at the same theatre for a series of English operas, and in 1843 his own first operetta, *Queen of the Thames*, was given with success. He had a successful career in Austria and the United States, and from about 1853 was engaged at the Princess's theatre to provide and conduct the music for Charles Kean's Shakespearean revivals. Hatton excelled in the lyrical forms of music, and won popularity by such songs as "To Anthea," "Good-bye, Sweetheart," and "Simon the Cellarer," the first of which may be called a classic in its own way. He died at Margate on Sept. 20, 1886.

HATZFELDT, MELCHIOR (1593–1658), **COUNT OF GLEICHEN** and Imperialist general, was born on Oct. 10, 1593 at Krottorf, Hesse. He served with the Imperialist army in the Thirty Years' War, was defeated by the Swedes, led by Bauer, at Wittstock (1636), and in the following year assisted at the relief of Leipzig. From 1639 to 1643 he led the campaigns in Restphalia and the Rhine lands. In 1644 he raised a new army in Bohemia; but in 1645, owing to his defeat at the battle of Jankau, in which he was made prisoner by Torstensson, he was succeeded in his command by Gallas. He retired in 1646. The war in Poland in 1657 brought him from his retirement. He led an army of 16,000 men to the help of the king of Poland against the Swedes, and captured Cracow. He then advanced against Thorn, but his health failed, and he surrendered the command to Montecucculi. He died on Jan. g, 1658 at Powitzka, near Traehenberg.

See J. Krebs, *Aus dem Leben des kaiserl. Feldmarschalls Grafen Melchior von Hatzfeldt* (1910).

HATZIDAKIS (CHATZIDAKIS), GEORGE N. (1848–1941), the first and greatest linguist of modern Greece, who was eminent in studies of ancient, medieval and modern Greek. and the initiator of the *Historical Lexicon of the Greek Langztage*, was born at Myrthio. Crete. on Nov 12, 1848. After his classical studies in Athens (1873–77), he devoted himself to comparative linguistics in Germany (1877-81). He obtained his Ph D. degree in Athens (1883) and taught linguistics there (1885-1923) and in Salonica (1926–28). Hatzidakis was among the first members of the Academy of Athens (1926). and an honorary member of five other European academies. Between 1881 and 1935 he wrote 9 books and nearly 600 other works, mostly on medieval and modern Greek, especially on the origin of its dialects from the *Koinē* (except *Tsakonian*). Adhering to the idea of Greek bilingualism, however. he failed to sense the rise of the new common Greek language even in Athens from *c* 1835; he supported the lost cause of the puristic language *(kathareuousa)* against the popular language as a literary and educational vehicle Among his norks are: *Einleitung in die nezrgriechisclze Grammatik* (1892) and *Medieval and Modern Greek* (1905–7), both aggregates of previously published articles. He died in Athens on June 26, 1941.

See *Orbis:* 4,574–576 (1955). (D J. G.)

HAUCH, JOHANNES CARSTEN (1790–1872), Danish poet, dramatist and novelist, whose works expressed his high moral seriousness and tragic philosophy, was born in Frederikshald. Norway, on May 12. 1790. As a student, he was strongly attracted by romanticism; but after early and unsuccessful literary attempts he turned to natural sciences, particularly zoology. He took his doctorate in 1821and then studied in Paris and Italy. In 1825 he had a foot amputated and shortly afterward attempted suicide. He emerged from the spiritual crisis which followed with a renewed desire to write. On his return to Denmark. he was successively lecturer in natural sciences at Soro, professor of Scandinavian literature at Kiel (1846–48) and. following his friend Adam Oehlenschlager. professor of aesthetics at Copenhagen from 1851 until his death in Rome on March 4, 1872.

Hauch was by nature gloomy and brooding, but also of exceptional rectitude and nobility: his works have a tragic quality and express high moral ideals and a belief in universal justice. As a dramatist he modeled himself upon Shakespeare and Oehlenschlager and wrote a number of historical tragedies about men of destiny: *Bajazet, Tiberius* and *Gregor den Syvende* (Pope Gregory 1-11) (all 1828); and great Danish figures: *Svend Grathe* (1841) and *Marsk Stig* (1850). Later, his historical novels exerted donsiderable influence. they include *Vilhelm Zabern* (1834); *Guldmageren* ("The Alchemist." 1836), *En polsk Familie* (1835) and *Robert Fulton* (1853). But his greatest success was as a poet, particularly as a writer of odes. One of his most important poetic works was the ballad-cycle *Valdemar Atterdag* (1861).

Hauch's collected poems were published, 2 vol. (1891); his collected novels, 7 vol. (1873–74); his plays, 3 vol. (1852–59); his essays and reflections upon aesthetics, 3 vol. (1855–69). *See* also G. Brandes, "Car-

sten Hauch," in Brandes' *Samlede Skrifter,* vol. i (1899); K. Ronning, J. C. *Hauch* (1890). (*S. M* K)

HAUCK, ALBERT (1845–1918), German theologian, was born at Hassertrudingen, M.-Franken, on Dec. 9, 1845, and studied at the universities of Erlangen and of Berlin. He took orders, and from 1875–8 was pastor at Frankenheim. Hauck was professor of theology at Erlangen (1882–89), and at Leipzig (1889–98), and then for a year rector of the university. He died on April 7, 1918. His most important work is *Kirchengeschichte Deutschlands* (j vols. 1887–1911; 5th ed 1920). He edited the 3rd edition of the *Realencyclopadie* of Protestant theology (24 vols. 1896–1913).

HAUER, FRANZ, RITTER VON (182 2–1899), Austrian geologist, born in Vienna on Jan. 30, 1822, was son of Joseph von Hauer (1778–1863), who was equally distinguished as a high Austrian official and authority on finance and as a palaeontologist. In 1886 Franz Hauer became superintendent of the imperial natural history museum in Vienna. Among his special geological works are those on the Cephalopoda of the Triassic and Jurassic formations of Alpine regions (1855–1856). His most important general work was that of the *Geological Map of Austro-Hungary,* in twelve sheets (186 7–1871; 4th ed , 1884, including Bosnia and Montenegro). He died on March 20, 1899.

PUBLICATIONS.—*Beiträge zur Paläontolographie von Österreich* (1858–59); *Die Geologie und ihre Anwendung auf die Kenntnis der Bodenbeschaffenheit drr österr.-ungar. Monarchie* (1875; ed. 2, 1878). See *Memoir* by Dr. *E.* Tietze; *Jahrbuch der* K. *K. geolog. Reichsanstalt* (1899, reprinted 1900, with portrait).

HAUFF, WILHELM (1802–1827), German poet and novelist, was born at Stuttgart on Nov. 29, 1802, and educated at the Klosterschule at Blaubeuren, and the university of Tubingen. For the children of the Wiirttemberg minister of war, von Hügel, to whom he acted as tutor, he wrote his *Märchen,* which he published in his *Märchenalmanach auf das Jahr 1826.* To the same period belong his *Mitteilungen aus den Memoiren des Satan* (1826) and *Der Mann im Monde* (1825). The latter, a parody of the novels of H. Clauren (pseudonym of K. G. S. Heun) was published under Clauren's name, and Hauff was mulcted in damages. Nevertheless he went on to write a *Kontroverspredigt über* H. *Clauren und den Mann im Monde* (1826). His historical romance *Lichtenstein* (1826), treating of the reign of duke Ulrich of Swabia, was one of the early imitations of Walter Scott. His other works include the charming *Bettlerin vom Pont des Arts; Phantasien im Bremer Ratskeller* (1827); and some short poems which have passed into *Volkslieder,* among them *Morgenrot, Morgenrot, leuchtest mir zum frühen Tod;* and *Steh' ich in finstrer Mitternacht.* Hauff died prematurely on Nov. 18, 1827. The freshness and originality of Hauff's talent, his inventiveness and his genial humour have made him a minor classic.

See his *Samtliche Werke,* ed. *G.* Schwab (3 vols., 1830-34; 5 vols., 18th ed, 1882); ed. F. Bobertag (1891–97); and a selection by M. Mendheim (3 vols., 1891). These and later editions contain biographical material.

HAUG, MARTIN (1827–1876), German orientalist, was born at Ostdorf near Balingen, Wiirttemberg, on Jan. 30, 1827. He studied oriental languages, especially Sanskrit, at Tübingen and Gottingen, and in 1854 settled as *Privatdozent* at Bonn. In 1856 he removed to Heidelberg, where he assisted Bunsen in his literary work; and in 1859 he went out to India, where he became superintendent of Sanskrit studies and professor of Sanskrit in Poona. The result of his researches into Zend literature was a volume of *Essays on the sacred language, writings and religion of the Parsees* (Bombay, 1862). Having returned to Stuttgart in 1866, he was called to Munich as professor of Sanskrit and comparative philology in 1868. He died on June 3, 1876.

HAUGE, HANS NIELSEN (1771–1824), Norwegian preacher, was born in the parish of Thuno, Norway, on April 3, 1771, the son of a peasant. In his twenty-sixth year, believing himself to be divinely commissioned, he began to preach, calling people to repentance and attacking rationalism. In 1804 he was arrested, and only released from prison in 1814. He died at Breddwill, near Christiania, on March 29, 1824. His pietistic adherents, who did not formally break with the church, but placed great stress on the evangelical doctrines of faith and grace, were called *Haugianer* or *Leser* (*i.e.,* Readers).

See C. Bang, *Hans Nielsen Hauge og hans Samtid* (Christiania; 2nd ed., 1875); O. Rost, *Nogle Bemaerkninger om Hans Nielsen Hauge og hans Retning* (1883).

HAUGESUND, a seaport of Norway in Rogaland *fylke* (county), on the west coast, 34 mi. N. by W. of Stavanger. Pop. (1950) 18,747. It is an important fishing centre, particularly for herrings which form the chief export. Macketel and lobsters are also important. The principal imports are coal and salt. There are factories for woollen goods and margarine, and a small shipbuilding industry. The town is difficult of access by land. Haugesund is the reputed death-place of Harald Haarfager, to whom an obelisk of red'granite was erected in 1872 on the thousandth anniversary of his victory at the Hafsfjord (near Stavanger) whereby he won the sovereignty of Norway. The memorial stands 1¼ mi. N. of the town, on the Haraldshaug.

HAUGHTON, WILLIAM (c. 1575–1605), English playwright whom Henslowe's *Diary* shows to have collaborated in plays for the Admiral's company from 1597 to 1602. Philip Henslowe first mentions "yonge Horton" on Nov. 5, 1597, and on March 10, 1600. he lent him ten shillings "to release him out of the Clink." With Thomas Dekker and Henry Chettle, Haughton wrote *The Pleasant Comodie of Patient Grissill* (1603), and he collaborated with many other playwrights including John Day and Richard Hathway. *English-Men For my Money* (1616) is ascribed to his sole authorship.

For a list of Haughton's lost and doubtful plays, *see* E. K. Chambers, *The Elizabethan Stage,* vol. iii (1923). *See* also *English-Men For my Money,* ed. by *A.* C. Baugh (1917); W. J. Lawrence, "Englishmen for my Money," *Review of English Studies, I* (1925).

HAUGWITZ, CHRISTIAN AUGUST HEINRICH KURT, COUNT VON, FRCIHERR VON KRAPPITZ (1752–1832), Prussian statesman, was born on June 11, 1752, at Peucke near Öls. In 1791 he was elected by the Silesian estates general director of the province. At the invitation of Frederick William II. he entered the Prussian service, became ambassador at Vienna in 1792 and a member of the cabinet at Berlin.

Haugwitz, who had attended the young emperor Francis II. at his coronation and been present at the conferences held at Mainz to consider the attitude of the German powers towards the Revolution, was at first opposed to intervention in France, but eventually entered on the negotiations for the subsidy treaty between Great Britain and Prussia, and Great Britain and Holland, signed at The Hague on April 19, 1794. Haugwitz, however, was not the man to direct a strong and aggressive policy; and in October the denunciation by Great Britain of The Hague treaty broke the last tie that bound Prussia to the Coalition. The separate treaty with France, signed at Basle on April 5, 1795, was mainly due to the influence of Haugwitz.

No guarantee of the retention of the Rhine provinces of the Empire had been inserted in the Basle treaty; but Haugwitz and the king hoped to preserve them by establishing the armed neutrality of North Germany and securing its recognition by the French republic. This policy was rendered futile by the victories of Napoleon Bonaparte and the virtual conquest of South Germany by the French. Haugwitz recognized this fact, and in vain urged Frederick William III. to join the new Coalition in 1798. When the king refused his urgent advice to demand the evacuation of Hanover by the French in 1803, he offered to resign, and in Aug. 1804 he was replaced by Hardenberg. In his retirement Haugwitz was still consulted, and used his influence against Hardenberg's policy of a *rapprochement* with France. He was recalled, as Hardenberg's colleague in the foreign office, in 1805. He pursued a vacillating policy, and was definitely worsted by Napoleon. The ultimatum he was to have conveyed to the French emperor was never delivered. Instead he signed the treaties of Schonbrunn (Dec. 15, 1805) and Paris (Feb. 15, 1806), which gave Hanover to Prussia in return for Ansbach, Cleves and Neuchbtel. The Prussian ultimatum to Napoleon was eventually forced upon him, and with the battle of Jena (Oct. 14), his political career came to an end.

The last eleven years of his life were spent in Italy, and he died in Venice on Feb. 9, 1832. During his retirement in Italy he wrote memoirs in justification of his policy, a fragment of which dealing with the episode of the treaty of Schonbrunn was published at Jena in 1837.

See L. von Ranke, *Hardenberg u. d. Gesch. des preuss. Staates* (Leipzig, 1879–81), note on Haugwitz's memoirs in vol. ii.; *Denkwürdigkeiten des Staatskanzlers Fürsten von Hardenberg,* ed. Ranke (5 vols., Leipzig, 1877).

HAUNTINGS. The supposed manifestations of existence by spirits of the dead in houses or places familiar to them in life. *See* SPIRITUALISM and PSYCHICAL RESEARCH.

HAUPT, MORITZ (1808–1874), German philologist, was born at Zittau, in Lusatia, on July 27, 1808. On the close of his university course at Leipzig (1830) he studied Greek, Latin, German, Old French, Provençal and Bohemian. In Sept. 1837 he "habilitated" at Leipzig as *Privatdozent,* and his first lectures, dealing with such diverse subjects as Catullus and the *Nibelungenlied,* indicated the twofold direction of his labours. He became professor extraordinarius (1841) and then professor ordinarius (1843) of German language and literature. But, having taken part in 1849 with Otto Jahn and Theodor Mommsen in a political agitation for the maintenance of the imperial constitution, Haupt was deprived of his professorship by a decree of April 22, 1851. Two years later, however, he was called to succeed his friend Lachmann at Berlin, and became a member of the Berlin academy. He died on Feb. 5, 1874.

Haupt edited texts of Ovid, Catullus, Tibullus, Propertius, Horace and Virgil. As early as 1836, with Hoffmann von Fallersleben, he started the *Altdeutsche Blatter,* which in 1841 gave place to the *Zeitschrift für deutsches Altertum,* of which he continued editor till his death. Hartmann von Aue's *Erec* (1839) and his *Lieder, Buchlein* and *Der arme Heinrich* (1842), Rudolf von Ems's *Guter Gerhard* (1840) and Conrad von Würzburg's *Engelhard* (1844) are the principal German works which he edited. Three volumes of his *Opuscula* were published at Leipzig (1875–77).

See Kirchhoff, "Gedächtnisrede," in *Abhandl. der Königl. Akad. der Wissenschaften zu Berlin* (1875); Otto Belger, *Moritz Haupt als Lehrer* (1879); Sandys, *Hist. Class. Sclzol.* iii. (1908).

HAUPTMANN, GERHART (1862–1946), German author, was born in Obersalzbrunn, Silesia, on Nov. 15, 1862, the son of an innkeeper. He was educated locally and in Breslau, and was at first intended for a farmer. His instincts were, however, always artistic. In 1880–81 he spent two years at the Breslau school of art, followed by a year's study at Jena university. He then travelled in France, Spain and Italy and in 1884 established himself in Rome as a sculptor. Obliged by reasons of health to return to Germany. he lived in Dresden, Berlin (where he had thoughts of going on the stage) and Erkner, near Berlin, later settling at Schreiberhau, Silesia. He died June 8, 1946.

A man of great versatility and exceptionally wide artistic sympathies, Hauptmann hesitated long before choosing literature as his means of expression. His earliest work was *Promethidenlos* (1885). In 1889 he began the series of dramas which set him at a bound at the head of the German dramatic writers of his time. Hauptmann's first drama, *Vor Sonnenaufgang* (1889), appeared at a moment when the cultivated German public read nothing but Scandinavian, French and Russian authors, and German writers, to gain a hearing, were obliged to adopt foreign pseudonyms. Hauptmann's genius forced German attention back to its native authors. He was at heart always rather a romanticist than a naturalist, but circumstances forced him to begin as a naturalist. *Vor Sonnenaufgang* aroused a storm of criticism similar to that encountered by Ibsen and Strindberg, by whose side he took his place. He persevered, however, with a series of dramas depicting the life of the working classes or the poverty-stricken middle classes until, by 1910, German naturalism was fully established. These naturalist dramas include *Einsanze Menschen* (1891), *Fuhrmann Henschel* (1898), *Gabriel Schillings Flucht* (1912), and most notably *Die Weber* (1892), a social drama on the grand scale, representing the rise, outbreak, development and failure of a miniature revolution, and perhaps Hauptmann's greatest work. These dramas had created the type of German naturalism; but in Hauptmann exact and conscientious observation was mellowed by his great sensibility and feeling for beauty and genuine poetic gift. His romantic tendencies found play as early as 1892 in the somewhat fantastic *Hanneles Himmelfahrt,* while *Die Versunkene Glocke* (1896) and *Und Pippa Tanzt* (1906) are fairy pieces in a rather vague symbolic style. Hauptmann's insight, intellectual honesty and earnest purpose maintained him in the position which he had won as the foremost and most representative German writer. His later plays, however, the best of which was perhaps *Der Weisse Heiland* (1919), met with less appreciation than his earlier work. The subjective vision which now permeated his work perhaps hardly replaced his earlier peculiar gift for reproducing the life of others. Hauptmann's narrative work is less famous than his dramatic, but he produced two stories almost perfect in form and content: *Der Narr in Christo Emanuel Quint* (1910) and *Der Ketzer von Soana* (1918), as well as one of the most famous of German novels in *Atlantis* (1912). Hauptmann's verse, though dignified and sincere, lacks warmth.

See C. Holl, *Gerhart Hauptmann,* etc. (1913); W. Bonsels, *Das junge Deutschland und der grosse Krieg, aus Anlass des Briefwechsels Romain Rollands mit G. Hauptmann uber den Krieg und die Kultur* (1914); A. Esprey, *G. Hauptmann und wir Deutschen* (1916); J. H. Marschan, *Das Mitleid bei G. Hauptmann,* bib. (1919); Paul Fechter, *Gerlzart Hauptmann* (1922); P. Schlenther, G. *Hauptmann* (1922).

HAUPTMANN, MORITZ (1792–1868), German musical composer and writer, was born at Dresden, on Oct. 13, 1792, and studied music under Scholz, Lanska, Grosse and Morlacchi, the rival of Weber. Afterwards he completed his education as a violinist and composer under Spohr, and till 1820 held various appointments in private families, varying his musical occupations with mathematical and other studies bearing chiefly on acoustics and kindred subjects. For a time also Hauptmann was employed as an architect, but all other pursuits gave place to music, and a tragic grand opera, *Mathilde,* dates from 1826. In 1822 he entered the orchestra of Cassel, again under Spohr's direction, and taught composition and musical theory to Ferdinand David, Burgmuller, Kiel and others. His compositions at this time chiefly consisted of motets, masses, cantatas and songs. In 1842 Hauptmann became cantor at the Thomas-school of Leipzig where one of his predecessors had been J. S. Bach, and professor at the conservatoire. Here his unique gift as a teacher developed, and was acknowledged by a crowd of enthusiastic pupils, among whom were Joachim, von Biilow, Sullivan and Cowen. He was, as already indicated, a mathematician and a philosopher as well as a musician, and brought his studies in philosophy to bear on music. His most important publication was *Die Natur der Harmonik und Metrik* (1853, Eng. trans. *The Nature of Harmony and Metric,* 1888), a standard work. He died on Jan. 3, 1868.

Amongst his vocal compositions — by far the most important portion of his work — may be mentioned two masses, choral songs for mixed voices (*Op.* 32, 47), and numerous part songs, which remain in the repertory of most German choirs.

See a selection from the two German volumes of his letters to Hauser, Spohr and others, *Letters of a Leipzig Cantor* (1892).

HAUREAU (JEAN), BARTHELEMY (1812–1896), French historian, was born in Paris. He was a deputy to the National Assembly of 1848; contact with the revolution gradually cooled his old ardour. He became director of the ms. department of the Bibliothbque Nationale but resigned after the *coup d'état* of 1851, and refused to accept any administrative post until after the fall of the empire. He was director of the national printing press from 1870 to 1881, and in 1893 became director of the Fondation Thiers. He died on April 29, 1896.

Hauréau devoted his life to the religious, philosophical and more particularly the literary history of the middle ages. From the time of his appointment to the Bibliothèque Nationale up to the last days of his life he made abstracts of all the mediaeval Latin writings (many anonymous or of doubtful attribution) relating to philosophy, theology, grammar, canon law and poetry, carefully noting on cards the first words of each passage. After his death this index of *incipits,* arranged alphabetically, was pre-

sented to the Académie des Inscriptions, and a copy was placed in the ms. department of the Bibliothèque Nationale.

See notice by Paul Meyer prefixed to vol. xxxiii. of the *Histoire littéraire de la France.*

HAUSA, a Negro people found chiefly in northern Nigeria and the region immediately to the north in French West Africa. They number approximately 5,537,000 and constitute the single most numerous ethnic group in northern Nigeria. The Hausa have a sense of ethnic unity based on common language, similarity of customs and a tradition of common origin. According to a widely known legend, a man named Bayajida, having fled from Baghdad, his place of origin, arrived ultimately in Daura, at present a minor Hausa kingdom in the north. There. as a reward for his valour in killing a snake in the town well which was terrorizing the local population, he married the queen. His son. Bawo, is the reputed progenito'r of six sons who founded the Hausa states of Gobir, Katsina. Kano, Zaria, Biram and Rano, which, together with Daura itself, form the original seven Hausa states. In addition, the states of Zanfara, Kebbi. Nupe, Gwari. Yauri, Bauchi and Kororofa are traditionally called the "illegitimate seven," since they arose out of the assimilation of populations of non-Hausa origin. A reckoning based on the Kano Chronicle, a main source of indigenous history, would place the beginning of the rule of Bagauda, the first king of Kano and the grandson of Bayajida, in A.D. 999.

The early rulers of the Hausa states were pagans. Islam was introduced in the latter part of the 14th century by a delegation of learned hioslems from the Negro kingdom of Mali, at the bend of the Niger in the Sudanese Republic. It gradually spread among the Hausa, profoundly influencing their traditional beliefs and customs. A small minority of pagan Hausa, generally called Maguzawa. persists in some rural areas.

With the destruction of the vast Songhai empire with its capital at Timbuktu at the end of the 16th century, the important trans-Saharan caravan trade largely moved eastward to the Hausa cities of Katsina and Kano, which became flourishing centres of trade and Moslem culture.

Fulani and British Rule.—At the beginning of the 19th century the Fulani (*q.v.*), a largely pastoral people, originally from Senegal. who had settled in considerable numbers in Hausa country and were thoroughly Islamic, waged a holy war against the native Hausa rulers who mere accused of religious laxity. Under the leadership of Usuman dan Fodio, the Fulani succeeded in conquering virtually all of the Hausa states and establishing an empire with its capital at Sokoto. After the death of the founder. the empire was divided and administered from two theoretically equal centres, Sokoto for the east and Gwando for the west. The individual states under their emirs, however, retained considerable autonomy, conducting independent wars and slave expeditions and even engaging in internecine warfare. The Fulani empire was on the verge of dissolution at the time of the advent of the British under the leadership of Lord Lugard in 1907. Under British administration the Fulani continued as the ruling class. The policy of indirect rule, by which indigenous political forms were as far as possible preserved and adapted to modern conditions, was first formulated by Lord Lugard in northern Nigeria as the result of his contact with the highly organized Hausa emirates and subsequently applied in other British territories in Africa. Slave-raiding and the legal status of slavery were abolished under British rule.

Political and Economic Organization.— In the pre-British period, the Hausa states were organized on a feudal basis, the emir being surrounded by a number of titled officeholders who held as fiefs various villages from which their agents collected taxes. In addition to the Fulani nobility and the free Hausa farmers and artisans there were large numbers of slaves obtained in warfare and slave-trading, some of whom were individually owned, in which case they were treated as members of the household. Others worked on the estates of the officeholders or of the king. A few royal slaves held important positions of authority. The children of those born in slavery held a special position and might not be sold.

The economy rested on the intensive cultivation of sorghum, maize, millet and other food plants. The principles of crop rotation and mixed farming based on the use of manure from the Fulani cattle were utilized; the plow was unknown. The existence of part-time specialists in leather, metalwork, weaving, dyeing and other crafts, professional traders, the use of cowrie shell currency and permanent markets in the larger cities, all testified to the vigour of the Hausa economy.

The chief political and commercial centres were large walled cities with mud-brick architecture, whose style and construction mere probably borrowed from the Negro Moslem centres of the Niger bend and ultimately from North Africa.

Language and Literature.— The Hausa language belongs to the Chad group of Hamito-Semitic languages (see AFRICAN LANGUAGES). As a result of Islamic influence, numerous Arabic words have been borrowed, particularly in the spheres of religion and technology. The number of people who speak Hausa as a second language is difficult to estimate, but is considerable, and the language has become the general lingua franca in northern Nigeria, where it enjoys official status. Many Fulani speak it as a mother tongue.

Hausa is traditionally written in an orthography based on the Arabic alphabet, and an indigenous literature both in poetry and prose exists. The poetry employs quantitative metres of Arabic origin. The Moslem literati, however, more often use Arabic in their nritings, which thus holds a position analogous to that of Latin in Europe in the middle ages. After the establishment of the British protectorate, an orthography based on the Latin alphabet came into widespread use and by the middle of the 20th century appeared likely to displace the older system. The standard literary dialect nas that of the important commercial centre of Kano, the largest Hausa city. Dialect differences were considerable, that of Sokoto and the northwest being, in general, the most divergent from the standard form. These differences, however. were not sufficiently serious to interfere with mutual intelligibility.

See also NIGERIA.

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(J. G.)

HAUSER, KASPAR (*c.* 1812–1833), a German youth whose origin is surrounded with mystery. The first record of him is in May 1828, when he appeared in h'iirnberg, dressed as a peasant, and with a helpless and bewildered air that attracted attention. In his possession was found a letter purporting to be nritten by a labourer, stating that the boy was given into his custody on Oct. 7, 1812, and that according to agreement he had instructed him in reading, writing and the Christian religion, but had kept him in close confinement. With this letter was enclosed another purporting to be written by the boy's mother, stating that he was born on April 30, 1812, that his name was Kaspar, and that his father, an ex-cavalry officer in the 6th regiment at h'iirnberg, was dead. For some time the lad was detained at Nurnberg as a vagrant; Daumer then undertook his guardianship and the charge of his education. Earl Stanhope became interested in his history, and sent him in 1832 to Ansbach to be educated. He became clerk in the office of Feuerbach, president of the court of appeal; and his strange history was almost forgotten when interest in it was revived by his death as the result of a wound received on Dec. 14, 1833. Whether the wound was self-inflicted or whether, as he alleged, it was dealt by a stranger, is unknown. Kaspar Hauser's story has been used by Jakob Wassermann in a novel (1908) and by Kurt Martens in a play (1904).

The theory of Daumer and Feuerbach and other pamphleteers (see E. E. Evans, *Story of Kaspar Hauser From* Authentic Rec*ords,* 1892) mas that the youth was the crown prince of Baden, the legitimate son of the grand duke Charles of Baden, and that he had been kidnapped at Karlsruhe in Oct. 1812 by emissaries of the countess of Hochberg (morganatic wife of the grand duke) in order to secure the succession to her offspring; but this theory was ansnered in 1875 by the publication in the Augsburg *Allgemeine Zeitung* of the official record of the baptism, post-mortem

examination and burial of the heir supposed to have been kidnapped. See *Kaspar Hauser und sein badisclzes Prinzentum* (1876). The evidence was analyzed by Andrew Lang in his *Historical Mysteries* (1904), with results unfavourable to the "romantic" version of the story. Lang's view was that possibly Kaspar was a sort of "ambulatory automatist," an instance of a phenomenon, known by other cases to students of psychical abnormalities, of which the characteristics are a mania for straying away and the persistence of delusions as to identity; but he inclines to regard Kaspar as simply a "humbug." The "authentic records" purporting to confirm the kidnapping story Lang stigmatizes as "worthless and impudent rubbish."

HAUSHOFER, KARL (1869–1946), German political geographer and popularizer of geopolitics (*q.v.*), a theory of organic national development, was born in Munich on Aug. 27, 1869. The son of a professor at the University of Munich, he followed a military career until the end of World War I, attaining the rank of general. He acquired his first taste of the world-wide problems of political geography during an extended stay in Japan (1908–10). He was fascinated by Japan's expansionist ambition to become the leading power of Asia, and several of his books, including his most ambitious study in political geography, *Geopolitik des Pazifischen Ozeans* (1924), dealt with the role of Japan in 20th-century politics. In 1924 Haushofer founded the *Zeitschrift für Geopolitik,* which greatly influenced the new elite of Germany in the 1920s and '30s, augmented by Haushofer's teachings at the Institute of Geopolitics which he directed at the University of Munich. Compounded of sound observations and hazy theories, Haushofer's concept of the dominant role of the vast spaces was based upon Friedrich Ratzel's theories of space and nation and Rudolf Kjellén's conception of the state as a biological organism; his vision of the future role of Russia led him to adopt wholeheartedly the "heartland" idea of Sir Halford J. Mackinder (*q.v.*).

Haushofer's influence was considerable in military circles, but his impact upon the Nazi leadership was probably less significant than was assumed during World War II when the German pseudo science of geopolitics was identified in the United States with the Nazi doctrine of world domination. During the war Haushofer continued his efforts to justify the drives of Germany and Japan for world power, although his cultural background and his marriage to a woman of Jewish extraction must have made this task increasingly distasteful to him. When, after Germany's collapse, he was investigated as an alleged war criminal, he and his wife ended their lives, March 13, 1946.

His son Xlbrecht, who held a chair in geopolitics in the University of Berlin, had been executed as a resistance fighter against the Hitler regime. (H. W. WT.)

HAUSSER, LUDWIG (1818–1867), German historian, who played an active part in the movement for German unity, was born at Kleebourg, Alsace, on Oct. 26, 1818. He became professor in Heidelberg in 1850 and was a member of the Baden parliament. A moderate liberal, he was a passionate supporter of Prussia's leadership and opposed the inclusion of Austria in the German confederation. Hausser was a founder of the newspapers *Deutsche Zeitung* (1847) and of the *Süddeutsche Zeitung* (1862) and won the enthusiasm of many students for German unification. His chief work is *Dezctsche Gesclziclzte vom Tode Friedrichs der Grosse bis zur Gründung des deutschen Bundes* (4 vol., 1854–57). He died at Heidelberg on March 19, 1867.

See E. Marcks, *Ludwig Hausser und die politische Geschichtsschreibung in Heidelberg* (1903).

HAUSSMANN, GEQRGES EUGENE, BARON (1809–1891), French financier: whose name is associated with the rebuilding of Paris, was born in that city on March 27, 1809. of a Protestant family, German in origin. He mas educated at the Collhge Henri IV, and subsequently studied law, attending simultaneously the classes at the Paris conservatoire of music, for he was a good musician. He became *sous-préfet* of Nérac in 1830. and advanced rapidly in the civil service until in 1853 he was chosen by Persigny prefect of the Seine in succession to Jean Jacques Berger. who hesitated to incur the vast expenses of the imperial schemes for the embellishment of Paris.

Haussmann laid out the Bois de Boulogne, and made extensive improvements in the smaller parks. The gardens of the Luxembourg palace were cut down to allow of the formation of new streets, and the Boulevard de Sebastopol, the southern half of which is now the Boulevard St. Michel, was driven through a populous district. A new water supply, a gigantic system of seners, new bridges. the opera and other public buildings, the inclusion of outlying districts — these were among the new prefect's achievements, accomplished by the aid of a bold handling of the public funds which called forth Jules Ferry's indictment, *Les Comptes fantastiques de Haussmann,* in 1867. A loan of 250 million francs was sanctioned for the city of Paris in 1865, and another of 260 million in 1869. These sums represented only part of his financial schemes, which led to his dismissal by the government of Émile Ollivier. After the fall of the Empire he spent about a year abroad, but he re-entered public life in 1877, when he became Bonapartist deputy for Ajaccio.

Haussmann died in Paris on Jan. 11, 1891. He had been made senator in 1857, member of the Academy of Fine Arts in 1867, and grand cross of the Legion of Honour in 1862. His name is preserved in the Boulevard Haussmann. His later years were occupied with the preparation of his *Mémoires* (3 vol., 1890–1893). *See* also PARIS.

HAUSSONVILLE, JOSEPH OTHENIN BERNARD DE CLERON, COMTE D' (1809–1884), French politician and historian, was born in Paris on May 27, 1809. the son of Charles Louis Bernard de Cléron, comte d'Haussonville (1770–1846), chamberlain at the court of Napoleon. After holding various diplomatic posts, he was elected to the chamber of deputies in 1842, and became a life senator in 1878. In the senate he defended the religious associations against the anticlericals. He died in Paris on May 28, 1884.

His wife, Louise (1818–82), daughter of Duc Victor de Broglie, published *Robert Emmett* (1858) and other books.

His son GABRIEL PAUL OTHENIN DE CLÉRON was born at Gurcy-le-Châtel (Seine-et-Marne) on Sept. 21, 1843. In 1891. as representative of the Comte de Paris in France. he tried to strengthen the Orleanist party, but their prospects were dashed in 1894 by the death of the comte de Paris. D'Haussonville died in Paris on Sept. 1, 1924.

His works include: *Etudes biographiques et littéraires* (2 series, 1879 and 1888); *Le Comte de Paris, souvenirs personnels* (1895); *Souvenirs sur [illegible] de Maintenon,* with *G.* Hanotaux, 3 vol. (1903–04); *Ombres françaises et visions anglaises* (1914).

HAUTE-GARONNE, a frontier *département* of southwestern France, formed in 1790 from portions of the provinces of Languedoc (Toulousain and Lauraguais) and Gascony (Comminges and Nébouzan). Pop. (1954) 525,669. Area 2.458 sq.mi. It is bounded north by the *département* of Tarn-et-Garonne. east by Tarn. southeast by Aude and Aribge, south by Spain and west by Gers and Hautes-Pyrénées. Quaternary and Tertiary deposits occupy the centre of the *département.* Toward the south the land rises gradually to the Pyrenees, which on the Spanish border exceed 10,000 ft. Two passes, the Port d'Oô and the Port de Vénasque. exceed 9.800 and 7,900 ft. respectively. The Garonne flows in a northerly direction and receives the Pique, the Salat, the Louge. the Ariège, the Touch and the Save. Except in the mountains the climate is mild, the mean annual temperature being rather higher than at Paris. The rainfall. which averages 24 in. at Toulouse, exceeds 40 in. in the mountains; and sudden inundations of the Garonne cause much damage. Thick forests of oak, fir and pine furnish timber for shipbuilding. Wheat, maize and other grains are the principal crops. and there is generally a surplus for export. Market gardening flourishes around Toulouse. Vineyards are extensive, though the wine is of medium quality; and chestnuts, apples and peaches are grown. Cattle and sheep are reared and co-operative dairies are numerous in the mountains; but deforestation has tended to reduce the area of pastureland, the soil. unretained by tree roots, having been gradually washed away. Haute-Garonne has deposits of zinc and lead. and saltworkings; there is an ancient marbleworking industry at St. Béat. The mineral springs of Bagnhres-de-Luchon, Encausse, Bar-

bazan and Salies-du-Salat are well known. Manufactures include iron and copper goods. woolen, cotton and linen goods, leather, paper. boots and shoes, and tobacco. The main line of the Southern railway from Bordeaux to Cette passes through Toulouse The Canal du Midi traverses the *département* for 32 mi and the lateral canal of the Garonne for 1j mi. The Garonne is navigable below its confluence with the Salat. There are three *arrondissements*—Toulouse, Muret and St. Gaudens—subdivided into 39 cantons and 589 communes. Toulouse is the seat of a court of appeal and of an archbishop, the headquarters of the 17th army corps and the centre of an academy; and St. Gaudens, Bagnères-de-Luchon and St. Bertrand-de-Comminges are important. St. Aventin, Montsaunks and Vénerque possess old churches in the romanesque style. The choir of St. Just at Valcabrkre dates from the 8th or 9th century and part of the nave from the 11th century. There are ruins of a Cistercian abbey at Bonnefont near St. Martory. Gallo-Roman remains have been discovered at Martres. Near Revel is the reservoir of St. Ferréol, constructed for the Canal du Midi in the 17th century.

HAUTE-LOIRE, a *département* of central France. formed in 1790 of Velay and portions of Vivarais and Gkvaudan, three districts formerly belonging to the old province of Languedoc, of a portion of Forez formerly belonging to Lyonnais, and a portion of lower Auvergne. Pop. (1954) 215,57j. Area 1,931 sq.mi. It is bounded north by Puy-de-DBme and Loire, east by Loire and Ardèche, south by Ardèche and Lozkre and west by Lozère and Cantal. Forming a portion of the Plateau Central, it is traversed from north to south by four mountain ranges. Its highest point, the Mont Mézenc (5,755 ft.), in the southeast, belongs to the mountains of Vivarais, nhich are continued along the eastern border by the Boutikres chain. The Lignon divides the Boutikres from the Massif du Mégal, which is separated by the Loire from the mountains of Velay, a granitic range overlaid with volcanic rocks. The Margeride mountains run along the western border. The Loire waters the eastern half of the *département*. The Allier, which joins it at Nevers, traverses the western portion. The chief affluents of the Loire within the *département* are the Borne on the left, joining it near Le Puy, and the Lignon, on the right. The winters are long and rigorous. Rye, oats, barley and wheat are cultivated, and aromatic and medicinal plants are abundant on the plateaus. Lentils. peas, mangel-wurzels and other forage and potatoes are also groan. Horned cattle belong principally to the Mézenc breed; goats are numerous The woods yield pine, fir, oak and beech. Lacemaking and coal mining (around Brassac and Langeac) are main industries. There are also mines of antimony and stone quarries. Silk milling. caoutchouc making, papermaking, glass blowing and wood sawing are also carried on. The principal imports are flour, brandy, wine, livestock. lace-thread and agricultural implements. Exports include fat stock, wool, aromatic plants. coal, lace. The *département* is served chiefly by the Paris-Lyon-Mkditerranee railway. There are three *arrondissements*—Le Puy, Yssingeaux and Brioude—with 29 cantons and 267 communes.

Haute-Loire forms the diocese of Le Puy in the ecclesiastical province of Bourges, and belongs to the academie (educational division) of Clermont-Ferrand. Its court of appeal is at Riom. The churches of Chamalikres. St. Paulien and Sainte-Marie-des-Chazes are romanesque in style; Le Monastier preserves the church, in part romanesque, and the buildings of the abbey to which it owes its origin. Arlempdes and Bouzols (near Coubon) have the ruins of large feudal châteaus. The rocky plateau overlooking Polignac is occupied by the ruins of the stronghold of the ancient family of Polignac, including a square donjon of the 14th century. Interesting Gallo-Roman remains have been found on the site.

HAUTE-MARNE, a *de'partement* of northeastern France, made up of districts belonging to the former province of Champagne (Bassigny, Perthois, Vallage), with smaller portions of Lorraine and Burgundy. and some fragments of Franche-Comté. Area 2,416 sq mi. Pop. (1954) 197,147. It is bounded northeast by Meuse, east by Vosges, southeast by Haute-Saône south and southwest by Côte d'Or, west by Aube and northwest by Marne. Its greatest elevation (1,693 ft.) is in the plateau of Langres between the sources of the Marne and those of the Aube; the watershed between the Rhône and the Seine and Meuse, formed by the plateau of Langres continued northeast by the Monts Faucilles. has an average height of 1,500 or 1,600 ft. To the north is Bassigny (the *paybas* or low country, as distinguished from the highlands), a district characterized by monotonous flats of little fertility and extensive wooded tracts. The principal river of the *département* is the Marne. It receives on the right the Rognon, and on the left the Blaise. The western portion is watered by the Aube and its tributary the Aujon, both of which have their sources on the plateau of Langres. The Meuse rises in the Monts Faucilles, and has a course of 31 mi. within the *département*. The Apance, the Amance, the Salon and the Vingeanne are tributaries of the Saône. The mean temperature is 51° F., nearly that of Paris; the rainfall is slightly less than the average for France.

Agriculture is carried on by small proprietors. The chief crops are wheat and oats; potatoes, lucerne and mangel-wurzels are next in importance. Horse and cattle raising flourish in Bassigny. The white wine of Soyers is notable. The *de'partement* is rich in iron and building stone is quarried. The warm springs of Bourbonne-les-Bains are among the earliest known and most frequented in France. Industrial establishments include blast furnaces, foundries, forges, plate-rolling works and shops for nail making and smith's work of various descriptions. St. Dizier is the chief centre of manufacture and distribution. The cutlery trade is important at Nogent-en-Bassigny and in the neighbourhood of Langres. Val d'Osne is well known for its metalwork. Flour-milling, glovemaking (at Chaumont), basketmaking and tanning are also carried on. The principal import is coal. while manufactured goods, iron! stone, wood and cereals are exported. The line of the Eastern railway from Paris to Belfort passes through Chaumont and Langres. The canal from the Marne to the Saône and that of the Haute-Marne together cover 99 mi.; there is a canal 14 mi. long from St. Dizier to Wassy. There are three *arrondissenzents* (Chaumont! Saint-Dizier and Langres), with 28 cantons and 550 communes. Chaumont is the capital. The *département* forms the diocese of Langres; it belongs to the 7th military region and to the educational circumscription (académie) of Dijon, where also is its court of appeal. At Montier-en-Der the remains of a 7th-century abbey include a church with nave and aisles of the 10th, and choir of the 13th century. Wassy, the scene of the massacre of Protestants in 1562, has a church largely of the romanesque period. Vignory has a church of the 11th century. Joinville, a metallurgical centre, preserves a château in the Renaissance style. Pailly. near Langres, has a late 16th-century château.

HAUTES-ALPES, a *département* in southeast France, formed in 1790 out of the southeastern portion of the old province of Dauphiné, together with a small part of north Provence. It is bounded north by the *de'partement* of Savoie, east by Italy and south and southeast by the *département* of the Basses-Alpes, south by the last-named *département,* and west by the *départements* of the Drôme and of the Isère. Its area is 2,179 sq.mi. Pop. (1954) 85,067. It is very mountainous and includes the Pelvoux mass of primary rocks rising to a height of 12,973 ft. in the north, the high line of the Cothian alps 12,609 ft. in the east: and the Papillon mountains of Mesozoic rocks in the south. The *de'parternent* consists of the basins of the upper Durance (with tributaries, Guisane, Gyronde and Guil), of the upper Drac, leading to Grenoble, and of the Buech. The *département* is divided into two *arrondissements* (Gap and Briançon), 24 cantons and 184 communes. There are no large industries and commerce is almost wholly local. The prolonged winter greatly hinders agricultural development, while the pastoral region has been greatly damaged and forests destroyed by the ravages of Provençal sheep, vast flocks of which are driven up there in the summer as the pastures are leased out to a large extent and but little utilized by the inhabitants. It now forms the diocese of Gap (this see is first certainly mentioned in the 6th century) in the ecclesiastical province of Aix-en-Provence; in 1791 there was annexed to it the archiepiscopal see of Embrun, which was then suppressed. There are 114 mi. of railway in the *de'partement.* This includes the main

line from Briançon past Gap toward Grenoble. About 16½ mi. west of Gap is the important railway junction of Veynes. from which branch off lines to Grenoble, to Valence by Die and Livron, and to Sisteron for Marseilles. The chief town is Gap; Briançon and Embrun are the other towns.

HAUTE-SAÔNE, a *de'partement* of eastern France, formed in 1790 from the northern part of Franche Comté. It is traversed by the river Sabne, bounded north by the *département* of the Vosges, east by the territory of Belfort and the *de'partement* of Haut-Rhin, south by Doubs and Jura and west by Côte-d'Or and Haute-Marne. Pop. (1954) 209,303; area, 2,075 sq.mi. The *département* is the upper basin of the Saône from the Ballon de Servance (3,986 ft.) in the northeast to its confluence with the Ognon in the southwest, and it also includes the right side of the lower Ognon valley extending over to the left side in the upper part of that valley toward Belfort. The sandstones and granite of the southern Vosges give place to limestones framing the two valleys at a level of 800 to 1.000 ft., and the water that soaks through these limestones emerges as springs feeding the streams in the valleys zoo ft. lower down. The northeastern districts are cold, due in part to the coldness of the soil, and have an annual rainfall ranging from 36 to 48 in. Toward the southwest the climate becomes more temperate. At Vesoul and Gray the rainfall reaches only 24 in. per annum.

Half of the area of Haute-Sabne is arable land, growing wheat, oats, meslin, rye and potatoes. The vine flourishes mainly in the *arrondissement* of Gray; tobacco is grown. Apples, plums and cherries (from which the kirsch, for which the *de'partement* is famous, is distilled) are the chief fruits. The woods which cover a quarter of the *de'partement* are composed mainly of firs in the Vosges and of oak, beech, hornbeam and aspen elsewhere. Horses and horned cattle thrive on the river pastures. Mines of coal (at Ronchamp) and rock salt (at Gouhenans) and stone quarries are worked. The hot springs of Luxeuil-les-Bains are the most famous of Haute-Saône. There are ironworking establishments, copper foundries, engineering works, steel foundries and factories at Plancher-les-Mines and elsewhere for producing ironmongery, nails, pins, files, saws, screws, shot, chains, agricultural implements, locks, spinning machinery, edge tools; there are also glassworks, potteries and brick and tileworks, cotton factories. of which Héricourt (pop. in 1954, 6,233) is the chief centre, paper mills, printworks, fulling mills, hosiery factories and straw-hat factories, as well as sugar works, distilleries, dye works, sawmills, starchworks, chemical works at Gouhenans, oil mills. tanyards and flour mills. The *de'partement* exports wheat, cattle, cheese, butter, iron. cotton cloth, wood, pottery, kirschwasser, plaster, leather, glass, etc. The Sabne provides a navigable channel of about 70 mi.. which is connected with the Moselle and the Meuse at Corre by the Canal de l'Est along the valley of the Coney. Gray is the chief emporium of the water-borne trade of the Saône. Haute-Saône is served chiefly by the Eastern railway. There are two *arrondissements*— *Vesoul* and Lure—comprising 28 cantons, 583 communes; Haute-Saône is in the district of the 7th army corps (Besançon), and in its legal, ecclesiastical and educational relations depends on Besançon.

Vesoul, the capital of the *de'partement,* Gray, Lure and Luxeuil are the principal towns. The Roman ruins and mosaics which may be seen at Membrey, the church (13th and 15th centuries) and abbey buildings in and around Faverney (10th, 13th and 14th centuries), in the *arrondissement* of Vesoul, are of antiquarian interest.

HAUTE-SAVOIE, a frontier *dkpartement* of France, formed in 1860 of the old provinces of the Genevois, the Chablais and the Faucigny, previously the northern portion of the duchy of Savoy neutralized in 1815. It is bounded north by the canton and Lake of Geneva, east by the Swiss canton of the Valais, south by Italy and the *dkpartement* of Savoie, and west by the *dkpartenzent* of the Ain. Pop. (1954) 293,852. Area, 1,775 sq.mi. It slopes from the Mont Blanc (15,771 ft.) chain on the southeast down to the lake and canton of Geneva and the Rhbne (945 ft.) on the west. It is drained by many streams, chief of which are the Arve and the Fier, feeders of the Rhône; the Fier forms the lake of Annecy. The climate varies considerably with the altitude; the maximum rainfall is in May and June. The tourist industry is highly important, especially at Charnonix. Cattle and poultry are reared, and Gruykre cheeses and honey are made. There are chalybeate springs at Évian and Amphion, and at St. Gervais and elsewhere. Anthracite and asphalt mines are numerous, as well as stone quarries. There is much trade in pine and other wood from mountain forests. Cotton is manufactured at Annecy; Cluses is the centre of the clockmaking industry; and there is a well-known bell foundry at Annecy-le-Vieux. The *département* is divided into four *arrondissements* (Annecy, the principal town, Bonneville, Saint-Julien-on-Genevois and Thonon-les-Bains), 28 cantons and 315 communes. It forms the diocese of Annecy in the province of Chambéry, is in the district of the 14th army corps (Lyons) and in the Académie (educational division) of Chambéry, where is its court of appeal. Thonon (the old capital of the Chablais) is the chief town on the south shore of the Lake of Geneva and, after Annecy, the largest place in the *de'partement.*

HAUTES-PYRÉNÉES, a *de'partement* of southwestern France, on the Spanish frontier, formed in 1790, half of it being taken from Bigorre and the remainder from Armagnac, Nébouzan, Astarac and Quatre Vallées, districts of the province of Gascony. Pop. (1954) 203,544. Area, 1,751 sq.mi. Hautes-Pyrénées is bounded south by Spain, west by the *de'partement* of Basses-Pyrénées, north by Gers and east by Haute-Garonne. The south of the *département,* comprising two-thirds of its area, is occupied by the central Pyrenees composed of Paleozoic rocks with Mesozoic rocks on the northward facing slopes. The ancient volcanic rocks stand out as the highest peaks, some exceeding 10,000 ft., the Vignemale (10,820 ft.) being the highest in the French Pyrenees. The imposing cirques (Cirques de Troumouse, Gavarnie and Estaubé), with glaciers and waterfalls, and the pleasant valleys attract many tourists. The north of the *de'pautement* has plains and undulating hills clothed with cornfields, vineyards and meadows. To the northeast, the cold and wind-swept plateau of Lannemezan (about 2,000 ft.) with Miocene and glacial deposits, presents a striking contrast to the plain below. The Adour and its tributary, the Gave de Pau, and the Neste, an affluent of the Garonne, drain the *de'partement.* The sources of the second and third lie close together in the Cirque of Gavarnie. An important section of the Pyrenees, which carries the Massif Néouvielle and the Pic du Midi de Bigorre runs northward between these two valleys. The Adour descends from the Pic du Midi through the Campan valley and leaves the mountains at Bagnkres and then divides into a multitude of channels, notably the Canal d'Alaric (36 mi. long), to irrigate the rich plain of Tarbes. Beyond Hautes-Pyrénées it receives the Arros, which flows through the *dkpartenzent* from south to north-northwest; on the left it receives the Gave de Pau; it is navigable in the lower stretches. The Gave de Pau, larger than the upper Adour, after passing Argelks. a well-known centre for excursions, and Lourdes, leaves the mountains. The Neste is important as furnishing the plateau of Lannemezan with a canal, the Canal de la Neste, the waters of which are partly used for irrigation and partly for supplying the streams that rise there and are dried up in summer—the Gers and the Bai'se, affluents of the Garonne. The climate of Hautes-Pyrénées, cold on the highlands, gives, on the plains, hot summers, fine autumns, mild winters and rainy springs. On the plateau of Lannemezan, summers are dry and scorching, winters very severe. The average annual rainfall at Tarbes, in the north, is about 34 in.; at the higher altitudes it is much greater. The mean annual temperature at Tarbes is 59° F.

Hautes-Pyrénées is agricultural in the plains, pastoral in the highlands. The more important cereals are wheat and maize, chiefly in the Adour valley and the northern part of the *département,* which is much used for the feeding of pigs and poultry, especially geese; rye, oats and barley are grown in the mountain districts. The wines of Madiran and Peyrigukre are well known, and chestnut trees and fruit trees are grown on the lower slopes. Horse breeding is important around Tarbes and Bagnères-de-Bigorre, and there is a famous stud at Tarbes. The horse of the region has Arab, English and Navarrese blood and is well fitted

for saddle and harness. Cattle raising is important; the milch cows of Lourdes and the oxen of Tarbes and the valley of the Aure are highly esteemed. Sheep and goats are also reared. The forests, which occur chiefly in the highlands, are mainly coniferous and still contain wild animals (bears, wolves, etc.). There are at Campan and Sarrancolin quarries of fine marble, which is sawed and worked at Bagnkres. There is a group of slate quarries at Labasskre and an important slate works at Tarbes. Deposits of lignite, lead, manganese and zinc are found. The principal mineral springs in the valley of the Gave de Pau are Cauterets (hot springs containing sulfur and sodium), St. Sauveur (springs with sulfur and sodium) and Barkges (hot springs with sulfur and sodium), and in the valley of the Adour Bagnkres (hot or cold springs containing calcium sulfates, iron, sulfur and sodium) and Capvern near Lannemezan (springs containing calcium sulfates).

The *département* has flour mills and sawmills, a large military arsenal at Tarbes, paper mills, tanneries and manufactories of agricultural implements and looms. The spinning and weaving of wool are carried on chiefly at Bagnkres-de-Bigorre.

Of the passes *(ports)* into Spain, even the chief, Gavarnie (7,398 ft.), is not accessible to carriages. The Southern railway main line, from Bayonne to Toulouse, traverses the *département*. There are three *arrondissements*, Tarbes, Argelks-Gazost and Bagnkres-de-Bigorre, 26 cantons and 480 communes. Tarbes is the capital of Hautes-Pyrénées, which is attached to the appeal court of Pau and forms part of the region of the 18th army corps (Bordeaux). There are bishops at Tarbes and Lourdes, under the archbishop of Auch. The *département* is in the académie (educational division) of Toulouse. Tarbes, Lourdes, Bagnères-de-Bigorre and Luz-St. Sauveur are the principal towns. St. Savin, in the valley of the Gave de Pau, and Sarrancolin have interesting romanesque churches. The church of Maubourguet was built by the Templars in the 12th century.

HAUTE-VIENNE, a *département* of central France, formed in 1790 of Haut-Limousin and of portions of Marche, Poitou and Berry. Pop. (1954) 324,429. Area, 2,145 sq.mi. It is bounded north by Indre, east by Creuse, southeast by Corrkze, southwest by Dordogne, west by Charente and northwest by Vienne. The highest altitude (3,130 ft.) is in the extreme southeast and belongs to the treeless but well-watered plateau of Millevaches, formed of granite, gneiss and mica. From that point the *département* slopes toward the west, southwest and north. To the northwest of the Millevaches are the Ambazac and Blond Hills, and the mountains of Limousin are on the south. The Vienne traverses the *département* from east to west, forming in its upper course the basin of Limoges, passing Eymoutiers, St. Léonard, Limoges and St. Junien, and receiving most of its tributaries from the south. The altitude, inland position and cold soils of Haute-Vienne and the northern exposure of its valleys make the winters long and severe; but the climate is milder in the west and northwest. The annual rainfall often reaches 36 or 37 in, and even more in the mountains. Rye, wheat, buckwheat and oats are the cereals most grown, but the chestnut still forms the staple food of large numbers. Potatoes, walnuts and cider apples are cultivated. Good breeds of horned cattle and sheep are reared in the valleys and find a ready market in Paris. Horses for remount purposes are also raised. The quarries furnish granite and large quantities of kaolin, which is both exported and used in the porcelain morks of the *département*. Limoges is a centre of the porcelain industry and has important liqueur distilleries. Agricultural implements and hats are other industrial products, and there are breweries, dye morks, tanneries, iron foundries and printing works. Wine and alcohol for liqueur-manufacture, coal, raw materials for textile industries, hops, skins and various manufactured articles are among the imports.

The *département* is served by the Orléans railway. It is divided into the *arrondissements* of Limoges, Bellac and Rochechouart (29 cantons and 206 communes), and belongs to the académie (educational division) of Poitiers and the ecclesiastical province of Bourges. Limoges, the capital, is the seat of a bishopric and of a court of appeal and the headquarters of the 12th army corps. The other principal towns are St. Yrieix and St. Junien. Solignac, St. Léonard and Le Dorat have fine romanesque churches. There are important remains of the château of Chalusset (S.S.E. of Limoges), and the château of Rochechouart dates from the 13th, 15th and 16th centuries.

HAUT-RHIN, *de'partement* of France. formed after the Revolution in 1790 from the southern portion of Alsace, and incorporated in 1870 nith the German empire; it was resuscitated by the Treaty of Versailles in 1918, when Alsace-Lorraine became French once more. It is bounded north by Bas-Rhin, east by the *land* of Baden-Wurttemberg, south by Switzerland, southwest by the territory of Belfort and west by the Vosges. Pop. (1954) 509,647. Area, 1,354 sq.mi.

The *département* occupies the southern portion of the Rhine trough. The Vosges and Black Forest are the remains of a Hercynian block, rifted, apparently, at some stage in the uprise of the Alps, with the result that the deep Rhine trough from Basle northnard was formed. Loess deposits occur in the south and along the foot of the Vosges and give good soil with layers useful for the manufacture of bricks. Haut-Rhin is one of the most fertile parts in central Europe. The hills are richly wooded, chiefly with fir, beech and oak. The agricultural products are corn, potatoes, flax, grapes and other fruit. Cotton spinning and weaving is the most important industry centred in Mulhouse, Colmar, Guebwiller and the Vosges valleys.

Other industries are the manufacture of woolen and silk goods, chemicals, paints, machinery, pottery, bricks, tiles and paper. Potash is produced near Mulhouse, and also lime. Haut-Rhin is also important for its wine.

Haut-Rhin is at a disadvantage as regards commerce, owing to its isolation from the rest of France and the fact that the Rhine, its main outlet, has its mouth outside France. The Rhine is navigable for small vessels as far as Basle, but the *de'partement* is served by the Ill; the Rhine-Rhône canal is another outlet. This *de'partement* and Bas-Rhin, however, gain from the fact that they are in the French customs boundary, and thus have French markets open to their industrial products.

Colmar is the capital of the *de'partenzent*, which includes six *arrondissements* (Colmar, Altkirch, Guebwiller, Mulhouse, Ribeauville, and Thann), 26 cantons, and 386 communes. It is under the académie of Strasbourg. Colmar is the seat of Superior Regional Tribunal. It is the bishopric of Strasbourg. The other important towns are Mulhouse, Guebwiller and Altkirch. Most of the towns are situated on the Ill; there are no important towns on the Rhine south of Strasbourg, owing to its marshy banks. The *département* is served by rail from Basle via Mulhouse and Colmar to Strasbourg.

HAUY, RENÉ JUST (1743–1822), French mineralogist one of the founders of the science of crystallography, was born at St. Just, Oise, on Feb. 28, 1743. An accident directed his attention to crystallography. Happening to let a specimen of calcite fall, he was led by examination of the fragments to make experiments which resulted in the statement of the geometrical law of crystallization according to which the secondary faces on a crystal are related to the primitive form, or cleavage nucleus, by a law of whole numbers, and the angles between them can be arrived at by mathematical calculation. Hauy's name is also known for the observations he made in pyroelectricity. the property of certain crystals, *e.g.,* tourmaline (*q.v.*), of developing electric charges on heating or cooling. In 1802, under Napoleon, he became professor of mineralogy at the museum of natural history, but was deprived of his appointment at the Restoration. He died in Paris on June 3, 1822.

Among his numerous works may be mentioned *Traite' de minkralogie* (4 vol., 1801); *Tableau comparatif des rksultats de la cristallographie, et de l'analyse chimique, relativement à la classification des minéraux* (1809); *Traite' des caractères physiques des pierres précieuses* (1817); and *Traite' de cristallographie* (2 vol., 1822). He also contributed papers to various scientific journals.

HAVANA (LA HABANA), a province in middle western Cuba, between Pinar del Rio and Matanzas provinces. Although the smallest province in area (3,174 sq.mi.), including the Isle of Pines,

it is densely populated (1961 est.. 1.858.112) because of the great concentration in and near the city of Havana. It consists mostly of hilly belts near the northern coast and in the centre. and a gently sloping plain in the south bordered by a swampy coast of mangrove forests. The northern coast is high and is characterized by an abundance of terraces: sandy beaches and the beautiful Bay of Havana.

The fertile soils of the province, especially in the Red plain of the south, yield considerable quantities of sugar cane. excellent quality cigar-wrapper tobacco. fruits, vegetables and milk for the urban market of Havana. Güines. in the southeastern section of the province, has been traditionally the supplier of agricultural products for Havana, using irrigation facilities of the Mayabeque river. The province has excellent communications. including a good network of modern highways, railways and airways. Many industrial plants are located around as well as in Havana.

(D. R. D.)

HAVANA (LA HABANA) capital, commercial metropolis and major port of the republic of Cuba. the largest city of the West Indies and one of the leading tropical cities in the new world, lies on the northern coast of the island, toward the western end. Its location on one of the fine harbours of the hemisphere made it commercially and militarily important from colonial times and is a major factor in accounting for its steady growth in population from 235.931 in 1899 to 897.042 (est.) in 1961. Other factors in its growth have been its salubrious climate, picturesque location and. before the advent to power of Fidel Castro in 1959, gay entertainment which made it a mecca for tourists. The mean annual temperature varies only about 10 degrees. averaging 76" F. Rain falls throughout the year. the wet season being from May to November.

The city has three sections: the old city; the new, closely settled subdivisions; and the suburbs. Old Havana is located on the peninsula between the harbour channel and the bay; the newer section of Vedado extends along the coast to the Almendares river; a little farther out are the residential and industrial suburbs of Guanabacoa and Marianao. The aspect of Havana from the sea is picturesque. Although the country clubs and many of the fashionable residential suburbs along the coast were expropriated by the Castro government, from a physical standpoint the view remains no less impressive. On the left of the entrance to the harbour rises the Morro castle and lighthouse. On the right La Punta fortress appears and beyond it the Prado. or Paseo de Martí. the main avenue leading to the heart of the city'. Lining the Prado are buildings constructed of West Indian white coral limestone.

The entrance-strait to the harbour, about 300 yd. wide and 1.750 yd. long, leads to the inner harbour. which lies east and south of the city. The water front in the older sections is lined with wharves and docks. There are three distinct arms of the inner bay, called respectively. Ensenada de Marimalena, Guanabacoa bay and the Ensenada de Atarés.

Streets and Buildings.— From well out toward the western suburbs. the Llalecon, or sea wall, a wide boulevard which skirts the sea and city, furnishes a colourful foreground which is extended along inside the harbour (on reclaimed ground which covers the shallows of the harbour entrance) and creates wide parks and valuable commercial lands. The Malecón merges at the Prado into the Avenida del Puerto. which, with a width varying from 50 to 125 ft., connects this outer drive to the old narrow streets of the business section. This entrance to the old business thoroughfares: Calles O'Reilly and Obispo, and Calle de Oficios eased much or' the old downtown congestion. Most of the old streets of Havana, originally laid out to furnish shade along their narrow drives and walks and to carry only a few dozen Cuban coaches (*quitrines* or *volantas*) were converted into one-way streets to accommodate motor vehicles. thus giving a more ordered control of the traffic problem.

Many public buildings were built along the Malecón and the Avenida del Puerto, including the Capitania, or office of the captain of the port. The newer section has also a number of hne parks. notably the Parque del Maine, with its monument by Felix Cabarrocas dedicated to the U.S. battleship "Maine," which was blown up in Havana harbour on Feb. 15, 1898. In 1960, in an angry gesture against the United States. Fidel Castro had the eagle atop the monument removed by a wrecking crane, resulting in the partial destruction of the main shaft of the monument as well. The announced intention was to replace the eagle with the "dove of peace." The Presidential palace, the residence of the chief executive, is at the head of the Avenida de las Misiones, a wide thoroughfare; this avenue leads from Xvenida del Puerto inland and was designed to be lined for its short length with the embassies and legations of foreign governments.

Historic *Landmarks.*—Of the older landmarks! one of the most important is the old palace of the Spanish governors, now the city

AUTHENTICATED NEWS

VIEW ALONG THE MALECÓN, SEA-WALL DRIVE IN HAVANA, SHOWING THE PARQUE DEL MAINE WITH THE MONUMENT DEDICATED TO THE MEN OF THE U.S.S. "MAINE"

hall and office of the Ayuntamiento or city government; this fine old pile stands on the site of the original parish church on the eastern side of the Plaza de Xrmas. the old centre of the colonial city. The palace was erected in 1773–92 and remodeled in 1835 and 1851. It was the scene of the surrender by the Spaniards of the sovereignty of the island to the United States at the close of the Spanish-American War and the scene, too. of the transfer of its sovereignty from the United States to the first president of Cuba. Tomás Estrada Palma. on May 20. 1902.

Havana was once the most strongly fortified city in Spanish America and many of its old forts built to withstand attacks irom pirates are still standing. The most precious of these old historical landmarks is the ancient stronghold. La Fuerza. or more properly, El Castillo de la Real Fuerza. begun in 1565 and completed in 1583. standing on the site of the yet older fortress built by order of Hernando de Soto in 1533, but destroyed by the French pirate Jacques de Sores. The later fortress was the home of the governors general and the citadel and refuge of the populace in times of danger from 1581 until the middle of the 18th century. Crowning the old watchtower of La Fuerza is a weather vane formed in the shape of an Indian maiden, called "La Habana." The two 16th-century fortresses. Morro castle or El Castillo de los Tres Reyes del Morro (castle of the three kings of the headland) and La Punta, on either side of the harbour entrance, are perhaps the best-known Cuban landmarks. La Cabaña, behind and above Morro castle is the largest fort in Havana and was completed in 1771.

Another old building (restored and used by the senate) is of elaborate 13th-century Spanish baroque architecture. The old city also contains the post office (the church of San Francisco), begun in 1575 and rebuilt in 1731–37; also the old municipal jail, a typical Spanish fortress on the Prado, and the Castillo del Principe, now the penitentiary. In this section also is the National library, the Llaestranza, formerly the navy yard and the headquarters of the artillery. The old city abounds in ancient private residences. Before the Castro revolution many of them had been acquired by the government and patriotic societies in order to restore and preserve them.

Many of the public buildings were formerly churches, and in-

deed churches of the colonial epoch are still among the most interesting and carefully preserved relics of the older days. The convent of Santa Clara, built in 1644, was bought by the government at a substantial price in 1928 and converted into the ministry of public works; in the large patio of this old building are still preserved the first houses and streets built in Havana, which were enclosed in the old church and monastery by its builders in the 17th century. The cathedral is the most noteworthy, architecturally. of the city's churches; it was originally the Jesuit church, erected between 1656 and 1724, although the interior decorations date only from 1790–1820. One of the tombs of Columbus is marked there; the remains of the discoverer were removed, according to certain claimants, from Santo Domingo (Dominican Republic) in 1796, and lay there until carried to Spain in 1898. *(See* COLUMBUS.)

Parks and Suburbs. — Havana has been famous since the days of the Spaniards for its parks and drives. The harbour's edge on the east is traversed in part by the old Paseo or Alameda de Paula, originally laid out in 1772, and by the Avenida del Puerto, the latter a portion of the elaborate modern reconstruction of Havana (including the opening of the Avenida de las Misiones and the beautification of the Prado), designed and carried out under Carlos Manuel de Céspedes while minister of public works under Pres. Gerardo Machado. The Malecbn or sea-wall drive, extended around the harbour entrance as the Avenida del Puerto, traverses the edge of the city along the sea for several miles, a beautiful drive and promenade. The Prado, rechristened the Paseo de Martí in honour of the "Apostle of Cuban independence," follows the line of the old city wall. The lower Prado is lined nith residences and clubs, but the so-called upper Prado leads to the Parque Central on one side of which was built the pretentious and costly capitol, begun by Pres. José Miguel Gomez about 1910 and completed under Pres. Gerardo Machado in 1929. The Prado continues to the Plaza de la Fraternidad, formerly Parque de Colón or Campo de Marte curving in its course and furnishing a highway into the heart of the old city, although its formal climax is the Parque de Colón where stand handsome monuments to José Martí and other Cubans notable in history and science. This park is surrounded by handsome offices, hotels and clubs, among them the more elaborate and costly Centro Asturiano, one of the two large Spanish clubs, the other being the Casino Español. In this section were some of the handsomely equipped hotels that made Havana an important winter resort.

From Plaza de la Fraternidad, the Avenida de Simbn Bolivar, formerly Calzada de la Reina, reaches the Paseo de Carlos III and the Paseo de Tacón, passing westward through the city to the botanical gardens and the Quinta de los Molinos to the old citadel of El Principe, begun in 1774 and finished 20 years later. Los Molinos was once the summer palace of the Spanish governors general and adjoins the gardens of the university. Near El Principe is the Colón cemetery, with many historic monuments and mausoleums. Another famous promenade and drive is the Avenida de Menocal, at the west end of the new city; the Cerro, in the southwest, is a residence quarter.

Suburban growth in Havana was rapid and extensive. The whole territory now tributary to the capital covers a large area. On the south and west the city is surrounded by a range of hills, with the conspicuous fortifications of Castillo del Principe on the west. Lower down on the hills are the suburbs of Vedado, Jesus del Monte and Luyanó; besides these, Puentes Grandes, old Marianao and Guanabacoa are populous suburbs.

Education. — In the upheaval of revolution and the establishment of the Castro regime, the Universidad de La Habana — the national university established in 1728 — suffered catastrophic damage. Shorn of its traditional autonomy and made subservient to the regime, two-thirds of its faculty were forced out and most of them went into exile. The Catholic university in the suburb of Marianao was closed, as were the once excellent secondary schools previously maintained under Protestant, Catholic and nonsectarian auspices. All private schools were outlawed.

Although it was the avowed aim of Castro's 26th of July movement to extend educational facilities to 'all Cubans, it was not known in the early 1960s to what degree that objective had been fulfilled. The content of instruction in the schools was being changed to support the political orientation of the Castro regime.

Among the libraries are those of the Sociedad Económica de Amigos del País founded in 1793, and the Biblioteca Nacional (National library). The only newspapers allowed by the Castro government were those under strict government control-Revolution, *Hoy* and a few others. The venerable and internationally respected *Diario de la Marina,* established in 1838, and all other private newspapers were suppressed.

Population and Health. — Havana had 51.307 people in 1791; 96,304 in 1811; 94,023 in 1817; 184.508 in 1841; 235,981 in 1899, the year following independence; 360,517 in 1919; 432,353 in 1925; 542,522 in 1931; 659,883 in 1943; and 785,455 in 1953, while the suburbs aggregated another 432,219. The population is mainly native-born and predominantly Afro-European. The European element is, of course, primarily Iberian and representative chiefly of northern and northwestern Spain. The knowledge of English became widespread in Havana because of the impact of American tourists and the advent of motion pictures, radio and television.

The workers' residence portion of the city is congested, and before the U.S. occupation *(see* CUBA: *History),* health conditions were notoriously bad and deaths from epidemics, including periodic scourges of yellow fever, rose to high figures. One of the worst of the yellow-fever epidemics broke out in 1900, immediately following the War of Independence, and concomitant with a heavy immigration from Spain. Stringent sanitary regulations failed to stop the epidemic until a commission of U.S. army surgeons led by Walter Reed *(q.v.)* definitely established in a series of experiments that the fever was transmitted by the mosquito known as *Stegomyia fasciata,* later classified as the *Aedes aegypti.* Immediately after Reed's findings (which corroborated a discarded hypothesis of Dr. Carlos J. Finlay, the noted Cuban physician and biologist) were announced, the campaign against the disease began. Maj. William C. Gorgas *(q.v.),* later the sanitary officer who cleaned up the Panama Canal Zone, led the fight that practically exterminated the mosquitoes of Havana and ended yellow-fever epidemics.

Havana became one of the most carefully protected ports in the world, so far as sanitary measures were concerned, and its death rate was reduced to normal proportions. Changes in the water system, with additions of new reservoirs, brought the excellent water from the hills into the capital and the fetid Havana of the colonial period became a memory only.

Transportation and Communication. — Havana is the hub of Cuba's transportation system. In its earlier history the commercial and military importance of Havana was derived from its location on its fine natural harbour, which is completely protected and accessible to ships of almost any draft. It was linked by coastwise navigation with various ports of the Caribbean.

To the importance of water transportation must be added the fact that Havana is the terminus for the chief railways and is therefore linked with all the major communities of the island. The coming of the automobile created new problems as well as new opportunities in transportation. The elongated shape of Cuba made highway communication difficult and costly until the completion of the paved central highway. Havana, quite naturally, is the focal point on this highway which feeds its heavy traffic into the city from both east and west. Havana is also the terminus of airlines; the airport serving both domestic and international airlines is about 8 mi. from the centre of the city at Rancho Boyeros.

Commerce and Industry. — About three-quarters of the imports and a large portion of the exports of the island pass through Havana, which is a world shipping centre.

The principal industrial activity is based on sugar and its by-products. Next to sugar, tobacco is probably the most important product, and Havana cigars are considered by general opinion to be the finest in the world. There are also textile mills, meat-packing plants, chemical factories and perfume plants.

History. — Havana was founded in 1514 as San Cristbbal de la Habana by Diego Velásquez de León on an unhealthful site proba-

bly where the town of Batabano now stands. but was early removed to its present location and rapidly assumed an increasing importance in the Spanish colonies of the new world and was used as a base for Spanish exploring expeditions. In 1634 its important strategic position was recognized by a royal decree declaring it to be the *Llave del Nuevo Mundo y Antemural de las Indias Occidentales* ("Key of the New World and Bulwark of the West Indies"), and the arms of the modern city carry the symbolic key.

The town was the object of numerous attacks by English. French and Dutch pirates. In 1537 it was sacked and burned, in 1555 it was plundered by French buccaneers and in 1586 Sir Francis Drake threatened it; but in 1589 Philip II of Spain ordered the erection of La Punta and the Morro castle, the ancient defenses, and the residence of the governor of the island was removed from Santiago de Cuba to Havana, which gained the rank of a city in 1592.

The estimated population of the city was about 3.000 by 1600 but had doubled by 1655, when many Spaniards fled there from Jamaica after the capture of that island by the English. During the 17th century Havana became the port of rendezvous of the east-bound fleets of Spanish galleons and was thus the object of many attacks by the English, Dutch and French. The port was blockaded four times by the Dutch in the first half of the 17th century and in 1671 the city walls were begun, being completed in 1702.

The European wars of the 17th and 18th centuries were marked by various incidents in local history. After the end of the War of the Spanish Succession (1713) came a period of comparative prosperity in slave-trading and general commerce. The creation, in 1740, of a monopolistic trading-company was an event of importance in the history of the island. English squadrons threatened the city several times in the first half of the 18th century. but it was not until 1762 that an investment, made by Adm. Sir George Pocock and the earl of Albermarle, was successful. The siege lasted from June to August and was attended by heavy losses on both sides. The British commznders wrung great sums from the church and the city as prize of war and price of good order. By the treaty of Feb. 10, 1763, at the close of the Seven Years' War, Havana was restored to Spain in exchange for the Floridas.

The English turned over the control of the city on July 6. Their occupation greatly stimulated trade, and from it dates the modern history of the city and of the island. The gradual removal of obstacles from the commerce of the island from 1766 to 1818 particularly benefited Havana. At the end of the 18th century the city was one of the seven or eight great commercial centres of the world, and in the first quarter of the 19th century was a rival, in population and in trade, of Rio de Janeiro, Buenos Aires and New York.

In general, the history of Havana under the Spaniards, and since independence, has been the history of Cuba. Various pirate raids, the slave traffic in the 18th and 19th centuries, filibustering expeditions in the 19th century, the war between Spain and the United States in 1898–99 and tension between the U.S. and Castro governments all had direct bearing on the history of Havana and the city suffered and triumphed with them.

The overthrow of the Batista government by Fidel Castro in Jan. 1959 brought profound and drastic changes in the life of Havana—and Cuba. Foreign-owned land. sugar factories. ranches. corporations and banks were an immediate target for expropriation or, indeed. confiscation. Property of wealthy Cubans. particularly those who were considered supporters of Batista. was likewise taken over by the government.

There followed also the development of close commercial and trade relations with the Soviet Union and other "iron curtain" countries. Meanwhile, continued hostility toward the United States by Castro led to the cancellation of the traditional sugar purchases by the United States. This was a major source of foreign exchange for Cuba. since the isiand for many years had been allowed a quota in the United States market of about one-third of the U.S. total consumption and for which a premium price was paid. The loss of that market was partially replaced by purchases by the Communist governments on a barter basis. but it was a severe blow to the economy of the island.

Equally severe was the impact of the revolution and its violent aftermath upon the tourist traffic. Tourism had long been of great importance to Havana. and during the 1950s it vastly increased. New luxury hotels and gambling casinos were constructed largely by U.S. capital. The estimated value to Cuba of tourism in 1958—the last year before Castro—was about $60.000.000. Castro at first made a strong effort to attract tourists after he rose to po er. and he employed an American advertising firm to promote his campaign Rut the news from Havana of unrest, coupled with the stream of government anti-United States propaganda. discouraged prospective visitors. Soon the cruise ships were canceling stops at Havana. and U.S. citizens began to look elsewhere for their vacations. Finally, on Jan. 3, 1961, came the official break in diplomatic relations between the United States and Cuba and. on Jan. 16. an announcement by the C.S. department of state that all Cnited States citizens desiring to visit Cuba must obtain passports specifically endorsed for such travel. Tourism from the United States thereafter was negligible.

See CUBA: *History.* (W. THO.; C. E. MC.; L. NN.)

HAVANT AND WATERLOO, an urban district (1932) in the Portsmouth, Langstone parliamentary division of the county of Hampshire. Eng ; Havant is 11 mi. S.E. of Portsmouth by road. Pop. (1961) 74.564. Area 18.9 sq.mi. It includes Waterlooville, much of the Forest of Bere, and Hayling Island. joined to the mainland by road and rail bridges, where a priory of the abbey of Jumièges was submerged by the sea in 1325. A Roman villa' was found at Langstone and *Havehunte* is mentioned in *Domesday Book.* Of medieval Havant. largely burned down in 1760, the 12th-century church of St. Faith survives. Many great documents were of Havant parchment, famous for 1,000 years, until it ceased to be made in 1936. Products include electronic equipment. sheet metal, gloves and coachwork; but agriculture and catering for yachtsmen and visitors are also important.

HAVASUPAI, abbreviated to Supai, a group of Indians speaking a Yuman (*q.v.*) language who live on a small reservation on Cataract creek in the western edge of Grand Canyon National park. Ariz. In 1776, Father Garces, their first European visitor. found them scattered over canyon and plateau east of the Walapai from whom they can hardly be distinguished. Their indifferent agriculture supplemented by the natural resources of some 4.000 sq.mi. provided a relative abundance for this group of 300. Men hunted game with bow and arrow. clubs, snares and traps. Women made twined baskets to harvest wild seeds and for transportation, storage and cooking. Red ochre. mined for face paint. was still widely traded in the second half of the 20th century. The Havasupai camped in brush shelters or. in minter. in dirt-covered conical wooden huts. Wherever in the canyon there was level land, and springs made irrigation possible, they planted corn, beans, squash and sunflowers for food and cotton for tinder. There they gathered in late summer for sports, games and gambling. A head chief and a council offered prayers and advice. After a feast and circle dance for visitors they stored the harvest in caves and moved back to the plateau.

They had medicine men, or shamans. to control weather, game, snakes and disease. Only rich men had two wives. Warfare was insignificant. After death the body and all personal property were burned. Sons of the Havasupai inherited agricultural land if they could use it.

About 1870 manufactured goods replaced pottery and skin clothing. and decorated coiled basketry was developed for trade. In the 20th century they raised peaches. alfalfa, horses and cattle, but the reservation (518 ac.) was inadequate when it was established in 1882 and the fields periodically eroded.

See Leslie Spier, "Havasupai Ethnography," American Museum of Natural History *Anthropological Papers,* vol. 29, part iii (1928) ; Joseph Wampler, *Havasu Canyon* (1959). (A. F. W.)

HAVEL, a river of former Prussia. Ger. rising at a height of 223 ft. on the Mecklenburg plateau. 7 mi. N.W. of Neu-Strelitz. and after threading several lakes flowing south as far as Spandau. From there it curves southnest, past Potsdam and Brandenburg, traversing another chain of lakes. and finally continues northwest until it joins the Elbe from the right several miles above Wittenberg after a total course of 213 mi, and a total fall of only 158 ft.

Its banks are mostly marshy or sandy, and the stream is navigable from the Mecklenburg lakes downward. Several canals connect it with other rivers. Area of river basin, 9,372 sq.mi.

HAVELBERG, a town in the former *Land* of Brandenburg, now in the district of Magdeburg, Ger., on the Havel just above its junction with the Elbe. Population (1950) 6,900. Havelberg was formerly a strong fortress and changed hands frequently during the Thirty Years' War. The town was incorporated in 1875, and is built partly on an island in the Havel, and partly on hills on the right bank of the river, on one of which is the Romanesque cathedral dating from the 12th century.

HAVELOCK, SIR HENRY (1795–1857), British soldier, one of the heroes of the Indian Mutiny, the second of four brothers (all of whom entered the army), was born at Ford hall, Bishop-Wearmouth, Sunderland, on April 5, 1795, the son of a wealthy shipbuilder. Educated at Charterhouse school, he entered the Middle Temple in 1813, studying under Chitty, the eminent special pleader. But in 1815 he took a commission in the 95th rifle brigade, procured for him by the interest of his brother William. In 1823, having exchanged into the 21st and then into the 13th light infantry, he followed his brothers William and Charles to India, first qualifying himself in Hindustani under John Gilchrist, a celebrated orientalist.

At the close of 23 years' service he was still a lieutenant, and it was not until 1838 that, after three years' adjutancy of his regiment, he became captain. Before this, however, he had held several staff appointments, notably that of deputy assistant adjutant-general of the forces in Burma till the peace of Yandabu, of which he, with Lumsden and Knox, procured the ratifications at Ava from the "Golden Foot." who bestowed on him the "gold leaf" insignia of Burmese nobility. In 1828 he published at Serampore *Campaigns in Ava,* and in 1829 he married Hannah Shepherd, daughter of Joshua Marshman. About the same time he became a Baptist, being baptized by John Mack at Serampore. During the first Afghan war he was present as aide-de-camp to Sir Willoughby Cotton at the capture of Ghazni, on July 23, 1839, and at the occupation of Kabul. After a short absence in Bengal to secure the publication of his *Memoirs of the Afghan Campaign,* he returned to Kabul in charge of recruits, and became interpreter to General Elphinstone. In 1840, being attached to Sir Robert Sale's force, he took part in the Khurd-Kabul fight, in the celebrated passage of the defiles of the Ghilzais (1841) and in the fighting from Tezeen to Jalalabad. Here, after many months' siege, his column in a sortie *en masse* defeated Akbar Khan on April 7, 1842. He was now made deputy adjutant-general of the infantry division in Kabul, and in September he assisted at Jagdalak, at Tezeen, and at the release of the British prisoners at Kabul, besides taking a prominent part at Istaliff. He also served in the Mahratta and Sikh campaigns of 1843 and 1845. After two years spent in England he became (1854), quartermaster-general, then full colonel, and lastly adjutant-general of the troops in India.

In 1857 he was selected by Sir James Outram to command a division in the Persian campaign. Peace with Persia set him free just as the Mutiny broke out; and he commanded a column "to quell disturbances in Allahabad, to support Lawrence at Lucknow and Wheeler at Cawnpore, to disperse and utterly destroy all mutineers and insurgents." At this time Lady Canning wrote of him in her diary: "General Havelock is not in fashion, but all the same we believe that he will do well. No doubt he is fussy and tiresome, but his little old stiff figure looks as active and fit for use as if he were made of steel." Havelock proved himself the man for the occasion. At Fatehpur, on July 12, at Aong and Pandoobridge on the 1 jth, at Cawnpore on the 16th, at Unao on the 29th, at Busherutgunge on the 29th and again on Aug. 5, at Boorhya on Aug. 12, and at Bithur on the 16th he defeated overwhelming forces. Twice he advanced for the relief of Lucknow, but twice prudence forbade a reckless exposure of troops wasted by battle and disease in the almost impracticable task. Reinforcements arriving at last under Outram, he crowned his successes on Sept. 25, 1857 by the capture of Lucknow. There he died on Nov. 24, 1857, of dysentery, brought on by the anxieties and fatigues connected with his victorious march and with the subsequent blockade of the British troops. He received a K.C.B. Other honours, a major-generalship and a baronetcy, he did not live to receive; they were conferred on his heir.

See J. C. Marshman, *Life of Havelock* (1860); A. Forbes, *Havelock* (English Men of Action Series, 1890); F. M. Holmes, *Four Heroes of India* (1892); G. B. Smith, *Heroes of the Nineteenth Century* (1901); L. J. Trotter, *The Bayard of India* (1903).

HAVELOK THE DANE, an Anglo-Danish romance. The hero. under the name of Cuheran or Cuaran, was a scullion-jongleur at the court of Edelsi (Alsi) or Godric, king of Lincoln and Lindsey. At the same court was brought up Argentille or Goldborough, the orphan daughter of Adelbrict, the Danish king of Norfolk, and his wife Orwain, Edelsi's sister; and Edelsi, to humiliate his ward, married her to the scullion Cuaran. But, inspired by a vision, Cuaran and Goldborough set out for Grimsby, where Cuaran learned that Grim. his supposed father, was dead. His foster-sister, moreover: told him that his real name was Havelok: that he was the son of Gunter (or Birkabeyn), king of Denmark, and had been rescued by Grim, who though a poor fisherman was a noble in his own country, when Gunter perished by treason. The hero then wins back his own and Goldborough's kingdoms, punishing traitors and rewarding the faithful. The story exists in two French versions: as an interpolation between GeffreiGaimar's *Brut* and his *Estorie des Engles* (*c.* 1150) and in the Anglo-Norman *Lai d'Havelok* (12th century). The English *Havelok* (c. 1300) is written in a Lincolnshire dialect and embodies abundant local tradition. The name of Havelok (Habloc, Abloec, Abloyc) is said to correspond in Welsh to Anlaf or Olaf. The close similarity between the Havelok saga and the story of Hamlet (Amlethus), as told by Saxo Grammaticus, was pointed out long ago by Scandinavian scholars (*see* HAMLET). Part of the Havelok legend lingers in local tradition. Havelok destroyed his enemies in Denmark by casting down great stones upon them from the top of a tower, and Grim is said to have kicked three of the turrets from the church tower in his efforts to destroy the enemy's ships. John Weever (*Antient Funerall Monuments,* p. 749, 1631) says that Grimsby merchants were free from toll in Elsinore through the interest of Havelok, the Danish prince; and the common seal of the town of Grimsby represents Grim, with "Habloc" on his right hand and Goldborough on his left.

The unique English ms. of *Havelok* (Mss. Laud Misc. 108) in the Bodleian was edited for the Roxburghe club by Sir F. Madden in 1828. This edition contains the two French versions. There are subsequent editions by W. W. Skeat (1868) for the E. E. Text Society, by F. Holthausen (1901), and by W. W. Skeat and K. Sisam (1915); and a modern English version by Miss E. Hickey (1902). Gaimar's text and the French *lai* are edited by Sir T. D. Hardy and C. F. Martin in *Rerum Brit. med. aev. scriptores,* vol. i. (1888). *See* also the account of the saga by H. L. Ward (*Cat. of Romances,* i. 423–446); for the identification of Havelok with hnlaf Curan *see* G. Storm, *Englische Studien,* iii. 533 (1880), a reprint of an earlier article; E. K. Putnam, *The Lambeth Version of Havelok* (Baltimore, 1900).

HAVENSTEIN, RUDOLF (1857–1923), German financier, was born at Meswitz on March 10, 1857, the son of an official in the Prussian judicial department. He studied at Heidelberg and Berlin and entered the judicial service, transferring in 1890 to the Ministry of Finance. He became president of the Prussian State bank in 1900, and in 1908 succeeded Koch as president of the Reichsbank, the affairs of which he conducted during the critical war and post-war periods. He was blamed for giving excessive credits after the war and thus conducing to the deterioration of the currency. He died in Berlin on Nov. 20, 1923.

HAVERFIELD (BALGUY), EVELINA (1867–1920), English war hospital worker, daughter of the 3rd Baron Abinger, was born on Aug. 9, 1867. She married Major Haverfield, R.A., in 1887, and *en secondes noces* General Balguy in 1899. She collected abandoned troop horses on the veldt during the Boer War and nursed them back to good condition. She was among the first London suffragists to be sentenced to imprisonment and organized a branch of the Women's Social and Political Union. She joined the Women's Emergency Corps in August 1914, founded and organized the Women's Volunteer Reserve, and was commandant-

in-chief of the Women's Reserve Ambulance (Green Cross) Corps. She gave heroic service to the Serbian wounded during the war. and returned to Serbia in 1919 to establish an orphanage for Serbian children She succumbed to pneumonia, brought on by fatigue and exposure, on March 21, 1920, at Baiyna-Bachta.

HAVERFIELD, FRANCIS JOHN (1860–1919), English historian and archaeologist, was born at Shipston-on-Stour on Nov 8, 1860. Educated at Winchester and New college, Oxford, he became a tutor at Christ Church in 1891, and Camden professor of ancient history in 1907. Haverfield was an authority on the history and antiquities of Roman Britain, and was entrusted by Mommsen with the editing of the British section of the *Corpus Inscriptionum.* He died at Oxford on Sept. 1, 1919. Amongst his publications were *The Romanization of Roman Britain* (1905, 4th ed. 1923), *Ancient Town Planning* (1913), and many monographs on Roman history.

For a bibliography of his works see ***The Journal*** of Roman ***Studies,*** vol. viii.

HAVERFORD, a residential village in eastern Pennsylvania, U.S., 9 mi. N.W. of Philadelphia, is situated in Haverford township, Delaware county, and in Lower Merion township, Montgomery county. The community was founded by Welsh settlers in the 1680s. It is the site of Haverford college for men, with an enrollment of about 450, founded by the Quaker Society of Friends in 1833. and one of the leading small colleges of the eastern United States. The income from a large trust fund permits employment of a distinguished faculty and the furnishing of board and lodging for students at less than cost. (R. F. WE.)

HAVERFORDWEST, chief town of Pembrokeshire, South Wales, a municipal borough and a county of itself, in the Pembroke parliamentary division, 7 mi. N.N.E. of Milford Haven. Pop. (1961) 8.872. Area 2.2 sq.mi. Situated at the highest navigable point on the Western Cleddau, where the river is also bridgeable, it is a focus of routes from St. David's, Fishguard, Cardigan, Carmarthen, Pembroke and Milford Haven. Haverfordwest is a market town, with traces of its medieval walls and fortifications, and streets that are steep because the houses cluster round the castle on a hillock. Large numbers of Flemings were permitted by Henry I to settle in the hundred of Roose or Rhos in the years 1106–08. 1111 and 1156. The castle, though first mentioned in 1214, is believed to have been built in 1120 by Gilbert de Clare, first earl of Pembroke, to keep an important road to Ireland open and to protect the English and Flemish colonists. It was garrisoned for the king in the Civil War but was captured by parliament in 1644–45 and afterward partly demolished. The church of St. Mary has beautiful 13th-century arches in the chancel, a carved 15th-century oak ceiling and many interesting memorials. The church of St. Thomas has a 15th-century tower, and St. Martin's dates from the 14th century. By the river are ruins of an Augustinian priory founded by Robert de Hmlford *c.* 1200. The earliest charter known is one from Henry II. During the palatinate the town was granted a lord lieutenant, being the only British town to be so favoured. In 1536 Haverfordwest was declared to be a town and county of itself and was further empowered to send representatives to parliament. It remained prosperous through maritime commerce during the 17th and 18th centuries, but with the rise of Milford Haven and the coming of the railways its trade declined. The town came to rely on the marketing of agricultural produce, but still retained an importance out of proportion to its modern significance. A special feature of such towns is the large number of charities which, in Haverfordwest, include John Perrot's bequest (1579) for the improvement of the town and Tasker's charity school founded in 1684. The people of Haverfordwest, like those in the surrounding districts in the southern part of the county of Pembroke, are almost entirely English-speaking.

HAVERHILL, a market town and urban district in the Bury St. Edmunds parliamentary division of West Suffolk, Eng., 19 mi. S.W. of Bury St. Edmunds by road. Pop. (1961) 5.446. Haverhill means "barley hill." The Perpendicular church of St, Mary was restored after a great fire in the town in 1665. There are manufactures of clothing and matting. brushes and twines; a considerable agricultural trade; corn mills; and ironworks.

HAVERHILL, a manufacturing city of Essex county in the lower Merrimack river valley of northeastern Massachusetts, U S., 35 mi. N. of Boston.

It was founded by the Rev. John Ward, who named the settlement after his native Haverhill in Suffolk. Eng. Haverhill was the home of Hannah Dustin, the redoubtable woman who was captured by the Indians in 1697 and managed several days later to slay ten of her abductors and escape. John Greenleaf Whittier (*q.v.*), the New England poet, was born there but lived most of his life in nearby Amesbury. Haverhill was incorporated as a town in f645 and as a city in 1869.

The village was originally agricultural until the growth of leather tanning and shipbuilding after 1795. and later shoe manufacturing and hatmaking became the dominant industries.

The city grew rapidly as the factories attracted many Italians, French Canadians. Greeks and other immigrants, but the total population has steadily decreased since reaching its peak of 53,884 in 1920, after uhich time Haverhill felt the decline of manufacturing common to Merrimack valley towns. Many workers commute to nearby cities, while new industries have been sought. Apart from leather and shoes, coin-operated machines, paper boxboard and electric coils are produced.

Bradford, a small part of the city south of the Merrimack river, was annexed in 1897 and is the seat of Bradford Junior college, founded 1803, one of the oldest upper schools for girls in New England. For comparative population figures *see* table in MASSACHUSETTS: *Population.* (G. K. L.)

HAVRE, LE, the second seaport of France and capital of an *crrondissement* in the *département* of Seine-Maritime, on the estuary of the Seine. 143 mi. W.N.W. of Paris and 55 mi. W. of Rouen. Pop. (1954) 137.175. Until 1516 Le Havre was only a fishing village possessing a chapel dedicated to Notre-Dame-de-Grâce, to which it owes the name. Le Havre (harbour) de Grbce, given to it by Francis I when he began the construction of its harbour.

The town in 1562 was delivered over to the keeping of Queen Elizabeth I by Louis I, prince of Condé. leader of the Huguenots, but the English were expelled in 1563 by Charles IX and his mother, Catherine de Medici. in person. Defenses and harbour works were continued by Richelieu and completed by Vauban. The English bombarded it in 1694, 1759, 1794 and 1795. It was a port of considerable importance as early as 1572 and dispatched vessels to the whale and cod fishing at Spitsbergen and Newfoundland. In 1672 it became the entrepôt of the French East India company and afterward of the Senegal and Guinea companies.

Napoleon I raised the city to a war harbour of the first rank, and under Napoleon III works begun by Louis XVI were completed. During World War I Great Britain and the U.S. used Le Havre as a base and point of landing for troops and stores. Also after the fall of Antwerp and Ostend the Belgian government was transferred there and housed in the Hôtel des Régales at St. Adresse. After the Armistice in Nov. 1918, Le Havre formed one of the U.S. embarkation points.

During World War II the city suffered severe damage. It was captured by the Germans in June 1940 and liberated in Sept. 1944. Le Havre was the target of over 170 bombings, which leveled nearly three-quarters of the city. Reconstruction began immediately after the cessation of hostilities.

The greater part of the town stands on a level strip of ground but on the north rises an eminence, la Côte, the richer quarter. The central point of the town is the Place de l'Hôtel de Ville in which are the public gardens. The church of Notre Dame. dating from the 16th and 17th centuries, is a mixture of late Gothic and Renaissance styles of architecture but the tower is older. The carved oak organ case was the gift of Cardinal Richelieu. The chief buildings of Le Havre, including the *hôtel de ville,* the law courts and the exchange, are all of modern erection.

The museum was totally destroyed during World War II, but its collection of antiquities and paintings had been evacuated. Le Havre is the seat of a subprefect, and a tribunal of first instance, a tribunal of commerce, a board of trade arbitrators, a tri-

bunal of maritime commerce, a chamber of commerce and a branch of the Bank of France. There are 14 basins (the oldest of which dates back to 1669) with more than 8 mi. of quays. A program of port improvements included a large graving dock and wharfage in tidal basin, a floating dock and pontoons, a basin for large oil tankers and reservoirs in the outer harbour, and a wharf and mole for goods storage in the north part of the port. A petroleum pipeline to Paris was built.

The chief docks are the Bassin Bellot and the Bassin de l'Eure. In the latter the mail steamers of the Compagnie Générale Transatlantique are berthed; and the Tancarville canal, by which river boats unable to attempt the estuary of the Seine can make the port direct, enters the harbour by this basin. The port, which is an important point of emigration, has regular steam communication with New York city and with many of the other chief ports of Europe, North, South and Central America, the West Indies and Africa.

Le Havre is the great French port for cotton' and coffee and also imports copper and other metals? wool, rum! foreign wines, oilseeds and dyewoods. Its industries are rope making, timber for building, wire drawing! machinery making, flour milling, oils, dye extracting from woods, spinning and weaving, toy and chemical manufacture.

HAWAII, nicknamed the "Aloha state." was the 50th state to be admitted (in 1959) to the Cnited States. Geographically Hawaii (the Hawaiian or Sandwich Islands) is a chain of islands near the centre of the North Pacific ocean, 1,578 mi. from E.S.E. to W.N.W. between 18° 55′ and 28° 25′ N. and 154° 48' and 178° 25' W. It consists of the islands ceded by the republic of Hawaii to the U.S. in 1898 and made a territory by congress in 1900, and hence excludes the small coral island, Midway, which was acquired by the U.S. in 1859. Several other small islands are not included in the state. The capital is Honolulu (*q.v.*).

Hawaii. with a total area of 6.424 sq.mi., 9 sq.mi. of which are inland water, ranks 47th among the states in land area. The state tree is the kukui or candlenut (*Aleurites Moluccana*) and the state flower is the red hibiscus. The Hawaiian goose. or *nene*, is the state bird (unofficial). The state flag consists of a field with eight horizontal stripes. from the top down of white, red and blue. A rectangular area containing a device resembling the British union jack extends half way down the hoist. (Although Hawaii was never under British rule. an English sea captain in the 1790s is said to have presented King Kamehameha I with a British jack which he used and whose design was incorporated into the present flag of Hawaii, officially adopted in 1845.) The state motto is *Ua mau* ke eu o ka *aina i ka pono* ("the life of the land is perpetuated in righteousness"). The state song is *Hawaii Ponoi* ("Hawaii's Own"), written by King Kalakaua.

In addition to the cross references to related articles given under the various headings of this article see OCEANIA; PACIFIC ISLANDS; POLYNESIA. See also UNITED STATES (OF AMERICA).

Following are the main divisions of this article:

I. GEOGRAPHY

A. PHYSICAL FEATURES

Hawaii, comprising both volcanic and coral islands built up from depths of 15,000 to 18,000 ft., is the northernmost of the Central Pacific island groups. It has the largest area (6.424 sq.mi.) and greatest altitude (13.784 ft.). It is also the most isolated of important land areas.

The nearest important groups to the south are Samoa, 2.263 nautical miles. and Tahiti. 2.390 nautical miles. To the north. Unalaska in the Aleutian Islands is 2,106 mi., and to the west. Guam is 3.337 mi. The distances in nautical miles from Honolulu to principal ports of the Pacific are: San Francisco. 2,100; Los Angeles, 2.226; Seattle. 2.409; Sitka, 2.395; Yokohama, 3,445; Sydney. 4.424; Panama. 4.665; Manila. 4.778; Hong Kong, 4.961: Valparaiso, 5.916. Cape Horn is 6.488 mi.

The large. high islands, Hawaii (4.021 sq.mi. land area), Maui (728), Molokai (259), Lanai (141), Kahoolawe (45), Oahu (595), Kauai (551) and Niihau (72), together with their near-by small islands, form the east-southeast fourth or about 375 mi. of the chain, extending to 22° 14' N. and 160° 15′ W.

The islands of the remainder of the chain are so small that their total area is only 3 sq.mi., and yet they afford a rich field for the naturalist. Those in the west half of this part of the chain are coral (mostly sand) islands; those in the other half, forming a transition link with the large inhabited islands, are lava rock. The islands of the entire chain apparently were formed beginning at the westerly and finishing at the easterly end, where there are still active volcanoes.

1. Westerly Islands. — The small westerly islands are remains of larger islands which have mostly eroded. The lava rock islands rest on more or less extensive banks lying at small depths, and the coral ones are sand islands or islets on the rims of large atolls. Those of lava rock are Nihoa or Bird (903 ft. high), Necker Island (276), French Frigate shoals (a rock 120 ft. high and 16 sand islets) and Gardner pinnacles (170); the coral ones, 10–14 ft. high! are Laysan Island, Lisianski Island, Pearl and Hermes reef (12 islets), Midway (Sand Island and Eastern Island) and Kure, or Ocean, Island (Green Island and two islets). None is inhabited except the station at Midway. The Hawaiians anciently visited Nihoa and Necker, not only for fish but also to obtain materials for their famous featherwork. The waters abound in fish and turtles. The islands are most noted, however, for their bird life, and in 1909 all of them, except Midway, were created by the national government into the Hawaiian Islands Bird reservation, to protect them from Japanese poachers who, for the feathers, killed 300,000 birds in one season. Collectively, the islands form the largest and most numerous bird colony in the world. Of the many varieties of sea birds, some are not found elsewhere.

2. Hawaii. — The "Big Island," as it is called, which contains two-thirds of the area of the group, is roughly triangular in shape, with sides of 90, 75 and 60 mi.; it consists of five volcanic mountains about 20 mi. apart, connected by saddles 3,000–7,000 ft.

high, formed by overlapping lava flows. Being the newest island, and still in the making by volcanic action. little of its 297 mi. of coast is bordered by coral reefs, and there has been little erosion except along the 60 mi. of the northeast coast from the principal harbour, Hilo, to the north end of the island. There, on the windward side of the older mountains, copious rains and ocean waves and currents have created valleys and cliffs increasing northward in depth and height and culminating in the Waipio and Waimanu valleys, which are several thousand feet deep and recede from coastal cliffs 1,500 ft. high. Throughout the rest of the island there is not a stream except at times of unusual rain—partly because of the porosity of the rocks and soils and, on the leeward side, partly because of insufficiency of rain.

The Kohala mountain or range (5,505 ft.), the oldest, its windward side deeply eroded. its top a water sponge, its leeward side dry, with the higher slopes covered with cinder cones. forms the north angle of the island. Next, southeasterly, is Mauna Kea ("White mountain," so-called from the frequent snow on its summit). This is the highest mountain of the group and one of the highest island mountains in the world (13,784 ft.).

Southwesterly from Mauna Kea is Hualalai (8,251 ft.), whose summit, like that of Mauna Kea, has no great crater and is covered with cinder cones, but, unlike Mauna Kea, has many small pit craters. Its only flow in historic times was in 1801.

Further south is Mauna Loa, "Long mountain," twin of and 104 ft. lower than Mauna Kea. It is an immense lava dome, not only the largest volcano, but the largest mountain in the world in cubic content; it discharges more lava than any other volcano. On the summit is an elongated caldera ("caldron"). Mokuaweoweo (3.7 sq.mi.). Eruptions within it occurred in historic times in 1849, 1865, 1903 and 1914; four others were partly on the adjacent rift zones, usually on two lines running northeast and southwest from the summit. Principal flows of the 19th and 20th centuries were in 1843, 1852, 1855–56 (lasting 16 months), 1859 (33 mi. long, 1 mi. wide in places). 1868, 1877 (submarine), 1880–81, 1887, 1899, 1907, 1916, 1919, 1926, 1935–36 (bombed to divert its course), 1942 and 1950 (the most voluminous flow in recorded history: 615,000 cu.yd. in three weeks). In 1955 a violent outbreak in the Puna district south of Hilo lasted for three months and destroyed two villages.

Lastly and easternmost is Kilauea, with the largest and most spectacular of all active craters, an oval pit 4.14 sq.mi. in area, with walls now 500 ft. high—1,000 ft. a century ago. Although an independent volcano and older than Mauna Loa. Kilauea is merely a hole in the side of the latter at an elevation of 4,090 ft.; it is reached by car in an hour, over 30 mi. of concrete road through tropical forests from Hilo.

Kilauea was continuously active for more than 100 years previous to 1924. Most of its activity has been confined to the fire pit of Halemaumau, 3,000 by 3,500 ft. and 470 ft. deep. Operating in cycles, the lava rises until it overflows and breaks through some subterranean passage and drains out. only to begin the cycle again. Just before the last dropout, in 1924, the lake of boiling molten lava covered about 50 ac. In 1954 a spectacular but short-lived eruption flowed on the floor of Kilauea as well as in the fire pit, Halemaumau. The only two explosive eruptions of historic times have occurred at Kilauea, in 1790 and 1924; the former destroyed a portion of a Hawaiian army. Since that time, almost no loss of human life has been caused by volcanoes in Hawaii.

In 1911 a volcanic observatory was established at Kilauea, and in 1916 the national government created the Hawaii National park. consisting of the Kilauea and Mauna Loa sections (245 sq.mi. together) on Hawaii and the Haleakala section (26 sq.mi.) on Maui (see below), to which was added in 1927 a strip (72 sq.mi.) connecting the first two sections. In the Kilauea section, besides the volcano, there is much of interest, such as numerous other pit craters, sulfur banks, pumice beds, lava tubes, tree molds, stalactites, tropical forests and birds and sulfur-steam baths.

Earthquakes have been numerous and tidal waves occasional in Hawaii. On April 1, 1946, the entire Hawaiian chain was struck by a seismic sea wave. Two hundred persons were killed and 1,300 rendered homeless. Damage to public and private property was $24,000,000. The waterfront area of the city of Hilo was wiped out. Since that time a seismographic warning system has been put in operation to alert residents when waves are expected.

3. Maui, Molokai, Lanai, Kahoolawe and Molokini (the last two uninhabited), probably once a single island, are now separated by channels 6 to 10 mi. wide and 250 to 600 ft. deep. They are separated from Hawaii by a channel 26 mi. wide and 6,192 ft. deep and from Oahu by one 23 mi wide and 2,244 ft. deep.

Maui, shaped like the head and bust of a woman, consists of two mountains (East and West Maui) connected by a low isthmus 6 mi. wide. One of these mountains, Haleakala ("House of the Sun," 10.02 j ft.), has on its summit the largest of all extinct craters, 20 mi. around and 2,720 ft. deep; on its floor of 19 sq.mi. are 16 reddish cinder cones 400 to 900 ft. high. The view from the summit is the grandest in the territory. The windward side, a succession of gorges, rich in waterfalls and verdure. supplies the water for the irrigation of the arid isthmus. It is traversed by a scenic drive. The other mountain, whose highest peak is Puu Kukui (5.788 ft.), being much older, is marked by deep radiating canyons such as the beautiful Iao or Wailuku valley (4,000 ft. deep).

Molokai likewise consists of two mountains, Mauna Loa peak (1,415 ft.) at the west end and Kamakou (4,970 ft.) at the east end, connected by a saddle 400 ft. high, both cut off by erosion on the windward side, so that the island, which is 40 mi. long, is narrow and of fairly even width. about 7 mi. The windward side, one of the most scenic coasts of tlie group. is a precipice. 500 to 4.000 ft. high, sheer from the ocean, the highest part of which is deeply indented by magnificent valleys. On a low peninsula, projecting from the base of the precipice and near its centre, is the site of the leper settlement of Kalawao, which is virtually empty because of the advance of treatment methods.

Lanai (3,370 ft.) and Kahoolawe (1,491 ft.) are single mountains, with cliffs on their southerly coasts exposed to the ocean, their northerly coasts being protected by Maui and Molokai. A pineapple company, having acquired Lanai, constructed a harbour on the south coast and a model village, Lanai City. in the centre of an extensive interior plateau, which has been placed in cultivation. Kahoolawe is uninhabited and for some years has been used as a target area by U.S. armed forces. Molokini is a small, crescent-shaped, barren, rocky island, 160 ft. high, between East Maui and Kahoolawe.

4. Oahu, which is roughly diamond shaped, was once two immense volcanoes; erosion has made of it two rugged, parallel mountain ranges. One range, Koolau (Puu Konahuanui. 3,105 ft.), is twice as long as and older than the other, Waianae (Kaala, 4,025 ft.); the two are connected by a saddle 800–1,200 ft. high. There are many small, recent tuff, ash and lava cone craters, mostly coastal, especially in and about Honolulu. such as Diamond Head and Punchbowl. This island, though third in size and fifth in height. is important agriculturally. It contains the state capital, Honolulu, the landlocked Pearl Harbor (see HONOLULU), Diamond Head and Waikiki beach. The picturesque sites of this island are easily accessible; the most noted panoramic view is that of the windward side at the Pali (precipice), the only traversable pass (1,200 ft.), 6 mi. up a beautiful valley back of Honolulu.

5. Kauai, separated from Oahu by a channel 63 mi. wide and 11,232 ft. deep, is roughly circular in form, about 25 mi. across, and consists mainly of one mountain (Waialeale, 5,080 ft.), with marginal lowlands except on the northwest. It is the oldest, most weathered and most verdant of the larger islands, abounding in rivers and waterfalls. Its chief scenic attractions are Waimea canyon (3,000 ft. deep) in the southwest, comparable in vivid colouration and forms to the Grand canyon of the Colorado; the spacious Hanalei valley in the north; and the Napali coast of precipices, 4,000 ft. high, on the northwest.

6. Niihau, separated from Kauai by a channel 15 mi. wide and 3,300 ft. deep, is a small island 17 by 6 mi.; it is privately owned and is operated as a sheep ranch. Lehua Island and Kaula, uninhabited, are crescent-shaped remains of tuff cones, respectively ½ mi. N. and 23 mi. S.W. of Niihau.

B. Climate

The chief determinants of the climate are the prevailing northeast trade winds from over cool ocean currents and the remarkable heights and contours of the land areas. The result is a climate cooler than elsewhere in the same latitude, equable temperatures, abundant sunshine and absence of tropical storms. Mauna Loa on Hawaii and Haleakala on Maui form such barriers to the trade winds that their leeward slopes have regular land and sea breezes. At times, especially in winter, a kona, or southerly wind, brings mugginess and local downpours. The windward slopes are cooler than the leeward, and the temperature falls about 1° F. for each 300 ft. of altitude. The year-round average temperature in the lowlands is about 75° F. There is no distinctly rainy or dry season, but usually more rain falls in winter than in summer. There is wide variation in temperature, rainfall and wind for neighbouring localities.

The record high temperature for the territory was 100° F. at Pahala, Hawaii, in April 1931. Except for the top of Mauna Loa, the record low of 18° was reached at Haleakala crater in May 1941. The mean annual temperature at the federal building at Honolulu is 75.2°, with a record maximum of 88° and a record minimum of 57°. Usually there is snow on Mauna Kea and Mauna Loa and sometimes on Haleakala. The summit of the island of Kauai has perhaps the greatest average rainfall in the world, 468 in., reaching 624 in. during the year ending in July 1948. The greatest precipitation measured in the islands during a 24-hour period was in the lowlands of Kauai, in Jan. 1956, when more than 46 in. fell. As little as 4 in. a year has been found in the Kona region of Hawaii. At the federal building in Honolulu on leeward Oahu, the average annual rainfall is 24 in., with a record range of from 43.5 to 11.7 in. Four miles distant, at 1,028 ft. in the lee of the mountain ridge, the average is 155 in. The record rainfall for Honolulu in a 24-hour period came in March 1958, with a downpour of more than 18 in.

C. Vegetation

The isolation of Hawaii, its division into islands, the barriers of deep canyons and high precipices and the wide variations in rainfall, temperature, wind, barometric pressure and geologic age of different localities have evolved a flora that not only is exceptionally extensive in the area, but ranks first in the world in percentage of endemic genera and species. There are about 900 species of flowering plants (more than 300 being trees), 140 ferns and also many hundred mosses, lichens, fungi and algae. Attractive forests of tall tree ferns are hung with vines such as the luxuriant ie and the fragrant *mazle,* both used as garlands or *leis.* The unique silversword plant is found in Hawaii National park. The forests are tropical and only a few shed their leaves seasonally.

Six botanical regions or zones are commonly treated more or less separately: strand, lowland, lower forest, middle forest, mountain bog and upper forest, with subdivisions of dry and wet, windward and leeward, etc.. each having in large measure its distinct flora. but with considerable overlapping. Above 11,000 ft. there is almost no vegetation.

Hundreds of species have been introduced into the islands since their discovery by Europeans and about 25 were introduced anciently by the Hawaiians. Among the ancient introductions are the coconut; breadfruit; ohia or Malay apple (*Jambosa malaccensis*); taro (*Colocasia antiquorum*), used for making a paste (poi), the principal food of the Hawaiians; sweet potato; yam; banana; pia or arrowroot (*Tacca pinnatifida);* sugar cane; gourd; kava and ti (*Piper methysticum* and *Cordyline terminalis*). roots used for making drinks; olona (*Touchardia latifolia*), yielding exceedingly strong and durable fibre for fish nets, etc.; *wauke* (*Broussonetia papyrifera*), fibre used for making kapa or paper cloth; *kukui* or candlenut (*Aleurites moluccana*), useful for candles. oil, dyes, paint, gum, food and medicine; milo (*Thespesia populnea*) and kou (*Cordia subcordata*), now almost extinct, and *kamanz* (*Calophyllum znophyllum*), all three yielding beautiful wood valued for making calabashes and other dishes; hau (*Pariti tiliaceum*), useful for making outriggers and rope and training over arbours for shade; *noni* (*Morinda citrifolia*), useful for dyes; and perhaps ginger, Among the more common later introductions are the avocado or alligator pear, mango. pineapple, orange and other citrus fruits. papaya, guava, coffee, grape, fig. poha or Cape gooseberry, litchi, mulberry, tamarind, date, passion fruits, cherimoya, custard apple and macadamia or Australian nut.

D. Animal Life

Isolation and wide variations in local conditions have had much the same effect, though in lesser degree, on the fauna as on the flora, resulting in a high percentage of native species and extreme localization. There is only one certainly indigenous land mammal, a small bat. Dogs, hogs and perhaps rats and mice were introduced anciently by the Hawaiians, and many domestic mammals have been brought in since Captain Cook's discovery; some very early, as goats and English pigs by Cook in 1778, cattle and sheep by George Vancouver in 1793 and horses by R. J. Cleveland in 1803. Axis deer *(Cervus axis)* were introduced in 1867 and the mongoose in 1883, to destroy rats.

There were about 125 species of birds, resident and migrant, of which perhaps a score are now extinct. On the inhabited islands the native birds are disappointingly few, as their habitats are mostly in the forests and on the heights. Most prized for featherwork were the yellow feathers of the now extinct mamo *(Drepanis pacifica)* and nearly extinct o-o *(Moho nobilis)*; the vermilion of the iiwi (*Vestiaria coccirzea)*; and the crimson of the apapane *(Hinzatione sanguinea)*. Very common are the brown *elepaio* (*Chasiempis sandwicensis*); the green and yellow *amakihi (Clzlorodrepanis* spp.); and the *ou (Psittirostra psittacea)*, the best Hawaiian songster. A wild goose, *nene (Bernicia sandwicensis)*, confines itself to dry areas on the island of Hawaii. The birds most commonly seen on the lower and more open areas are introductions. Chickens were anciently introduced by the natives, and later importations include, besides domestic fowls, the skylark: cardinals, Chinese thrush, myna, turtledove, pigeon, linnet, blue-cheeked parrot, ricebird, English sparrow, pheasant, quail and California partridge.

The only native land reptiles are seven species of small skinks and geckos, commonly called lizards. There are no snakes. Frogs and toads are introductions, including *Bujo marinus,* imported in 1932 to control insects. Although there are several thousand species of indigenous insects, mostly endemic, they are not troublesome or destructive. The noxious forms, which are mostly introductions, include the sugar-cane leafhopper and borer, rice borer, Mediterranean fruit fly, Asiatic fruit fly, melon fly, Japanese beetle, horn fly, cutworms, army worms, termites, fleas and mosquitoes. Perhaps no animal group has contributed more light on the subject of evolution than the joo species of land and freshwater shells of Hawaii, especially the beautiful tree shells (*Achatinella).* The exceptionally rich marine animal life includes more than 650 species of fish, many of which are fantastic in shape and colour. Among introduced fishes are trout, carp, black bass, catfish, goldfish and top minnows.

E. Geographical Regions

The territory of Hawaii was divided into five counties by the territorial legislature in 1905 and these revisions were retained when the territory became a state in 1959. These are county of Oahu (superseded in 1909 by city and county of Honolulu); county of Maui (including islands of Maui, Molokai—except Kalawao—, Lanai, and Kahoolawe), with county seat at Wailuku; county of Hawaii, with county seat at Hilo; county of Kauai (including the island of Niihau), with county seat at Lihue; and county of Kalawao, the peninsula on Molokai. (For area of city and county of Honolulu, *see* Honolulu.)

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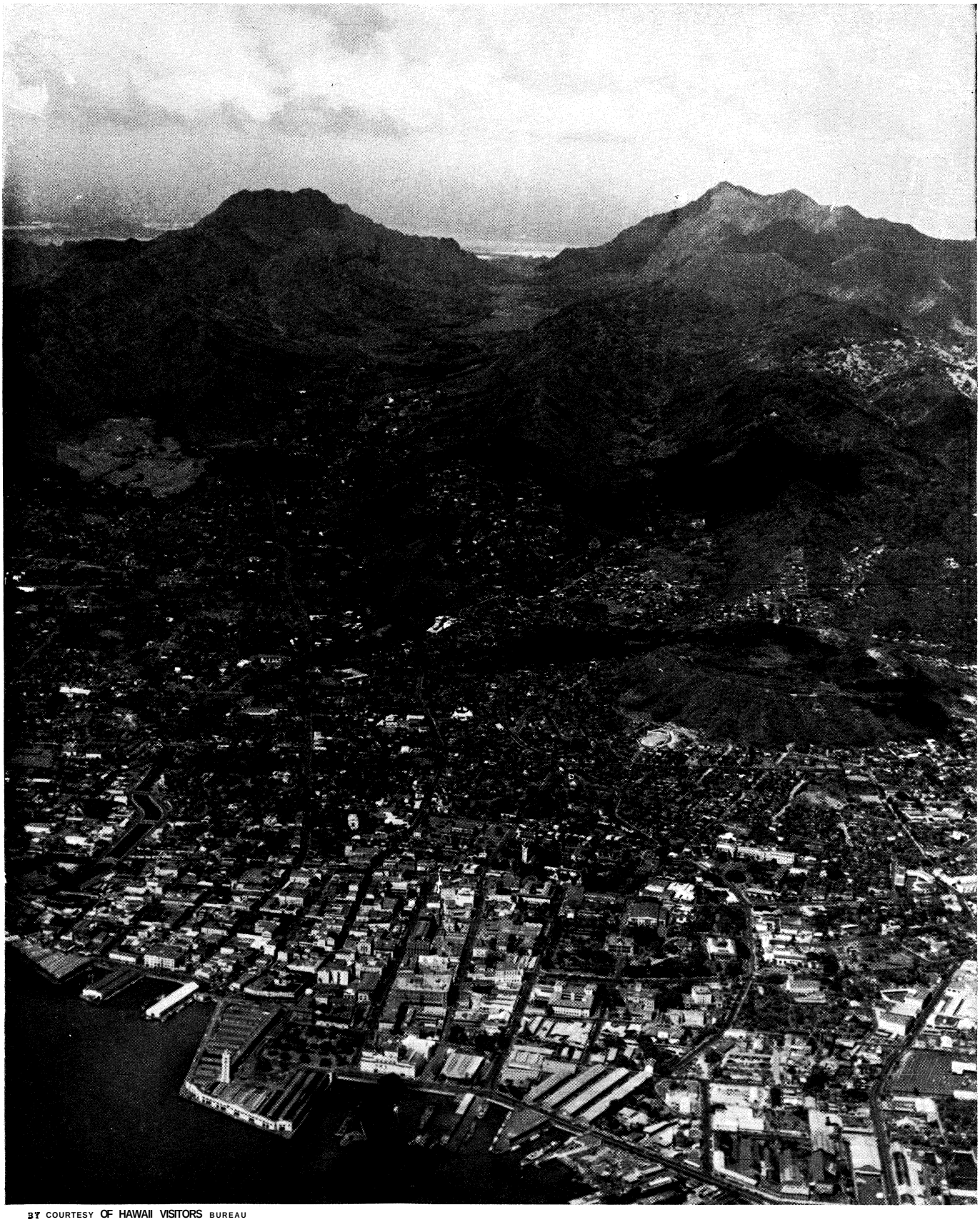
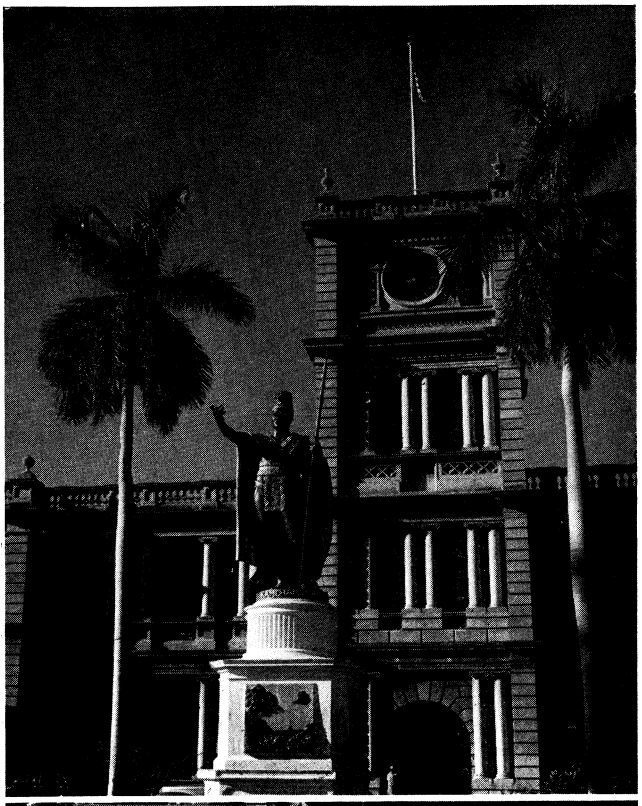


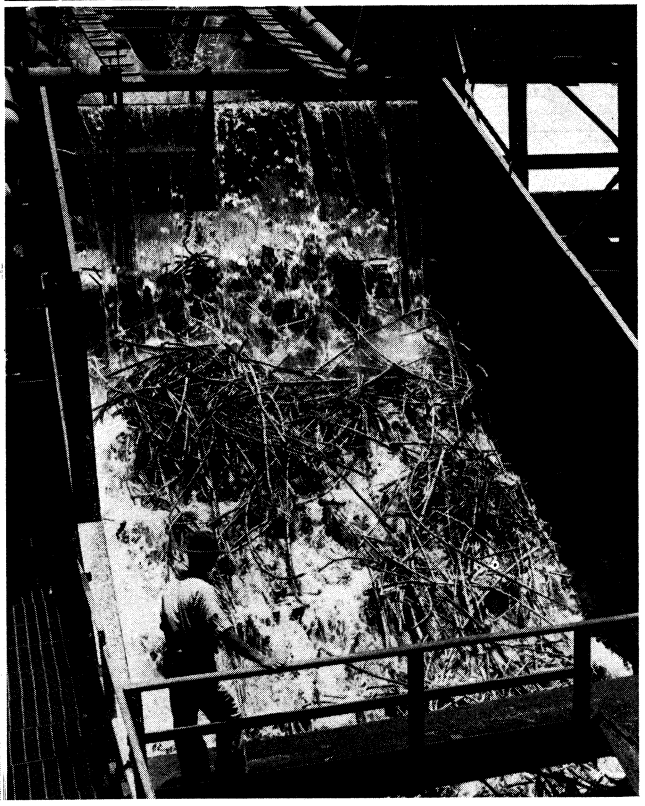
37 COURTESY OF HAWAII VISITORS BUREAU

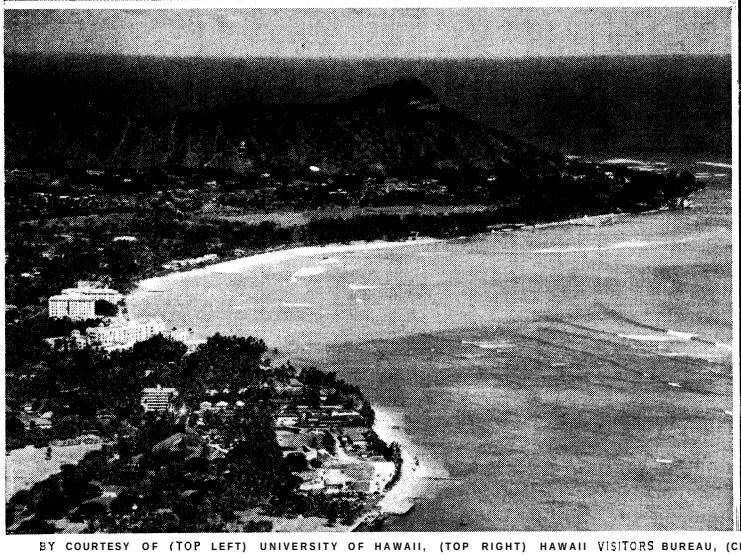
HONOLULU

The capital and principal port of Hawaii as seen from the south. Behind the harbour and business section rise the Punchbowl (right), an extinct volcano, and the Koolau mountains

HAWAII







BY COURTESY OF (TOP LEFT) UNIVERSITY OF HAWAII, (TOP RIGHT) HAWAII VISITORS BUREAU, (CENTRE LEFT) HAWAIIAN PINEAPPLE CO., (BOTTOM RIGHT) HAWAIIAN SUGAR PLANTERS' ASSOC.; PHOTOGRAPH, (BOTTOM LEFT) WERNER STOY FROM FPG

VIEWS OF HAWAII

Top left: The Gregg M. Sinclair library on the campus of the University of Hawaii, Honolulu

Top right: Bronze statue of King Kamehameha I in front of the Judiciary building, Honolulu

Centre left: Terraced and contour-planted pineapple fields. Pineapples are a leading Hawaiian export

Bottom left: Cianond Head, an extinct volcano, rises above Waikiki beach, Honolulu

Bottom right: Harvested sugar cane being washed before going through processing at a Hawaii mill

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II. THE PEOPLE

Hawaii is often called the melting pot of the Pacific, because its population is a mixture of many ancestral stocks who are slowly welding a neo-Hawaiian type combining features from not only Caucasian, European groups but from those of the Pacific islands and the far east as well (see History, below).

The descendants of the Polynesians who came to the islands 1,000 years ago are called Hawaiians. They have bronze skin, large dark eyes, heavy features and dark-brown or black hair that may be straight or wavy. The population of about 300.000 found by the discoverers in 1778 shrank until at the beginning of the second half of the 20th century there were only about 12.000 full-blooded Hawaiians in Hawaii—slightly more than 2% of the population. There were, however, about 80.000 part-Hawaiians, and together the Hawaiians and part-Hawaiians formed the fastest expanding racial group.

People of many other stocks came to the islands or were brought to work on the sugar plantations (see *Population*, below). Most of these folk, enjoying the opportunities provided in Hawaii, successively left the ranks of unskilled labour, and those of Chinese. Japanese, Korean and Filipino ancestry entered all walks of life, including the professions and finance.

TABLE I.—Population by Racial Groups

Race	1950		1940	
	Number	%	Number	%
Hawaiian	86,091	17.2	64,310	
Caucasian	114,793	23.0	103,791	24.5
Chinese	32,376	6.5	28,774	6.8
Filipino	61,071	12.2	52,569	12.4
Japanese	184,611	36.9	157,905	37.3
Others	20,852	4.2	15,981	3.8
Total	499,794	100.0	423,330	100.0

After 1950 racial data were not kept because the intermixture of groups made it impossible to list individuals even according to race of father. The oriental component was steadily declining in proportion; the Caucasian group had grown in the first half of the 20th century and the trend was not altered after World War I. Intermarriage of racial groups is very common in Hanaii, and many of the finest physical specimens are of half a dozen stocks. In a schoolroom in the islands, the children may be of 50 different combinations of racial ancestries. There is no segregation in the islands of any kind, and no housing area where there is a barrier to home ownership. Anyone who stirs up racial antagonisms is severely criticized, and Hawaiian or oriental blood is frequently a political asset in the state.

The daily life of the people may vary from the metropolitan existence of Honolulu to the sheltered seclusion of Niihau, an island where Hawaiians speak their own language and do not have telephones, automobiles, motion pictures or liquor stores.

1. Languages.—English is spoken by almost everyone in Hawaii. Hawaiian is one of the two official languages of the government, but except for a number of loan words used daily by the inhabitants, one has to go to some trouble to hear Hawaiian spoken. Many other languages may be heard on the streets, and radio programs in Japanese and several Filipino dialects are popular.

2. Religion.—All the great religions of the world are represented in Hawaii. In 1819 a royal decree ordered the Hawaiians to give up their paganism, and the field was open to the Congregationalist missionaries who arrived from New England in 1820. Roman Catholic missionaries came first in 1827, and Mormons in 1850. (See also History, below.) Religious tolerance as well as racial tolerance is a part of island life. There are more than 150 churches on Oahu alone. The Roman Catholic and Buddhist religions were the leading faiths in Ha aii at mid-20th century.

3. Customs and Culture.—The spirit of hospitality represented by the welcoming Hawaiian word *aloha* has continued through history to make the stranger feel at home in those islands. Easy informality is found in the customary dress of 20th-century Hawaii. Outside of business offices, people of all races wear both traditional and modern versions of Hawaiian garments. The women at home relax in a *muumuu*, modeled on the Mother Hubbard gowns made for the natives by missionary women. A fitted *muumuu* with a train is called a *holoku*. Men wear *aloha* shirfs all year round; these are patterned sport shirts. usually worn with the tail outside the trousers. Flowers are a favourite expression of affection, and on many occasions a lei, or wreath, is presented. A lei may be formed of flowers or of seeds, coral, shells. nuts, or pieces of ivory, and may be worn not only around the neck but on the head or around a hat.

Foods enjoyed in the islands are as varied as the many nationalities and races represented there. Most people eat foods similar to those consumed in mainland United States. but special dishes of the orient and the Pacific islands are popular. At a *luau* or Hawaiian feast, one might eat poi, a starchy paste made from the pounded root of the taro plant; *laulau*, a steamed package of chopped taro leaf mixed uith fish and pork or chicken; salmon and tomato; *haupia*, a coconut pudding; limu. an edible seaweed; steamed yams, breadfruit and bananas; and pineapples, papayas and mangoes. The main dish is usually a whole roasted pig, cooked by preheated stones in an underground oven or imu.

The mild climate makes Hawaii a recreational paradise all year round. Hotels and vacation resorts provide comfort for visitors on the five largest islands. Water sports are particularly popular, and the ocean temperature varies little from summer to winter.

During the winter months there is skiing on the slopes of Mauna Kea. In addition to the usual U.S. holidays others are celebrated. These include Chinese New Year's, in January or February; Cherry Blossom festival. in the spring; Lei day, on May 1; Kamehameha day. June 11; and Aloha week, in October or November.

Arts and crafts are popular in Hawaii, reflecting the skill of the ancient Hawaiians in such forms as featherwork. wood carving and mat weaving. examples of which may be seen at the Bishop museum in Honolulu.

Early Hawaiian music mas a chant accompanied by simple instruments. Enjoyment in singing hymns introduced by the missionaries led to the development of vocal music, so that today Hawaiian music is heard round the world. The words to the most famous Hawaiian song, "Aloha Oe" ("Love to Thee"), were composed by Queen Liliuokalani. The ukulele was not native to the islands but was developed from a small guitar brought by Portuguese labourers in the latter 19th century. The steel guitar was invented in 1895. The Royal Hawaiian band. formed in 1872, still gives concerts in Honolulu. The Honolulu Symphony orchestra was founded in 1900.

Performances of various forms of hula may be seen in Hawaii, but it is increasingly difficult to find exhibitions of the ancient hula, the sacred dance and chant of prediscovery Hawaii.

The literature of Hawaii both in Hanaiian and English is extensive and still groning. Ancient types, drawn from native memories, include legends, folk tales, epics of heroes and chants. The missionaries early reduced the Hawaiian language to a Roman alphabet, established printing presses and translated many works into both Hanaiian and English. Both the Bible and the Book of Mormon were translated into Hawaiian, along with textbooks and literary works. Many accounts of voyagers. mission workers and travelers are highly readable. Writers associated with the islands include Herman Melville, Mark Twain, Robert Louis Stevenson. Charles Warren Stoddard. Jack London and Genevieve Taggard. A number of 20th-century novelists and other writers have added to the shelf of works using Hawaii as a setting.

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III. HISTORY

A. History Before Discovery

Polynesia was probably the last habitable area to be occupied by man. The Polynesians, although of similar features, language, customs, religion and traditions. are not a pure race. They are supposed to be mainly of Caucasian origin, with infusions of other bloods. and to have come from Asia by way of the Malay peninsula and Java, and thence from island to island by various routes in their migrations eastward. northward and southward. and to have reached Hawaii, probably from Tahiti, about A.D. 750, or earlier, in huge sailing canoes. Until about 1300, some Hawaiians voyaged back and forth to Tahiti, more than 2,000 mi. to the south. During this period many chiefs, who intermarried with Hawaiian reigning families, and priests came to Hawaii; both classes became powerful and the severity of taboos and frequency of human sacrifices increased. Then followed a long period of isolation, the last centuries of which were full of wars and rebellions — the result of pressure of population, rapacity of the nobility and dynastic ambitions and jealousies.

Feudalism grew up much as it did in medieval Europe and from much the same causes. The unit of land, the *ahupuaa,* usually extended from the shore to the mountain top, with rights in the adjoining sea waters, so that the occupants had the means of supplying all their wants — the sea for fish, the littoral for coconuts, the valley for taro, their principal food, the lower slopes for sweet potatoes, yams and bananas and the mountain for wood.

The next subdivision was called the *ili,* either subservient to the *ahupuaa* or independent. Within these were small areas: *kuleanas,* occupied by the common people, who also had certain rights of fishery, water and mountain products. Besides open sea fisheries, there were stone-walled fish ponds, some now 1,000 years old, built semicircularly from the shore. Taro was raised in terraces flooded by conduits from streams. Elaborate systems of water rights were evolved. A conqueror or a successor king often redistributed the lands.

The Hawaiians were a brown race, with straight or wavy black hair, attractive features, large and of fine physique, like the New Zealand Maoris, whose dialect resembled theirs. The ruling classes tended to inbreed. Polygyny and polyandry were practised, especially among the chiefs. Rank descended mainly through the mother.

The language is soft and musical, vowels and liquids predominating. There are only 12 letters, the vowels and *h,* k, *l, m, n, p* and *w, l* and *r* and k and *t* being very similar, and, as each syllable consists of only a vowel or a consonant followed by a vowel, there are only 40 syllables to make the more than 20,000 words. The Hawaiians were fond of oratory, poetry, history, storytelling, chants, riddles, conundrums and proverbs, and paid much attention to the proper use and pronunciation of words. Without writing, knowledge of all sorts was preserved and taught to successive generations by persons specially trained for the purpose.

Without metals, pottery or beasts of burden, the people made implements, weapons and utensils of stone, wood, shell, teeth and bone, and great skill was displayed in arts and industries. The featherwork (capes, robes, helmets, *leis,* kahilis) has not been excelled. Houses were of wood frames and thatched, with stone floors covered with mats. Food was cooked in holes in the ground, imus, by means of hot stones, but many foods, including fish. were often eaten raw. Many of the best foods were taboo to women. Men usually wore only a *malo* or girdle and women a skirt of kapa or paper cloth or leaves or fibre, though both sometimes wore mantles thrown over the shoulders. Canoes were outrigger or double, sometimes 100 ft. long. The men have hardly been surpassed as sailors. fishermen or swimmers. They were skillful navigators, knowing stars, winds and currents. Their year began on Nov. 20 and consisted of 12 lunar months with occasionally an intercalary month They had remarkable knowledge of animals and plants and mere great warriors, using spears, javelins, clubs and slings, but no shields or bows. the latter being small and used only for shooting rats and mice for sport.

They excelled in athletics, in which there were frequent contests, even between champions of different islands, in surfboarding on the crests of waves, swimming, wrestling, boxing, spear throwing (at each other), coasting down permanently prepared courses while standing on narrow sleds, bowling, foot racing, etc. Surfing has become a favourite sport for others as well as Hawaiians. They gambled much and made narcotic and fermented drinks of the awa (kava) and ti roots! but not distilled liquors. They were fond of music: vocal and instrumental, and had percussion, string and wind instruments, including a nose flute but no mouth flute. The ukulele is of Portuguese origin, developed and popularized by the Hawaiians. Their dances were largely the hula of many varieties, the better forms of which have become popular with others. They loved flowers, which they wore much in *leis* or wreaths about necks and hats. This has become customary with non-Hawaiians, especially on arrivals and departures of steamers and airplanes and on May day. They tattooed little. Their proverbially courteous, generous, hospitable spirit has affected the remainder of the population.

There were four principal gods, Kane, Kanaloa, Ku and Lono, and innumerable lesser gods and tutelary deities. Animals, plants, places. professions, families, all objects and forces had their gods or spirits. Temples of stone and idols of wood abounded and hardly anything was undertaken without religious ceremonies. On important occasions there were human sacrifices. There was a vague belief in a future state. Priests and sorcerers were potent. There were cities of refuge to which one might flee and be safe. Cannibalism was unknown but infanticide was prevalent. The political and religious systems were closely interwoven.

During the last period before the discovery, although there were occasional bright intervals and notwithstanding that there was much that was praiseworthy, the nobility and priesthood became more and more tyrannical, the common people more and more oppressed; the laws, chief among which were the intricate and oppressive taboos, bore heavily upon the masses, especially the women, and their administration became largely a matter of arbitrariness and favouritism. (See also Oceania; Pacific Islands; Polynesia.)

B. History After Discovery

Foreigners other than Polynesians who may have arrived in Hawaii as castaways prior to 1778 did not return to the civilized world. Capt. James Cook (*q.v.*), the English navigator, is regarded as the discoverer. He named the group the Sandwich Islands after his patron, the earl of Sandwich. Cook first landed at Waimea, Kauai Island. on Jan. 20. 1778. The natives thought him the god Lono. On his return the next year, he was killed, after a period of friendly relations with the natives, on Feb. 14, 1779, in an affray at Kealakekua bay, Hawaii, where a monument to him now stands.

Then followed a period of contact with premissionary whites (1778–1820), a period of political consolidation and religious disintegration. Kamehameha I, the most striking figure in Hawaiian history, came to the throne of one of the then four kingdoms in 1782 and, equipping himself better than his foes with vessels, firearms and foreign and native aids, succeeded by 1795 in conquering all the islands except Kauai and Niihau, and in

securing these two by cession in 1810. Having effected consolidation, he organized the government. checked oppression. encouraged industry and suppressed crime. until, as it was said, "the old, men and women, and little children could sleep safely in the highways." He thwarted Russian designs upon the island (1815–16) and eliminated Spanish pirates (1818). It was in this period that the sandalwood trade developed. In 1804 an epidemic, probably cholera, destroyed much of the population.

A new period opened after the accession of Kamehameha II (Liholihoj in 1819 and the arrival of the first company of missionaries from New England on March 31, 1820. Fourteen other companies followed during the next 3j years, in all more than 1jo men and women—ministers, teachers, physicians, printers, farmers and businessmen. They introduced the church, the school and the press. The Hawaiians were most eager to learn. By Jan. 7, 1822, the missionaries had learned the language, reduced it to writing and begun printing the first textbook. Two months later the first printed law was issued. By 1840. 50 books had been printed. In 1834 two Hawaiian newspapers were published. An English newspaper: founded in 1843, is still published. The Sew Testament was completed in 1832, the Old in 1839, the dictionary in 1865. Of great assistance was William Ellis. English missionary in Tahiti, who visited Hawaii in 1822. While Christianity soon came to be regarded as the national religion and churches were well attended everywhere, little interest was taken in it as a personal matter until 1829, when there were 18; church members, of whom 117 joined that year.

Interest culminated in the great revival of a decade later! which added one-fifth of the population to church membership. The first convert (1823) was Keopuolani, head queen of Kamehameha, mother of the next two kings and highest chief by blood in the nation. Indeed the chiefs, especially the females, led in embracing and supporting the new religion and learning. Kaahumanu, Kamehameha's favourite queen. was converted in 1825 and was thereafter known as the "New Kaahumanu," as strong for good as she had theretofore been haughty and cruel. Of the ten who joined the church in 1826. nine mere chiefs, including Kalanimoku, known as the "Iron Cable." Kamehameha I had appointed Kaahumanu to be his *kuhina nui,* or premier. with power almost equal to that of the king. She acted as regent when the king and queen visited England in 1824. and, they having died there she continued as regent until her death (1832). Kalanimoku had been prime minister and treasurer to Kamehameha I and continued as such under Kaahumanu until his death in 1827.

The first score or so of years after the arrival of the missionaries was a crucial period, not so much because of the opposition of the Hawaiians as because of the opposition of whites. This opposition came, most dangerously, from British, French and U.S. consuls and naval officers. They opposed the laws against licentiousness and drunkenness, slandered the missionaries, made unjust claims against the government, insisted that they were not subject to Hawaiian laws, attacked with arms the homes of missionaries and chiefs and aimed at the overthrow of the government. The British consul claimed that the islands had become British territory.

1. Growth of Government. — This period was not without bright spots in helpful foreign influences both from residents and from such visitors as Lord Byron of the Royal Navy, cousin of the poet, who brought back the bodies of the king and queen in 1825, and Capt. Thomas ap Catesby Jones (1826) and Captain W. B. Finch (1829) of the U.S. navy, the former of whom negotiated the first treaty entered into by Hawaii. Whaling had become active in 1820 and the sugar industry in 1835.

The first Roman Catholic missionaries arrived in 1827, as part of a French settlement scheme. The priests mere resented by the Hawaiian chiefs not only as colonizers but for religious reasons, because by this time Protestantism had virtually become the state religion. During the next decade, attempts to set up Catholicism were resisted and some native converts were punished. But in 1840 the cornerstone of a Catholic church was laid in Honolulu and from that time dates the expansion of membership which made Catholicism the most numerous Christian denomination in the islands *(see* also *The People: Religion,* above).

The first mission of the Mormon sect arrived in 1850 from the California gold diggings. Almost at the outset this group learned the Hawaiian language and appointed native converts to various church offices. The Book of Mormon was printed in Hawaiian in 1854. The Mormons continued to be active in mission work, their success being symbolized by their temple, a landmark at Laie on the island of Oahu.

Because of increasing complications with foreigners, growth in liberal and humane sentiments on the part of the chiefs and realization of their natural rights by the common people. a conviction arose of the need of a better defined and more advanced form of government as a condition of peace, progress and independence. After vain attempts to secure teachers of the science of government from New England, the missionaries were induced to detach one of their number, William Richards (1793–1847), U.S. Congregational clergyman, to the service of the Hawaiian government, in 1838. He gave valuable advice to the government as did two other missionaries, G. P. Judd and R. Armstrong, similarly detached later. After hearing a course of lectures on government (1839) delivered to the king. chiefs and leading commoners, Kamehameha III promulgated the Declaration of Rights, called Hawaii's Magna Carta, June 7, 1839, the Edict of Toleration, June 17, 1839, and the first constitution, Oct. 8, 1840. This first written constitution for Hawaii contained several innovations: including a representative body of legislators elected by the people. It also set up a supreme court. The first compilation of laws was published in 1842 and in that year Richards obtained recognition of Hawaiian independence by the United States, which was formalized by U.S. secretary of state Daniel Webster in July 1843; Richards later obtained recognition by Great Britain and France.

Contrary to the usual course of history, in Hawaii democratization evolved from the top downward rather than from the bottom upward.

But troubles with foreigners were not at an end. French naval officers in 1839, 1842, 1849 and 1851 made unjust demands. the first and third times accompanied by force. A British naval officer took possession in 1843 and held it until the flag was restored by higher authority. After the ceremonies, the king, addressing his people on the means of preserving independence, used the expression *"Ua mau ke ea o ka* ***aina*** *i ka pono"* ("The life of the land is perpetuated by righteousness"), which became Hawaii's official motto.

Further troubles with foreigners, and especially the outrageous French demands of 1849 and 1851, led to diplomatic missions and, in the latter year, a secret proclamation putting the islands under the protection of the United States. The French: having learned this, retracted and the United States declined the protectorate, but, as a result of further troubles and dangers, within and without, including threatened filibustering from California and the "manifest destiny" sentiment awakened in the United States by the acquisition of the Oregon territory and California, negotiations were opened in 1854 for annexation to the United States. They were terminated by the death of the king. The troublesome foreign representatives were removed and fairer treaties entered into.

2. New Codes.—An able lawyer: John Ricord. was appointed attorney general in 1844 and made a famous report to the legislature of 1845, as a result of which he was requested to draft comprehensive organic acts, which were enacted in 1846–47. W. L. Lee was appointed chief justice in 1846. He was chief drafter of the penal code of 1850 and the more modern constitution of 1852 and chief compiler of the civil code of 1859. Most important of these reforms, perhaps. was the Great *Mahele,* or division of lands. which provided a basis for modern land titles in the islands. Action was taken in 1845 and subsequent years by which the old feudal tenures were changed to allodial (absolutely independent), and the interests of government, crown, chiefs and common people were severed and all claims adjudicated by a board of which Lee was chairman. R. C. Wyllie, a Scot, was minister of foreign affairs 1845–65. For able and untiring service, Lee, Wyllie and Ricord are among the outstanding personages in Hawaiian history.

A tower of strength was Kekuanaoa (father of Kamehamehas IV and V), governor and judge of Oahu. The long and fruitful reign of the liberal-minded Kamehameha III ended on Dec. 15, 1854. Hawaii had become a civilized and Christianized country with constitutional government, highly creditable legislative, executive and judicial branches, secure personal and property rights, allodial tenures, modern industries, the respect of other nations and assured independence.

The next two kings. high-minded, educated and traveled. Kamehameha IV (1854–63) and V (1863–72), were slightly reactionary and pro-British. The former and his consort. Queen Emma. are remembered for founding the Queen's hospital (1860) and introducing (1862) the Episcopal Church. The U.S. board of missions (Congregational), which had sent out workers since 1820, deeming Hawaii qualified to graduate from the field of Christian missions, in 1863 transferred its work to the Hawaiian board. Kamehameha V, after calling and dismissing a constitutional convention, himself promulgated a new constitution (1864).

With his death ended the beneficent Kamehameha dynasty. and after the brief reign (1873–74) of 'the liberal, popular, pro-American Lunalilo, elected against Kalakaua, came the decidedly reactionary reign (1874–91) of the latter, elected as pro-American against Queen Emma as pro-British. At first Kalakaua ruled fairly well and was largely instrumental in bringing about the Reciprocity treaty with the United States (1876). The treaty was terminable after seven years on one year's notice. An extension for a like term was obtained in 1887 but only by giving the United States the exclusive right to enter Pearl Harbor and maintain a naval coaling and repair station there.

3. Reaction and Annexation.— There was ever-increasing endeavour by the king to restore the ancient order nith its customs and ideas of absolutism and divine right, accompanied by extravagance. corruption. personal interference in politics and fomentation of race feeling, until he was compelled to promulgate (1887) a new constitution providing for responsible ministerial government and other guarantees. The struggle continued. however, not only until the end of his reign (1891), during which there was an armed insurrection (1889) by the opposition, but even more hotly during the reign of his sister, Liliuokalani. She had rare qualities as a poet and musical composer and mas interested in welfare work; however, it was deemed necessary to depose her (Jan. 17. 1893) and set up a provisional government, with annexation to the United States as its aim.

This failed for the time being, and a republic was established. July 4, 1894 It continued. disturbed only by an unsuccessful insurrection in 1895. until annexation was accepted by joint resolution of congress in 1898, and further until the territory was established. June 14, 1900.

4. Hawaii, **U.S.**—In 1900 the people of Hawaii, now American citizens. began striving to earn an honoured place in the nation. Population trebled under U.S. administration. The islands slowly won a niche in the national economy, producing sugar and pineapple products for mainland consumption. In turn. Hawaii as a customer for mainland goods was yearly paying about $400,000,000 for these goods by mid-20th century. The third source of income in Hawaii was the growing tourist industry, which met the demand for a romantic vacation spot.

Politically, the islanders slowly won maturity in self-government and began the uphill task of earning statehood. The first legislative session under territorial status was dominated by a quarrelsome Home Rule party, but newly formed Republican and Democratic parties on the national pattern soon began competing to supply the needs of citizenship.

Hawaii was converted during this period into the westernmost bastion of American defense. Garrison troops were stationed on Oahu as early as 1898. Schofield barracks, first occupied in 1909, grew to be the largest permanent army post under the flag. The great naval base at Pearl Harbor was authorized by congress in 1908 and construction and maintenance thereafter made the U.S. government one of Hawaii's biggest employers.

Hawaii saw no hostile action in World War I but its people contributed their share in the conflict. Almost 1,000 men served in the U.S. army or navy, and many others did their bit in the Red Cross or other organization in Europe or Siberia.

In the 20th century, large shipping lines grew up to meet the need for Pacific passenger and freight service. The first cargo to pass through the Panama canal was a bargeload of Hawaiian sugar. The air age likewise arrived in Hawaiian skies. and caused the Honolulu International airport to become the busiest landing field in the entire Pacific. Military aviation started in the islands in 1917. The first flight between California and Oahu was completed by two army lieutenants in 1927. Air passenger service began among the islands in 1929, as well as air freight deliveries. In 1936, regular transpacific clipper flights were started, connecting the U.S. with the orient.

As early as 1903 the territorial legislature had petitioned congress for admission as a state, and many subsequent sessions made the same request without avail. Charges of colonialism and paternalism arose, and fear of carpetbagger rule by nonresidents of the islands was also rife In 1924 congress passed a law extending to Hawaii the benefits of appropriations for general welfare in the states. but Hawaii was still subject to all taxes imposed on the states. and the cry of "taxation without representation!" nas often heard. The Jones-Costigan sugar control act of 1934 clearly discriminated against the rights of sugar producers in Hawaii. Territorial delegate Samuel W. King introduced a statehood bill in congress in 1935 and succeeded in getting the house committee on territories to send a subcommittee to visit Hawaii—the first of many such congressional investigations. When a plebiscite on the question "Do you favour statehood?" was held in 1940, despite fears of Japan the people voted 67% in favour (see *Campaign for* Statelzood, below).

5. World War 11.—On Dec. 7, 1941, the Japanese. while still talking peace in Tokyo and Washington, made a surprise air and submarine attack on Pearl Harbor and the army and navy airfields of Hawaii. Casualties numbered over 3.000, including more than 2,300 killed. The battleship "Arizona." target ship "Utah," destroyers "Cassin." "Downes" and "Shaw" (later salvaged) and the mine layer "Oglala" were lost. The battleship "Oklahoma" also capsized, and other ships were severely damaged Many planes were destroyed or damaged on the ground, and much other damage was done. No fuel depots were destroyed. Some bombs fell on Honolulu; civilian casualties totaled over 100, including 49 dead, but material damage was slight. The Japanese lost 41 planes and 3 submarines. (See also WORLD WAR II.) But a bigger result was the unification of the U.S. people for the nar. The slogan "Remember Pearl Harbor" became reminiscent of "Remember the Maine." The attack marked the extension of World War II to the Pacific and between Japan and the United States, which was joined at once by Great Britain, the Netherlands and China. U.S officers and men individually and collectively exhibited great heroism and resourcefulness during the attack Japanese submarines later briefly shelled Hilo (Hawaii), Nawiliwili (Kauai) and, twice, Kahului (Maui), without casualties and with negligible damage.

The people of Hawaii earned a proud war record, at home and on various world fronts. Memorable is the achievement of the A J.A. (Americans of Japanese Ancestry) volunteers who served at Anzio and Cassino in Italy in the 100th infantry battalion, later incorporated into the 442nd regimental combat team. Many men from Hamaii also served as interpreters in the island-hopping campaigns against Japan.

Martial Law.—The governor of Hawaii issued a proclamation suspending the privilege of the writ of habeas corpus and declaring martial law A military government was set up to exercise executive, judicial and legislative functions. Provost courts, under martial law, supplanted district or police courts throughout the territory.

During the early months of 1942 military precautions were continued. Among them were black-out restrictions mhich provided that only persons on official business could be on the streets. highways, beaches or parks on foot or in vehicles between 6 o'clock P.M. and 6 A.M. Hundreds of thousands of individuals were fingerprinted and an extensive immunization program of the whole population against smallpox and typhoid was completed. The civilian

population was supplied with gas masks.

By the following year the danger of invasion or concentrated air attack had apparently passed, and the management of civil affairs was restored to the civil authorities in March 1943. Martial law remained in effect, however, and the writ of habeas corpus continued to be suspended. Members of the bar association of Hawaii strongly opposed the practice of trying civilians in provost courts. In Oct. 1944 Pres. Franklin D. Roosevelt announced the suspension of martial law and the restoration of habeas corpus. Military authority was restricted thereafter to delense measures in the islands. The U.S. supreme court held in 1946 that the military courts which were set up under martial law during the war period had no power to try civilians.

6. Campaign for Statehood. — After the close of World War II Hawaii renewed its efforts to obtain admission to the sisterhood of states. In 1946 Harry Truman became the first president to urge congress to grant statehood to Hawaii, but a house bill passed in 1947 did not pass the senate. In the spring of 1950 Hawaii drafted a state constitution to submit to the congress for ratification. This constitution was prepared at a convention of 63 delegates elected from all the islands and mas ratified by the voters in the general election held Nov. 7, 1950.

An enabling act for statehood passed the house in March 1950, for a second time, by a majority of 262 to 110, but four days after the senate committee reported favourably, the Korean war broke out and action was deferred. In the last few weeks of the special session toward the end of 1950, opponents of the bills to grant statehood to both Hawaii and Alaska were able to prevent a vote. In 1952, similar bills for the first time reached the senate floor, but a vote of 45 to 44 sent the Alaska bill back to committee and the Democratic leadership decided not to bring up the Hawaii bill. In 1954 a statehood bill passed the senate for the first time but no final action was taken to combine house and senate versions.

The expectation that Hawaii might always send Republicans to congress was upset when in Feb. 1955, the legislature convened for the first time in the history of the territory with a majority of Democrats in both the senate and the house of representatives. In 1956 a Democrat, John A. Burns, was elected as Hawaii's nonvoting delegate to congress; he was re-elected two years later.

In Nov. 1955, Gov. Samuel W. King, in his capacity as president of the 1950 constitutional convention, called the delegates of that body together to act on the reapportionment provision of the proposed state constitution. The convention passed a resolution reaffirming its desire for statehood and requesting the congress meanwhile to permit reapportionment of the legislature as provided by the state constitution. Congress approved in 1956, and in 1958 the first election was carried out under the new plan, which provided for 25 senators and 51 representatives.

In 1957, statehood failed to pass the congress for the 22nd time since 1903. In 1958, as a result of an active effort, Alaska was granted statehood and in 1959 Hawaii's long campaign met with success when Hawaii became the 50th state.

The enabling act was passed by the U.S. senate on March 11, 1959, by a vote of 76 to 15 and by the house of representatives on the following day by 323 to 89. President Eisenhower signed the act on March 18. Citizens voted for statehood in a plebescite on June 27. *(See* also HONOLULU; PACIFIC ISLANDS.)

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IV. POPULATION

The population of Hawaii, according to the 1960 federal census was 632,772, exclusive of armed forces personnel. About half the population lived in the capital, Honolulu, a busy, modern city with 294,179 inhabitants. The second city was Hilo (25,996) on the island of Hawaii. The remaining centres mere small towns or villages, or else part of the Honolulu metropolitan area. Urban population was 69%, rural 31%; density was 98.5 per square mile.

TABLE *11.— Hawaii: Places of 5,000 or More Population (1960 census)**

Place	Population				
	1960	1950	1940	1920†	1900†
Total state	632,772	499,794	423,330	255,912	154,001
Aiea	11,826	3,714	3,553	—	—
Hilo	25,996	27,198	23,353	10,431	—
Honolulu	294,179	248,034	179,326	83,327	39,306
Kailua-Lanikai	25,622	—‡	970	—	—
Kaneohe	14,414	3,208	1,762	—	—
Lualualei-Maili	5,045	—‡	—§	—	—
Wahiawa	15,512	8,369	5,420	—	—
Waianae-Makaha	6,844	—	—	—	—
Wailuku	6,969	7,424	7,319	—	—

*Populations are reported as constituted at date of each census.
†Returns unavailable for 1920 and 1900 for towns and villages.
‡Not separately returned in 1950.
§Not separately returned in 1940.

From the discovery of the island (1778) the population changed from extreme homogeneity to extreme heterogeneity because of the decrease of Hawaiians during the first century and immigration of others during the next century (see *The People,* above). At the time of the discovery the population probably did not exceed 300,000. Their decrease. attributable to many causes, was rapid, but latterly continued at a diminishing rate. The Hawaiians seemed destined to disappear more through intermarriage with other races than through excess of deaths. The part-Hawaiians increased more rapidly than the pure Hawaiians decreased.

1. .Characteristics. — In 1823 the missionaries estimated the Hawaiians at 142,050. The first census (1832) showed a total population of 130,313, including the few foreigners. The census of 1872 showed a low ebb in the total, 56,897 (51,531 Hawaiians and part-Hawaiians, or 90.5% of the total). That of 1878, just after the reciprocity treaty with the United States began to stimulate the sugar industry and immigration, showed a total population of 57,985, comprising 47,508 Hawaiians and part-Hawaiians (81.9% of the total) and 10,477 of other races.

The census of 1900, the first taken after Hawaii became a territory, showed a total population of 154.001, comprising 37,656 Hawaiians and part-Hawaiians (24.4% of the total) and 116,345 others, including 28,819 Caucasians, 5,767 Chinese and 61,111 Japanese. In 1920 the total population of the territory was 255,912, of which number 41,750, or 16.3%, were Hawaiians and part-Hawaiians. In 1930 the population was 368,336, of which number 50,860, or 13.8%, were Hawaiians and part-Hawaiians. This census represents the smallest recorded percentage of Hawaiians and part-Hawaiians taken together. In 1940 there were 64,310 Hawaiians and part-Hawaiians, forming 15.2% of the total of 423,330. In 1950 there mere 12,245 Hawaiians and 73,846 part-Hawaiians, forming 17.2% of the total population of 499,794.

The growth of the population of the territory up to 1930 was rather rapid, with a 43.9% increase registered in the decade ending in 1930. The increase between 1930 and 1940 was only 14.9%, between 1940 and 1950 it was 18.0% and between 1950 and 1960 was 26.6%.

The number of males per 100 females reached its highest point,

at 223.3, in 1900 and an equal proportion between the sexes was not reached until 1930 The population of Hawaii is predominantly youthful; in 1950, 40% of the residents were under the age of 21.

2. Immigration. — Polynesians from the South Sea Islands were introduced into Hawaii between 1859 and 1885, but the total was less than 2.500 and they proved disappointing both as labourers and prospective citizens, so that most of them nere returned to their homes. Nonoriental immigration was encouraged, principally Portuguese. In the latter part of the 19th century. after the reciprocity treaty increased the need for plantation workers, about 11,000 Portuguese were brought from Madeira and the Azores in 1878–90 and 337 more in 1899. They proved to be industrious, thrifty and law abiding. They brought their families and most of them remained and multiplied. In 1906–13, more than 5.000 more were introduced. many from Portugal itself. Other groups were brought — mainland Americans Norwegians, Germans, Galicians. Russians. Poles. Spaniards from Málaga and Italians. In 1900–01 about 5,000 Puerto Ricans were brought in, and contrary to first expectations, most of them developed well and increased to more than 9,500 by 1950. About 100 Negroes and their families were brought in 1901 and about 500 Hindus (1908–11), most of whom soon left.

To solve the problem of finding a source of willing plantation labour, it was early decided that groups from Asia should be introduced. The Chinese came first (1852–67); then, opposition having arisen, 148 Japanese were brought in 1868. The Japanese government objected, however. and the Chinese continued to come in growing numbers until restrictive measures nere applied by the Hawaiian government in 1883 and attention again turned to Japan. Japanese came in large numbers—65,034 during 1885–99, of nhom almost 20,000 came in the last year. fearing that such immigration might be prohibited. Upon annexation, the United States laws on Chinese exclusion were extended to Hawaii. After the gentlemen's agreement of 1907 with Japan, arrivals were chiefly women. and a rapid increase continued through births. Opposition on the mainland led to Japanese exclusion in 1924. Koreans to the number of 7,859 came in 1903–05, but there were only 4,533 in 1910, 4,950 in 1920 and 7,030 in 1950.

Finally. largely because of the enactment of federal laws prohibiting assisted immigration from foreign countries. the sugar companies turned to Filipinos as the only available labour source. beginning in 1906, and, although many nent on to the mainland, their number grew to 21,031 in 1920 and 63,052 in 1930; they numbered 61.062 in 1950 and constituted the largest racial element on the sugar plantations.

All the various national groups brought into Hawaii prospered. The Puerto Ricans remained United States citizens after arrival. Nearly all the Portuguese became citizens, and after World War II many Filipinos and Chinese took out citizenship papers under laws favouring such action. The Hawaiian-born children of all alien residents are citizens at birth.

See U.S. Bureau of the Census, *Reports. See* also bibliography under *The People,* above.

V. ADMINISTRATION AND SOCIAL CONDITIONS

1. Government. — From 1900 to 1959 the Hawaiian Islands were a territory, an integral part, not a possession, of the United States. governed under an organic act. effective from June 14, 1900. Having been previously an independent sovereignty. Hawaii was the most highly organized territory created by congress and the only one to which was given the administration and revenue of its public lands. The federal officers were a delegate to congress, elected for two years. who could introduce bills and debate but not vote, two judges of a federal district court and a U.S. attorney and marshal, appointed for six years by the president with the consent of the federal senate, and various officials of the treasury, post office, agriculture, commerce and interior departments. The territorial legislature met for a 60-day term every two years. In 1959 the first session was held under a reapportionment act which provided for 51 members of the house of representatives, elected for two years, and 25 members of the senate. nith 12 or 13 elected each two years for four-year terms. This plan anticipated a similar scheme of representation under the state constitution which was ratified by the people of Hawaii in 1950 and went into effect in 1959.

This constitution required that to be eligible for the state senate a candidate must be 30 years old, a resident of the state for not less than three years and a qualified voter of the senatorial district from which he seeks to be elected. A candidate for the house of representatives must be at least 25, a resident of the state for three years and a qualified voter of the representative district.

Regular sessions of the legislature are held annually. starting on the third Wednesday in February. Regular sessions in odd-numbered years are known as general sessions and run for 60 days; regular sessions in even-numbered years are knonn as budget sessions. Budget sessions and special sessions are limited to 30 days, but the governor may extend any session for not more than 30 days

Under the constitution the governor and the lieutenant governor are elected by the voters for four-year terms. All executive and administrative offices and bureaus are allocated by law among not more than 20 principal departments. each headed by a single executive who is appointed by the governor with the advice and consent of the senate The terms of these executives expire at the end of the governor's term.

Local Government.—Under the state constitution the legislature "shall create counties and may create other political subdivisions within the state. and provide for the government thereof." Each political subdivision has the poner to frame and adopt a charter for its own self-government. The taxing power is reserved to the state except so much thereof as may be delegated by the legislature to the various subdivisions.

Qualifications of Voters.—Qualifications for voting include citizenship, registration, residence of one year in the state, age of 20 years and ability to speak, read and write the English or Hawaiian language. Voters do not lose residence through absence in the service of the United States or while engaged in navigation or studying at any institution of learning. The legislature provides for registration and for absentee voting General elections are held on the first Tuesday after the first Monday in November in all even-numbered years.

During territorial rule direct primaries mere adopted in 1913 and women's suffrage in 1920. Political parties are the Republican and Democratic. Until 1955 the Republicans predominated, but in that year, for the first time in history, the territorial legislature convened with a majority of Democrats in both house and senate. Since that time the Democrats have been the preponderant party and since 1956 the delegate to congress has been a Democrat. During the general election of 1958 the registered voters numbered 175,221, of whom more than 88% voted, usual in Hawaii but much higher than in most other places.

2. Taxation. — The tax structure under territorial rule comprised an elaborate system of taxes which included every major type of tax found in the other states and several others not in general use. Among the latter was a general excise (gross income) tax of $3\frac{1}{2}\%$ levied against almost all business activities. In 1957 the territorial income tax law was revised to make payments more closely comparable to the system used by the federal government. The rate on homes occupied by owners was lower than that on real estate in most states. The net assessed valuation of real property at the time statehood was achieved in 1959 was more than $1,085,000,000. All federal taxes, including individual income and corporate income taxes, were applicable in the territory and continued to be in the state. The funded debt of the state at any time was set at $60,000,000.

3. Living Conditions. — The cost of living in Hawaii is slightly higher than that of the mainland United States because most of the goods used by the people must come by ship from other places. Per capita personal income when Hawaii was admitted to the union was about $1,700. Wage scales were about the same as on the mainland. Approximately 200.000 persons were employed. The average weekly wage was about $60 for industrial workers covered

by employment insurance. Payroll for all industries was more than $711,000,000. The sugar plantation companies paid wages of more than $58,000,000 to an average number of full-time equivalent employees totaling almost 19,000. The pineapple companies paid more than $35,500,000 to employees totaling about 11,000. But the biggest employer, governmental agencies, with a payroll of more than $320,000,000 to territorial, county and federal workers. accounted for 45% of all wages. A lively home-building program was being carried on, despite high costs and relative scarcity of residential land.

4. Welfare Services.—Services in Hawaii parallel those of mainland states. The department of public health is second in importance only to that of education. Physicians are employed or subsidized for the benefit of all, however indigent or remote from population centres. The incidence of Hansen's disease (leprosy) has declined greatly so that only about 150 patients are confined. All cases discovered since 1949 have been confined at Hale Mohalu, Pearl City. Oahu, rather than at Kalawao. Tuberculosis hospitals are found on Oahu, Hawaii. Maui and Kauai. Two hospitals on Oahu care for the mentally handicapped. There is one prison system with three units, two of which are minimum security projects. There is also a correctional school for boys and another for girls. The department of health has allocated in one year more than $1,000,000 to the counties for hospital and medical aid to the indigent. All workers in the islands benefit under the social security act and other federal laws concerning child labour, minimum wages and unemployment insurance. In 1945, the local government extended collective bargaining to agricultural labour. As a state, Hawaii automatically benefits by all federal welfare laws.

5. Justice.—Judicial decisions are made by the United States district court of Hawaii and by the state courts. These consist of one supreme court, circuit courts and such inferior courts as the legislature may establish. The supreme court consists of a chief justice and four associate justices. The justices, as well as judges of the circuit courts. are appointed by the governor with the advice and consent of the state senate. from those persons who have practised law before the supreme court of Hawaii for at least ten years. Justices serve seven years and judges of the circuit courts serve six years. Equity and law are kept distinct but with simplified procedures. Appeals may be taken from the federal district court and, when a federal question or a value in excess of $5,000 is involved, from the state supreme court to the federal circuit court of appeals of the ninth circuit, in San Francisco.

6. Education.—Twelve years after the arrival of the first missionaries in 1820 there were 900 schools with 53,000 pupils (40% of the population, mostly adults); 12 years later about 80% were literate. In 1824 the regent and chiefs prescribed schools and compulsory attendance. In 1831 and 1834 there were founded two higher institutions for training teachers and religious assistants, which were also largely manual and industrial training schools, said to be the first of the kind established in what is now the United States. In the 1830s and 1840s pupils came from Spanish California, Kamchatka and other Pacific islands to attend an English-taught school opened in Honolulu in 1833. At first Hawaiian was the language of public instruction. but in 1854 the change was made to English, and American teachers, textbooks and methods became popular.

When Hawaii became a state the educational system included all grades from kindergarten through university, as well as special classes for physically defective or feeble-minded students. There were many evening classes. Much attention was given to agricultural, trade and industrial vocational work, home economics and medical, dental and nutritional needs. School attendance was compulsory for children 6 through 15 years of age. The public school system was under the territorial government; buildings and other physical equipment were under the local governments. There were about 200 public schools, including kindergartens and grades through 12. The total school enrollment was almost 160,000 or about 27.5% of the population of the territory. Of those enrolled, not quite 30,000 were in private schools. Public school teachers numbered about 5,000; they were all under a standard salary schedule regardless of teaching location.

Under the state constitution, a board of education is appointed by the governor, with the advice and consent of the senate, from panels submitted by local school advisory councils. The superintendent of public instruction is appointed by the board. The education system is state wide rather than local, continuing the centralization found under the monarchy and under territorial rule. The constitution provides that "there shall be no segregation in public educational institutions because of race, religion or ancestry."

Prominent among private schools are Punahou, founded in 1841, which specializes in college preparatory courses; the Kamehameha schools (for those of Hawaiian blood). largely industrial: St. Louis college (Catholic, for all races); and Mid-Pacific institute (for all races).

7. University of Hawaii.—The state-supported University of Hawaii lies at the crossroads of the Pacific. There are more than 7,000 students earning credits. The campus in Honolulu lies in Manoa valley, three miles from the business centre and two miles from Waikiki. It was established by the territorial legislature in 1907 and is a federal land-grant institution. Originally called the College of Agriculture and Mechanic Arts (1907–11) and later the College of Hawaii (1911–20), it became the University of Hawaii in 1920. As a state university it receives a major portion of its financial support from the state legislature. Its colleges include arts and sciences, business administration, engineering, education. agriculture and general studies. In addition to the bachelor degree, the university grants the master's degree in 29 departments and the doctor's in 7. Co-operating institutions include the Pineapple Research Institute of Hawaii; the Hawaiian Sugar Planters' association; Fruit Fly laboratory; the U.S. fish and wildlife service. which established the permanent headquarters of its Pacific oceanic fishery investigations on the university campus; the Bernice P. Bishop museum, which built an extensive Polynesian collection; the Pacific and Asian Affairs council; and the Honolulu Academy of Arts. The Gregg M. Sinclair library of the university contains more than 300.000 bound volumes and is a regional depository for C.S. government publications. It holds extensive collections of works in Chinese and Japanese and also books and periodicals concerning Hawaii and the Pacific. The university operates the aquarium at Waikiki and the Hawaii Marine laboratory with a branch at Coconut Island off the north shore of Oahu. It also operates a junior college at Hilo.

Other collegiate institutions in Hawaii are Chaminade college (founded 1957), Honolulu Christian college (1953) and Jackson college (1949), all in Honolulu, and Church College of Hanaii at Laie, Oahu.

8. Armed Forces.—Hawaii is the centre for the unified command of the U.S. armed forces for the entire Pacific area; the admiral in charge is also in command of the Pacific fleet, with headquarters at Pearl Harbor. The army maintains six major posts on the island of Oahu, including Schofield barracks, about 20 mi. from Honolulu. Air defense of the Pacific is a function of the Pacific air force (USAF) with headquarters at Hickam air force base on Oahu. The Hawaii national guard is available for immediate call in time of national emergency and also may be called out by the governor in local emergencies. A national guard fighter squadron is stationed at Hickam air force base.

VI. THE ECONOMY

Hawaii's economy has increasingly expanded in the 20th century because of closer integration into the U.S. national market. and by specializing in four major sources of income. which may then be used to purchase the needs of the population. The four are sugar, pineapples, tourism and government spending. Hanaii grows one-seventh of all the sugar used in the United States, and 75% of all the pineapples marketed in the world. Although Hawaii is predominantly agricultural, the cultivable land is only about 7% of the total area; 40% is suitable only for grazing and another 25% is forest reserves. Three-fourths of the agricultural

acres are used for sugar cane, but the entire sugar crop of more than 1.000,000 tons a year is grown on 221,300 acres — an area about the size of New York city. When Hawaii became a state the sugar crop was worth about $147,000,000 annually, and the pineapple crop about $115,000,000. But the largest source of income was federal expenditures, mostly for defense, including payrolls. purchases and contracts, running to more than $385,000,000 annually. Tourism was a growing industry which may compete with agriculture.

Sandalwood was Hawaii's first important commercial product. The industry (1800–30) originated through the discovery of fur traders that the wood was in demand in China. When the trade was at its height during 1810–2j. the king and chiefs found it so lucrative that they compelled most of the available population to get the wood from the forests. so that it was soon exhausted. But before that time. whaling (1820–80) began. The vessels usually called twice a year for rest. repairs.. supplies, storage or transshipment of oil and whalebone and engagement of Hawaiians as seamen. The annual calls during 1840–60, when the industry was at its height, averaged about 400. Whaling was also carried on locally. The discovery of petroleum (1859) and the destruction of whaling vessels in the Civil War and by the northern ice pack in 1871 lessened its importance. Hawaiians were excellent seamen; in 1846 about a fifth (3,000) of the young men of 15–30 were so engaged.

A. Production

1. Sugar has long been the chief product of the islands. Small quantities were produced from 1802 to 1835. when the industry really began, and yet the output had increased to only 13,036 short tons by 1876, when there was great impetus from the reciprocity treaty with the United States. It increased to 229,414 tons by 1898, the year of annexation. and to 1,035,548 by 1933. after which there was a reduction of about 9% in output under the national quota system. Tonnage was more than 1,000,000 in the 1950s. Laboursaving devices and improved scientific methods have reduced the working force; in the 1950s the same amount of sugar was produced by one-third the number of employees as in the 1930s. In 40 years tons per employee rose from 12.6 to 56.1. Wages paid these unskilled workers increased to an average of $11.10 daily in the second half of the 20th century. Employment is on a year-round basis. The yield per acre is the highest in any sugar area, averaging $7\frac{1}{4}$ tons of sugar per acre, with a maximum of 18 tons. The cane requires 14 to 24 months to mature. and two or three crops at different stages grow at the same time. Nowhere have scientific methods been applied in agriculture more than to the sugar and pineapple industries in Hawaii. About half the area is irrigated — by conduits from mountain streams and pumping from artesian and surface wells. The irrigation system of one plantation cost nearly $6,000,000, and supplies amounts of water that would meet the needs of a medium-sized city. Before a field is harvested it is set on fire to bum off the leaves. Conveyance to the mills is by large trucks. flumes and overhead trolley. The centrifugal drying process for sugar was introduced in Hawaii in 1851. Almost all the sugar is shipped ram, mainly to a co-operative refinery in California. Corporations own the mills and raise most of the cane. In the second half of the 20th century there were 27 sugar plantation companies and some 2.000 independent sugar planters.

2. Pineapple growing, an industry rising in the 20th century, is second only to sugar as a crop. Annual production of all companies increased from 1.893 cases in 1903 to more than 30,000.000 cases of canned fruit and juice in the 1950s. Nine companies dominate the industry, and the working force of about 20.000 persons grows. harvests and processes the fruit. Some of the by-products of processing include citric acid, bran. calcium citrate, alcohol and sugar. Cnlike the sugar industry. the pineapple companies have had to create their market.

3. Other Agriculture. — The livestock, coffee and rice industries have successively occupied third place. There are numerous ranches and dairies. many with thoroughbred stock — cattle. sheep. horses, hogs and poultry. Livestock products brought about $30,000,000 a year in the 1950s. More than 30,000,000 quarts of milk are produced annually. The coffee, valued at about $6,000,000 annually. is of superior quality, known as Kona from the district on western Hawaii where most of it is raised. Rice is a waning industry. Hilo on the island of Hawaii is the centre of the flower trade. The banana supply is steady, though not large. Other industries which are still small or have had their day are silk. cotton. tobacco, rubber. vanilla. sisal. potatoes and wheat. New methods have made a future for the growing of macadamia (Australian) nuts. There is much subsistence farming and a wide variety of diversified crops can be grown in the islands. but for many years the people have found it most economical to grow the two important money crops — sugar and pineapples — by large-scale methods. and to import most of their supplies, chiefly from mainland United States. Purchases by Hawaii from the mainland amount to more than $748,000,000 a year. Little lumber is produced.

4. Fisheries. — Commercial fishermen catch millions of pounds of fish each year, valued at about $3,000,000. Most important commercially are the aku. or ocean bonito, and the *ahi*, or yellow-fin albacore. both of which are canned as tuna. Fishing in island waters, however. does not begin to supply local needs and much frozen fish is imported into Hawaii.

5. Industry. — Although Hawaii is essentially agricultural, the principal industries are such as require much manufacturing directly. as in sugar, pineapple. rice. coffee and fish mills and canneries. and indirectly. as in iron. fertilizer and can works of large size. A petroleum refinery has been erected on Oahu by a large mainland corporation. More than 150 products are made in the islands, from acetylene to zinc sulfate, but all on a small scale. Handicraft items, perfumes. curios. costume jewelry and jams and jellies are exported. Apparel. particularly Hawaiian sportswear, is a growing industry. and annual sales reached more than $10,000,000 in the 1950s.

Practically the only mineral products are building stone, lava aggregates for concrete. lime and salt, but important deposits of bauxite. raw material for aluminum; were identified in the 1950s. There are no local sources of power except a few waterfalls, and most electricity is produced by conversion of imported petroleum.

6. Tourism. — Third largest source of income from industry comes from tourism. In the second half of the 20th century almost 200.000 tourists spent nearly $80,000,000 in the islands annually. The industry has been promoted by the Hawaii Visitors bureau. established in 1903. The tourist income, which unlike sugar and pineapple has no apparent saturation point, may increase greatly and its effects will spread throughout the economy.

B. Trade and Finance

In quantity imports have exceeded exports. approaching a ratio of two to one. but dollar earnings have shown a favourable balance As indicated above (see *Production*) the major exports are sugar and pineapples. and the tourist trade is the third largest source of income. At the time Hawaii became a state about two-fifths of the total dollar income nas based on the export of agricultural products and three-fifths on the sale of services and goods to tourists and to defense agencies and shipping and airlines. Roughly three-fifths of expenditures outside Hawaii were for commodities imported, less than one-fifth for services and other items (like freight and passenger services) and about one-fifth for payments to the federal government.

C. Transport and Communications

The territorial highway system includes more than 3.000 mi. of concrete and macadam roads. There were more than 150.000 passenger cars in Hawaii in the 1950s. The people are served by many bus lines as well. Most of the heavy hauling is done by trucks, since there are virtually no railway lines. Water and air transport is preferred over road transport in these islands. Shipping lines connect with all the ports of the world. Chief shipping terminals in the islands are Honolulu: Hilo, on Hawaii; Kahului, on Maui; and Port Allen, on Kauai. About 50 shipping companies have representatives in Honolulu. There are about 1,200 ship

arrivals annually at. Honolulu harbour with incoming freight of almost 3,000,000 tons and outgoing freight of more than 1,000,000 tons. Eleven commercial airports accommodated travelers. flying more than 400,000 individual passenger trips to and from the territory. and 600,000 individual trips between islands. Eight international airlines use the Honolulu airport. Use of jet planes reduces the flying time from San Francisco to Honolulu to about four hours.

There are about 170,000 telephones in use: the dial system may be used even for calling a party on another island. In 1957 a dual trunk line telephone cable connected Honolulu and San Francisco. capable of carrying 34 conversations simultaneously. Hawaii is also connected with the rest of the world by cable. radio. radio telephone and ship-to-shore radio service. At the time Hawaii was admitted to the union in 1959. there were 16 broadcasting stations in the islands and 6 television stations, of which 3 were in Honolulu.

D. Labour

Unionization in the islands has followed an unusual pattern. Before 1934 there was very little organizing activity by labour unions. Workers mere often of different races and tended to be unfamiliar with U.S. labour movements. Union organization was perhaps delayed by certain paternalistic policies of employers who. in the face of prospective organization. voluntarily improved conditions and supplied various benefits such as housing and medical care. There mas little labour leadership until after the 1934 waterfront strike in San Francisco. During the two years following, some 500 striking seamen were ashore in Honolulu and built up strong sentiment among the stevedores and other workers. 'The International Longshoremen's and Warehousemen's union (I.L.W.U.), formed at that time. became Hawaii's most militant union and organized not only the dock workers but workers in the sugar and pineapple fields and later even had some success in organizing retail clerks in competition with A.F.L.–C.I.O. locals. For a considerable period the rivalry of west-coast organizations such as the Sailors' Union of the Pacific under Harry Lundeberg and the I.L.W.U. under Harry Bridges was reflected in union activities in and pertaining to the islands.

During World War II union activities were necessarily restricted in scope. The pressure of wartime duties, the early curfew and blackout and gasoline rationing all impeded activities of labour as well as other organizations. Moreover. under martial law wage rates were frozen and workers were forbidden to move from one job to another. At the war's end unionization proceeded rapidly. There was a wave of strikes comparable to those on the mainland at that time, reflecting desires to obtain gains in the postwar world and to meet rising living costs. Doubtless here. as elsewhere. resentment over wartime regulation played a role. Late in 1946, the I.L.W.U.–C.I.O. leadership called a strike on 33 plantations involving 28,000 workers. The strike lasted for 7j days, and involved substantial losses to all concerned. An even more important strike occurred in the summer of 1949, the longest major maritime tie-up in U.S. history. when for 178 days shipping between the mainland and Hawaii was suspended. Many persons felt this strike and the territory's means of dealing with it pointed up the need for statehood. That labour controversy had not vanished was evidenced by the sugar strike which began on Feb. 1. 1958, and lasted for 126 days. Its effect on the general economy of the islands was to a substantial extent offset by a continued boom in building construction.

Estimated membership in A.F.L.–C.I.O. locals at mid-century was 10,000. and I.L.W.U. membership at 23.000. There were also four organizations representing federal and territorial employees. Labour union leaders were active politically in the islands and their efforts met with varied success. In the general election of 1946, the political action committee of the C.I.O. endorsed 51 candidates from both parties, of whom 35 were elected. Later attempts in the support of candidates ior the legislature met less clear-cut success. In general, but with exceptions. the unions lent their considerable influence to candidates of the Democratic party. To present a united front in respect to labour controversy the Hawaii Employers council was founded in 1943. In the 1950s it represented more than 200 firms, large and small, employing 46,000 persons.

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Current statistics on production, employment, industry, etc., may be obtained from the pertinent state departments; the principal figures, together with current history, are summarized annually in the *Britannic Book of the Year,* American edition. (A. G. Dy.)

HAWARDEN, a town and civil parish in the East Flint parliamentary division of Flintshire. Wales, 7 mi. W. of Chester by road. Pop. (1951) 13,812. Hawarden castle (1752) stands near the 13th-century castle which suffered in Welsh raids and in the Civil War. The modern house passed to W. E. Gladstone, who lived there for 60 years and added a library and study which he called the 'Temple of Peace. St. Deiniol's library was founded by Gladstone in 1896 and rehoused in 1902. There is also a Gladstone museum. In St. Deiniol's church, an Early English building restored. is a memorial window to Gladstone by Sir E. Burne-Jones. In the town are the William Temple Memorial college for women and a grammar school (1606).

HAWEIS, HUGH REGINALD (1838–1901), English clergyman, lecturer and writer on music, was born at Egham, Surrey: on April 3, 1838. On leaving Trinity college, Cambridge, he traveled in Italy and served under Giuseppe Garibaldi in 1860. On his return to England he was ordained and held various curacies in London, becoming in 1866 incumbent of St. James's Marylebone. His unconventional methods of conducting the service, his dwarfish figure and lively manner, soon attracted crowded congregations.

Haweis was much interested in music, and wrote on violins and church bells. His best-known book was *Music and Morals* (1871). For a time he was editor of *Cassell's Magazine.* He also wrote *Christ and Christianity* (1886–87), a popular work on the origins of Christianity. Other writings include *Travel and Talk* (1896) and similar entertaining books. He died on Jan. 29, 1901.

HAWES, STEPHEN (*fl.* 1502–1521), English poet, was born, if his own statement of his age may be trusted, about 1474. He was educated at Oxford, and traveled in England, Scotland and France. He became groom of the chamber to Henry VII as early as 1502. Hawes could repeat by heart the works of most of the English poets, especially the poems of John Lydgate, whom he called his master. He was still living in 1521. His capital work is *The Passetyme of Pleasure, or the History of Graunde Amour and la Bel Pucel, conteining the knowledge of the Seven Sciences and the Course of Man's Life in this Worlde,* printed by Wynkyn de Worde, 1509, but finished two years earlier. The poem is a long allegory in seven-line stanzas of man's life in this world. It is divided into sections after the manner of the *Morte d'Arthur* and borrows the machinery of romance. Its main motive is the education of the knight, Graunde Amour, based, according to W. J. Courthope *(History of English Poetry,* vol. i, p. 382). on the Mar*riage of Mercury and Philology,* by Martianus Capella, and the details of the description prove Hawes to have been well acquainted with medieval systems of philosophy. At the suggestion of Fame, and accompanied by her two greyhounds, Grace and Governance. Graunde Amour starts out in quest of La Bel Pucel. He first visits the Tower of Doctrine or Science where he acquaints himself with the arts of grammar, logic, rhetoric and arithmetic. After a long disputation with the lady in the Tower of Music he returns to his studies, and after sojourns at the Tower of Geometry, the Tower of Doctrine, the Castle of Chivalry, etc., he arrives at the Castle of La Bel Pucel, where he is met by Peace, Mercy, Justice. Reason and Memory. His happy marriage does not end the story, which goes on to tell of the oncoming of Age, with the concomitant evils of Avarice and Cunning. 'The admonition of Death brings Contrition and Conscience, and it is only when Remembraunce has delivered an epitaph chiefly dealing with the Seven Deadly Sins, and Fame has enrolled Graunde Amour's name with the knights of antiquity, that the story ends. This long poem was widely read and esteemed, and exercised an in-

fluence on the genius of Spenser.

BIBLIOGRAPHY.— *The Passetyme of Pleasure* was edited by T. Wright for the Percy society in 1845 and by W. E. Meade for the Early English Texts society in 1928. *The Convercyon of Swerers* (1509) was edited by David Laing for the Xbbotsford club (186;). Other extant works, all bibliographical rarities, are *The Example of Vertu* (1504?), *Comfort of Lovers* (1512?) and *A Joyfull Medytacyon to all Englande of the Coronacyon of Kynge Henry the Eyght* (1509). See also G. Saintsbury, *The Flourishing of Romance and the Rise of Allegory* (London, 1897), *History of English Prosody*, vol. 1 (London, 1906); J. M. Berdan, *Early Tudor Poetry* (New York, 1920).

HAWES, WILLIAM (1785–1846), English musician, was born in London in 1785 and was for eight years (1793–1801) a chorister of the chapel royal. He subsequently held various musical posts. being in 1817 appointed master of the children of the chapel royal. He also carried on the business of a music publisher, and was for many years musical director of the Lyceum theatre, then devoted to English opera. In the last-named capacity (July 23, 1824), he introduced C. M. von Weber's Der *Freischütz* for the first time in England, at first slightly curtailed, but soon afterward in its entirety. Peter von Winter's Interrupted Sacrifice, W. A. Mozart's Cosi fan *tutte*, Heinrich Marschner's Der *Vampyr* and other important works were also brought out under his auspices.

Hawes died on Feb. 18, 1846.

HAWFINCH, *Coccothraustes coccothraustes*, one of the largest of the finch family (Fringillidae), found over nearly the whole of Europe and north Asia and in Africa north of the Atlas. It breeds in England, Wales and south and east Scotland. It is a grosbeak, the male with black, white and light-brown plumage, rather like a chaffinch (*q.v.*), but its much larger size and enormous beak make it easily recognizable, while the singular bill-hook form of some of its wing feathers will be found remarkable. Though frequenting gardens and orchards as well as woods, it is exceedingly shy. It has an unfortunate predilection for green peas. In winter it may gather in flocks. It is unusual in that courtship begins while the birds are still in flocks, the mated pairs then separating to find individual territories.

HAWICK, a small burgh of Roxburghshire, Scot., 57 mi. S.S.E. of Edinburgh by road. Pop. (1951) 16,717. Area 1.9 sq.mi. One of the chief border towns, it lies at the confluence of the Slitrig with the Teviot, which flows through it. The only church of historical interest is that of St. Mary's, the third of the name, built in 1763. The first church, believed to have been founded by St. Cuthbert (d. 687), was succeeded by one dedicated in 1214, which was the scene of the seizure of Sir Alexander Ramsay of Dalhousie in 1342 by Sir William Douglas. The Buccleuch memorial hall, commemorating the 5th duke of Buccleuch, is used as a technical college and a museum. The Moat or Moot hill at the south end of the town is an earth mound 30 ft. high and 300 ft. in circumference, possibly the place where the court of the manor formerly met. The Baron's tower, founded in 1155 by the Lovels, lords of Branxholm and Hawick, and afterward the residence of the Douglases of Drumlanrig, is said to have been the only building that was not burned down during the raid of Thomas Radcliffe, earl of Sussex, in 1570. It became an inn in 1773 and was visited by W. Wordsworth, his sister Dorothy and Sir Walter Scott. Bridges across the Teviot connect Hawick with the suburb of Wilton where Wilton lodge is now a museum. Leading industries are the manufacture of hosiery, tweeds and knitwear. Markets for livestock are also important.

In 1537 Hawick received from Sir James Douglas of Drumlanrig a charter which was confirmed by the infant Queen Mary in 1545 and remained in force until 1861, when the corporation was reconstituted by act of parliament. Sir Robert Umfraville (d. 1436), governor of Berwick, burned the town about 1417. In 1514, the year after the battle of Flodden, in which Hawick burghers had suffered severely, a number of young men or "callants" routed an English force at Hornshole on the Teviot 2 mi. below the town. This event is celebrated every June in the "Common Riding" ceremony, in which a facsimile of the captured pennon is carried in procession by the "cornet" to the accompaniment of a chorus "Teribus ye Teri Odin" (or, as the other version, "Tyr-ibus ye Tyr Odin") supposed to be an invocation to Thor and Odin—a survival of Northumbrian paganism. An equestrian statue was erected in 1914 to mark the quatercentenary of the victory.

Two miles southwest of Hawick is the massive peel of Goldielands—the "watchtower of Branxholm," a typical border stronghold. One mile beyond it is Branxholm castle, the Branksome hall of The *Lay of* the Last Minstrel, once owned by the Lovels, but since the middle of the 15th century the property of the Scotts of Buccleuch. It was destroyed in 1570 and was rebuilt the next year, the peel forming part of the modern mansion.

HAWK, a name applied generally to any diurnal bird of prey belonging to the families Accipitridae—kites, buzzards and harriers (*qq.v.*), excepting the larger species known as eagles and vultures (*qq.v.*)—and Falconidae—falcons and caracaras (*qq.v.*). The most typical hawks, however, are the goshawks (*q.v.*) and their relatives in the genus *Accipiter*, with about 40 species, and allied genera in the subfamily Accipitrinae. They are small or moderately large, with short wings, comparatively long legs and tail, beak curved directly from the cere and the upper beak edge wavy but not notched. The young are striped below but barred in the adult, and the female is considerably larger than the male. They pursue their prey by raking, or swiftly following its efforts to escape; occasionally destroying poultry and smaller birds, they usually eat small mammals, reptiles, insects and the like. They were used in falconry (*q.v.*). They build nests of sticks well up in trees and lay three to six brown-spotted eggs. The largest is the goshawk, about two feet long, while some of the smaller sparrow hawks, such as *A. minul-*

BY COURTESY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

AMERICAN SPARROW HAWK (FALCO SPARVERIUS), LIKE THE KESTREL

lus of Africa and allied birds in South America, are but slightly larger than a thrush. Cooper's hawk (*A. cooperii*), of southern Canada and the United States, length 15–19 in., like the goshawk is well known to poultry raisers, as is the smaller (11–14 in.) sharp-shinned hawk (*A. striatus velox*), ranging over North America to the Mexican border, with allied races in Cuba, Hispaniola and Puerto Rico. The common sparrow hawk (*A. nisus*) breeds from the limit of trees in Europe and Asia south to the Mediterranean and Himalayas. Other species occur in Central and South America, Africa and Madagascar, Asia, Australia, Malay Islands and nearby Pacific and Indian ocean. (G. F. Ss.)

HAWKE, EDWARD HAWKE, BARON (1705–1781), British admiral, son of a barrister, entered the navy on Feb. 20, 1720, and served the time required to qualify him to hold a lieutenant's commission on the North American and West Indian stations. When war began with Spain in 1739, he served as captain of the "Portland" (50) in the West Indies. His ship was old and rotten. She nearly drowned her captain and crew, and was broken up after she was paid off in 1742. In the following year Hawke was appointed to the "Berwick" (70), and fought his ship in the ill-managed battle of Toulon on Jan. 11, 1744. In July 1747 he attained flag rank, and was named second in command of the Channel fleet. He was sent in command of the 14 ships detached to intercept a French convoy on its way to the West Indies. On Oct. 14, 1747, he fell in with it in the Bay of Biscay, attacked at once and captured six of the eight French ships.

In 1747 Hawke had been elected M.P. for Portsmouth, which he continued to represent for 30 years, though he can seldom have been in his place, and it does not appear that he often spoke. In the interval between the War of the Austrian Succession and the Seven Years' War, Hawke was almost always on active service. From 1748 till 1752 he was in command at home, and he rehoisted his flag in 1755 as admiral in command of the Western Squadron. In June 1756 the news of John Byng's retreat from Minorca reached England. Hawke was at once sent out to relieve him in the Mediterranean command, and to send him home for trial. Minorca had fallen, from want of resources rather than the attacks of the

French, before he could do anything for the assistance of the garrison of Fort St. Philip. He returned to England in January 1757, and next month was promoted full admiral.

When Pitt's great ministry was formed in June 1757, Hawke was not included in the Board of Admiralty, but he was continued in command of important forces in the Channel. In the late summer of 1757 he commanded the abortive expedition against Rochefort. During the end of 1757 and the beginning of 1758 he continued cruising in the Channel in search of the French naval forces In May of that year he was ordered to detach a squadron under the command of Howe to carry out further combined operations He retired in June for a time on the ground of health, but happily he was able to hoist his flag in May 1759, the "wonderful year" of Garrick's song.

France was then collecting an army for the invasion of England in the Morbihan in Brittany; its transport was to be covered by a fleet to be made up by uniting the squadron at Brest with the ships at Toulon. The proposed combination of the French fleet was defeated by the annihilation of the Toulon squadron on the coast of Portugal by Boscawen in May, but the Brest fleet was still untouched and the troops were still at Morbihan. It was the duty of Hawke to prevent attack from this quarter. The way in which he discharged his task marks an epoch in the history of the British navy. Until his time, or very nearly so, it was still believed that there was rashness in keeping great ships out after September. Hawke maintained his blockade of Brest till far into November. By the care he took to obtain fresh food, and the energy he showed in pressing the Admiralty for stores, he kept his men healthy. Early in November severe gales forced him off the French coast, and he anchored in Torbay. His brief absence allowed the French admiral. M. de Conflans, time to put to sea, and to steer for the Morbihan. Hawke, who had left Torbay on Nov. 13, learnt of the departure of the French at sea on the 17th from a look-out ship, and followed the French admiral to the Morbihan. He sighted the French about 40 m. to the west of Belleisle on the morning of Nov. 20. The British fleet was of twenty-one sail. the French of twenty. There was also a small squadron of British ships engaged in watching the Morbihan as an inshore squadron, which was in danger of being cut off. After making a motion to give battle, Conflans changed his mind and gave the signal to his fleet to steer for the anchorage at Quiberon, thinking that the British admiral would not dare to follow him, for the coast is one of the most dangerous in the world, and the wind was rising to a storm. Hawke, however, caught up the rear of the French fleet in the afternoon. It was dark before the action began in Quiberon Bay. Five ships only were taken or destroyed, but others ran ashore, and the French navy as a whole lost all confidence. Two British vessels were lost, but the price was little to pay for such a victory. No more fighting remained to be done. The fleet in Quiberon Bay suffered from want of food, and its distress is recorded in the lines:—

"Ere Hawke did bang
Mounseer Conflang
You sent us beef and beer;
Now Mounseer's beat,
We've nought to eat,
Since you have nought to fear."

Hawke returned to England in Jan. 1760 and had no further service at sea. Sixteen years later (1776) he received a peerage as Baron Hawke of Towton From 1766 to 1771 he was first lord of the Admiralty. His administration was much criticized He was no favourite with Chatham's partizans It is very credible that, having spent all his life at sea, his faculty did not show in the uncongenial life of the shore. As an admiral at sea and on his own element Hawke had no superior. On his death on the 17th of October 1781 his title passed to his son, Martin Bladen (1744–1805), and it is still held by his descendants

MARTIN BLADEN HAWKE 7TH BARON HAWKE (1860–1938), was among the foremost authorities on cricket of his time. He was the son of the 6th Baron Hawke, whom he succeeded in 1887 He was captain of the Yorkshire eleven from 1883 until 1910, and president of the Marylebone Cricket club from 1914 to 1918. Hawke organized and promoted cricket tours to the United States, Canada, South America, Australia, New Zealand, India and South Africa. He died in Edinburgh on Oct. 10, 1938. and was succeeded by his brother. Edward Julian Hawke.

There is a portrait of Edward Hawke in the Painted Hall at Greenwich. His *Life* by Montagu Burrows (1883) superseded all earlier authorities; it is supplemented in a few early particulars by Sir J. K. Laughton's article in the *Dict. Nat. Biog.* (1891).

HAWKER, ROBERT STEPHEN (1803–1875), English antiquary and poet, was born at Plymouth, Devonshire. He became vicar of Morwenstow, a village on the north Cornish coast, in 1834 He had an eccentric and powerful personality and was the original Canon Tremaine of Mortimer Collins' *Sweet and Twenty.* He died in Plymouth on Aug. 1j, 1875. Before his death he was formally received into the Roman Catholic Church, a proceeding which aroused a bitter newspaper controversy. The best of his poems is *The Quest of the Sangraal: Chant the First* (1864). Among his *Cornish Ballads* (1869) the most famous is "The Song of the Western Men," the refrain of which, "And shall Trelawny die," etc., he declared to be an old Cornish saying.

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HAWKERS AND PEDLARS. The designations of itinerant dealers who convey their goods from place to place to sell. The word "hawker" seems to have come into English from the German or Dutch in the early 16th century. In an act of 1533 (25 Henry VIII. c. 9, s. 6) we find "Sundry evill disposed persons which commonly beene called hawkers . . . buying and selling of Brasse and Pewter."

The earlier word for such an itinerant dealer is "huckster," which is found in 1200. "For that they have turned God's house intill hucksteress bothe" (*Ormulum* 1j, 817).

"Pedlar" occurs much earlier than the verbal form "to peddle." which is therefore a derivative from the substantive. The origin is to be found in the still older word "pedder," one who carries about goods for sale in a "ped," a basket or hamper. This is now used only dialectically and in Scotland. The French term for a hawker or pedlar of books. *colporteur,* was adopted by the Bible Society and other English religious bodies as a name for itinerant vendors and distributors of Bibles and other religious literature.

The occupation of hawkers and pedlars has been regulated in Great Britain, and the two classes have also been technically distinguished. The Pedlars act, 1871, defined a pedlar as "any hawker, pedlar, petty chapman, tinker, caster of metals, mender of chairs, or other person who, without any horse or other beast bearing or drawing burden, travels and trades on foot and goes from town to town or to other men's houses, carrying to sell or exposing for sale any goods, wares or merchandise . . . or selling or offering for sale his skill in handicraft." Any person who acts as a pedlar must have a certificate, which is to be obtained from the chief officer of police of the police district in which the person applying for the certificate has resided during one month previous to his application. He must satisfy the officer that he is above 17 years of age, is of good character, and in good faith intends to carry on the trade of a pedlar. The fee for a pedlar's certificate is *js.,* and the certificate remains in force for a year from the date of issue. The act requires a register of certificates to be kept in each district, and imposes a penalty for the assigning, borrowing or forging of any certificate. It does not exempt any one from vagrant law, and requires the pedlar to show his certificate on demand to certain persons. It empowers the police to inspect a pedlar's pack. and provides for the arrest of an uncertificated pedlar or one refusing to show his certificate. A pedlar's certificate is not required by commercial travellers, sellers of vegetables, fish, fruit or victuals, or sellers in fairs. The Hawkers act, 1888, defines a hawker as "anyone who travels with a horse or other beast bearing or drawing burden." An excise licence (expiring on March 31 in each year) must be taken out annually by every

hawker in Great Britain. The duty imposed upon such licence is £2. A hanker's licence is not granted otherwise than by way of licence, except on production of a certificate signed by a clergyman and two householders of the parish or place wherein the applicant resides, or by a justice of the county or place, or a superintendent or inspector of police for the district, attesting that the person is of good character and a proper person to be licensed as a hanker. There are certain exemptions from taking out a licence—commercial travellers. sellers of fish, coal, etc., sellers in fairs and the real worker or maker of any goods. The act also lays down certain provisions to be observed by hawkers and others, and imposes penalties for infringements. In the United States there is no distinction between the words pedlar and hawker. In that country and. in a lesser degree. in Great Britain the improvement in transportation, the increase of the chain or multiple shops and the gron th of the mail-order business caused a great decrease in the number of pedlars. In their place the canvassing salesman became common. the distinction between the two being that the canvassing salesman takes orders from samples, or from pictures of the goods, whereas the pedlar carries his stock with him.

HAWKESWORTH, JOHN (*c.* 171j–1773), English miscellaneous writer. succeeded Samuel Johnson in 1744 as compiler of the parliamentary debates for the *Gentleman's Magazine,* and from 1746 to 1749 contributed poems signed Greville, or H. Greville,, to that journal. In company with Johnson and others he started a periodical called the *Adventurer,* which ran to 140 numbers, of which jo were from the pen of Hawkesworth himself. He died on Nov. 16. 1773, and was buried at Bromley. Kent. where he and his wife had kept a school. Hawkesworth was a close imitator of Johnson both in style and thought, and was at one time on very friendly terms with him. It is said that he presumed on his success, and lost Johnson's friendship as early as 1756. He edited the works of Swift (12 vol., 1754–55, and 27 vol., 1766–79) and Cook's papers relative to his first voyage (3 vol., 1773), and was the author or adapter of several plays.

HAWKHURST, a small town in the Cranbrook rural district of Kent, Eng., 14 mi. E.S.E. of Tunbridge Wells by road, and near the Sussex border. It lies mainly on a ridge above the Kent Ditch, a tributary of the Rother, in hilly and wooded country. The 14th- to 1 jth-century church of St. Lawrence, founded from Battle abbey, was damaged by bombs in World War II. William Penn owned furnaces in this centre of the Weald iron industry.

HAWKINS, or HAWKYNS, **SIR JOHN** (1532–1595), English admiral. was born at Plymouth, the second son of William Hawkins, mayor of Plymouth, who represented the town in parliament and was a successful merchant in the African trade. John's elder brother, William, was also a merchant seaman and became mayor of Plymouth three times; it was owing to this family that Plymouth became the leading port in the west country. Other members of the family distinguished themselves at sea, notably their kinsman Francis Drake and John's son, Richard (*q.v.*).

John followed his father in the African trade, which he extended to the carrying of slaves between Guinea and Brazil or the West Indies. As the first English slave trader he aroused the hostility of the Portuguese, whose example he was following, and the Spanish, whose trade monopoly he infringed without licence. His first independent voyage to Hispaniola in 1562–63 on behalf of a syndicate of London merchants was so successful that a more important group (including the queen herself. who lent him a ship and permitted him to fly her standard) supported his second voyage in 1564–65. The narrative of this expedition introduced to English readers the potato and tobacco, and included Hawkins' famous advice to his men, "Serve God daily, love one another, preserve your victuals, beware of fire, and keep good company." His success led to the grant of a coat of arms with a "demi-Moor proper, bound" as his crest. His third voyage of 1567–68 ended disastrously. The queen again lent him the "Jesus!' and another royal ship, while Drake commanded one of the four other ships. After selling his slaves in the Caribbean, Hawkins was forced by lack of water to take refuge at San Juan de Ulua, the port of Veracruz. After he had gained permission to enter, the Plate fleet arrived unexpectedly, bringing the governor of New Spain. They entered the harbour and made terms with Hawkins, but the Spaniards treacherously attacked the English ships, of which all were captured save two, Hawkins returning home in the "Minion" and Drake in the "Judith." This affair marks the beginning of the long quarrel with Spain which led to open war in 1585.

In 1570, probably at Lord Burghley's instigation, Hawkins offered his services to the king of Spain. Though he was never employed by Spain, he obtained evidence of the complicity of the duke of Norfolk to release Mary, queen of Scots, and overthrow Elizabeth I; he also secured the release of some of the prisoners taken at San Juan de Ulua. In 1571 he became M.P. for Plymouth. After his marriage (in about 1559) to Katherine, daughter of Benjamin Gonson, treasurer of the navy. Hawkins became connected with the administration of the navy board. In 1577 he succeeded his father-in-law as treasurer and in 1589 he also became comptroller, while his brother-in-law was clerk of the ships. He was chiefly responsible for rebuilding the 22 ships inherited by the queen, increasing the fleet to 25 in 1588, rearming it with more guns and encouraging the new and faster type of galleon typified by the "Revenge." He also improved the pay of seamen and was unusually attentive to their health. In 1590 he and Drake founded the Chatham Chest fund, and in 1592 he founded a hospital at Chatham for the relief of sick and aged mariners.

In the Armada campaign he commanded the "Victory" and was knighted by Lord Howard off the Isle of Wight on July 26, 1588. Afterward he was responsible for the only original strategic idea during the remainder of the war, the Azores blockade, by which it was hoped to intercept returning treasure fleets. The idea was in advance of the time and never succeeded in its object, though Hawkins himself sailed with Sir Martin Frobisher on one of the periodic cruises in 1590. In 1591 his first wife died and he married Margaret Vaughan.

His last voyage was in 1595, when he sailed with Drake and 27 ships on a raid on the Spanish West Indies. Their departure was delayed by a Spanish landing at Penzance and by dissensions between the commanders after they had put to sea. Warned of their intentions, the Spanish repulsed their attack on Puerto Rico. On Nov. 12. 1595, the night before the attack, Hawkins died after a short illness.

Hawkins was the leading naval administrator of his age, and though he had his detractors he was as honest as any public servant of that time. In his attacks on the Spanish monopoly he led the way for Drake and others. By his reconstruction of the nation's fleet he was the chief architect of the Elizabethan navy.

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HAWKINS, SIR JOHN (1719–1789), English musical historian, was born in London on March 30, 1719. While apprenticed to an attorney, he spent his scanty leisure studying music, becoming a friend of Handel and in 1749 a member of Johnson's select Thursday Evening club, though Johnson described him as "a most unclubbable man." A wealthy marriage in 1; 53 enabled him to become a collector of rare musical works, many of which he later presented to the British Museum. He became chairman of Middlesex quarter sessions and was knighted in 1772. His *General History of the Science and Practice of Music* was published in five volumes in 1776; contemporaries preferred Burney's history, the first volume of which appeared in the same year, but the 1853 and 1875 editions of Hawkins' work were popular, particularly for their accounts of early 18th-century music. A keen fisherman, Hamkins also published an annotated edition of the *Compleat Angler* (1760; reprinted several times) and in 1789 published a life of Samuel Johnson and a complete edition of his works. He died on May 21, 1789.

HAWKINS, or HAWKYNS, **SIR RICHARD** (*c.* 1560–1622), English seaman, was the only son of Sir John Hawkins (*q.v.*) by his first marriage. In 1582 he sailed with his uncle William to the West Indies, and in 1585 he commanded a ship on Sir Francis Drake's raid on the Spanish Main. In the Armada campaign he

was captain of the royal ship "Swallow" and afterward built a ship of about **300** tons named "Repentance," renamed the "Dainty." Not till 1593 was he able to use her for his own purposes on an intended voyage round the world, following the examples of Drake and Thomas Cavendish.

In June 1593 he sailed from Plymouth in her with two smaller vessels which parted company before reaching the Pacific. In Feb 1594 he sighted what he called Hawkins Maidenland, probably the Falkland Islands, which had been discovered two years previously by John Davis. After burning four ships at Valparaiso, Hawkins continued up the coast until he met six Spanish warships off Callao. He overcame them; but on June **22**, when north of Paita, he mas wounded and forced to surrender after a fight lasting three days with two more Spanish ships. He was imprisoned at Lima and then from 1597 till **1602** in Spain, at which date his ransom of £3,000 was paid. On his return he was knighted and elected mayor and M.P. for Plymouth. In **1608**, after five years as vice-admiral of Devon, he was arrested and fined for condoning piracy. In **1620** he sailed as second in command of Sir Robert Mansell's ineffective expedition against the Algerine corsairs. He died in London on April **18, 1622.**

His *Observations* in *His Voyage Into the South Sea* was printed that year, having been composed about **1603.** This gives the best extant idea of Elizabethan life at sea and was used by Charles Kingsley for *Westward Ho!*

See Richard Hawkins, *Observations* . . , ed. by C R D Bethune, Hakluyt Society (1847), ed. by C. R. Markham, Hakluyt Society (1878), ed. by J A. Williamson (1933); *Monson's Tracts,* ed. *by M.* Oppenheim (1913) (C. C. L.)

HAWKSBILL (*Eretmochelys imbricata),* a marine turtle, so called from the shape of its snout. common in the tropical parts of the Indian, Pacific and Atlantic oceans, and producing the tortoise shell (*q v*) of commerce. Its flesh is valueless, though the eggs are edible. The hawksbill is carnivorous.

See TURTLE.

HAWKSHAW, SIR JOHN (1811–1891), English engineer, was educated at Leeds grammar school. He became chief engineer of the Lancashire and Yorkshire railway, for which he constructed a large number of branch lines.

In **1850** he moved to London and began to practise as a consulting engineer, at first alone, but subsequently in partnership with Harrison Hayter. In London he was responsible for the Charing Cross and Cannon Street railways, together with the two bridges which carried them over the Thames; he was engineer of the East London railway, which passes under the Thames through Sir M. I. Brunel's well-known tunnel; and jointly with Sir J. Wolfe Barry he constructed the section of the underground railway which completed the "inner circle" between the Aldgate and Mansion House stations. Hawkshaw was concerned with many railway works in all parts of the world—Germany, Russia, India, Mauritius, etc,

He advocated, in opposition to Robert Stephenson, steeper gradients than had previously been thought desirable or possible, and he protested against the maintenance of the broad gauge on the Great Western, as he foresaw that it complicated railway extension.

In **1862** he became engineer of the Amsterdam ship canal, and in the next year he may fairly be said to have been the saviour of the Suez canal by presenting a favourable report on the question to the khedive. As a member of the international congress to consider the construction of an interoceanic canal across Central America, he preferred the Nicaraguan route. He regarded the Panamá scheme as impracticable at a reasonable cost, although publicly he expressed no opinion on the matter and left the congress without voting. He mas engineer of the Severn tunnel, one of the most notable engineering undertakings of the 19th century.

Hawkshaw died in London on June **2, 1891.**

HAWKSMOOR, NICHOLAS (1661–1736), English architect, a disciple of Sir Christopher Wren, nas born in Nottinghamshire in **1661** and died in London on March **25, 1736.** Through Wren's influence he became deputy surveyor at Chelsea and Greenwich hospitals and clerk of the works at Whitehall, St. James's and Westminster.

He succeeded Wren as surveyor general of Westminster abbey. Rawksmoor shared in much of the work done by Wren and Sir J. Vanbrugh; the early Gothic designs of the two towers of All Souls, Oxford, north quadrangle, and the library at Queen's college, Oxford. appear, however, to be his own. He also designed several London churches, notably St. Mary Woolnoth (1716–19) and St. George's, Bloomsbury (1 720–30).

See H S. Goodhart-Rendel, *Nicholas Hawksnzoor* (1924).

HAWKWEED, the name given to species of the genus *Hieracium,* of the family Compositae (*q.v.*), containing an enormous number of species inhabiting the northern hemisphere, south Africa and the Andes. The flowering heads, often yellow, are borne, often several at a time, on an elongated axis. Various hawkweeds are serious pests, especially in rundown grasslands.

Hundreds of species occur in the British Isles, and more than **40** are found in North America, including several from the old world. Of the latter, the orange hawkweed or devil's-paintbrush (*H. aurantiacum*) of Europe, the field hawkweed (H. *pratense*), king devil (*H. florentinum*) and mouse-ear hawkweed (*H. pilosella*) are pestiferous in pastures and meadows. Once established, the perennials are almost ineradicable, but the annuals can be eliminated by mowing before flowering. (N. TR.)

HAWKWOOD, SIR JOHN (d. 1394), an English adventurer who attained great wealth and renown as a *condottiere* in the Italian wars of the 14th century. His name is variously spelled as Haccoude, Aucud, Aguto, etc., by contemporaries. He was perhaps the son of a tanner of Hedingham Sibil in Essex, and was apprenticed in London, whence he went, in the English army, to France under Edward III and the Black Prince. He was certainly of knightly rank, which he may have received from Edward III.

On the peace of Bretigny in **1360,** he collected a band of men-at-arms and moved southward to Italy. where the white company, as his men were called. assisted the marquis of Monferrato against Milan in 1362–63 and the Pisans against Florence in **1364.** After several campaigns in central Italy, Hawkwood in **1368** entered the service of Bernabb Visconti. In **1369** he fought for Perugia against the pope, and in 1370 for the Visconti against Pisa, Florence and other enemies.

In 1372 he defeated the marquis of Monferrato, but soon afterward, resenting the interference of a council of war, resigned his command, and the white company passed into the papal service, in which he fought against the Visconti in 1373–75. In 1375 the Florentines agreed to pay him and his companion 130,000 gold florins in three months on condition that he would not fight against them; and in the same year the priors of the arts and the gonfalonier awarded him a pension of **1,200** florins per year.

In 1377, under the orders of the cardinal Robert of Geneva, legate of Bologna, he massacred the inhabitants of Cesena, but in May of the same year, disliking the executioner's work put upon him by the legate, he joined the antipapal league and married. at Milan. Donnina, an illegitimate daughter of Bernabb Visconti. In 1378 and 1379 Hawkwood was constantly in the field; he quarreled with Bernabb in **1378,** and entered the service of Florence receiving, as before, 130,000 gold florins. He served the republic up to **1382,** when for a time he was an English ambassador at the papal court.

He fought in Naples in **1383,** for the marquis of Padua against Verona in **1386,** and in **1388** made an unsuccessful effort against Gian Galeazzo Visconti, who had murdered Bernabb. In 1390 the Florentines took up the war against Gian Galeazzo in earnest, and appointed Hawkwood commander in chief. His campaign against the Milanese army in the Veronese and the Bergamask was a triumph of generalship, and in 1392 Florence forced a satisfactory peace from Gian Galeazzo. Hawkwood's latter years were spent near Florence. On his death in 1394 the republic gave him a public funeral. Paolo Uccello painted his portrait in terre-verte on the inner facade of the cathedral.

Of his children by Donnina Visconti, who was probably his second wife, the eldest daughter married Count Brezaglia of Porciglia, podesta of Ferrara, who succeeded him as Florentine commander in chief, and another a German *condottiere,* Conrad

Prospergh. His son John returned to England and settled at Hedingham Sibil.

The children of the first marriage were two sons and three daughters, of whom the youngest married John Shelley, an ancestor of the poet.

See Muratori, *Rerum Italicarum scriptores,* and supplement *by* Tartinius and Manni; *Archivio storico italiano;* Temple-Leader and Marcotti, *Giovanni Acuto* (1889), **Eng.** trans. by Leader Scott (1889); Nichol, *Bibliotheca topographica Britannica,* vol vi; J. G. Alger in *Register and Magazine of Biography,* vol. i; and article in *Dictionary of National Biography.*

HAWLEY, HENRY (c. 1679–1759), British lieutenant general, entered the army, it is said, in *1694.* Under Cumberland's orders he led the cavalry in the campaign of Culloden, and at that battle his dragoons gained an evil name by their ruthless butchery of the fugitive rebels.

Hawley died at Portsmouth in 1759.

HAWORTH, SIR WALTER NORMAN (1883–1950) British organic chemist, sharer with Paul Karrer of the 1937 Nobel prize in chemistry for his work on carbohydrates and vitamin C, was born on March *18, 1883,* at Chorley. Lancashire. Eng. A graduate of Owens college. Manchester. he received his Ph.D. at Göttingen. From 1911 to *1948* Haworth held positions at the Imperial college. London, at St. Andrews university, at Kings college. Sewcastle (1920–25), and the directorship of the chemistry department at Birmingham university (1925–48). With W H. Perkin, Jr., and Otto Wallach he investigated terpenes. Associated with T. Purdie and J. C. Irvine at St. Xndrews, he turned to carbohydrates. By *1928* he had decided the constitution of maltose, cellobiose, lactose, gentiobiose, melibiose. gentianose. raffinose and the ring structures of glucosides of normal sugars. Examination of polysaccharides settled the basic features of the starch, cellulose, inulin and xylan molecules. In 1932 Haworth developed a method to ascertain the chain lengths in methylated polysaccharides, an important structural problem. In 1934, with E. *L* Hirst Haworth announced the first laboratory synthesis of a vitamin, ascorbic acid. so that less expensive commercial production was made possible. Later work led to further co-ordination of chemistry, physics and biological problems related to bacterial polysaccharides. His book *The Constitution of Sugars* (1929) is a classic. From 1945 he served on the committee for advances in carbohydrate chemistry. He became a fellow of the Royal society in *1928.* Recipient of the Longstaff. Davy and royal medals. he was knighted in 1947 after war service as chairman of a general research board. Retired in *1948,* he died at Birmingham, March *19, 1950* (V. Bw.)

HAWORTH, a former urban district of the West Riding of Yorkshire. Eng., 3 mi. S.S.W. of Keighley. It is picturesquely situated at an altitude of *600* ft. surrounded by wild moorland, on the steep slope of a tributary valley of the Worth, which flows north to join the Aire.

The parsonage was the home of Charlotte, Emily and Anne Bronte (*qq.v.*) and a memorial in St. Michael's church bears their name and that of their father, the Rev. Patrick Bronte; Charlotte and Emily are buried in the church. In 1895 a museum was opened by the Bronte society, and in *1928* the parsonage was presented by Sir James Roberts to the society as a museum and library. The worsted industry of Haworth employs most of the inhabitants. The district was transferred to the borough of Keighley (*q.v.*) in *1938.*

HAWSER, a small cable or thick rope used at sea for the purposes of mooring or warping, in the case of large vessels made of steel. When a cable or towline is made of three or more small ropes it is said to be "hawser laid."

The hawse of a ship is that part of the bows where the hawseholes are made. These are two holes cut in the bows of a vessel for the cables to pass through, having small cast-iron pipes, called hawsepipes, fitted into them to prevent abrasion. In bad weather at sea they are plugged with hawse plugs to prevent water from entering.

HAWTHORN is a shrub or tree of the genus *Crataegus* of the rose family (Rosaceae. *q.v.*), overwhelmingly North American, but known also in Europe. north Africa and Asia Minor. They are unknown south of the equator. In eastern North America there are over 100 species; some estimate the number as nearer 900.

Hawthorns comprise a prolific group of thorny shrubs and trees with alternate, simple leaves. nearly always toothed or lobed. The flowers are white or pink. usually borne in clusters (corymbs), rarely solitary, and followed by often showy, red. blue or black fruits suggesting a miniature apple, containing bony nutlets or stones All have hard wood, hence the name *Crataegus,* from the Greek *kratos,* "strong."

The use of the hawthorn as a boundary for fields certainly dates from Roman times, but its use as a pleached hedge appears to have been since about the end of the 17th century. Annual pruning, to which the hawthorn is particularly amenable, is necessary if the hedge is to maintain its compactness and sturdiness. When the lower part shows a tendency to go bare. the strong stems may be split. bent over and pegged to the ground, so that new growths may start.

BY COURTESY OF GERALD R. MASSIE MISSOURI DIVISION OF RESOURCES AND DEVELOPMENT

HAWTHORN BLOSSOMS AND LEAVES (CRATAEGUS MOLLIS)

The tree is particularly suited to the common practice of ditching and hedging as it thrives on the earth thrown up from the ditch. The combination of sturdy twigs, hard wood and many thorns makes a formidable barrier to cattle and hogs It is seldom used for this purpose in America.

In Great Britain the name hawthorn is confined to two species: *C oxyacantha* and *C. monogyna,* both also called may, hedgerow thorn and ahitethorn They differ in that there is only one stone in the fruit of *C. monogyna,* but two in the fruit of *C. oxvacantha.* The fruit of both are commonly known as haws. Often they are not distinguished as different species because their superficial resemblance is striking.

Both have deeply lobed leaves. many thorns. white or pinkish flowers in May and rather persistent and profuse red fruit. Normally they would be medium sized (15–25 ft.). round-headed trees! but their wide use for hedges and frequent pruning make of them close twigged, practically impenetrable barriers, especially *C. monogyna* which is preferred for hedges.

Hawthorn flowers emit the faint odour of decayed fish as a result of the plant's mixture of coumarin and aminoid compound. Many legends among tustics warn against bringing flowering branches of hawthorn into their houses as it was supposed to portend death in the family. More factual is the avoidance of hawthorn by bees and butterflies. so that the plant is pollinated only by flies.

The cultivation of hawthorns for ornament is extensive in the United States. where the finest collections in the world will be found in the Genesee Valley park at Rochester, N.Y., and at the Arnold arboretum of Harvard university at Jamaica Plain. Mass.

The outstanding species for cultivation, outside the English hawthorn, either for their showy flowers or for their spectacular. often persistent, coloured fruit or both, are the following: the Washington thorn (*C. phaenopyrum*), a tree from the southeastern U.S. with red fruit; the pear haw (*C. calpodendron),* a shrub from eastern North America with orange-red fruit; the cockspur thorn (*C. crus-galli*), a shrubby tree of eastern North America with red fruit; *Crataegus lavallei,* a hybrid hawthorn whose brick-red fruits persist throughout the winter; *Crataegus arnoldiana,* a tree up to 30 ft. high with pear-shaped red fruit, native from Massachusetts to New York; and the red haw (C. *mollis*), a tree from the central U.S with scarlet fruit one inch thick. (N. TR.)

HAWTHORNE, NATHANIEL (1804–1864), one of the greatest fiction writers in .American literature, was born in Salem, Mass.. on July *4, 1804.* His earliest American ancestor, William Hathorne (the *w* was added by Nathaniel himself when he was in college), came from England to Massachusetts Bay Colony with John Winthrop in *1630.* Later, as a magistrate in Salem, he ordered the public whipping of a Quakeress. William's son John

was one of the three judges (the other two being Samuel Sewall and William Stoughton) in the Salem witch trials in 1692. Nathaniel was sensitively aware of the prominence of these 17th-century ancestors, and wondered if the decline of his family's fortunes (his immediate forebears had followed the sea with indifferent success; his father had died in a faraway port when Nathaniel was four years old) might be a retribution for their crimes.

Nathaniel's boyhood was spent in Salem and in Maine, near Lake Sebago, nhere he enjoyed outdoor sports. He attended Bowdoin college, at Brunsnick, Me . and was graduated in the class of 1825. Three fellow collegians became his lifelong friends: Franklin Pierce. 14th president of the United States, belonged to the class just before him; Horatio Bridge, commodore in the United States navy, and Henry Wadsworth Longfellow, the poet, were of his own class.

After college, Hawthorne returned to his mother's home in Salem, and devoted himself closely to mastering the craft of fiction. He read much and wrote much. Being his own severest critic he destroyed much of what he wrote. After publishing a rather undistinguished "college novel," *Fanshawe* (1828), he happily hit upon the short tale as a distinctive métier.

His tales were published first in various periodicals and later collected in book form. *Twice-Told Tales*, his first collection, appeared in 1837; a second, enlarged edition appeared in 1842. Since these volumes brought their author more fame than money (the 1842 *Tales* was highly praised by Poe), he held a job in 1839–40 in the Boston customhouse to eke out his income. and for six months in 1841 he was a resident at Brook Farm (*q.v.*). Meannhile he had met (in 1839) and fallen in love with Sophia Peabody (one of the three famous "Peabody sisters"), and she with him, and after their marriage on July 9. 1842, they went to the "Old Manse" in Concord, Mass , to live. Their life together during the three and one-half years at the Old Manse, as recorded in Hawthorne's *American Notebooks* and his essay "The Old Manse." is a famous marital idyl of American literature.

In Concord, Hawthorne saw a good deal of his neighbours. Ralph Waldo Emerson and Henry David Thoreau; he welcomed their companionship while rejecting their transcendentalism. At the Old Manse, too, he returned to the writing of tales, with the same result as before: literary success, monetary failure *Mosses From an Old Manse,* a new collection, appeared in 1846. Not being able to pay his rent, hotiever. he with his wife and daughter. late in 1845, had moved to his mother's house in Salem. In 1846 he received from the Polk administration (he had always been a loyal member of the Democratic party and he had pulled all the political strings he possibly could to get this appointment) a position in the Salem customhouse. Three years later he was turned out of office when the Whigs came into poner under Zachary Taylor.

Hawthorne uas very angry (especially at the local bigwig Charles Wentworth Upham, whom he was to lampoon recognizably in the character of Judge Pyncheon in *The House of the Seven Cables).* and appealed to influential friends in the effort to force his reinstatement, making the point that literary men nere traditionally entitled to sinecures from government: but the spoils system was already firmly established. Hawthorne later saw his dismissal as a great blessing ("Thank God for my enemies." he said). for in the gloom of his disappointment and chagrin he had sat down to write *The Scarlet Letter*. The book. which appeared in 1850 made him famous. It was eventually to be recognized as probably the greatest of American novels.

The sharp local references in "The Custom House." the introductory essay to *The Scarlet Letter,* made Hawthorne *persona non grata* in Salem, and, looking westward for a change of air. he and his family settled in "the little red house" near Lenox, overlooking the Stockbridge Bowl in the Berkshires. There Han thorne wrote *The House of the Seven Gables,* a sombre study in heredity, which appeared in 1851. And there he enjoyed the stimulating friendship of Herman Melville, who lived in nearby Pittsfield. This relationship was one of the most fortunate in American literature; each encouraged and stimulated the other. Melville wrote an enthusiastic essay, "Hawthorne and His Mosses," in praise of Hawthorne, and was undoubtedly influenced by Hawthorne's work at many points; the similarity between "Ethan Brand" and *Moby Dick* (which appeared in 1851, with a dedication to Hawthorne) is only one instance of Melville's indebtedness. Hawthorne, being 15 years Melville's senior, was less susceptible to influence; but his admiration for Melville and his work was very great.

These two writers at least confirmed each other in the opinion that the romantic, progressive 19th century took much too rose coloured a view of the human condition; that the Emersonian optimism so dominant in the century was premature; that a balanced view of man even in the new world (the essential human condition being indeed the same in the new world as in the old, since the mere expedient of removing to a new continent could hardly be expected to make sinful man sinless) would have to include somenhere along the line something approximating Jonathan Edwards' notion of "original sin." Hawthorne and Melville (patriotic. democratic Americans that they were) would stand together on some such proposition as this in an American world which seemed to believe that Americans could do no wrong.

Late in the autumn of 1851 the Hawthornes—Nathaniel, Sophia, Una (born in 1844), Julian (born in 1846) and Rose (born in 1851) —returned to eastern Massachusetts (Hawthorne had always preferred ocean to mountains), and settled for the minter at West Newton. There Hawthorne wrote *The Blithedale Romance,* a study of a socialist community based upon his residence at Brook Farm. In the spring of 1852 he purchased "The Wayside" in Concord. There. Franklin Pierce having been nominated for the presidency by the Democrats, he loyally wrote a campaign biography, and after Pierce's election he accepted in 1853, the lucrative appointment, generously bestowed by Pierce, to the consulship at Liverpool.

The Hawthornes mere in England from 1853 to 18 j7, Hawthorne resigning his post at the end of Pierce's administration. He performed his consular duties faithfully and efficiently, and at the same time found leisure for much travel and sight-seeing, the rich record of which can be read in his *English Notebooks*. Nearly two years (1858–59) were spent in Italy—in Rome and in Florence —and there again he recorded in a voluminous journal his acute observations *(see* his *Italian Notebooks)*. In the autumn of 1859 the Hawthornes returned to England, where. at Redcar on the German ocean and later at Leamington, Hawthorne wrote *The Marble Faun,* his last completed novel and his most earnest study of the problem of good and evil. The book appeared early in 1860, being published simultaneously in London and in Boston; in London it uas given the title *Transformation,* and it has remained so known and referred to among the English. In June of the same year, the Hawthornes returned to America and settled at The Wayside, after an absence of nearly seven years. The residence abroad had been rewarding. Hawthorne had seen the places he had always longed to see; he had studied sympathetically sculpture, painting and architecture; he had stored up impressions One sorrow, hoaever. darkened both retrospect and prospect Una had nearly died of the fever in Rome, and though improved. did not completely recover upon her return to America.

Mrs. Hawthorne believed that her husband's failing health, noticeable upon their return, was the result of anxiety for Una. and also of some deep-seated Roman infection which he himself had contracted. Whatever the reason, Hawthorne's health after 1860 failed rapidly and mysteriously. He managed to salvage some of the material of the English journals (he had incorporated a good deal of the Italian journals in *The Marble Faun)* in a series of essays published in the *Atlantic Monthly* and later collected under the nostalgic title *Our Old Home*. But his attempts at imaginative literature proved less successful. He filled hundreds of manuscript pages with drafts of stories, but the old skill seemed to have deserted him. *Septimius Felton* and *Dr. Grimshawe's Secret,* published posthumously, were fragmentary and inferior to their author's best work.

In 1862 Hawthorne visited Washington and the battlefields of northern Virginia, and nrote for the *Atlantic* an article entitled "Chiefly About War Matters." which is remarkable for its contemporary portrait of Lincoln. The dedication of *Our Old Home,*

in 1863, to Pierce, who was sympathetic with the Southern side of the war, caused a flurry of protest around Boston. But Hawthorne, while loyal to the North. insisted that the dedication was a fitting and deserved compliment to his friend. "If Pierce is so exceedingly unpopular," he told his publisher, James T. Fields, "there is so much the more need that an old friend should stand by him." He died in his sleep on May 19, 1864, at Plymouth, N.H., where, accompanied by the faithful Pierce, he had stopped overnight. en route to the White mountains. Longfellow's poem "Hawthorne," written soon after the burial in Concord, spoke of his friend's "wand of magic power."

Hawthorne's high rank among American fiction writers, and indeed among the fiction writers of the world, is the result of at least three considerations, which can be particularized with some definiteness.

First, he was a skillful craftsman. He had an architectonic sense, a sense of form. (Henry James was to resemble him in this respect.) The structure of *The Scarlet Letter* is tightly integrated. It has a beginning, middle and end. No chapter, no paragraph, no sentence even, could be omitted without doing violence to the nhole. The four characters — Hester Prynne, Arthur Dimmesdale, Roger Chillingworth and little Pearl — are inextricably bound together in the tangled web of a life situation which seems to have no solution The calculated use of the "scaffold" in three crucial scenes (at the beginning, middle and end) gives unity of place. The tightly woven plot gives unity of action — an action which rises slowly but inexorably to the climactic scene of Arthur's public confession. The same structural virtue is found in Hawthorne's other writings also. especially in the shorter pieces or "tales."

Hawthorne not only had a sense of structure, he had a sense of style. His was the older classic, literary style, but one remarkable nevertheless for its directness, its clarity, its firmness and its sureness of idiom. Fields tells us that when, on occasion, he queried some phrase in a manuscript, Hawthorne could always point to a precedent in the King James Bible. And indeed there is in Hawthorne that infallible rightness of language which is a mark of literary greatness. The great uriter must first of all be master of the word, master of *le mot juste.* This is a truth learned later from Henry James and T S. Eliot, and it is important to give to Hawthorne his rightful place as their predecessor in this tradition.

A second reason for Hawthorne's greatness is his moral insight. He inherited the Puritan tradition of moral earnestness; he was concerned everywhere with what the theologians would call "original sin" But it should be noted that the background of Hawthorne's religious attitudes is not confined to New England Puritanism; it reaches to pre-Reformation times, and can be regarded in certain basic respects as essentially Catholic. As for New England Puritanism. he was critical of its narrowness, intolerance and cruelty. A story like "The Maypole of Merrymount" is just as critical of the bigoted zealots as of the wanton revelers. Hawthorne's general position can more properly be called Christian than Puritan.

Hawthorne was deeply involved in the perennial debate concerning the nature of man In his own century there was a strong "romantic" current of thought which insisted that man is innately good. This view stemmed from Rousseau, and its chief proponent in American literature was Emerson. "Trust thyself." proclaimed Emerson. Hawthorne was not unresponsive to the romantic fascination. His treatment of Hester in *The Scarlet Letter* shows a latent sympathy. Hester is a splendid self-reliant heroine. She is never truly repentant for the act of adultery committed with the minister. She never quite understands the minister's agony of conscience. "What we did," she says to Arthur, "had a consecration of its onn" When she meets the minister at the brookside, she tears the scarlet letter from the bosom of her dress and casts it on the ground. This casting aside of the letter was Hester's "romantic revolt" The action of the story at this point seems to suggest that there is much to be said for Hester's position. It is the kind of action which might have been applauded by great 19th-century romantics like Byron or Browning.

But there is more to be said. the story seems to say, for the claims of law and conscience. Arthur speaks of "the law we broke." Hester redons the letter, at the insistence of the child Pearl. The lovers do not elope, as Hester planned, but instead Arthur, in the profoundly moving climactic scene, mounts the scaffold, speaks his confession to the assembled parishioners and dies with a smile on his lips and Pearl's hand in his own. There is no "romantic escape" here; rather, a firm and resolute facing (heartily approved, incidentally, by 20th-century psychologists) of the psychological and moral facts of the human condition.

All of Hauthorne's fiction shows pride as the great besetting sin, whether it is the intellectual pride of Ethan Brand or the reforming zeal of Hollingsworth in *The Blithedale Romance* or the arrogation to oneself of godlike power, as in the case of Aylmer in "The Birthmark," or a selfish concern for one's reputation, as with Arthur Dimmesdale who played the hypocrite in his Puritan parish for seven years. Man is a fallible, imperfect being in Hawthorne's stories. He is isolated from his fellows by his endless self-involvement; one of his most memorable tales is appropriately entitled "Egotism, or the Bosom Serpent." Man can be "saved" only through humility, only through the surrender of the proud, stubborn individual will to the divine will. Man finds his life only through losing it. Humility (not the vain-boasting "Trust thyself") is the best solvent, the true equalizer in human relations. The tales and novels of Hawthorne embody these truths in enduring dramatic situations.

A third reason for Hawthorne's eminence is his mastery of allegory and symbolism. The allegorical method was depreciated in Hawthorne's own century, but the critics of the 20th century have recognized its merit. All great fables, in a sense, are allegories. Symbols enlarge and deepen the meaning. Hawthorne's symbolism is especially successful in *The Scarlet Letter.* Places. characters and incidents take on larger meanings. The scaffold stands for punishment at the beginning and for expiation at the end. The forest is a place where one goes morally astray. The scarlet letter itself stands for adultery; but more than that, for any sin; and still further, as its scope enlarges more and more, for all faults and limitations which prevent the happy working of human society. The fall of man in Hawthorne, however, is the "fortunate fall." Through sin and suffering, man achieves a depth and wisdom not otherwise attainable. Adam fell, these remarkable fictions seem to say, that we might ultimately rise to a loftier paradise than his.

The craftsmanship, the moral insight, the intensification of symbol — these have recommended Hawthorne's work with special cogency to readers of the mid-20th century and after. The dangers and tensions of the modern atomic. anxious age seem reflected almost clairvoyantly in his symbolic depths.

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(R. ST.)

HAWTHORNE, an industrial community of Los Angeles county, Calif., U.S., about 10 mi. S.W. of Los Angeles, was founded in 1906 by B. L. Harding and H. D. Lombard and named by the Harding family in honour of Nathaniel Hawthorne. Its earlier economy centred around a series of small factories producing furniture, clothing and leather goods. Hawthorne grew very slowly for 30 years, being incorporated in 1922 and changing to a city-manager government in 1948.

The chief industry is the Northrop Aircraft corporation, supplemented by more than 100 smaller manufacturing plants within the city limits.

Stimulated by aircraft construction during World War II, the

population tripled in the decade ending 1460. This sudden increase in population. of mixed racial and economic status, brought housing and land-use problems, and considerable delinquency. A unique arrangement with school and county officials resulted in establishment of improved recreational facilities. With over half the city budget devoted to improvement of civic and recreational facilities Haathorne made rapid progress toward developing a balanced industrial and residential city.

For comparative population figures *see* table in CALIFORNIA: *Populatzon.* (R. C. GM)

HAXO, FRANÇOIS NICOLAS BENOÎT, BARON (1774–1838), French general and military engineer, was born at Lunéville on June 24, 1774, and entered the Engineers in 1793. He remained unknown, doing duty as a regimental officer for many years, until, as major, he had his first chance of distinction in the second siege of Saragossa in 1809, after which Napoleon made him a colonel. Haxo took part in the campaign of Wagram, and then returned to the peninsula to direct the siege operations of Suchet's army in Catalonia and Valencia. In 1810 he was made general of brigade, in 1811 a baron, and in the same year he was employed in preparing the occupied fortresses of Germany against a possible Russian invasion. In 1812 he was chief engineer of Davout's 1st corps, and after the retreat from Moscow he was made general of division. In 1813 he constructed the works around Hamburg which made possible the famous defense of that fortress by Davout, and commanded the Guard Engineers until he fell into the enemy's hands at Kulm. After the Restoration, Louis XVIII wished to give Haxo a command in the Royal Guards, but the general remained faithful to Napoleon, and in the Hundred Days laid out the provisional fortifications of Paris and fought at Waterloo. It was, however, after the second restoration that the best work of his career as a military engineer was done. As inspector-general he managed, though not without meeting considerable opposition, to reconstruct in accordance with the requirements of the time, and the designs which he had evolved to meet them, the old Vauban and Cormontaigne fortresses which had failed to check the invasions of 1814 and 1815. For his services he was made a peer of France by Louis Philippe (1832). Soon after this came the French intervention in Belgium and the famous scientific siege of Antwerp citadel. Under Marshal Gérard, Haxo directed the besiegers and completely outmatched the opposing engineers, the fortress being reduced to surrender after a siege of a little more than three weeks (Dec. 23, 1832).

He was after this regarded as the first engineer in Europe, and his latter years were spent in urging upon the government and the French people the fortification of Paris and Lyons, a project which was begun in his time and completed after his death. He died at Paris on June 25, 1838.

He wrote *Mémoire sur le figuré du terrain dans les cartes topographiques* (Paris, n.d.), and a memoir of General Dejean (1824).

HAXTHAUSEN, AUGUST FRANZ LUDWIG MARIA, FREIHERR VON (1792–1866), German economist, was born near Paderborn in Westphalia on Feb. 3, 1792. Having studied at the school of mining at Klausthal and having served in the Hanoverian army, he entered the university of Gottingen in 1815. Finishing his course there in 1818 he was engaged in managing his estates and in studying the land laws. The result of his studies appeared in 1829 when he puhlished *Über die Agrarverfassung in den Fürstentümern Paderborn und Corvey,* a work which attracted much attention and which procured for its author a commission to investigate and report upon the land laws of the Prussian provinces with a view to a new code. After nine years of labour he published in 1839 an exhaustive treatise, *Die ländliche Verfassung in der Provinz Preussen,* and in 1843. at the request of the emperor Nicholas, he undertook a similar work for Russia, the fruits of his investigations in that country being contained in his *Studien über die innern Zustände des Volkslebens, und insbesondere die ländlichen Einrichtungen Russlands* (Hanover, 1847–52). He received various honours, was a member of the combined diet in Berlin in 1847 and 1848, and afterwards of the Prussian upper house. Haxthausen died at Hanover on Dec. 31, 1866.

In addition to the works already mentioned he wrote *Die Eandliche Verfassung Russlands* (Leipzig, 1866) His *Studien* has been translated into French and into English by R Farie as *The Russian Empire* (1856). Other works of his which have appeared in English are: *Transcaucasia; Sketches of thr Nations and Racrs between the Black Sea and the Caspian (1854).* and *The Tribes of the Caucasus* (1855). Haxthausen edited *Das konstitutionelle Prinzip* (Leipzig, 1864), *a* collection of political writings by various authors, which was translated into French (1865).

HAY, SIR GILBERT (SIR GILBERT [OF] THE HAYE) (fl. 1456), Scottish translator of works from the French whose prose translations are the earliest extant examples of literary Scots prose. He probably belonged to the family of the Hays of Errol, and if he was the "Gylbertus Hay" named in the registers of St. Andrews university in 1418 and 1419, must have been born about 1403. That he received degrees as a master of arts and as bachelor in decrees, that he became a knight and that he mas at some time chamberlain to the king of France (Charles VII) are facts known from his own description of himself at the beginning of the manuscript of his prose translations: he is known to have been in France by 1432. By 1456 he had returned to Scotland and had entered the service of the earl of Orkney and Caithness, at whose request he began in that year the translation of three of the most popular works of the middle ages: Honoré Bonet's *L'Arbre des Batailles* (as *The Buke of the Law of Armys* or *Buke of Bataillis*); *Le Livre de l'ordre de chevalerie,* a French version of Rnimon Lull's *Libre de cavaylerza* (as *The Buke of the Order of Knichthood*); and *Le Gouvernement des Princes,* a French version of the pseudo-Aristotelian *Secreta secretorum* (as *The Buke of the Governaunce of Princes).* The second of these precedes William Caxton's translation by at least ten years These remained in manuscript until found in Sir Walter Scott's library at Abbotsford and edited for the Abbotsford club by D. Laing in 1847 An edition for the Scottish Text society (2 vol., 1901–14) by J. H. Stevenson has an introduction containing all that is known of Hay's life.

By 1456 he must have become a priest, for the earl's father-in-law, in a will dated then, left him instructions to say ten psalters for his soul. He was apparently still alive in 1499.

Hay is named as a poet in William Dunbar's *Timor mortis conturbat me* and by Sir David Lyndsay in his *Testament and Complaynt of the Papyngo.* His only extant poetical work, *The Buik of Alexander the Conqueror,* is a translation of the French *Roman d'Alexandre.* It is in heroic couplets and a portion remains in a manuscript copy at Taymouth castle; extracts were printed by A. Herrmann in 1898. This shows interesting differences in treatment from other versions and, like his prose, a thorough knowledge of French, and vigour in the use of his own language.

HAY, JOHN (1838–1905), U.S. statesman and author, was born at Salem. Ind., on Oct. 8, 1838. He graduated at Brown university in 1858, studied law in the office of Abraham Lincoln, was admitted to the bar in Springfield, Ill., in 1861, and soon afterwards was selected by President Lincoln as assistant private secretary. in which capacity he served till the president's death, being associated with John George Nicolay (1832–1901). Hay was secretary of the U.S. legation at Paris in 1865–67, at Vienna in 1867–69, and at Madrid in 1869–70. After his return he was for five years an editorial writer on the *New York Tribune*; in 1879–81 he was first assistant secretary of state to W. M. Evarts. Cpon the inauguration of President McKinley in 1897 Hay was appointed ambassador to Great Britain, from which post he was transferred in 1898 to that of secretary of state, succeeding W. R. Day, who was sent to Paris as a member of the peace conference. He remained in this office until his death at Newburg, N.H., on July 1, 1905. Hay directed the peace negotiations with Spain after the war of 1898. and not only secured American interests in the imbroglio caused by the Boxers in China, but grasped the opportunity to insist on "the administrative entity" of China; influenced the powers to declare publicly for the "open door" in China; challenged Russia as to her intentions in Manchuria, securing a promise to evacuate the country on Oct. 8, 1903. In 1904 he again urged "the administrative entity" of China and took the initiative in inducing Russia and Japan to "localize and limit" the area of hostilities. It was due largely to his management, in concert with Lord Pauncefote, the British ambassador,

that negotiations for abrogating the Clayton-Bulwer treaty and for making a new treaty with Great Britain regarding the Isthmian canal were successfully concluded at the end of 1901; subsequently he negotiated treaties with Colombia and Panamá, looking towards the construction by the United States of a trans-isthmian canal. He arranged the settlement of difficulties with Germany over Samoa in 1899, and the settlement, by joint commission, of the disputed Alaskan boundary in 1903. As secretary of state under Presidents McKinley and Roosevelt his guidance was invaluable during a critical period in foreign affairs, and no man of his time did more to create confidence in the increased interest taken by the United States in international matters. He also represented the best American traditions in literature. He published *Pike County Ballads* (1871)—the most famous being "Little Breeches"—a volume worthy to rank with Bret Harte; *Castilian Days* (1871), recording his observations in Spain; and a volume of *Poems* (1890); with John G. Nicolay he wrote *Abraham Lincoln: A History* (1890), a monumental work indispensable to the student of the Civil War period in America, and published an edition of Lincoln's *Complete Works* (1894). The authorship of the brilliant novel, *The Breadwinners* (1883), is now certainly attributed to him. Hay was an excellent public speaker; some of his best addresses are *In Praise of Omar; On the Unveiling of the Bust of Sir Walter Scott in Westminster Abbey,* May 21, 1897; and a memorial address in honour of President McKinley. The best of his previously unpublished speeches appeared in *Addresses of John Hay* (1906); his correspondence in *Letters of John Hay and Extracts From His Diary* (1908) and in *A Poet in Exile: Early Letters of John Hay,* edited by Caroline Ticknor (1910); and his poems in *Complete Poetical Works of John Hay* (1916).

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HAY, OLIVER PERRY (1846–1930), **U.S.** paleontologist and author of many valuable works on fossil vertebrates, was born in Saluda, Ind., May 22, 1846. He was graduated from Eureka college, Ill., in 1870, and joined the college faculty as professor of natural sciences in the same year. He held the same position at Oskaloosa college, Ia., from 1874–76 and at Abingdon college, Ill., from 1877–78. In 1879 he became professor of biology and geology at Butler university, Indianapolis, Ind.. where he remained until 1892. He served as assistant curator of zoology at the Field Museum of Natural History in Chicago from 1895–97 and subsequently went to the American Museum of Natural History in New York where he worked from 1901–07, serving first as assistant and later as associate curator. He was employed by the Carnegie institution, Washington. D.C., where he did research on the history of the vertebrates of the Pleistocene epoch in North America, from 1912 until his retirement in 1926. He was also employed during his lifetime as assistant in the geological surveys of Arkansas (1884–88), Indiana (1891–94 and 1911–12) and Iowa (1911–13). He died in Washington, D.C., Nov. 2, 1930.

Among Hay's works on various phases of vertebrate paleontology the following are outstanding: *The Bibliography and Catalogue of the Fossil Vertebrata of North America* (1902); *The Fossil Turtles of North America* (1908); *Pleistocene Period in Indiana and its Vertebrates* (1912); *Pleistocene Mammals oj Iowa* (1914); and a three volume study of the vertebrates of the Pleistocene epoch in North America (east of the Mississippi river, 1923; the middle region, 1924; the western region, 1927). In 1929–30 Hay published the two volumes of his *Second Bibliography and Catalogue of the Fossil Vertebuata of North America,* and it is for this work and his earlier bibliography and catalogue that he is most noted.

HAY (HAY-ON-WYE), a market town and urban district in the Brecon and Radnor parliamentary division of Breconshire (q *v.*), south Wales, 21 mi. W. of Hereford by road. Pop. (1951) 1,454. Area 0.6 sq.mi. Hay occupies rising ground on the south bank of the Wye, nhich there separates the counties of Brecon and Radnor but immediately below enters Herefordshire, from which the town is separated on the east by the Dulas. Hay guards an important way into Wales between the Radnor forest and the Black mountains. This district was heavily forested in early times and settlement was unimportant until the Norman period. Bernard de Newmarch conquered the district about 1088 and gave the manor of Hay to Sir Philip Walwyn, but it soon reverted to the donor and was subsequently forfeited to the crown as part of the duke of Buckingham's estate in 1521.

The motte and bailey castle, probably built in Newmarch's time and rebuilt by his great-grandson William de Braose, passed on the latter's attainder to the crown, but was again seized by De Braose's second son, Giles, bishop of Hereford, in 1215, and retaken by King John in the following year. In 1231 it was burned by Llewelyn ap Iorwerth, and in the Barons' War it was taken in 1263 by Prince Edward, but in the following year was burned by Simon de Montfort and the last Llewelyn. The castle was largely rebuilt in the 16th century as a private residence.

The Welsh name of the town is Y *Gelli* ("the wood"), or in full (Y) *Gelli ganddryll,* which roughly corresponds to *Sepes Inscissa,* used by Walter Map. Its Norman name, *La Haia* (from the Fr. *haie; cj.* English "hedge"), was probably intended as a translation of *Gelli.*

Hay manor, like that of Talgarth, consisted of an Englishry and a Welshry, the latter, known as Haya Wallensis, comprising Llanigon parish with the hamlet of Glynfach, and in this Welsh tenures and customs prevailed. The manor is mentioned in the act of Henry VIII (1535) as one of those which were then taken to constitute the new county of Brecknock. Even down to John Leland's time Hay was surrounded by a "right strong wall," but the town within the wall had "wonderfully decayed," while to the west of it was a suburb with the church of St. Mary (rebuilt in 1834) overlooking the river. The old chapel of St. John within the walls, not used as a church since the 16th century, has been restored for parochial purposes. There are 18 almshouses for poor women, built and endowed by Frances Harley in 1832–36, and Gwyn's almshouses for six aged persons, founded in 1702 and rebuilt in 1878. Hay is the centre of a rich agricultural country, and cattle and ewe sales are held there as well as a weekly market. There is good fishing in the Wye and other streams.

HAY: *see* GRASSLAND.

HAYA, an East African people of the Interlacustrine Bantu group, also known as the Bahaya, Wahaya, Baziba or Waziba, who inhabit the northwestern corner of Tanganyika between the Kagera river and Lake Victoria. Although forming a single modern administrative district (Bukoba) with a single local government, the Haya peoples, whose language is very similar to that of the Nyoro, were traditionally divided among eight small states (Kiamtuara, Ihangiro, Kianja, Karagwe, Maruku, Bugabo, Kiziba, Missenyi), each under a ruler called the *Mukama.* Together they numbered about 300,000 in 1960. The production of coffee, an indigenous crop, was expanded under German and British administration to form the basis for a thriving modern economy; the staple food, however, is the plantain. (*See* also TANGANYIKA: *Population.*)

As among the Nyoro, there are two main elements in the population: the pastoral Nfula, or Hima (Bahima), and the more agricultural Iru (Bairu). In some of the states, the rulers are apparently Hima, while in others the dynasties are related to the Nilotic Bito (Babito) rulers of the Nyoro. Traditionally, rulers appointed subordinate chiefs and officials from both royal and commoner clans. Age groups of boys were brought to the capital for military and character training. Traditional religion resembled that of the Nyoro.

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HAYA DE LA TORRE, VÍCTOR RAÚL (1895–), Peruvian political theorist, founder and *jefe* (leader) of the Aprista party, Peru's largest, was born on Feb. 22, 1895, in Trujillo, Peru. He was educated in Peru and England. As president of the Peruvian federation of students in 1919 he led the students in creating popular universities to educate workers. After leading a mass demonstration May 23, 1923, protesting the dedication of Peru to the Sacred Heart of Jesus he was jailed. When he began a

protest hunger strike he was deported.

Haya founded the Alianza Popular Revolucionaria Americana (American Popular Revolutionary Alliance), popularly known as the Aprista movement, or Apra, May 7, 1924, in Mexico. From 1924 to 1931 he traveled through the Americas and Europe, studying, writing and organizing. After Pres. Augusto Bernardino Leguia y Salcedo (1863–1932) was overthrown, Haya returned to Peru in 1931, as the Aprista candidate for president. The consensus of opinion is that Haya was elected, nevertheless his opponent, Col. Luis M. Sánchez Cerro (1894–1933), was inaugurated president. Sánchez Cerro imposed a sanguinary dictatorship and jailed Haya. Protests in all parts of the world apparently saved Haya from execution. He was released after Sánchez Cerro's assassination in 1933. From 1934 to 1945 Haya lived in hiding in Peru becoming a living legend as his underground life and writings became widely known.

In 1945 the Aprista party was legalized and took the name Partido Popular (Popular party). Desiring a transitional administration, the Apristas helped to elect José Luis Bustamante y Rivero president. His conduct in office and refusal to co-operate with the Apristas led to a new dictatorship under Gen. Manuel Odria in 1948.

Following his party's orders Haya took refuge in the Colombian embassy Jan. 3. 1949. His status became a *cause célèbre* as the governments of Peru and Colombia argued about his right to asylum. The case was taken to the International Court of Justice but the court's decisions were never clear. On April 7, 1954, under pressure from the other American republics. Odria permitted Haya to leave Peru and go to Mexico. His asylum case stimulated the American republics to strengthen their treaty regulating political asylum. Haya returned to Peru July 20, 1957, after constitutional government under Manuel Prado had replaced Odría's tyranny.

Haya de la Torre has written a number of books and scores of articles and manifestos expounding his political theories and experience. He maintains that the people of Latin America live within a historical space-time which molds them and their institutions. To create a better life they must cease imitating Europe and the United States, and establish institutions in harmony with Latin America's character and needs. Specifically, Haya maintains that the Indian population must be brought into the main stream of Peruvian life, democracy must be strengthened and Latin America must be unified and industrialized to spare her from all imperialisms, including Russian Communism. He advocates cooperation between the U.S. and Latin America, which he prefers to call Indo-America. Haya and the Aprista movement have stimulated the founding of indigenous reformist organizations in all parts of Latin America. *See* also PERU: *History*. (H. KR.)

HAYASHI, SENJURO (1876–1943), Japanese army officer and politician. was born on Feb. 23, 1876, in Ishikawa-ken. Educated and trained at the Military academy and Military Staff college, he held many responsible posts. In 1931, as commander of Japanese troops in Korea, he ordered his forces to march into Manchuria without waiting for permission from Tokyo, an action that had much to do with Japan's success in that territory. Promoted to full general in 1932, he was appointed inspector general of military training. one of the three most important positions in the Japanese peacetime army. In 1934 Hayashi succeeded Gen. Sadao Araki as minister of mar. He attempted to purge the army of Araki's supporters. who had strong fascist leanings, and by bold and varied means removed an estimated 5,000 officers from important posts. After his resignation in 1935, he took a position on the supreme war council. However, in Feb. 1936, after the assassination of some of the principal Japanese military leaders, he and the other council members resigned. He became premier in Feb. 1937 but remained in office only a few months; when a general election revealed that he had few supporters, he resigned on May 31. He died in Tokyo on Feb. 4, 1943. (S. L. FK.)

HAYASHI TADASU, COUNT (1850–1913), Japanese diplomat and statesman whose greatest diplomatic triumph was the Anglo-Japanese alliance of 1902. was born in Chiba prefecture on Feb. 22, 1850. Sent to study in England in 1866, he returned home just in time to join Enomoto Buyo (*q.v.*) in his last-ditch defense of the shogunate against the Meiji emperor's armies. Imprisoned until 1871 by the imperial government, he was then assigned as interpreter to the mission headed by Iwakura Tomomi (*q.v.*) to the western powers. Thereafter he joined the diplomatic service and also served in other governmental offices. Appointed vice-minister for foreign affairs in 1891, he played a leading role in the renegotiation of the Anglo-Japanese treaty in 1894. In the following year. after participating actively in the conclusion of the treaty of Shimonoseki, ending the Chinese-Japanese war, Hayashi was dispatched as ambassador to China. In 1897 he became minister to Russia and in 1899 was appointed minister to England. There he nas to achieve his greatest diplomatic triumph. Alarmed by the expansion of Russian power in the far east, which he viewed both as a threat to his country's security and as an obstacle to the extension of Japanese interests, Hayashi was instrumental in concluding the Anglo-Japanese alliance. Renewed several times, the alliance was a pillar of Japanese foreign policy for the next 20 years (*see* JAPAN). After the Russo-Japanese war he completed his diplomatic career by serving as minister for foreign affairs from 1906 to 1908. Hayashi died in Tokyo on July 10, 1913.

See A. M. Pooley (ed.), *The Secret Memoirs of Count Tadasu Hayashi* (1915). (HS. KN.)

HAYDEN, EDWARD EVERETT (1858–1932). U.S. naval officer and meteorologist, was born April 14, 1858, in Boston, Mass. He was educated at the Boston Latin school and at the U.S. Naval academy, from which he was graduated in 1879. He was shortly ordered to duty with the Smithsonian institution and subsequently assigned to the U.S. geological survey. While he was serving with that bureau, an injury necessitated the amputation of a leg. He retired from active service, spent a year (1884) at the observatory at Harvard, and in 1885 was made assistant geologist in the geological survey. He served as marine meteorologist of the U.S. Hydrographic office and editor of the pilot chart issued by that office from 1886–92. During the Spanish-American War he was stationed at Mare Island, Calif., as head of the naval observatory there and in the following year he was transferred to Manila, P.I., as head of the branch hydrographic office. In this capacity he traveled extensively in the Pacific islands making meteorological observations. He was restored to the active list of the navy in 1901 and subsequently served as head of the department of chronometers and time service of the U.S. Naval observatory in Washington, D.C. (1902–10), commandant of the U.S. Naval station at Key West, Fla. (1910–1j) and president of the General Court Martial at the Norfolk, Va., navy yard (1916–21). On June 30, 1921, having reached the rank of rear admiral, he was retired. He died in Baltimore, Md, Nov. 1, 1932.

Hayden was a noted authority on meteorology. particularly in the field of ocean storms. He was the author of numerous monographs and articles on his specialty, including *The Great Storm off the Atlantic Coast of the United States, March 11–14, 1888* (1888). "The Law of Storms" (1889) and many others. He is also notable for the improvements he introduced as head of the department of chronometers and time service at the naval observatory.

HAYDEN, FERDINAND VANDEVEER (1829–1887), U.S. geologist, a pioneer investigator of the western states who clarified many fundamental geological relationships in the Great Plains and Rocky mountains, laying sound groundwork for subsequent researches, was born at Westfield, Mass., on Sept. 7, 1829. He graduated from Oberlin college in 1850 and Albany medical college in 18j3. in which year, with F. B. Meek, he visited the Dakota bad lands. Their discoveries reinforced Hayden's interest in the west and thus began scientific explorations prosecuted for three decades, Hayden's industry and contagious enthusiasm becoming legendary. In 18j4 and 18jj he explored the upper Missouri country aided by American Fur company employees; from 1856 to 1860 he was attached to military expeditions. During the Civil War, he served the Union army as surgeon of volunteers, being breveted lieutenant colonel for meritorious service. He

then became professor of geology at the University of Pennsylvania (1865–1872); he resumed explorations in 1866, and the next year organized the geological and geographical survey of the territories, which continued 12 years and won world-wide acclaim. When federal surveys were consolidated in 1879, he became geologist with the United States geological survey. He played a leading role in the creation of Yellowstone National park, which he had explored; and he popularized western geology throughout the United States. The "Hayden surveys" launched numerous scientists on brilliant careers, and their maps and about 50 published volumes embody scientific information of enduring value. In large measure they laid the foundation for the U.S. geological survey. He died at Philadelphia on Dec. 22, 1887. (F. M. FL.)

HAYDEN, HORACE H. (1769–1844), U.S. dentist, cofounder of the first dental college in the world, was born in Windsor, Conn., Oct. 13, 1769. He was for a time a school teacher and later became an architect, but about 1790 became interested in dentistry. Probably in 1804 he began to practise in Baltimore, where he remained for most of his lifetime. He participated in the War of 1812 as a surgeon, a profession he had studied at the same time he learned dentistry. He was the founder, with Chapin A. Harris, of the Baltimore College of Dental Surgery, the first school of its kind in the world. It opened in 1840, its charter being dated Feb. 1 of that year, with Hayden as its first president and first professor of dental pathology and physiology, a post he retained until his death. The school continued in existence under its original name until 1923, when it became a part of the University of Maryland. In 1840 Hayden also founded the American Society of Dental Surgery, an organization of uhich he was the first president. In addition to his interest in dentistry, he was much interested in geology and wrote a number of essays on geological subjects. Haydenite, a form of the mineral chabazite, was named for him. He died in Baltimore, Jan. 26, 1844.

HAYDN, FRANZ JOSEPH (1732–1809), Austrian composer, was born on March 31, 1732, at Rohrau (Trstnik), a village on the borders of Lower Austria and Hungary. There is sufficient evidence that his family was of Croatian stock: a fact which throws light upon the distinctively Slavonic character of much of his music. He received the first rudiments of education from his father, a wheelwright with 12 children, and at an early age evinced a decided musical talent. This attracted the attention of a distant relative named Johann Mathias Frankh, who was schoolmaster in the neighbouring town of Hainburg, and who, in 1738, took the child and for the next two years trained him as a chorister. In 1740, on the recommendation of the Dean of Hainburg, Haydn obtained a place in the cathedral choir of St. Stephen's, Vienna, where he took the solo part in the services and received, at the choir school, some further instruction on the violin and the harpsichord. In 1749 his voice broke, and the director, Georg von Reutter, took the occasion of a boyish escapade to turn him into the streets.. A few friends lent him money and found him pupils, and in this way he was enabled to enter upon a rigorous course of study (he is said to have worked for 16 hours a day), partly devoted to Fux's treatise on counterpoint, partly to the "Friedrich" and "Wiirttemberg" sonatas of C. P. E. Bach, from which he gained his earliest acquaintance with the principles of musical structure. The first fruits of his work were a comic opera, *Der neue krumme Teufel,* and a *Mass* in F major (both written in 1751), the former of which was produced with success. About the same time he made the acquaintance of Metastasio, who was lodging in the same house, and who introduced him to one or two patrons, among others Señor Martinez, to whose daughter he gave lessons, and Porpora, who, in 1753, took him for the summer to Mannersdorf, and there gave him instruction in singing and in the Italian language.

The turning point in his career came in 1755, when he accepted an invitation to the country house of Freiherr von Fiirnberg, an accomplished amateur who was in the habit of collecting parties of musicians for the performance of chamber works. Here Haydn wrote, in rapid succession, 18 divertimentos which include his first symphony and his first quartet; the two earliest examples of the forms with which his name is most closely associated. Thenceforward his prospects improved. On his return to Vienna in 1756 he became famous as teacher and composer, in 1759 he was appointed conductor to the private band of Count Morzin, for whom he wrote several orchestral works (including a symphony in D major erroneously called his first), and in 1760 he was promoted to the sub-directorship of Prince Paul Esterhazy's Kapelle, at that time the best in Austria.

During the tenure of his appointment with Count Morzin he married Maria Anna Keller, the daughter of a Viennese hairdresser, who had befriended him in the days of his poverty, but the marriage proved to be an unhappy one.

From 1760 to 1790 he remained with the Esterhazys, principally at their countryseats of Esterhàz and Eisenstadt, with occasional visits to Vienna in the winter. In 1762 Prince Paul Esterhazy died and was succeeded by his brother Nicholas, surnamed the Magnificent, who increased Haydn's salary, showed him every mark of favour, and, on the death of Werner in 1766, appointed him Oberkapellmeister. With the encouragement of a discriminating patron, a small but excellent orchestra and a free hand, Haydn made the most of his opportunity and produced a continuous stream of compositions in every known musical form.

To this period belong five *Masses,* a dozen operas, more than 30 clavier-sonatas, more than 40 quartets, more than 100 orchestral symphonies and overtures, a *Stabat Mater,* a set of interludes for the service of the Seven Words, an oratorio, *Tobias,* written for the Tonkiinstler-Societat of Vienna, and a vast number of concertos, divertimentos and smaller pieces, among which were no fewer than 175 for Prince Nicholas' favourite instrument, the baritone.

Meanwhile his reputation was spreading throughout Europe. A Viennese notice of his appointment as Oberkapellmeister spoke of him as "the darling of our nation"; his works were reprinted or performed in every capital from Madrid to St. Petersburg (Leningrad). He received commissions from the cathedral of Cadiz, from the grand duke Paul, from the king of Prussia, from the directors of the Concerts Spirituels at Paris; beside his transactions with Breitkopf and Härtel, and with La Chevardière, he sold to one English firm the copyright of no fewer than 129 compositions. But the most important fact of biography during these 30 years was his friendship with Mozart, whose acquaintance he made at Vienna in the winter of 1781–82. There can have been little personal intercourse between them, for Haydn was rarely in the capital, and Mozart seems never to have visited Eisenstadt; but the cordiality of their relations and the mutual influence which they exercised upon one another are of the highest moment in the history of 18th-century music. "It was from Haydn that I first learned to write a quartet," said Mozart; it was from Mozart that Haydn learned the richer style and the fuller mastery of orchestral effect by which his later symphonies are distinguished.

In 1790 Prince Nicholas Esterhazy died and the Kapelle was disbanded. Haydn, thus released from his official duties, forthwith accepted a commission from Salomon, the London concert-director, to write and conduct six symphonies for the concerts in the Hanover square rooms. He arrived in England at the beginning of 1791 and was welcomed with the greatest enthusiasm, receiving among other honours the degree of D.Mus. from the University of Oxford. In June 1792 he returned home, and, breaking his journey at Bonn, was presented with a cantata by Beethoven, then aged 22, whom he invited to come to Vienna as his pupil. The lessons, which were not very successful, lasted for about a year, and were then interrupted by Haydn's second visit to England (Jan. 1794 to July 1795), where he produced the last six of his Salomon symphonies. From 1795 onward he resided in the Mariahilf suburb of Vienna, and there wrote his last eight *Masses,* the last and finest of his chamber works, the Austrian national anthem (1797), the *Creation* (1799) and the *Seasons* (1801). His last choral composition which can be dated with any certainty was the *Mass in C minor,* written in 1802 for the name-day of Princess Esterhazy. Thenceforward his health declined and his closing years, surrounded by the love of friends

and the esteem of all musicians, were spent almost wholly in retirement. On March 27, 1808, he was able to attend a performance of the Creation, given in his honour, but it was his last effort and on hfay 31, 1809, he died, aged 77. Among the mourners who followed him to the grave were many French officers from Napoleon's army, which was then occupying Vienna.

Haydn's place in musical history is best determined by his instrumental compositions. His operas, for all their daintiness and melody, no longer hold the stage; the Masses in which he "praised God with a cheerful heart" have been condemned by the severer decorum of our own day; of his oratorios the Creation alone survives. In all these his work belongs mainly to the style and idiom of a bygone generation; they are monuments, not landmarks, and their beauty and invention seem rather to close an epoch than to inaugurate its successor. Even the naive pictorial suggestion, of which free use is made in the Creation and in the Seasons, is closer to the manner of Handel than to that of the 19th century; it is less the precursor of romance than the descendant of an earlier realism. But as the first great master of the quartet and the symphony his claim is incontestable. He began, half-consciously, by applying through the fuller medium the lessons of design which he had learned from C. P. E. Bach's sonatas; then the medium itself began to suggest wider horizons and new possibilities of treatment; his position at Eisenstadt enabled him to experiment without reserve; his genius, essentially symphonic in character, found its true outlet in the opportunities of pure musical structure.

The quartets in particular exhibit a wider range and variety of structural invention than those of any other composer except Beethoven. Again it is here that we can most readily trace the important changes which he wrought in melodic idiom. Before his time instrumental music was chiefly written for the *Paradiesen*saal, and its melody often sacrificed vitality of idea to a ceremonial courtliness of phrase. Haydn broke through this convention by frankly introducing his native folk music, and by writing many of his own tunes in the same direct, vigorous and simple style. The innovation was at first received with some disfavour; critics accustomed to polite formalism censured it as extravagant and undignified; but the freshness and beauty of its melody soon silenced all opposition, and did more than anything else throughout the 18th century to establish the principle of nationalism in musical art.

The actual employment of Croatian folk tunes may be illustrated from the string quartets op. 17, No. 1; op. 33, No. 3; op. 50, No 1; op 77, No 1, and the Salomon symphonies in D and E♭, while there is hardly an instrumental composition of Haydn's in which his own melodies do not show traces of the same influence. His natural idiom in short was that of a heightened and ennobled folk song. and one of the most remarkable evidences of his genius was the power with which he adapted all his perfection and symmetry of style to the requirements of popular speech. His music is in this way singularly expressive; its humour and pathos are not only absolutely sincere, but so outspoken that we cannot fail to catch their significance.

In the development of instrumental polyphony Haydn's work was almost as important as that of Mozart. Having at his disposal a band of picked virtuosi he could produce effects as different from the tentative experiments of C. P. E. Bach as these were from the orchestral platitudes of Reutter or Hasse. His symphony Le Midi (written in 1761) already shows a remarkable freedom and independence in the handling of orchestral forces, and further stages of advance were reached in the oratorio of Tobias, in the Paris and Salomon symphonies, and above all in the Creation, which turns to good account some of the debt which he owed to his younger contemporary. The importance of this lies not only in a greater richness of musical colour, but in the effect which it produced on the actual substance and texture of composition. The polyphony of Beethoven was unquestionably influenced by it and, even in his latest sonatas and quartets, may be regarded as its logical outcome.

The compositions of Haydn include 104 symphonies, 16 overtures, 76 quartets, 68 trios, 54 sonatas, 31 concertos and a large number of divertimentos, cassations and other instrumental pieces; 24 operas and dramatic pieces, 16 Masses, a *Stabat Mater,* interludes for the "Seven Words," three oratorios, two Te Deums and many smaller pieces for the church, over 30 songs, over 50 canons and arrangements of Scottish and Welsh national melodies.

His younger brother, JOHANN MICHAEL HAYDN (1737–1806), was also a chorister at St. Stephen's, and shortly after leaving the choir school was appointed Kapellmeister at Grosswardein (1755) and at Salzburg (1762). The latter office he held for 43 years, during which time he wrote over 360 compositions for the church and much instrumental music, which, though unequal, deserves more consideration than it has received. He was the intimate friend of Mozart, who had a high opinion of Haydn's genius, and the teacher of C. M. von Weber.

His most important works were the *Missa hispanica,* which he exchanged for his diploma at Stockholm, a Mass in D minor, a *Lauda Sion,* a set of graduals, 42 of which are reprinted in Diabelli's Ecclesiasticon, three symphonies (1783), and a string quintet in C major which has been erroneously attributed to Joseph Haydn.

Another brother, JOHANN EVANGELIST HAYDN (1743–1805), gained some reputation as a tenor vocalist, and was for many years a member of Prince Esterhazy's Kapelle.

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HAYDON, BENJAMIN ROBERT (1786–1846), English historical painter and writer, was born at Plymouth on Jan. 25, 1786, and educated at Plymouth, Honiton and Plympton. In 1804 he went to London and attended the Royal Academy schools, of which Henry Fuseli was keeper. There began his lifelong friendship with the Scottish painter, David Wilkie.

In 1807 he first exhibited at the Royal Academy, but because of subsequent quarrels most of his later paintings were shown at the British gallery or at private exhibitions. Among his principal paintings "Leigh Hunt" and "Wordsworth Ascending Helvellyn" are at the National Portrait gallery; "The Raising of Lazarus" and "Punch or May-Day" are at the Tate gallery. Others are at the Royal Albert Memorial museum, the Royal hospital, Chelsea, and Buckingham palace. Two of his paintings are in America: "Napoleon Musing at St. Helena" in the Metropolitan Museum of Art, New York city, and "Christ's Entry Into Jerusalem" at Mount St. Mary's seminary, Norwood, O. The latter contains portrait heads of Wordsworth, Hazlitt and Keats.

Haydon's stormy career, down to 1821, is recorded in his superb Autobiography (1847). This and his unpublished journals mere the basis for Taylor's Life and the Correspondence and Table-Talk edited by Haydon's son. He was a frequent contributor to periodicals and wrote a number of pamphlets on controversial subjects His acquaintance among literary people was extensive.

His friends included Wordsworth, Coleridge, Scott, Lamb, Hazlitt. Keats, the Hunts, Mary Russell Mitford and Elizabeth Barrett, several of whom composed poems to honour him. Intimate glimpses of persons eminent in literature, art, politics and society enliven his writings, for he had a keen eye for character and a striking gift of phrase.

Haydon's fantastic incompetence in financial matters and the disappointment of his hopes resulted in his ruin. Four times he was confined in King's Bench prison for debt, and on June 22,

1846, he committed suicide in his painting room.

His influence upon art was not great. The day of the Raphaelesque "high art" which he upheld had passed; and his attempts to "improve the public taste" were a failure. As a lecturer and writer, however, he advocated social concepts of art which anticipated those of Ruskin and Morris. Haydon is also remembered for his courageous defense of the Elgin marbles, sculptures from the Parthenon, and was largely responsible for their acquisition in 1816 by the nation.

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(C. O.)

HAYES, AUGUSTUS ALLEN (1806–1882), U.S. chemist, noted for his isolation of sanguinarine, an emetic, and for improvements in the smelting of pig iron, was born in Windsor, Vt., on Feb. 28, 1806. He was educated at Captain Partridge's Military academy, Noruich, Vt., from which he was graduated in 1823, and at Dartmouth college, Hanover, N.H., where he began the study of chemistry under James Freeman Dana.

After his graduation in 1826 he was appointed assistant professor of chemistry at the New Hampshire Medical college, remaining there until 1828 when he moved to Boston. Mass., to become consulting chemist for a number of manufacturing industries in that and neighbouring cities. He was for a time director of a large plant for manufacturing colours in Roxbury, Mass., and for the remainder of his life served other concerns in an advisory capacity. For a time he was also state assayer of Massachusetts. He died in Brookline, Mass., on June 21, 1882.

In 1825, while he was still at Dartmouth, he was successful in isolating the alkaloid sanguinarine, present in the plant bloodroot, which is useful as an emetic. In 1838 he devised a notable improvement in the technique of operating steam boilers. He was responsible for improved methods of refining pig iron and copper and for a simple method of discovering the extent of impurities existing in bodies of water used as sources of drinking water. During the U.S. Civil War, noting that the foreign supply of saltpetre, a constituent of gunpowder, might be cut off, he devised a satisfactory substitute, potassium nitrate, manufactured from potassium hydroxide and sodium nitrate.

HAYES, HELEN (HELEN HAYES BROWN) (1900–), U.S. actress of stage, screen. radio and television, was born on Oct. 10, 1900, in Washington, D.C., daughter of Francis and Catherine (Hayes) Brown. She first appeared at the age of five nith the Columbia Players as Prince Charles in *The Royal Family.* Juvenile successes included *Pollyanna, The Prince Chap, Lzttle Lord Fauntleroy* and *The Prince and the Pauper.* She graduated from Sacred Heart academy, Washington, in 1917 and not long after began to play adult roles. Some of her successes were *To the Ladies* (1922), *Caesar and Cleopatra* (192j), *Coquette* (1927), *Mary of Scotland* (1933), *Victoria Regina* (1935), *Happy Birthday* (1946) and *Mrs. McThing* (1952). Miss Hayes was awarded the medal of the Drama League of New York for her performance in *Victoria Regina.* In 1955 she played Mrs. Antrobus in the revival of *The Skin of Our Teeth,* presented in Paris, and the same year the Fulton theatre in New York city was renamed the Helen Hayes in her honour. From 1930 she was heard often in radio drama, and when television developed she performed in that medium. She acted in several motion pictures and received an Oscar in 1932 for her performance in *The Sin of Madelon Claudet.* She married the playwright Charles MacArthur (1895–1956) in 1928. (B. HT.)

HAYES, ISAAC ISRAEL (1832–1881), U.S. arctic explorer who discovered and explored Grinnell Land. was born in Chester county, Pa., on March 5, 1832. He was educated at Westtown academy and received his M.D. degree at the University of Pennsylvania, Philadelphia, in 1853. He immediately volunteered to serve as surgeon with Elisha Rent Kane's expedition in search of the missing explorer. Sir John Franklin. The expedition sailed from New York on May 30, 1853, in the ship "Advance." During the winter of 1853–54, the vessel was beset in Kane basin, northwest Greenland. Hayes took part in several expeditions on Ellesmere Island during this period and discovered Grinnell Land on May 28, 1854. When it became obvious that the ship would have to spend a second winter in the ice, Hayes, with nine men, attempted to reach Upernavik on the west coast of Greenland. This attempt failed and the party was forced to turn back, reaching the "Advance" in Dec. 1854. The following summer the entire crew successfully made the same journey, reaching Upernavik in August and New York in October.

Hayes had determined that there must be an open sea about the north pole and that he would discover it. In July 1860, therefore, he sailed from Boston, Mass.. in command of the schooner "United States." He wintered somewhat south of the point at which the "Advance" had been frozen in. and in the spring of 1861 began to proceed northward by sledge. Although he thought that he reached latitude 81° 35' N. and looked upon the open polar sea that he had set out to find, it is almost certain that he actually reached a point only slightly north of 80° and that the "open polar sea" was only Kennedy channel. In July 1861 he sailed for Boston, arriving in October. He gave his ship to the government to use in the prosecution of the Civil War and became an army surgeon. In July 1869 Hayes again traveled to Greenland with the artist William Bradford. Later in his life he was for a number of years a member of the New York state assembly. He died in New York city on Dec. 17, 1881.

Hayes was a careful scientific observer and his first two expeditions made valuable contributions in natural history, meteorology, glaciology and hydrology. The photographs taken on the second expedition were among the first to be taken in the arctic. Hayes was the author of *An Arctic Boat Journey . . .* (1860). *The Open Polar Sea* (1867), *Cast Away in the Cold* (1869) and *The Land of Desolation* (1871). (H. G. KG.)

HAYES, PATRICK JOSEPH (1867–1938), U.S. Roman Catholic archbishop and cardinal, whose most notable achievement was the unification of Catholic welfare activities under a central agency, Catholic Charities, was born in New York city, Nov. 20, 1867. Upon graduation from Manhattan college in 1888, he entered St. Joseph's Provincial seminary, Troy. N.Y., and was ordained a priest in 1892. After graduate courses at the Catholic University of America, he returned to New York city as curate at St. Gabriel's parish. Subsequently secretary (1895) to Bishop (later Archbishop and Cardinal) John Farley, chancellor of the archdiocese (1903), and first president (1903) of Cathedral college, the archdiocesan preparatory seminary, he became bishop auxiliary to Cardinal Farley in 1914. During World War I he served on the executive committee of the National Catholic War council and as first bishop of the armed forces (1917), in charge of all Catholic chaplains in the army and navy. In Sept. 1919 he succeeded to the archbishopric of New York and five years later was named a cardinal. As archbishop he created Catholic Charities (1920), an organization which became a model for other U.S. dioceses. Cardinal Hayes died in Monticello, N.Y., on Sept. 4, 1938.

See J. B. Kelly, *Cardinal Hayes, One of Ourselves* (1940).
(J. A. RS.)

HAYES, RUTHERFORD BIRCHARD (182 2–1893), 19th president of the United States, 1877–81, was born in Delaware, O., on Oct. 4, 1822. His ancestry was English and Scotch, his people having first settled in America in New England. He attended an academy at Norwalk, O., and later went to a school in Middletown, Conn. In 1842 he graduated from Kenyon college, Gambier, O., and in 1845 from the Harvard Law school. The same year he was admitted to the bar, and began to practise at Lower Sandusky (now Fremont), O. Three years later he moved to Cincinnati. From 1858 to 1861 he was city solicitor there. Hayes was married in 1852 to Lucy Ware Webb (1831–89).

In 1861 Hayes became major of a regiment of volunteers, the 23rd Ohio infantry, and in July of that year was sent to western Virginia for active service. He served throughout the Civil War, and was severely wounded at South mountain. By successive promotions he became a brigadier general of volunteers, and by brevet a major general of volunteers. In 1864 he was

elected a member of congress on the Republican ticket, and again in 1866. In the national legislature he supported his party's program of reconstruction. In 1868 he became governor of Ohio, serving until 1872. In 1875 he was again elected governor after a campaign wherein the Republicans advocated the resumption of specie payment, and the Democrats an increase of fiat paper money.

The "sound money" campaign in Ohio attracted national attention, and in 1876 Hayes received the Republican nomination for the presidency over James G. Blaine. Samuel J. Tilden was the Democratic candidate. Tilden had a reputation as a reformer, having destroyed the "Tweed ring" in New York and been prominently engaged in other public work. The strength of the Democratic candidate, together with the scandals of Pres. Ulysses S. Grant's administrations which had tended to discredit the Republican party, resulted in a close election, which depended upon the contested returns from South Carolina, Florida, Oregon and Louisiana.

Partisans on both sides were much excited. It was agreed, however, to refer the contested returns to an electoral commission created by act of congress. The commission, voting eight to seven, decided all of the contested returns in favour of the Republicans, and Hayes was declared elected on March 2, 1877.

The administration of President Hayes is notable principally for the pacification policy adopted by it with respect to the southern states. The federal troops, which had since the war been stationed in the southern capitals, were withdrawn, thereby bringing about the end of the "carpet-bag governments" conducted often by unprincipled politicians from the north. This action brought Hayes into sharp conflict with many of the political leaders of his party. It, however, made more rapid the slow recovery of the south from the effects of the war, and was highly beneficial to the nation. In his endeavours to bring about reforms in the civil service, and in his advocacy of the establishment of a civil service commission, Hayes also met with the opposition and disapproval of the politicians of his party. The New York faction, under the leadership of Roscoe Conkling, particularly resented his measures in endeavouring to divorce the service from politics.

Another notable accomplishment of the Hayes administration was the provision for the resumption of specie payments on Jan. 1, 1879. Prior to this time Hayes vetoed a bill, known as the Bland-Allison bill, providing that a silver dollar should be coined of the weight of 412½ gr. to become full legal tender for all debts and dues, public and private, except where otherwise expressly stipulated in the contract, but the measure passed over his veto. He was at all times a sincere advocate of sound money.

Hayes has generally been considered an able executive, thoroughly honest and sincerely devoted to the interests of the people and the country generally. He was not, however, popular with the professional politicians of his own party and was exposed to bitter attacks on the part of the Democratic opposition because of the cloud which hung over his election. In the presidential election of 1880 the Republican party carried the day with James A. Garfield after an unusually quiet canvass, largely the result of popular contentment with the existing state of public affairs. On March 4, 1881, Hayes retired to his home at Fremont, O. Various universities and colleges conferred honorary degrees upon him. His remaining years were devoted to active participation in philanthropic enterprises, serving as president of the National Prison association and of the board of trustees chosen to administer the John F. Slater fund for the promotion of industrial education among the Negroes of the south. He was also a member of the board of trustees of the Peabody Education fund for the promotion of education in the south. He died at Fremont, after a short illness, on Jan. 17, 1893.

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HAYES AND HARLINGTON, an urban district (1940) and parliamentary division of Middlesex, Eng., 12 mi. W. of London along the Uxbridge road. Pop. (1961) 67,912. Hayes is highly industrialized, the chief products being aircraft and electrical and musical instruments. Its parish church was used by St. Anselm. Archbishop Thomas Cranmer lived for a time at the Manor house. At Harlington, still mainly rural, Overburgh house was the home of William Byrd, the composer, about 1578–93. In Cranford park are stables once used by the Berkeley hunt; the house, a seat of the earls of Berkeley, was razed in 1946. The district's southern boundary overlaps the Bath road and includes a portion of London airport.

HAY FEVER is an inflammation of the membranes of the nose and eyes caused by allergy to the pollens of certain plants. It is manifested by sneezing, congestion of the nose, itching and tearing of the eyes, characteristically recurring at the same season each year, when the causative pollen is in the air. Despite the name. fever is not a usual symptom. Irritation of the membranes by allergy to other dusts in the air may cause similar symptoms, called allergic rhinitis, without the typical seasonal pattern of recurrence. The type of allergy causing hay fever is similar to that causing asthma (*q.v.*) and infantile eczema so that persons affected by one of these diseases are particularly susceptible to others of the group. Unless properly treated, about one-third of patients with hay fever later develop asthma. The tendency to develop allergies of this group is apparently hereditary in certain families. If both parents are affected, more than half the children may be expected to develop allergic diseases.

Hay fever is caused chiefly by plants which depend upon the wind to carry pollen to other plants of the same species for cross-fertilization. In order to ensure perpetuation of the species, such plants produce large amounts of light, buoyant pollen which is blown many miles by the wind. Plants with showy blossoms are in general adapted to cross-pollination by insects, and they produce only small amounts of heavy, sticky pollen which does not blow about. Such flowers rarely cause hay fever except on close contact. For this reason, roses and goldenrod, which have often been blamed for hay fever, are actually relatively minor causes.

The incidence and seasons of hay fever vary greatly in different parts of the world according to the vegetation present. In the temperate zones. most species of trees, certain weeds and essentially all grasses produce wind-borne pollen in large amounts. Among these, the pollens of pine trees and related conifers are relatively inert, but practically all others liberated in adequate amounts are potential causes of allergy in susceptible people. In North America and western Europe, various trees are the principal causes of hay fever occurring in the spring, and the grasses are the cause of hay fever in early summer. In North America, pollens of weeds. particularly ragweed, cause hay fever in the late summer and early autumn. Throughout central and eastern North America ragweed is by far the commonest cause of hay fever; hence late summer and early autumn is the principal season of the disease. Ragweed does not occur in Europe, and the autumn weeds growing there are relatively unimportant as causes of hay fever; hence in that area the late season is less severe than the spring and early summer. In any locality, the season of pollination of each plant is remarkably constant from year to year, so that hay fever due to any one pollen may be expected to recur in the same weeks each year, and one familiar with the plants of the area can usually suspect which pollen is the cause from the dates of onset and cessation.

More conclusive proof of the pollens affecting a particular patient is afforded by skin tests, in which minute amounts of extracts of various pollens are scratched or injected into the upper layers of the skin. Extracts of pollens to which the patient is allergic produce local swelling and redness within a few minutes; others produce no reaction. Patients whose symptoms last through several months are usually allergic to several different pollens.

Absorption of pollen into the membrane of a person allergic to it causes release from the tissues of histamine, a substance intensely irritating to the small blood vessels and the glands which secrete mucus. This produces dilation of the vessels and escape

of fluid through their walls, causing the membrane to become congested and swollen. The occurrence of the reaction does not depend on the nervous system, but its intensity may be influenced by emotional factors which also affect the blood vessels and mucus glands through the nerves. This aggravation occurs only in persons susceptible because of allergy; typical seasonal hay fever cannot be attributed to purely psychic factors.

Temporary relief of symptoms may be afforded by antihistamine drugs, which block the action of the histamine released in the membrane. Even more effective in temporary relief are the drugs related to cortisone, but these are less often used since they may cause undesirable effects elsewhere in the body. All these drugs serve only to suppress symptoms and do not alter the basic allergy. However, in mild cases they may produce adequate relief. (*See* also ANTIHISTAMINES.)

The most effective treatment over a period of time is desensitization or immunization, in which the allergic reaction is lessened by a series of injections of an extract of the causative pollen. The first dose must be very small, subsequent doses being increased gradually as the patient's tolerance is improved. Ordinarily a course of 1j to 20 injections is given, one or two each week, before the full dose is reached. Treatment therefore should be started three or four months before the onset of the season. Such treatment produces relief in 75% to 80% of patients, but must be repeated each season, or may be carried out continuously with injections every two to four weeks throughout the year. The best results are obtained by the continuous or perennial type of treatment, and it is also believed to offer the best chance of permanent relief after several years of treatment. However, the duration of treatment that will be needed ,cannot be predicted with certainty. Attempts are being made to shorten the course of treatment by injecting slowly adsorbed pollen extracts.

Another measure which may be considered is the avoidance of exposure to a particular pollen by traveling during the season to an area in which it does not exist. Relief may also be obtained by air conditioning or air filtration. Attempts to exterminate ragweed have been made in many areas, but have generally failed to prevent hay fever because of the long distances that the pollen may be carried by wind. *See* also ALLERGY AND ANAPHYLAXIS.

(W. B. SN.)

HAYLEY, WILLIAM (1745–1820), English writer, the friend and biographer of William Cowper, was born at Chichester and educated at Eton and Trinity hall, Cambridge. His private means enabled him to live on his patrimonial estate at Eartham, Sussex, and he retired there in 1774. Hayley won contemporary fame by his poetical *Essays and Epistles* addressed to various distinguished men. On Thomas Warton's death in 1790 he was offered the laureateship, which he refused. In 1792, while writing the *Life of Milton* (1794), Hayley made Cowper's acquaintance. A warm friendship sprang up between the two which lasted till Cowper's death in 1800. After Hayley had moved in 1800 to his "marine hermitage" at Felpham, Sussex, William Blake settled near him for three years to engrave the illustrations for the *Life of Cowper*. This, Hayley's best-known work, was published in 1803–04 (Chichester) in three volumes.

In 1805 he published *Ballads Founded on Anecdotes of Animals* (Chichester), with illustrations by Blake, and in 1809 *The Life of Romney*. For the last 12 years of his life Hayley received an allowance for writing his *Memoirs*. He died at Felpham on NOV. 12, 1820.

Hayley's *Poetical Works* were published in 3 vol. (1785); his *Poems and Plays* in 6 vol. (1788). See *Memoirs . . . of William Hayley . . . and Memoirs of his son T. A. Hayley*, ed. by John Johnson, 2 vol. (1823), containing many of Hayley's letters; an article on these memoirs by Robert Southey in the *Quarterly Review*, vol. xxxi (1825); *The Correspondence of William Cowper*, arranged by Thomas Wright, vol. iv (1904), containing many letters to Hayley.

HAYNAU, JULIUS JACOB (1786–1853), Austrian general, was the natural son of the landgrave—afterward elector—of Hesse-Cassel, William IX. He entered the Austrian army as an infantry officer in 1801, saw much service in the Napoleonic wars, and between 1815 and 1847 rose to the rank of field marshal lieutenant. A capable officer, but of violent temper and fanatical hatred of revolutionary movements, he was employed against the Italian revolutionaries in 1848, and became notorious for the severity with which he repressed and punished, not without provocation, a rising in Brescia. Appointed next to command in Hungary, he was successful in the field, but was again accused of brutality.

In London Haynau was attacked and beaten by Barclay and Perkins' draymen when visiting the brewery, and was saved from mob violence in Brussels with difficulty. He died on March 14, 1853.

See R. von Schönhals, *Biographie des K. K. Feldzeugmeisters Julius Freiherrn von Haynau* (Vienna, 1875).

HAYNE, PAUL HAMILTON (1830–1886), U.S. poet, best known as a southern literary leader, was born in Charleston, S.C., Jan. 1, 1830, and attended Coates school there. He was graduated from Charleston (S.C.) college in 1850. After practising law for a short time, he worked on the staff of the *Charleston Evening News* and the Richmond *Southern Literary Messenger*, and was associate editor of the weekly *Southern Literary Gazette*. His first collected verses he published at his own expense in 1855. He was co-editor of the influential *Russell's Magazine*, launched under the leadership of William Gilmore Simms, during its three years of publication (1857–60). For a short time during the Civil War Hayne was an aide to Gov. Francis Pickens, but had to give up active service because of ill-health. He contributed patriotic verse to the *Southern Illustrated News* of Richmond. After the war, his home burned and his fortune destroyed, Hayne and his family moved to a shanty at "Copse Hill" near Augusta, Ga., where he earned his living writing prose and composed some verse. In 1873 he edited a posthumous edition of Henry Timrod's verse. Hayne died on July 6, 1886.

His published works include: *Poems* (1855), *Sonnets and Other Poems* (1857), *Avolio: a Legend of the Island of Cos* (1860), *Legends and Lyrics* (1872), *The Mountain of the Lovers* (1875), *Lives of Robert Young Hayne and Hugh Swinton Legaré* (1878) and *The Broken Battalions* (1885).

See Kate Harbes Becker, *Paul Hamilton Hayne: Life and Letters* (1951).

HAYNE, ROBERT YOUNG (1791–1839), U.S. political leader, born in St. Paul's parish, Colleton district, S.C., on Nov. 10, 1791. He studied law in the office of Langdon Cheves (1776–1857) in Charleston, S.C., and in Nov. 1812 was admitted to the bar there, soon obtaining a large practice. For a short time during the War of 1812 against Great Britain he was captain in a South Carolina regiment. He was a member of the lower house of the state legislature from 1814 to 1818, serving as speaker in the latter year; was attorney general of the state from 1818 to 1822, and in 1823 was elected, as a Democrat, to the U.S. senate. There he was conspicuous as an ardent free-trader and an uncompromising advocate of states' rights, opposed the protectionist tariff bills of 1824 and 1828 and consistently upheld the doctrine that slavery was a domestic institution and should be dealt with only by the individual states. In one of his speeches opposing the sending by the United States of representatives to the Panama congress, he said. "The moment the Federal Government shall make the unhallowed attempt to interfere with the domestic concerns of the States, those States will consider themselves driven from the Union." Hayne is best remembered, however, for his great debate with Daniel Webster (*q.v.*) in Jan. 1830.

The debate arose over the so-called "Foote's resolution," introduced by Sen. Samuel A. Foote (1780–1846) of Connecticut, calling for the restriction of the sale of public lands to those already in the market, but was concerned primarily with the relation to one another and the respective powers of the federal government and the individual states, Hayne contending that the constitution was essentially a compact between the states, and the national government and the states, and that any state might, at will, nullify any federal law which it considered to be in contravention of that compact. He vigorously opposed the tariff of 1832, was a member of the South Carolina Nullification convention of Nov. 1832, and reported the ordinance of nullification

passed by that body. Resigning from the senate, he was governor of the state in 1832–34, and as such took a strong stand against President Jackson, though he was more conservative than many of the nullificationists in the state. He was intendant (mayor) of Charleston, S C , 1835–37, and was president of the Louisville, Cincinnati and Charleston railway 1837–39. He died at Asheville, N.C., on Sept. 24,1839. His nephew, Paul Hamilton Hayne (1830–86). was a poet of some distinction, and in 1878 published a life of his uncle.

See Theodore D Jervey, *Robert* Y. *Hayne and His Times* (1909); and John Bomai Cleveland, *Controversy Between John C. Calhoun and Robert Young Hayne* (1913).

HAY RIVER, 530 mi. long, rises in the foothills of the Rocky mountains in northern Alberta, Can., makes a bend through British Columbia and descends to Great Slave lake, Northwest Territories. Upper Hay river is quite rapid. From Hay Lake (elevation 1,078 ft.) it meanders sluggishly north-northeast through flat muskeg country.

A stretch of rapids culminating in the Alexandra falls (106 ft.), 50 mi from the mouth, is followed by a 46-ft. fall and a 250-ft. deep gorge ahich opens onto the flat country around Great Slave lake (159 ft.).

The hlackenzie highway is parallel to the river, connecting the settlements of Meander River, Alberta and Hay River. on Great Slave lake. (AN. KR.)

HAYTON (HAITHON, HETHUM), king of Little Armenia or Cilicia from 1226 to 1269, was a traveler in western and central Asia; the narrative of his journey, written by a member of his suite. Kirakos Gandaketsi, is one of the earliest and fullest accounts of Mongolian geography and ethnology. Throughout his reign he followed the policy of friendship and alliance uith the overwhelming power of the Mongols. After Mangu's accession in 1251, Hayton was summoned to the court of the new grand khan. Carefully disguised, so as to pass safely through the Turkish states in the interior of eastern Asia Minor (nhere he was hated as an ally of the Mongols against Islam), Hayton made his way to Kars, the central Mongol camp in Great Armenia, and thence by way of Derbent to the residence of Mangu at or near Karakorum, south of Lake Baikal, nhere he arrived on Sept. 14(?), 1254. There the king remained till Nov. 1, when he left with diplomas, seals and letters of enfranchisement ahich promised great things for the Armenian state, church and people. He returned by way of the Urumtsi region. Talas, Samarkand. Merv and Khorasan.

See E Bretschneider, *Mediaeval Researches From Eastern Asiatic Sources,* i, 164–172, "Trubner's Oriental Series" (1888); C R Beazley, *Dawn of Modern Geography,* ii, 381–391 (1901). (WM C. B)

HAYWARD, ABRAHAM (1801–1884), translator of Goethe and author of *The Art of Dining,* was born at Wilton, near Salisbury. Educated at Blundell's school, Tiverton, he entered the Inner Temple in 1824, and was called to the bar in June 1832. Hayward edited the *Law Magazine* from 1829 to 1844, and became a conspicuous figure in London literary society. His translation of Goethe's *Faust* was privately printed in 1833, and a revised edition appeared in 1834 In Feb 1835 he was elected to the Athenaeum club under Rule II., and he remained for nearly 50 years one of its most conspicuous and most influential members. He was also a subscriber to the Carlton, but ceased to frequent it when he became a Peelite. At the Temple, Hayward, whose reputation was rapidly growing as a connoisseur not only of a bill of fare (the famous *Art of Dining* appeared in 1852) but also (as Swift would have said) of a bill of company, gave famous dinners, at which ladies of fdshion appreciated the wit of Sydney Smith and Theodore Hook, the dignity of Lockhart and Lyndhurst and the oratory of Macaulay. At the Athenaeum and in political society he to some extent succeeded to the position of Croker. His sharp pen made him many enemies. He disgusted the friends of Mill by the stories he raked up for an obituary notice of the great economist *(The Times,* May 10, 1873). He broke with Henry Reeve in 1874 by a venomous review of the *Greville Memoirs,* in which Reeve was compared to the beggarly Scot deputed to let off the blunderbuss which Bolingbroke (Greville) had charged. Samuel Warren attacked him (very unjustly, for Hayward was anything but a parasite) as Venom Tuft in *Ten Thousand a Year;* and Disraeli aimed at him partially in Ste. Barbe (in *Endymion),* though the satire here was directed primarily against Thackeray. After his break with Reeve, Hayward devoted himself more exclusively to the *Quarterly.* He died in London on Feb. 2, 1884.

Two volumes of Hayward's *Correspondence* (edited by *H.* E. Carlisle) were published in 1886. In *Vanity Fair* (Nov. 27, 1875) he may be seen as he appeared in later life.

HAYWARD, SIR JOHN *(c.* 1560–1627), English historian, was born at or near Felixstowe, Suffolk, where he was educated, and afterwards proceeded to Pembroke college, Cambridge. In 1599 he published *The First Part of the Life and Raigne of King Henrie IV.* dedicated to Robert Devereux, earl of Essex. This was reprinted in 1642. Queen Elizabeth and her advisers disliked the tone of the book and its dedication, and the queen ordered Francis Bacon to search it for "places in it that might be drawn within case of treason." Bacon reported "for treason surely I find none, but for felony very many," explaining that many of the sentences were stolen from Tacitus; but nevertheless Hayward was put in prison, where he remained until about 1601. On the accession of James I. in 1603 he courted the new king's favour by publishing two pamphlets, one of which, an argument in favour of the divine right of kings, was reprinted in 1683 as "The Right of Succession" by the friends of the duke of York during the struggle over the Exclusion Bill. He died in London on June 27, 1627. Hayward's other works are: *Lives of the Three Norman Kings of England* (1613), *The Life and Raigne of King Edward VI.* (posthumously printed, 1630, included in *Complete History of England,* anon., vol. ii. 1706) and *Certain Yeres of Queen Elizabeth's Raigne* (ed. John Bruce, Camden Society, 1840, with a life of the author).

HAYWARD, a city of Alameda county, Calif., U.S., less than ½ mi. from San Francisco bay and 15 mi. from the centre of Oakland in the rapidly growing bay area. This important commercial centre, situated between Oakland and San Jose, is served by two railways, a municipal airport and a superhighway.

The first inhabitants of the site were Indians who gathered shellfish and salt at San Leandro creek. After 1797 the region was grazed by cattle of the Mission San Jose de Guadalupe. Following the gold rush in 1849, William Haymard purchased land on the Guillerma Castro estate and built the first general store in 1851. The town was incorporated in 1876. Meanwhile the economy of the region shifted from livestock to wheat raising and cherry orchards. After World War II the leading manufactured products were canned fruit, ironwork and electrical equipment.

Pop. (1960) 72,700. For comparative population figures *see* table in CALIFORNIA: *Population.* (R. M. W.)

HAYWOOD, ELIZA (1693?–1756), English writer of sensational romances which made her notorious but prepared the nay for later women novelists, was the daughter of a London tradesman. When very young she married Yalentine Haywood, a middle-aged clergyman; but she appears to have left him to go on the stage, supporting herself by writing. In 1721 she revised *Tlze Fair Captive,* by a Captain Hurst. for Lincoln's Inn Fields theatre. Two original pieces folloned, in one of nhich she acted herself: but she took a dislike to the stage and instead continued to write, in a light, crisp style, the extravagantly passionate fiction for which there was already a great vogue. She produced a total of 70 novels, writing as many as ten in one year (1724).

She became notorious, however, as an imitator of Mrs. Manley *(q.v)* in writing novels based on contemporary scandal. To *Memoirs of a certain Island adjacent Utopia . . .* (1725) she appended a key in which society leaders were denoted by initials: the British museum has a copy giving their full names. *The Secret History of the Present Intrigues of the Court of Caramania* (1725) was similarly explained. This infuriated Pope, who attacked her with coarse brutality in *The Dunciad* (II, 11, 149 *et seq.),* imputing to her a personal immorality that her earlier novels certainly do-not suggest. Although she attempted to retaliate in *The Female Dunciad* (1729) she almost ceased writing for 16 years. Pope's friends attacked her also, Swift calling her a "stupid, infamous,

woman." Later she achieved some success with *The Female Spectator* (1744–46; mod. ed. by Mary Priestley, 1929), the first periodical written by a woman, and with her most realistic novel, *The History of Jemmy and Jenny Jessamy* (1753). She died in London on Feb. 25, 1756.

See C. H. Whicher, Life *and Romances of Mrs. Haywood* (1915).

HAZAEL (fl. 9th century B.C.), king of Damascus. He became king after the death of Benhadad II, under whom he was probably a court official. According to II Kings, Benhadad, who was ill. sent Hazael to the prophet Elisha to inquire concerning his chances of recovery. Elisha prophesied that Benhadad would die and that Hazael would succeed him. Hazael, on his return, smothered Benhadad and became king. He ruled for many years, during which time he fought the kings of Judah and Israel with some success, capturing all Israel's possessions east of the Jordan. He was eventually conquered by Shalmaneser II, king of Assyria, who in 842 and 839 defeated Hazael's forces in battle, the first time taking an enormous toll in lives and equipment and driving Hazael into Damascus and the second time capturing a number of Syrian cities.

HAZARA, a people found in the Hazarajat or Hazaristan in Afghanistan, descended from military colonists settled by Jenghiz Khan in the highlands of the upper Helmund and on the slopes of the Hindu Kush range north of Kabul Probably of almost pure Mongol origin they now speak a Persian dialect. Strict Shiite Moslems by sect, they were only subjugated by the great amir of Afghanistan. Adburrahman Khan, between 1890 and 1893 after a long resistance; but they were then enlisted in his engineer companies, and they were also recruited in pioneer regiments of the Indian army. As Turks and Shiites, intermarriage with them is avoided by the Afghans. and though they may once have intermarried with the Persians, they have preserved the purity of the Mongol type to a marked degree. In the western part of the Hazarajat. extending nearly to Herat and the Harud valley, the Hazaras include four tribes, the Chnhar Aimak, which speak Turki and are Sunni Moslems by sect.

HAZARA, a district in the Peshawar division of West Pakistan. Area 3,030 sq.mi. Pop. (1951) 856,173, predominantly Gujars, who claim to be aboriginal, and Awans. The district includes the acceded princely states of Amb, west of the Indus (area 203 sq.mi.; pop. 1951, 48,656) and Phulra, little more than a small town (pop. 8,jog), 22 mi. N.W. of Abbottabad. The large tribal area (area 2,214 sq.mi.; pop. 427,004) northwest and west of the district proper is administered with it. The district forms a wedge of territory extending far into the Himalayas. The picturesque Kagan valley in the northeast, which is drained by the Kunhar into the Jhelum, became important for communications and economy in the 1950s. About 15 mi. wide and 800 sq.mi. in area, it is shut in by parallel ranges of hills with an average height of 10,000 ft. rising to more than 17,000 ft. in the highest peak. It is connected with Chilas (Gilgit) through Babusar pass (13,690 ft.).

Three main lines of hills with outer ranges divide the district into four main valleys, running from northeast to southwest and drained respectively by the Unar, the Siran, the Dor and the Harroh. all tributaries of the Indus. In the lower valleys of these rivers the country here and there opens into plains of varying extent, the largest of which are Haripur, Rash or Orash. at the southern end of which is Abbottabad. the district capital (pop., 1951, 27,602, including 14,1j6 in cantonment). and Pakhi. in Mansehra tehsil. The plains and the terraced slopes are cultivated for maize, wheat, barley and rice. Many hill slopes are forested, mainly with deodars. Honey is produced. (K. S. AD.)

HAZARD, ROWLAND GIBSON (1801–1888), U.S. manufacturer and author, one of the founders of the Republican party, was born in South Kingstown, R.I., on Oct. 9, 1801. After studying at the academy of the Society of Friends in Westtown, Pa., he entered the Peace Dale woolen mills, founded by his father, and remained with the mills until 1866. Before this time delicate health forced him to spend his winters in the south, but this necessity permitted him to establish personal business contacts with many leading southern planters. In 1841–42 in New Orleans he won the release of free Negroes taken off ship and impressed in the chain gang. He became a bitter opponent of the fugitive slave laws and the extension of slavery into the territories. This led him to the organizational convention of the Republican party at Pittsburgh, Pa., in 1856. He attended three of the first four national conventions of the party and served often on policy-forming committees. Hazard was elected three times to the Rhode Island house of representatives and once to the state senate.

Hazard's literary interests were broad and largely metaphysical. He wrote numerous essays on politics, language, history and philosophy. At the request of William Ellery Channing, to whose views he devoted one of his essays, he prepared a treatise, *Freedom of Mind in Willing* (1864), in answer to Jonathan Edwards' writings on the freedom of the will. He addressed another volume, *Two Letters on Causation and Freedom in Willing* (1869), to his friend John Stuart Mill. This book opened a lengthy debate between Mill and Hazard, for their ideas on causation were in sharp conflict. Hazard was a senior member of the Rhode Island Historical society and a benefactor of Brown university, endowing a chair in physics. He died on June 24, 1888, at Peace Dale, R.I. (N. A. G.)

HAZARD (Span. *azar*, unlucky throw at dice, misfortune, from Arab. *al*, and *zar*, "dice"), a game of dice once popular in England and played for large stakes at the rooms of Crockford and Xlmack, London. In the U.S. the name hazard is applied to a different game. but a game somewhat similar to hazard, called craps, is the principal gambling game; *see* DICE.

HAZARIBAGH, a town and district in the Chota Nagpur division of Bihar state, India. The town is at an elevation of 2,000 ft., 43 mi. N. of Ranchi. Pop. (1951) 33,812.

HAZARIBAGH DISTRICT comprises an area of 7,010 sq.mi. In 1951 the population was 1,937,210. The physical formation of Hazaribagh exhibits three distinct features: (1) a high central plateau occupying the western section, the surface of which is undulating and cultivated; (2) a lower and more extensive plateau stretching along the north and eastern parts; to the north the land is well cultivated, while to the east the country is of a more varied character, the elevation is lower, and the character of a plateau is gradually lost; (3) the central valley of the Damodar river, occupying the southern section. Rice and oilseeds are the principal crops. The most important river is the Damodar, site of an important power and irrigation project. A dam at Tilaiya and the thermal power station at Bokaro were opened in 1953, and a dam at Konar in 1955. The district contains the important Giridih, Bokaro, Rangarn and Karanpura coal fields. A mica-producing belt, which extends into the district of Gaya and Monghyr, produces about half the world's total output of mica. The production of shellac is another local industry of some importance. The subdivisional town of Giridih, on which the export of coal has hitherto centred, had 29,167 inhabitants in 1951. Parasnath hill is annually visited by many Jain worshippers,

HAZE, a slight or moderate diminution of atmospheric visibility. when objects as near as about 1½ mi. are still identifiable, caused either by dry dust or salt particles or by water droplets so small or so widely dispersed as not to be discoverable individually by the unaided eye. There is a "smoky," opalescent or greasy, sometimes dirty-yellow, sometimes whitish, grayish or bluish cast to the air and distant objects. In the U.S. the weather services began in 1938 to distinguish dry haze as one caused chiefly by dust, and damp haze as caused largely by water droplets, but it often happens that dry and water particles are so mixed that the distinction is difficult to make in practice. In Great Britain haze is mainly "damp" and the term is generally used there synonymously with light fog (*q.v.*) or mist. In desert lands the prevalent dry dust haze may be given special names. The shimmering effect of the intensely heated air near the ground on a clear summer day is sometimes called optical haze. (R. G. SE.)

HAZEL, one of three names which in English writings have long been applied to plants and nuts of the genus *Corylus*, the others being filbert and cobnut. The distinction was based wholly upon the relative length of the involucre or husk in comparison with the nut. Filberts were those having husks distinctly longer

than the nuts; cobnuts, those with husks and nuts of about equal length; and hazels, those with husks shorter than the nuts. While, in general, filberts were long nuts. cobnuts of medium length and hazels were short and roundish. it is obvious that these names were not clearly distinctive. especially after the husks were removed. Moreover. the relation of length between nut and husk varied both in different parts of the tree during the same year and in the same tree from year to year.

In an effort to clarify this situation. in 1942, the American Joint Committee on Horticultural Nomenclature officially recognized filbert (*q.v.*) as the one name which henceforth should be applied to this genus.

HAZEN, WILLIAM BABCOCK (1830–1887), U S. soldier, noted for his contributions, as chief signal officer, to the improvement of weather-reporting and forecasting methods. was born in West Hartford, Vt., Sept. 27, 1830. On graduation from the United States Military academy, West Point, N.Y., in 1855, he entered service against the Indians in the west He served with distinction during the Civil War, afterward acting as an infantry colonel on the frontier. In 1880 he was appointed chief signal officer and remained in that capacity until his death, as a brigadier general, on Jan. 16. 1887.

Since 1870, under the first chief signal officer, Brig. Gen. Albert J. Myer, signal corps duties had included provision of the national weather service, using military telegraph lines to transmit weather data gathered at many reporting stations. Hazen continued Myer's practice of employing able meteorologists, notably Cleveland Abbe. Co-operating with other nations in arctic studies (actually the first International Geophysical year), Hazen in 1881 dispatched expeditions to Point Barrow, Alaska, and Ellesmere Island. Can. Members of the latter expedition, under Lieut Adolphus W. Greely (*q.v.*), reached farther north than any white men to that date, but only 7 of the original party of 25 were alive when they were belatedly rescued in 1884. For his public criticism of the secretary of war's ineffective rescue efforts. Hazen was court-martialed and reprimanded. Meanwhile he introduced Abbe's standard-time meridians and improved upon weather-reporting methods and forecasting procedures, such as signaling the approach of storms and cold waves, to the benefit of commerce and agriculture. Hazen published a number of books, including Our Barren Lands (1875) and A *Narrative* of *Military* Service (1885). (G. R. T.)

HAZLETON, a city of Luzerne county in eastern Pennsylvania, U S., stands on Buck Mountain plateau at an altitude of 1,624 ft surrounded by rugged and picturesque terrain 23 mi. S.S.W. of Wilkes-Barre. Laid out in 1836 by the clerk of the newly organized Hazleton Coal company, it was named for Hazel creek, incorporated as a borough in 1856 and as a city in 1891. The city's growth was identified with the expansion of anthracite coal mining. which ended with the depression of 1930 and continued to diminish thereafter in both tons of production and number of workers. Some of the unemployed found jobs in the textile mills, but the population declined as the miners sought work elsewhere. Manufactures include fabrics, clothing, paints and crayons, furniture, electronic tubes, centrifugal pumps, iron wire and steel products, foam rubber; and paper boxes (at West Hazleton, a residential suburb incorporated 1889). The first settlers were from Wales and Ireland, the later ones from central and eastern Europe. The domes of the Greek Orthodox churches, towering above the houses, and the existence of several Protestant and Roman Catholic churches, testify to the transplanting of European culture to Hazleton. For comparative population figures see table in PENNSYLVANIA: Poperlation. (R. G. Co.)

HAZLITT, WILLIAM (1778–1830), English writer. nho worked as journalist lecturer, dramatic critic and painter. but will be remembered for his essays. His interests embraced politics. philosophy, literature and all the arts, but he was basically a student of human life and liberty and it is the humanity of his essays that gives them permanent value. He lived by his pen and his writings are voluminous, much of what he published is no longer of general interest, but many of his essays are classics in their kind and his opinions have permeated the national consciousness more intimately than is commonly appreciated. His intellect nas brilliant, yet his style of writing is "ordinary" in the best sense; it has no conscious artistry or literary pretensions and can be read for sheer enjoyment of the lively intelligence informing it.

Hazlitt was born at Maidstone, Kent, on April 10, 1778. He was the fourth child and younger son of William Hazlitt, Unitarian preacher, and of Grace Loftus. daughter of a Wisbeach ironmonger The elder Hazlitt had settled at Maidstone in 1770, but while William was still an infant the family moved to Ireland and thence to America. the father's sympathies having been with the American rebels. There they remained for three years, but when William was nine they returned to England, settling at Wem in Shropshire. William was described as an exceedingly happy and lively child, but at the age of puberty his character changed and he became somewhat sullen and unapproachable. His father even said of him that he "passed under a cloud, which unfitted him for social intercourse." This tendency persisted through his life, and gave rise to Coleridge's well-known description of his manners as "singularly repulsive — brow-hanging, shoe-contemplative, strange." He was always excessively conscious of himself, jealous and quick to take offense. Yet he could be a generous admirer of genius in others, and his consistent championship of Keats against his critics is always remembered to his credit.

As a youth Hazlitt read intensively and so laid the foundation of the wide knowledge of literature and philosophy that he used so effectively in his writing. Yet he found great difficulty in expressing himself both in conversation and writing, so that he turned first to painting as an outlet for his ambitions. His elder brother John nas already in 1798 established in London as an artist. and his example no doubt had some influence. For several years Hazlitt worked hard at what seemed to be his profession. In 1802 he nent to Paris to nork in the Louvre but war between France and England in 1803 compelled his return. By 1804, when he first met Charles Lamb, he was a more than proficient portrait painter, and his portrait of Lamb (in the National Portrait gallery, London) is sufficient evidence that he could have excelled had he persisted. He was encouraged by Coleridge and Wordsworth, who had been his friends since 1798, but in 1805 he turned from his painting and gave his mind to the metaphysics and philosophy uhich had interested him earlier, publishing his first book On the *Principles* of *Human* Action. Other books followed — Free *Thoughts* on Public Affairs (1806), an abridgment of Abraham Tucker's *Light* of *Nature* Pursued and a Reply to *Malthus's* Essay on *Population* (both 1807). He nas also working on a collection of parliamentary speeches with comments on the speakers; two volumes appeared in 1807. In the same year he formed an attachment to Sarah Stoddart, a friend of the Lambs, and in May 1808 they were married, going to live at Winterslow on Salisbury plain. which was to become Hazlitt's favourite retreat for thought and writing Here he worked on a series of literary projects — a History of Englzsh *Philosophy,* which was abandoned, an English Grammar (1810) and *Memoirs* of *Thomas* Holcroft (1816), the dramatist and novelist and a friend of Hazlitt's for some years up to his death in 1809.

Hazlitt's first child was born at Winterslow in 1809, but did not live. His second child. William, was born in 1811. He had before this again tried to return to painting in London, but he seemed to himself to have failed both as artist and writer, and by the end of 1811 he was penniless. He retrieved his position by a course of lectures on philosophy in London and by reporting for the *Morning Chronicle.* Two years later he was fully established as critic, journalist and essayist, his collected dramatic criticisms being published as *A View* of *the* English Stage (1818). He was also contributing to a number of journals, including Leigh Hunt's *Examiner.* This association led to the publication of The *Round* Table, 2 vol. (1817); 12 of the 52 essays were by Hunt. though Hazlitt's name only appeared on the title page In the same year Hazlitt published his *Characters* of *Shakespeare's* Plays, which met with immediate approval in most quarters. At the same time he was fearlessly expressing himself in forcible terms in the journals and was involved in many quarrels with his friends. In

addition he was savagely attacked by William Gifford in the *Quarterly Review,* the sales of his Shakespeare volume being greatly damaged thereby. In 1815 he had been profoundly upset by what was to him a bitter blow, the defeat of Napoleon at Waterloo. Napoleon had been his idol for some years, and B. R. Haydon, the painter, said that he attempted for a time to drown his mortification with drink. Hazlitt's irritability was accentuated by ill-health. perhaps initiated by his indulgences and certainly made worse by the journalistic battles which came to a head in the action he brought against *Blackwood's Magazine.* This was settled in his favour out of court and in 1819 he had the satisfaction of publishing his *Letter to William Gifford,* paying off old scores with barbed invective to the admiration of his friends, particularly Keats who, with Shelley, had been added to his circle of friends and admirers.

Meanwhile Hazlitt was consolidating his reputation as a lecturer, delivering a course *On the English Poets* (published in 1818) and another *On the English Comic Writers* (published in 1819). Keats was not able to hear the second course, but, having read them, quoted in a letter to his brother, George, "a specimen of his usual abrupt manner and fiery laconicism." In 1819 Hazlitt also published a collection of his political essays written during his years of journalism, adding some "characters" of statesmen first printed in earlier books. He resolved thereafter to withdraw from political controversy and occupied himself during 1819 with preparation of his *Lectures on the Dramatic Literature of the Age of Elizabeth.* These mere the last lectures he delivered, and he subsequently devoted himself chiefly to essays for various journals. especially John Scott's *London Magazine,* of which he temporarily became editor after Scott's death.

Many of these essays were written at Winterslow, where he was often alone, having lived apart from his wife since the end of 1819. When in London he occupied lodgings in Southampton buildings, where he fell in love with Sarah Walker, daughter of his landlord. This girl he intended to marry after completing arrangements in Edinburgh for divorcing his wife. He was a free man by June 1822, but some weeks later it became known that he had been deceived by Sarah Walker, who, while seeming to favour his attentions, had admitted another lover. This rebuff caused him intense suffering, which he sought to "burn out of his mind" by writing an account of his affair. This strange work was published in 1823 under the title *Liber Amoris; or, The New Pygmalion,* and attracted greater notoriety than its merits deserve. Its publication was, however, necessary for its author's peace of mind.

Hazlitt's two most famous books of essays, *Table Talk* (1821) and *The Plain Speaker* (1826), contain all the best essays written in the years 1820–25. Many other essays were collected in posthumously published volumes edited by his *son—Sketches and Essays* (1829), *Literary Remains* (1836) and *Winterslow* (1850); many more remained to be collected as *New Writings,* 1st and 2nd series (1925–27) edited by Hazlitt's biographer, P. P. Howe. Hazlitt also found time to produce a volume of *Characteristics, in the Manner of La Rochefoucauld's Maxims* (1823), to edit a large volume of *Select British Poets* (1824) and to complete sketches of the *Principal Picture Galleries in England* (1824), including his celebrated essay on the Dulwich gallery.

In April 1824 Hazlitt married for the second time, his bride being a widow named Bridgwater whom he had met in a stagecoach; but the presence of the new Mrs. Hazlitt was resented by young William, to whom his father was devoted, and they separated three years later. Hazlitt had spent part of his second period of matrimony in France and Italy, and while in France on this and other occasions worked at his most ambitious and least successful work, the *Life of Napoleon,* 4 vol. (1828–30). His travels in 1824–25 he recorded in his *Notes of a Journey in France and Italy* (1826). He also published in 1825 a series of essays on contemporary figures entitled *The Spirit of the Age,* containing some of his most animated and effective writing. His last book, *Conversations of James Northcote* (1830), was a record of his friendship with that eccentric painter over many years, the "conversations" having been published as a series in the *New Monthly Magazine* (1826–27), and in other journals in 1829.

During these latter years Hazlitt's health had deteriorated and he died of cancer of the stomach at his lodgings in Frith street, Soho, on Sept. 18, 1830. He was buried at St. Anne's, Soho. His last words were reported by his son to have been, "Well, I have had a happy life." Although he had been through unhappy episodes, there is no doubt that his zest for living and his intense interest in human affairs had kept him happy most of his life. It may be said of him in the words which he wrote of Dr. Johnson, "He had faults, but they lie buried with him. He had his prejudices and his intolerant feelings. but his nere not time-serving, heartless, hypocritical prejudices, but deep, inwoven, not to be rooted out but with life and hope. which he found from old habit necessary to his own peace of mind. I do not hate, but love him for them."

Hazlitt's essays are so numerous that it is difficult to select any small number for special mention. But it is generally agreed that he is represented at his brilliant best in essays such as "On Living to One's-self." "The Fight" (an account of his unpremeditated expedition to Hungerford to see Bill Neate fight the Gas-man), "On Disagreeable People," "My First Acquaintance with Poets" (chiefly about Coleridge and Wordsworth), and "Of Persons One would Wish to have Seen."

His *Complete Works* were edited by A. R. Waller and Arnold Glover, with an introduction by W. E. Henley, in 13 vol. (1902–06; reissued, ed. by P. P. Howe, 21 vol., 1930–34). Among selections from the essays are those edited by F. Carr (1889); by A. Ireland, with a memoir (1889); by D. Nicol Smith, on poetry (1901); by C. Whibley (1906); by Jacob Zeitlin (1913); by G. Sampson (1917); by P. P. How-e (1923); by C. H. Gray (1926); and by G. Keynes (1930).

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(*G* L. K)

HEAD, the upper portion of the body in man, consisting of the skull with its integuments and contents, including the lower jaw. It is attached to the spinal column by way of the first cervical vertebra, the atlas, and connected with the trunk of the body by the muscles, blood vessels, nerves, etc., that comprise the neck. The term also is used to describe the anterior or fore part of animals other than man.

See also BRAIN; SKULL; articles on the various organs, etc.. that are located in the head. (F. L. A.)

HEAD AND NECK, SURGERY OF, is a term that describes loosely a branch of modern surgery specializing in operations on the face, throat and neck. It does not include surgery of the brain, eye or neurosurgery, nor does it include dental operations. In medical centres in both Europe and America surgeons trained in general surgery, plastic surgery or both perform most of the major head and neck surgery. The largest number of these operations are performed to correct congenital deformities such as cleft lip and palate, to eliminate cancer of the face. oral cavity, larynx, salivary glands and jaws, and to correct the deformities and functional loss suffered as a result of injury to the facial bones and features. Because of the exposed location of the head and neck, deformity subsequent to disease, injury or surgery is extremely important to any patient. As a result, emphasis has been placed on the development of immediate and early reconstructive surgery to make operations less crippling to the patient. Plastic surgery has made great strides in this direction.

The rapid growth of the field of head and neck surgery results from several factors. (1) The use of antibiotics greatly reduced the dangers of infection following surgery; formerly the normal bacteria in the human oral cavity caused devastating infections after operations in which these organisms were allowed to enter the tissues of the neck. (2) The widespread use of blood transfusions has made it possible to carry out long and tedious operations without shock on that part of the body which is notorious for the amount of bleeding produced during surgery. (3) Modern techniques of anesthesia also have greatly reduced the dangers to

the patient, so that even major operations in the head and neck region now carry an operative mortality of less than 1%.

The role of plastic surgery is important, and the experiences of World War II showed surgeons that techniques of rebuilding the human face could be used to great advantage in most head and neck surgery. These techniques include skin grafting to replace missing surface or features, muscle transplants for paralyzed facial muscle, nerve grafts and transplants, bone grafts to rebuild jaws or nose, and blood vessel grafts for arteries.

Maxillo-facial surgery is a term generally used to denote a field related primarily to dental surgery and jaw deformities.

See also PLASTIC SURGERY; TRANSPLANTS, TISSUE AND ORGAN.

(M. T. E.)

HEADDRESS, a covering for the head, which may be considered as (1) protective, originating as a defense against climate and physical violence; (2) ceremonial, as a badge of rank and office. Frequently combining both functions, its history is bound up with the mask (*q.v.*), the veil, the coiffure and the tonsure (*q.v.*); its aesthetic development belongs to a later period.

The additions and changes made to the hair, the natural protection, whether defensive or ceremonial, appeared first and chiefly among men. Women wore their hair long, while men cut their hair or shaved their heads. The practical band employed to confine the hair and keep it from the eyes, in widespread. use among primitive and savage people, gave rise to a variety of headdresses worn chiefly by women and surviving in historic civilization, while the comb and hairpin, assuming ornamental forms, became essential elements in the woman's headdress in many lands. Two pins, worn right and left, ornamented with artificial flowers and terminating in vestigial spoons are the usual hair ornaments among the women of eastern Asia.

Defensive and protective head coverings fall into two general classes: (1) the hat and helmet type; (2) the cloth or garment tied around or worn over the head, such as the turban. The classic world of Greece and Rome, wearing a garment that when necessary was drawn over the head, eschewed other coverings. The hat or helmet arose as a hide or leather head cover in the north and as a wood or basketry sunshade in the tropics, metal being a later replacement. A round cap, made of cloth or felt, closely fitting the skull or terminating in a peak, and later truncate, appeared early in western Asia. The turban was wound either directly around the head, or usually around such a cap. Its size, shape and colour varied in different countries and in accordance with the rank and occupation of the wearer, and to it, as well as to the felt cap, an aigrette or jewel was sometimes added as a badge of regal and other rank.

Ceremonial headdresses are varied and complex, and their beginnings may be traced to primitive conditions. Like the mask, they were assumed frequently to identify the wearer with a divinity or to perpetuate the tradition of a divine ancestor. Chinese imperial headdresses bear the symbols of the sun and moon. The pointed crown may be regarded as a solar emblem. The custom of shaving the head was common at the initiation of a warrior or priest, but a head ornament or cap was commonly a badge of rank and its prerogatives jealously guarded. In China and Japan a straight, standing knot was left on the top of the head to which the imperial cap was attached by a transverse pin. The North American Indian warrior shaved his head. leaving a medial crest, or wore a similar crest made of the hair of rhe moose in which a tablet bearing the symbol of a bird was embedded. This object, tied to the so-called scalp lock, serves to explain the feathers fastened to his hair as well as his feather headdresses. The peacock feather badge of the Chinese Manchu dynasty had a similar mechanism. The feathers of the Plains Indian war bonnets, assumed to symbolize exploits, may be regarded as a composite and cumulative expression of the bird on the tablet. The horns of these war bonnets were those of the buffalo. A miniature netted shield and two feathered darts, emblems of the Twin War Gods, were of widespread recurrence in the headdress of the Indian warrior. The aboriginal headdresses of the Indian tribes of the North American continent may be regarded as emanations from ancient Mexico, where elaborate headdresses of feathers were worn by the priests and warriors who personated the gods. The military headdress of historic Europe was in the main defensive, but the bear skin shako and lofty plumed hat of the 18th century were intended to increase the apparent height of the wearer and impress the enemy. Ecclesiastic headdresses both east and west had secular origins.

The ceremonial crowns and headdresses of women were borrowed and imitated from those of their consorts, whose rank they shared. The peasant wedding-crowns of central Europe are reminiscent. Flowers, natural and artificial, were their common and widely used hair ornaments, but the rule that women should not appear in church uncovered led to the universal use of the women's head cloth or kerchief in Catholic Europe. The sunbonnet is a combination of this cloth with a band, by which it was tied over the head. The headdress of fashion for both men and women reached its highest development in Europe in the 18th century. Its simplification due to the general adoption of short hair resulted in the employment of the felt hat worn by women in Europe and America. (*See* also COSTUME DESIGN, THEATRICAL; DRESS.)

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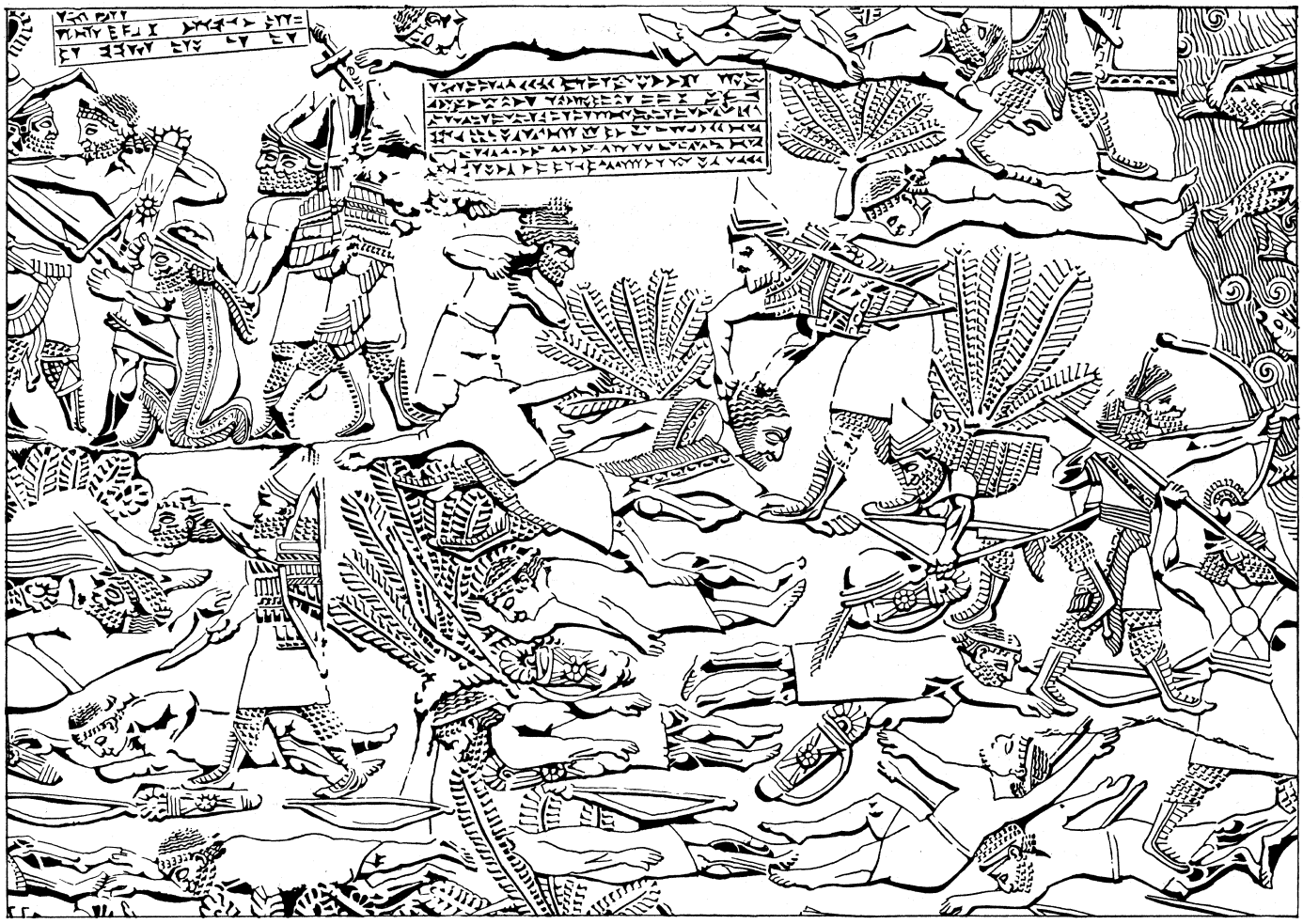
(S. Cu.)

HEAD-HUNTING. The practice of head-hunting, although no doubt due partly to the acquisitive instinct, arises from a belief in the existence of a more or less material soul matter on which all life depends. In the case of human beings this soul matter, often, apparently, in diminutive human form, is located particularly in the head. In abstracting a head the soul within is captured and thus added to the general stock of soul matter belonging to the community and so contributes to the fertility of the human population, the cattle and the crops; for the soul is conceived of, according to the Karens of Burma at any rate, as a sort of pupa, filled with a vaporous substance which bursts, its contents spreading over and fertilizing the fields, passing again through the eaten grain or herb into the bodies of men or animals and so again into the seminal fluid enabling men and animals to propagate life. While precisely the same formula cannot be postulated of all head-hunters, head-hunting is generally based on a similar belief in a cycle of life dependent on the possession of soul (*see* METEMPSYCHOSIS), and on a belief in life as something concrete and transferable.

Head-hunting is therefore associated (1) with ideas regarding the sanctity of the head as the seat of the soul; (2) with some forms of cannibalism where the body or part of the body is consumed in order to transfer to the eater the soul matter of the viand; and (3) with phallic and often fertility cults intended to imbue the soil with productivity. It may thus develop into human. sacrifice, a practice which has been generally associated with agriculture. Head-hunting, or at any rate some practice closely allied to it, has been found sporadically all over the globe either actually existing or in some degenerate survival.

In Europe the practice actually survived until the early 20th century in the Balkan peninsula, where the taking of the head affected the future life of the soul in some way that is no longer quite clear, but no doubt implied the transfer of the soul matter of the decapitated to the decapitator. The complete head was taken by Montenegrins as late as 1912, it being carried by the lock of hair worn allegedly for that purpose. In the Balkan war of 1912–13 nose-taking was substituted, and it was the practice to cut off the nose and upper lip nith the moustache by which it was carried, just as in Kafiristan and in Assam an ear was sometimes carried off instead of the whole head. In the British Isles the practice continued approximately to the end of the middle ages in Ireland and the Scottish marches; and in Ireland, until the 20th century at any rate, a Martinmas pig was killed that the fields might be sprinkled with blood and so rendered fertile. In some parts of the continent murderers have been known to eat part of their victims to secure themselves against ill will on the part of the ghost. The underlying idea is, no doubt, that the consumption of the flesh leads to spiritual identity.



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PORTION OF ASSYRIAN BAS-RELIEF DEPICTING ASSUR-BANI-PAL'S SECOND WAR AGAINST **ELAM**, *c.* 650 B.C.: ON THE LEFT IS SHOWN THE LAST STAND OF TE-UMMAN. **KING** OF **ELAM**, AND TAMRITU. HIS SON. AND IN CENTRE, THE BEHEADING OF TE-UMMAN AND TAMRITU

In Africa the principle involved has shown itself rather in the form of human sacrifice than of true head-hunting. Dahomey and Ashanti being notorious examples; but even here the fact that the human sacrifices in Dahomey made the rain magic more efficacious suggests the working of the same ideas. while an instance is known of a Matabele chief who anointed his body and fertilized his fields with human fat. So, too, the eating of an enemy's heart has been reported from Dahomey and Whydah. and the use of skulls as drinking cups from the Guinea coast. Bona fide head-hunting occurred in Kigeria, where a number of usages strongly suggest Indonesian culture. As in Indonesia, head-hunting among the Kagoro, and perhaps other tribes in Nigeria, mas associated with the fertility of the crops, with marriage, and with the service in the next world by the victim.

In Asia Herodotus mentions head-hunters, and on a bas-relief from Kineveh in the British Museum is represented a battle in the 7th century B.C. between Assur-bani-pal and the king of Elam. in which the Assyrians are depicted as cutting and carrying off the heads of the slain. In Kafiristan on the northwest frontier of India head-hunting was practised until about the end of the 19th century, women showering wheat upon men returning with heads from a successful raid. In the northeast of India. Assam was famous for head-hunting. All the hill tribes living south of the Brahmaputra — Garos, Khasis, Nagas and Kukis — formerly were head-hunters, and some of the Naga tribes continued to practise the decaying cult.

Head-hunting in Assam was normally carried on by parties of raiders who depended on surprise tactics almost entirely. The heads. and sometimes also the hands and feet or even the whole limbs, were cut off and carried home to the village. where the head was usually placed on a stone or pile of stones kept for that purpose. The practice of cutting off the limbs had possibly a ditierent origin, as there were tribes north of the Brahmaputra who did not take heads, but did cut off the feet and hands of slain enemies, presumably to incapacitate the ghost. The skull was subsequently variously treated. After its virtue had passed into the stone on which it was laid: it was either buried face downward (as by the Angami tribe), hung up in trees (as by Semas and Lhotas) or suspended in the chief's house or the bachelors' hall. In the latter case some tribes decorated it with a pair of buffalo horns, probably as a fertility symbol, and with long tassels of a broad-bladed grass which rustled when the skull was swung by a dancer at a feast, much as in Borneo. If several participants in a raid were all in at the death, the head was often divided on a fixed system. certain definite portions going to the first, second and third spears, etc. The insignia and, where tattooing was practised. the tattoo patterns worn by the successful warrior had specific reference to success in head-hunting. Thus the Angami warrior wore one hornbill feather for each success — "touching-meat" as it was called — while the Konyak warrior had his neck tattooed only if he had actually performed the act of decapitation in person, though he might have his chest tattooed for "touching meat" and his face for the act of killing the enemy in person. With the Naga, the genuine head-hunter, a head had to have cut. its teeth to count, and a female head was at least as good as a male; but with the Kuki, whose cult was probably mixed and whose desire for heads was merely to supply a dead relative with servitors in another world, any head, even that of an embryo, was good. The Kagoro and Moroa tribes of West Africa, like the Kuki of Assam and the Kayans of Borneo, desired slaves in the next world rather than soul matter in this. The Naga never took the head of a fellow-villager even though clan feuds within the village were very bitter and lead

to much bloodshed, and even outside the village heads were not as a rule taken between men of the same or nearly related clans, a self-denying ordinance shared with the Kagoro. The younger women were everywhere great instigators of head-hunting, and refused to marry men who had not "touched meat," probably with the idea that until they had taken life they were unlikely to beget offspring.

In Burma several tribes have followed similar customs. The Wa tribe observed a definite head-hunting season when the fertilizing soul matter was required for the growing crop and all wayfarers moved about at their peril. In Borneo, Indonesia generally, the Philippines and Formosa, similar methods of head-hunting obtained, and the hill tribes of Malaya and Indochina probably are or have been head-hunters at some period. The Ibans of Borneo were particularly enthusiastic in this respect. The practice was reported of the Philippines by Martin de Rada in 1577, and was only abandoned by the Igorot and Kalinga of Luzon at the start of the 20th century, while in Formosa it prevailed among the hill tribes. Elsewhere in Indonesia it extended through Ceram where the Alfurs were head-hunters, to New Guinea, where the Motu, like the Lhota Naga of Assam, wore a hornbill's head as the insignia of achievement; here and there, as in the Battak country and in Timorlaut, it seems to have been replaced by cannibalism.

In New Guinea the Tugeris used a bamboo knife for the act of decapitation, perhaps because iron would adversely affect the soul within. Throughout Oceania head-hunting prevailed sporadically till comparatively recently. In the Solomon Islands the actual expedition to obtain a head formed the climax in a series of ceremonial acts extending over a number of years, and the suppression of head-hunting, on which depended an important part of the social life, was a serious factor in the decay of society and the decrease of population which followed under British administration. Throughout Oceania head-hunting was closely associated with cannibalism and the latter institution tended to obscure the former, but in many islands the importance attached to the head was unmistakable. In parts of Micronesia the head of the slain enemy was paraded about with dancing, which served as an excuse for raising a fee for the chief to defray public expenditure, after which the head would be lent to another for the same purpose. In Melanesia the head was often mummified and preserved, and sometimes, as in New Britain, seems to have been worn as a mask in order that the wearer might acquire the soul of the dead man. Even in Australia this underlying principle was active as it was reported that the Australian believed the spirit of a slain enemy entered the slayer. In New Zealand the heads of the foe were dried and preserved so that the tattoo marks and often the actual features were recognizable; this practice led to a development of head-hunting when tattooed heads became desirable curios and the demand in Europe for Maori trophies caused "pickled heads" to become a regular article of ships' manifests.

In North America the general practice was to take the scalp rather than the head, indicating probably that the soul was thought to be located in the hair; an idea present in the Biblical story of Samson; common in Malaya and Indonesia, where Nagas and Borneans used the hair of their dead enemies for ornaments, as did the North American Indians; in Oceania, where the Marquesans used the hair of the victims of their cannibal rites for making arm rings and necklets of magic virtue; and frequent in South America, where the heads were often preserved, as by the Jivaros, by removing the skull and packing the skin with hot sand. thus shrinking it to the size of the head of a small monkey while preserving the features intact as a vivid portrait in caricature. There. again, head-hunting was probably associated with cannibalism in a ceremonial form. and the heads of certain animals were also treated similarly *(see* LYCANTHROPY). Head-hunting, therefore, has been world-wide. It was associated with tribes still living in the stone ages, and may even go back to palaeolithic times; as in the Azilian deposits at Ofnet in Bavaria, heads were found carefully decapitated and buried separately from the bodies, indicating beliefs in the special sanctity or iniportance of the head.

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HEALTH, a condition of physical and mental well-being. A selected list of the *Britannica's* articles on the preservation and restoration of health is given under MEDICINE AND SURGERY (ARTICLES ON). Customs connected with the drinking of "healths" are discussed in TOASTS.

HEALTH, EDUCATION AND WELFARE, DEPARTMENT OF: *see* GOVERNMENT DEPARTMENTS: *United States.*

HEALTH, MINISTRY OF: *see* GOVERNMENT DEPARTMENTS: *Great Britain.*

HEALTH AND SAFETY LAWS. One of the earliest and most important objectives of government and law is the provision of public health and safety. In many societies law as a distinct means of social control originates when some official agency is created to protect communal health and safety from some supposed danger threatened by natural or supernatural forces. In primitive cultures, and in western civilization up to the middle ages, this social concern usually was manifested in a negative way by the isolation or destruction of the patient in order to protect the healthy. The public health laws, social legislation and preventive medicine of today largely are the products of the scientific advancements of the 19th and 20th centuries.

This article is divided into the following sections:

I. INTRODUCTION

The interest of the individual and society in health and safety finds expression in the orders of executives, the ordinances and statutes of legislatures and councils and the decisions of courts and administrative bodies. That such an interest is conceded to be among the most important values is also shown by the deference courts have shown for legislative and executive formulations of health and safety policy. In the United States, even during the period when courts wielded their power of judicial review to an unprecedented extent and readily substituted judicial preference for legislative judgment, health and safety laws were subject to milder scrutiny than measures involving, for example, economic experimentation. The common law at times gave priority to health and safety matters over property rights and economic interests.

Ultrahazardous undertakings, the creation or maintenance of dangerous conditions or objects, long have been a basis for special classification. Although most states have rejected the English

doctrine of *Rylands* v. *Fletcher* (1868). which imposes strict liability for the escape of dangerous substances, the concept of nuisance has been construed to cover such cases.

The common law created an implied narranty of fitness for human consumption in the sale of foodstuffs, and the liability of products today may be based on the fact of sale rather than on negligence in processing or failure to inspect. In short, danger to human health and safety is a special circumstance and a paramount value. Summary procedure and something less than the due process usually required may be invoked when health authorities or fire marshals act to cope with emergency, and both the police power of the state and the power of eminent domain may be utilized to protect or promote public health and safety.

II. HISTORY

In addition to isolation of the sick, principles of hygiene and sanitation have been developed by many preliterate peoples. Whenever these matters are deemed to be of sufficient social concern, they receive the coercive sanction of law, as well as the informal sanctions of custom or religion. The preservation of peace and order, the conservation of manpower and a desire to prevent offenses that may provoke the wrath of the gods against the community are among the immediate objectives of law that may be included under the general title of public health and safety laws. They are the forerunners of what is termed the police power of the modern state.

The history of health and safety laws has been determined in large measure by the influences of religion and science and by political and economic forces. A public concern with the health problems of community life, the control of communicable diseases and improvement of environmental and sanitary conditions, such as the provision of food and water, medical care, and sewerage and drainage facilities, may be found in varying degrees in primitive, ancient and modern societies. Moreover, religious and health objectives may be inextricably intermingled, as, for example, in dietary laws, the rules of hygiene and precautions against contagion specified in *Leviticus* and *Numbers,* prohibitions against consanguineous marriages and the merging of functions in priests and shamans. In the western world there was a close relationship, if not identity, between church and state until the Reformation, and for centuries virtually all literate men were clerics. which meant that most scientific knowledge was in their hands and subject to church control.

1. Early Influences. — The emphasis of the early church upon spiritual matters and the belief that disease and death were the wages of sin stood as major obstacles to a positive program for public health and social reform On the other hand, the church and its religious orders did establish and maintain relieving institutions for travelers, the sick and widows, such as that founded by Basil the. Great in AD. 370 at Caesarea; and Pope Leo XIII's encyclical *Rerum novarum* (1891) and Pope Pius XI's *Quadragesimo anno* (1931) were most important for the social reform movement of the 19th and 20th centuries. It is only since the Industrial Revolution, however, that cleanliness has been officially promoted.

The middle ages (about A.D. 500–1500) saw a decline from the standards of hygiene and sanitation of classical Rome. Although we are greatly indebted to the Greeks for principles of personal hygiene and to the Romans for the development of public sanitation, there are records of elaborate programs in even more ancient times. Ruins in the Indus valley and at Harrapa, in the Punjab, reveal that building codes were in effect and that sanitation engineering was far advanced as early as 4000 B.C. Egyptian ruins dating from the middle kingdom (2100–1700 B.C.) include bathroom facilities and sewerage systems as do those of the Incas in the new norld. In addition to the formulation of principles of hygiene, the Greeks were responsible for the first attempt to show a causal relation between environmental factors and disease. The book in the Hippocratic collection known as *Air, Waters and Places* for over 2.000 years served as the basic text on epidemiology and helped to sustain the miasmatic (contaminating atmosphere) theory of disease *(see* HIPPOCRATES AND THE HIPPOCRATIC COLLECTION) until use of the microscope led to the discovery of microbes and the beginning of bacteriology *(q.v.)*. The Romans perceived a relation between swamps and malaria, devised crude respirators to protect workers from dust, in the 2nd century instituted a public medical service built sewerage systems and public baths and engineered 14 great aqueducts. They also built the first hospitals and codified and successfully administered health laws. Officials were appointed to maintain the banks of the Tiber, to guard the aqueducts against pollution, to inspect and maintain sewers, to destroy impure foodstuffs, to check weights and measures and to regulate public baths. brothels and burial grounds. Justinian I, when one of the worst plagues in history came to Byzantium in 532, set up quarantine posts and required certificates of health for admission to that city.

2. Middle Ages. — Upon the disintegration of the Roman empire, there was a general decline of urban culture and with it an abandonment of public health measures. Ryzantium became the cultural and medical centre for Europe, and from there Greco-Roman medical knowledge spread to the Arab world, while in the west, health problems were still dealt with largely in terms of magic and religion. During medieval times some of the larger monasteries had proper water supplies and heating and ventilation facilities. but smaller buildings did not. Most medieval cities had a chronic problem in trying to provide a sufficient supply of nonpolluted nater and in protecting the public from disease. During the middle ages in England the common-law concept of public nuisance provided a means for relief against some flagrant cases of pollution of water supply as did the common-law crime of malicious mischief, and in both England and on the continent, ordinances and statutes were enacted to outlaw some of the most prevalent threats to public health. For example. Douai, France, in 1271, Augsburg, Ger., in 1453 and Rome in 1468 forbade tanners to wash animal skins on the banks of streams. dyers to pour dye residue therein and the public from washing clothes at a river which served as a source of water supply. Early in the 15th century several German cities forbade the construction of hogpens facing the street. In 1185 the streets of Paris were paved to help keep the city clean. London from 1309 had ordinances dealing with sewage disposal, and Milan from the 14th century had statutes regulating cesspools and sewers. Most of these ordinances and laws, however, received only sporadic enforcement and tended to become dead letters.

The health measures that received the most conscientious enforcement during the middle ages were those pertaining to the sale of adulterated or contaminated food and those providing for quarantine in the case of epidemics. Municipal authorities in many places policed the fairs and market place to protect purchasers of food. Inspection mas practised, and detailed regulations were enforced. For example, Augsburg in 1276 ordered meat that was not freshly slaughtered to be sold at a special stand, and the Florentines forbade the sale on Monday of meat that had been offered for sale the previous Saturday.

Although epidemics were regarded by many as a punishment for man's sin, the transmissibility of certain diseases was well known during the middle ages and had been for centuries. Thucydides had portrayed a vivid account of an epidemic during the second year of the Peloponnesian War. Between the plague of Justinian (A.D. 543) and the Black Death (1348) there were a large nurnber of plagues, involving such diseases as leprosy, bubonic plague, smallpox, diphtheria, measles, influenza and sweating sickness, and lesser diseases. The medieval urban dweller lived in constant fear of epidemics, and when leprosy reached serious proportions in the 13th and 14th centuries, quarantine laws were rigidly enforced. At the beginning of the 13th century, in France alone there were about 2,000 leprosaria, and in all of Europe the number probably exceeded 19,000.

The third Lateran council in 1179 promulgated detailed rules to govern the commitment of lepers. The experience with lepers was carried over when the Black Death (bubonic plague) killed thousands of workers in the 14th century *(see* PLAGUE). Suspicious cases were required to report to local authorities who examined them; if the patients were found to have the plague, they were iso-

lated, as were all those who came into contact with them, food and necessities were provided, the dead with their personal effects were buried outside the city, and the place where they had died was fumigated. Venice, the chief port for trade with the orient, usually is credited with originating the pattern of quarantine procedure that was in effect during the middle ages, and other seaports also established observation stations and isolation hospitals.

In England from the 12th to the 15th century more than 720 hospitals were established, 217 of which were for lepers. At the beginning of the 14th century, Paris had about 40 hospitals and at least an equal number of leper houses. During the latter part of the middle ages, cities and guilds took an active part in founding and maintaining hospitals.

3. Later History.—Europe.—By the close of the middle ages, medicine and public health had fallen under local governmental control. Regulations protecting the water supply from pollution were supplemented by other provisions dealing with street cleaning, garbage disposal and the like. all of which collectively might be termed sanitary codes. Physicians and surgeons were required to follow rigid codes and set fee schedules. In addition, writings on nutrition began to appear, and public bathhouses were licensed. When syphilis became widespread early in the 16th century, the first control measures were directed against prostitutes.

The attempt to deal with public health problems on a municipal basis was far from successful. Inland cities were all but defenseless against the spread of disease from the seaports. Moreover, in the larger cities the administration of particular ordinances was delegated to various boards, commissions and officials, so that the net result was a crazy quilt of sanitary committees. London in the 1830s divided such authority between the city corporation and the city companies, 7 boards of commissioners for sewers and nearly 100 paving, lighting and cleansing boards, and there were about 172 vestries of one sort and another and boards of guardians appointed under the poor lams. The parish of St. Pancras alone had 21 paving and lighting boards, on which sat about 900 commissioners.

Colonial America.—Colonial America followed the pattern of utilizing inspection and quarantine for communicable diseases and the enactment of sanitation legislation. The account of George Percy regarding the settlement of Jamestown, Va.. describes the "cruell diseases, Swellings, Fluxes, Burning Fevers" and famine that afflicted that colony. Almost half of the 100 (or 102) Pilgrims that landed at Plymouth, Mass., in Dec. 1620 died within three months after arrival. During the winter before the Pilgrims' arrival, an epidemic reduced the numbers of Indian warriors of New England from 9.000 to a few hundred. Inoculation was brought to the colonies by Zabdiel Boylston and Cotton Mather and later was regulated by colonial legislatures. As early as 1647, ships from the West Indies were quarantined in Boston harbour; and in 1663, during a smallpox epidemic, New York regulated entry into its city by travelers from contaminated regions. Abatement of public nuisances seems to have been in the hands of local authorities throughout most of the 17th century, but a South Carolina statute of 1692 forbade swine running at large in the city of Charleston and directed all persons to cut noisome weeds in and about the lots and streets. During the same year the Massachusetts general assembly empowered selectmen and justices to assign locations for slaughterhouses and places for the testing of tallow and the currying of leather. The charters granted by William Penn to Philadelphia and Chester, Pa., in 1701 conferred power upon mayors and magistrates to abate nuisances. Detailed quarantine regulations were enacted in Massachusetts in 1701. The first American health board was appointed in Baltimore, Md., in 1793, and by 1797 there were similar boards in New York and Massachusetts.

Influence of the Industrial Revolution.—The industrial revolution (q *v.*) occasioned a tremendous increase in urban population, and slum conditions became acute in many manufacturing areas. The first English attempt at slum clearance was in London in the 1760s, when many timbered buildings were pulled down and replaced by brick structures, and streets were paved, drained and lighted. In addition to disease and slum conditions, the urban population faced poverty and frequent unemployment. The Elizabethan poor laws imposed the duty on the individual parish to provide relief for the indigent (see Poor Law).

III. SOCIAL REFORM

By the beginning of the 19th century, in England and on the continent, the interrelationship between poverty, disease, physical environment and crime was apparent, and the view that such conditions were neither inevitable nor irremedial was gaining ground, To the rationalists of the age of reason, a scientific approach to social problems would provide the answers. Industrialists, such as Sir Robert Peel and Robert Owen, and physicians, such as Sir John Simon and Thomas Southwood Smith, joined the social reform movement under the leadership of Jeremy Bentham and Edwin Chadwick. Royal commissions investigated and reported, studies were made, statistics were compiled and, beginning in the 1830s, social legislation was enacted.

An integral part of the social reform movement was the compilation and publication of statistics which afforded a factual basis for legislative and other investigations and reports which were an essential prelude to legislation and which served to create a demand for reform by informing the public of existing conditions. William Farr was perhaps the greatest medical statistician in the 19th century, but the father of political arithmetic was the 17th-century physician, scientist and economist William Petty, who urged the collection of numerical data on population, education, diseases, revenue, etc. Petty's friend John Graunt wrote the first important study of health statistics in 1662. In Germany the philosopher Gottfried Wilhem Leibnitz recommended statistical investigations of health problems and in the 1680's published several essays on the urgent need for vital statistics. Leibnitz's work was carried on and furthered by his contemporary Veit Ludwig von Seckendorff, who is credited with having developed the public health philosophy for Germany that was systematized by Johann Peter Frank and enacted into law by Bismarck. Sweden was the first country, however, to require nationwide reporting of vital statistics, legislation having been passed in 1748, following the recommendations of Pehr Elvius, mathematician and secretary of the Swedish Academy of Science.

In the United States, Massachusetts was the first state to establish a bureau of labour statistics. The first important study of public health was the 1845 report of John Griscom, city inspector for the New York board of health. During the same year the National Institute of Washington undertook a survey of the nation's health. Perhaps the best-knon-n early document dealing with public health problems in America was the Shattuck report, published in Boston in 1850. The report was written by Lemuel Shattuck, a Boston bookseller and publisher, who had helped found the American Statistical society in 1839 and had secured passage in 1842 of a Massachusetts vital statistics law that became a model for other states. Shattuck's work also led to the first effective state health department, namely that created in Massachusetts in 1869. Several other states followed the Massachusetts example within the next few years. In the second half of the 20th century the compilation of vital statistics was regarded as a matter of general public importance and in the United States constituted a proper exercise of police power. Almost all of the health, safety and welfare laws that were passed in the 19th and in the first half of the 20th century were based on factual studies and statistical reports. Louis D. Brandeis, as counsel in a case involving the constitutionality of Oregon's ten-hour day for women workers, secured judicial acceptance of such material when his so-called Brandeis brief was relied upon by the supreme court in its decision.

IV. EARLY LEGISLATION

1. Europe.—There were but few examples of social or health legislation on a national scale before the 19th century. In order to check the high rate of infant mortality and for reasons of public morality, parliament passed a series of gin acts, culminating in an act of 1751 which gave control of licensing to magistrates, and perhaps the first example of social insurance was an act of 1757 "for the relief of coal-heavers working upon the River Thames,"

which required the employer to deduct sums from employees' wages for a fund from which benefits would be paid in case of sickness, invalidity, old age or death. Because of its abuse by employers, however, this early insurance scheme was abolished in 1770 but was revived in 1792, when a similar act mas passed providing for trustees to manage the fund. The Health and Morals of Apprentices act, sponsored by Sir Robert Peel, was enacted in 1802 to improve the conditions of child labour in the cotton mills. Although this legislation was largely ineffective, it did establish the government's interest in industrial conditions and led to agitation for child labour laws in other industries and countries.

The Benthamite reformer Edwin Chadwick, who was convinced people were poor because they were sick, was chairman of both the commission that reported on the poor laws in 1834 and the commission that reported on public health in 1844 and 1845. These reports eventually were embodied in legislation and established national supervision over health, safety and social problems. The Factory act of 1833 was the immediate forerunner of modern industrial legislation, and the Liverpool Sanitary act of 1846 provided for health officers and borough engineers for that city. The Nuisances Removal and Diseases Prevention act and the Baths and Washhouses act, passed the same year, were preludes to the Public Health act of 1848. The first general housing acts were passed under the sponsorship of Lord Shaftesbury in 1851.

In addition to the rise of social legislation in England, similar movements gained momentum in Germany and France. Johann Peter Frank, German pioneer in public health, ambitiously undertook to systematize all existing knowledge on the subject and to devise detailed codes of hygiene for enactment. Frank, because of his broad scholarship, was one of the first to urge international regulation of health problems and creation of a national health authority to co-ordinate matters within the country. Advanced by Wolfgang Thomas Rau and Franz Anton Mai and endorsed by Frank was the creation of "medical police" to make and enforce health and safety regulations. In France, during the Revolution, the constituent assembly, on the motion of Joseph Ignace Guillotin, created a Comité de Salubrité. In 1793 and 1794 a national system of social assistance, including medical care, was passed. Both France and Germany thus became committed to the proposition that government had a positive duty to promote the health, safety and welfare of workers. In 1884, when Bismarck indemnified workers against the risk of industrial accidents and provided for maternity care and benefits or pensions for sickness, disability, old age and death, Germany provided the inspiration and established the model for subsequent social legislation elsewhere in Europe and in America.

2. United States. — In the United States the same patterns that led to English legislation may be found, although English social legislation generally antedated its American counterpart by at least a generation and the American doctrine of judicial review slowed down development. Early in the 19th century there was considerable support for maximum hour laws to protect women and for restrictions upon child labour. A few of the industrial states passed such laws, but there was no effective enforcement because of fear of competitive disadvantage. For example, Massachusetts in 1842 enacted a child labour law, and in 1848 Pennsylvania prohibited the labour of children under the age of 12 in certain mills and limited the hours of work to ten unless there was a special contract. The latter provision was nullified when special contracts became customary, and since in any event the statutory sanction mas merely a $50 fine, the statute had little effect. As early as the 1830s some industrialists suggested national legislation to regulate child labour and hours of work. Until after the American Civil War, state social legislation was regarded as constitutional. The judicial canon of *laissez faire* philosophy that social legislation violated the due process clause or impaired the obligations of contracts did not gain currency until about the 1890s.

Congress enacted only a few pieces of social legislation before the 20th century. In 1798 a federal scheme was established of state insurance for disabled seamen based on a 20 cent per month deduction from wages, and in 1870 the deduction was increased to 40 cents. In 1878 the National Quarantine act was enacted and empowered the surgeon general to enforce port quarantines, and the following year the national board of health was established.

V. RISE OF INDUSTRIAL MEDICINE

In the past most regulation in behalf of the worker was an expression of religious conviction, such as the duties imposed upon the master in Deuteronomy, or a reflection of the ancient concept that a ruler was supposed to be a father to his people. During the middle ages the craft guilds regulated working conditions in detail. Rothari, king of the Lombards, in 643 ordered that bodily harm caused by accidents to builder's labourers should be compensated. The Ordinance of Labourers in 1349 and the Statute of Labourers in 1351, enacted in order to negate the economic bargaining power of the survivors of the Black Plague, impaired the mobility of the workers, as did the settlement laws that were part of the poor laws after 1601. Since workers in England were not free to travel about and to seek other jobs, humanitarian impulses alone furnished an incentive to improve their lot. Of greater direct importance were the decrees issued by Queen Elizabeth in England and Colbert and Vauban in France which regulated working conditions.

Industrial medicine, the enactment of factory laws and safety laws and eventually the expansion of workmen's compensation acts to include occupational diseases in their coverage were a direct application of the new enlightenment. The founder of industrial medicine was Bernardino Ramazzini, professor at Modena and Padua, Italy, uho in 1713 published his book *De morbis artificum diatriba*, which discussed the relation between disease and poverty. Before and after Ramazzini there were reports on industrial health, such as the pamphlet by Ulrich Ellenbog in 1473 "on the poisonous wicked fumes and smoke" that afflicted goldsmiths, the treatise on the diseases of miners by Georgius Agricola in 1556, that by Percivall Pott in 1775 on the diseases of chimney sweeps, and the comprehensive study of industrial disease and poverty by Charles Turner Thackrah in 1831. The latter study was relied upon heavily by social reformers such as Chadwick and Lord Shaftesbury.

1. Liability in Industrial Accidents. — Common-law principles in England and the United States resulted in placing the cost of industrial accidents on injured workers in the vast number of cases. To recover in a suit against his employer, the employee had to prove that the master was either personally at fault or had violated a nondelegable duty. Moreover, the injured worker had to overcome the defenses of contributory negligence, assumption of risk and the fellow servants rule, which meant that if the injured man had himself been careless for his own safety, or knew or should have known of the danger or was hurt because one of his fellow workers was negligent, the employer was not liable for damages. Although the courts recognized that certain nondelegable duties were assumed by the employer, such as an obligation to provide a reasonably safe place to work and reasonably safe machines, tools and appliances, kept in a reasonably good state of repair, and the issuing of safety rules and warnings of dangerous conditions, nonetheless a violation of such duties did not result in employer liability if one of the common-law defenses was applicable. Most significant, the common-law defenses frequently barred employer liability even though the employer had violated a health or safety statute or ordinance, as, for example, when the employee knew of the existing conditions and was said to have assumed the risk.

In England in 1880 parliament enacted the Employers' Liability act, which modified the defense accorded by the fellow servants rule but left untouched the defenses of contributory negligence and assumption of risk and required that there be negligence by the employer or a supervisory employee for the worker to maintain suit against his employer. This act was ineffective because English courts construed it so as to permit employees to contract away their rights under the act. The German compensation insurance laws enacted under the sponsorship of Bismarck in 1884 set the pattern for future legislation, and parliament's Workmen's Compensation act of 1897 was modeled on its provisions, as were the later U.S. statutes *(see* below).

In the Gnited States prior to 1880 five states enacted statutes that made railroads liable to employees upon the same basis as

they were liable to strangers. Georgia enacted such a law in 1855, Montana territory in 1873.

Between 1885 and 1910 most states enacted some kind of employer liability law, either trying to abrogate some of the common-law defenses or to impose safety inspection and regulation upon hazardous industries. In 1906 congress enacted the first federal Employers' Liability act, which covered railroad workers, but that act was held unconstitutional because employees not engaged in interstate commerce were included within its purview. The second Employers' Liability act was passed by congress in 1908 to remedy this defect and subsequently was upheld as constitutional. In effect, these railroad statutes abrogated the common-law defenses but required negligence for recovery. For example, contributory negligence by the employee diminished the amount of recovery had against his negligent employer, and assumption of risk remained a good defense until abolished by amendment in 1939.

2. Workmen's Compensation. — In the U.S., despite temporary setbacks and, for a time, strict judicial construction, workmen's compensation acts came to be enacted by each state. Additional congressional legislation covering occupations related to federal commerce, such as those of stevedores and longshoremen, were passed. All but a few states came to include occupational diseases, as well as accidents, as a basis for recovery when either arises out of and in the course of employment. Also. such acts have been extended beyond so-called hazardous industries to include most industrial and commertial enterprises. See WORKMEN'S COMPENSATION.

VI. PUBLIC WELFARE

Public assistance, unemployment compensation and social insurance of various kinds became the subjects of national legislation in Europe in the 19th century and in the United States in the 20th. Until the poor laws were enacted at the start of the 17th century, care of the indigent usually had been a matter for church charity or mutual aid by people of the same occupation. The Jews made and enforced regulations for the relief of the poor and regarded charity as a duty. Charlemagne ordered his counts to care for the poor at their own expense and made them *advocati* of the distressed. This action was the beginning of secularization and regulation of charity in Europe, and gradually poor relief was abandoned as a general function of the church and was assumed by the parish. From ancient times people in the same social class or occupation banded together in friendly societies that arranged burials, financial help where needed and benefits in case of sickness or widowhood. In time these societies expanded beyond a particular calling, and in England at the beginning of the 19th century they had a membership of 1,000.000 out of a total population of 9,000,000 and were almost as numerous in Holland and Belgium. Neither public nor private assistance, however, was adequate for the problems created by great depressions and chronic unemployments, and a national responsibility for the care of the sick and the poor was repeatedly urged. Sir Thomas More in his *Utopia,* nhich appeared at the beginning of the 16th century, advocated public health measures, social insurance, social security and public housing. "Freeborn John" Lilburne, pamphleteer for the Leveller movement during the Puritan revolution, called for a comprehensive program of government action to cope with social problems. Daniel Defoe in his Essay *Upon* Projects, at the end of the 17th century, proposed many reforms, including social insurance, and Denis Diderot in his Encyclopaedia, in an article on the Hospital, outlined a public assistance scheme, including old-age insurance and medical care.

1. England. — England finally eradicated the last traces of its Elizabethan poor laws in 1948 by the enactment of the National Assistance act, which eliminated the old concepts of parish responsibility, primary family responsibility and the rules as to settlement and removal. Near the end of and immediately following World War II, parliament also passed the Ministry of National Insurance act (1944), the Family Allowances act (1945), the National Health Services act (1945) and the National Insurance act (1946). The report by Sir William Beveridge in 1942, experience with prior legislation, and postwar conditions combined to provide a favourable political climate for a comprehensive welfare system on a national scale. (See SOCIAL SECURITY: Social Insurance in Great Britain and the Commonwealth.)

2. United States. — Federal Legislation. — Although the department of health, education and welfare mas created in 1953, most social legislation continued to be based on federal-state cooperation rather than on an exclusively national basis. For example, such acts as the Sheppard-Towner act of 1921 (Maternity and Infancy act), the National School Lunch act of 1946 and Title V of the Social Security act are based on federal-state cooperation, the federal government extending grants-in-aid and setting standards and the states administering the programs. The United States has not moved as far as England and the Scandinavian countries in creating the welfare state, but there has been a steady trend toward adoption of the insurance principle as a basis for social legislation.

It was not until the depression of the 1930s that public assistance, unemployment compensation, social security benefits and an integrated program of welfare legislation were enacted for the nation as a whole. The Social Security act of 1935 and the Fair Labor Standards act of 1938 were perhaps the most significant pieces of social legislation congress enacted under its constitutional authority to regulate interstate commerce and things which affect such commerce.

Beginning in 1937 the supreme court upheld the validity of such legislation, overruling prior decisions that had held that congress had no authority to abolish child labour or to regulate wages and hours. The separation of powers doctrine was viewed by the court as exacting due deference for the legislative and executive judgment and determination of public policy, and the court declined to substitute its economic and social predilections for those of congress. Most important, the powers reserved to the states or to the people under the 10th amendment were held to be no limitation whatsoever upon federal power granted by the constitution. Consistently with this commitment to judicial humility, the court also permitted state legislatures to experiment with social legislation unless a federal statute or power had pre-empted the field, and state welfare laws mere sustained although analogous statutes formerly had been held unconstitutional. Sociological jurisprudence had replaced the *laissez faire* commitment that had dominated the supreme court from the 1890s to 1937.

Although health, safety and welfare legislation, whether enacted by congress or by the states, was in the second half of the 20th century regarded as a legitimate exercise of the police power of government, there remained many issues as to substance and procedure that might arise under such laws. The principal limitation upon an attempted exercise of federal power was that some basis therefore must be found in the constitution.

States' Powers. — State courts determine the constitutionality of state legislation under state constitutions. Historically, health regulations have presented numerous issues, including problems as to the delegation of authority by the legislature to health officials, the specification of sufficient standards to guide administrators so that an arbitrary discretion is not assigned, the reasonableness of rules and regulations promulgated by officials and the reasonableness of legislative classification. Moreover, local boards are confined to their own territory and must act within it or they are without legal authority. Usually, the courts will not review the judgment of health officials who have legal authority to exercise discretion, and a private person who alleges he was aggrieved by a board's action ordinarily cannot hold officials personally liable for action taken in good faith within the scope of their authority. An arbitrary, capricious or unreasonable exercise of power, or action that lies outside the scope of the power delegated by statute, may raise a due process issue under state or federal law. Courts are reluctant to enjoin health officials except where there is an obvious abuse of authority.

State health officials utilize many methods of regulation, including inspection, destruction of private property to prevent the spread of contagion or to abate a nuisance, closing of public places, disinfection and sterilization, vaccination and quarantine. Compliance with orders may be sought by injunctions or the imposition of fines. Some states do not require health officials to give no-

tice and to provide a hearing before taking summary action where the statute neglects such procedure, a condition which places a heavy burden on the citizen who cares to challenge the validity of the action in a subsequent legal proceeding. The state may act under either its power of eminent domain or its police power. Generally, if it exercises eminent domain, just compensation is due; such is not the case for an expression of police power. A citizen who upon reasonable grounds reports a suspected case of contagious disease to proper health officials usually is not held liable in damages to the person reported when the suspicion turns out to have been in error. One who negligently or deliberately infects another with a contagious disease may be held accountable for damages, at least if there was no consent to such contact.

VII. ENFORCEMENT OF LEGISLATION

1. Food and Drug Laws.—One of the most important areas of health legislation is that pertaining to adulteration. Both Athens and Rome had laws to prevent the adulteration of wine, and England prohibited the adulteration of certain foods from the time of Henry III. Parliament from time to time passed statutes prohibiting the adulteration of such commodities as tea, cocoa and beer, and in 1872 enacted the Adulteration of Food and Drugs act, which had general application to foodstuffs; it provided for inspection and analysis of samples and for levying of a £50 fine for the first violation and six months imprisonment at hard labour for a second offense. After that time additional statutes were passed to plug loopholes and to correct judicial construction.

In the United States an act prohibiting the adulteration of drugs was passed by congress in 1848, and in 1890 a similar statute was passed regarding food. Between 1880 and 1906 there were 103 bills introduced in congress to control interstate traffic in food and drugs, but none were enacted until the Pure Food and Drugs act of 1906 was signed by Pres. Theodore Roosevelt.

Difficulty was encountered in the enforcement of this act because of the definitions given to such terms as adulteration, the narrow construction given by the courts and the "distinctive name" exemption that permitted a manufacturer who adopted a distinctive name for his article to ship what he pleased. Moreover, the sanctions of a maximum fine of $200 for the first offense and $300 or a year's imprisonment, or both, for subsequent offenses, and the seizure provisions, did not prove to be successful deterrents.

Except for minor amendments, the 1906 act and similar state legislation remained in effect until the Federal Food, Drug and Cosmetic act of 1938 was passed following the tragic death in 1937 of at least 73 persons who had taken a drug known as Elixir Sulfanilamide. (Existing legislation did not prohibit the distribution of poisonous or dangerous drugs.) The 1938 act, within the limits of the commerce power, prohibits foods dangerous to health and also prohibits foods, drugs or cosmetics in insanitary or contaminated containers. Loopholes in the 1906 act, such as the distinctive name and compound exemptions, were eliminated. Penalties under the new law include seizure of the offending article and a maximum fine of $1,000 or a year in jail, or both, for each violation charged; in the case of intentional fraud or'a second offense the fine may be $10,000 and imprisonment for three years. In addition, the federal courts were authorized to issue injunctions to restrain further violations. Enforcement of the act was given to a food and drug administration, and inspection stations were set up in several large industrial cities.

In addition to the 1938 Federal Food, Drug and Cosmetic act, state legislation is important in covering food and drugs that are outside the scope of the federal act because of its limitation to interstate commerce. Of jurisprudential significance is the fact that under both the federal law and the statutes of some states it is not essential that there be a specific criminal intent for conviction. It may be enough that the manufacturer or processor intended to ship the articles in question even though he neither knew nor had reason to know that there was a violation.

2. Safety Laws.—The enactment of safety legislation has been contemporaneous with the passage of workmen's compensation acts and public health laws. In this area, however, education and the activities of voluntary groups have almost completely overshadowed legal developments. There has been an intensive safety movement in the 20th century, and safety codes have been devised by engineers for various industries. At the outset humane industrialists promoted accident prevention campaigns by imposing safety rules in plants. In part this may be due to the fact that employers have come to realize that safe working conditions are an asset to the business, particularly if the factory comes under workmen's compensation laws. In the United States, cities and states at an early date required inspections of steam-power boilers, and later on building inspectors, fire marshals and elevator inspectors exercised municipal authority. Mine safety was a subject for legislation in many coal-producing states, and the Safety Appliances act for railroads, originally passed in 1887, and expanded and amended in 1893, 1903, 1910 and 1920, was the first significant federal statute. The Walsh-Healey Public Contracts act of 1936 requires government contractors to comply with the health and safety laws of the state where the contract is being fulfilled. During and since World War II it has been one of the most important statutes because it reinforces state laws that otherwise might be ignored. For the most part, state safety laws have been strictly enforced only in a few industrial states that have provided a sufficient number of inspectors. Substantial progress was mainly due to the efforts of certain large employers and the top priority given by modern management to accident prevention. The American Standards association has promoted a safety code program for American industry, and the International Association of Industrial Accident Boards and Commissions has been a major force in the movement. The United States department of labour and, since 1953, the department of health. education and welfare are both concerned with certain aspects of the general problem of industrial safety. Federal Coal Mine Inspection acts, passed in 1941 and 1952, require inspection and reports, empower the director of the bureau of mines to forbid miners to enter dangerous portions of a mine and specify detailed rules concerning roof support, ventilation, equipment, fire protection and other safety matters.

Before workmen's compensation acts were securely established as constitutional around 1920, most state safety acts relied upon inspection and indirect enforcement through civil litigation in damage suits brought by injured workmen. After 1920, when damage suits all but ceased because most workmen were limited to compensation claims, administrative boards with power to make rules, investigations and reports and to seek injunctions became the mode of enforcement. In a few states, *e.g.*, Washington, educational standards of safety, as well as rules dealing with safe working conditions, were, in the early 1960s, issued by the supervisor of safety. Statutes which provide for apprenticeship systems, limit the hours of work or require rest periods may be classified as safety laws because of their bearing on accident prevention. The constitutionality of safety laws in the second half of the 20th century was usually upheld unless there was a showing of arbitrary action in a particular situation, and such regulations typically were enforced by inspection plus criminal or administrative sanctions. In addition to laws pertaining to industrial safety are statutes concerning regulation of traffic; inspection of theatres, schools and other public places; highways and sidewalks, public carriers, bathing beaches and fire prevention. It should also be noted that collective bargaining agreements frequently contain provisions that have a bearing on industrial safety and that joint committees of management and employees may co-operate in formulating policies and rules.

VIII. INTERNATIONAL EFFORTS

International concern as to health and safety has been expressed in the writings of public health pioneers, such as Johann Peter Frank, in international conventions, such as that held in Paris in 1851, and in health organizations within the framework of the League of Nations and United Nations (UN). The preamble to the constitution of the World Health organization (WHO) provides that "an informed opinion and active co-operation on the part of the public are of the utmost importance in the improve-

ment of the health of the people"; it further declares that every individual has a right to the maximum health his organism permits. The WHO is committed to the principle of mutual aid in dealing with social and health problems, and its work is supplemented by and correlated with the activities of such other UN agencies as the United Nations Children's fund, the Food and Agriculture organization, the International Labour organization and the United Nations Educational, Scientific and Cultural organization.

Private organizations have also laboured in the field of international health and safety problems. The International Association of Industrial Accident Boards and Commissions has promoted safety codes, and the Rockefeller foundation has sponsored major international health work. Numerous international conferences have been held to promote health and safety. In 1833 Mohammed Ali, ruler of Egypt, called a conference to discuss quarantines and international hygiene, the International Association for the Legal Protection of the Poor was organized in Paris in 1900 and the International Labour office was organized at Basel, Switz., in 1901. The Berne conferences of 1905, 1906 and 1913 drew up international conventions prohibiting the use of white phosphorus in the manufacture of matches and employment of women or children under 16 on nightuork and limited their hours of work. President Truman's Point Four program included technical assistance on health matters, and many underdeveloped nations have continued to receive such help from the U.S. and other governments in an effort to eliminate various preventable diseases that were eradicated in Europe and the United States in the 19th century.

The health and safety laws of the future will have to deal with such new matters as radiation from atomic power, fall-out, air pollution and the dangers created by space travel. Such problems may be the subject of international regulation, as well as local law. Air pollution and urban redevelopment have created numerous problems in metropolitan areas. A sound solution of such problems will require the co-operation of local, state and national agencies. The increased urbanization of major industrial countries inevitably will intensify old and proliferate new health and safety problems. However, the prevailing perspective that national and international action is essential and that health and safety programs are no longer solely matters of local concern has made organized and concerted effort possible.

Among many articles having to do with health and safety regulations in general are the following articles: HEALTH INSURANCE; INDUSTRIAL ACCIDENTS; INDUSTRIAL MEDICINE; LABOUR LAW; MEDICAL JURISPRUDENCE; PREVENTIVE MEDICINE; PUBLIC HEALTH; SOCIAL SECURITY; SOCIAL SERVICE; WORKMEN'S COMPENSATION; WORLD HEALTH ORGANIZATION. The reader should look to the index volume for many other articles touching on specific aspects of health and safety laws.

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HEALTH INSURANCE, a system for advance financing of health costs that consists of a common fund of contributions or taxes for the payment of health services specified in a policy or law. The key elements are advance payment of premiums or taxes, pooling of funds, the elimination of part or all of the financial barrier to the receipt of medical care, and eligibility for benefits on the basis of contributions or services without an income or means test. Health insurance is sometimes also considered to include cash payments for loss of income due to sickness or disability. A health insurance system may be organized and administered by a private agency, with the provisions specified in a contract; in this case it is a voluntary insurance plan. If the system is financed by taxes and the provisions are specified by statute, it is a governmental health insurance plan, often referred to as compulsory health insurance by its opponents. The contrast between voluntary and compulsory health insurance, however, is not always a clear one. In some countries, governmental subsidies are used to finance part of the cost of health benefits administered by nongovernmental societies. Health insurance is not primarily a method of organizing medical care, although it may be combined with measures to improve the organization and distribution of medical services. It may be coupled with the individual practice of medicine or with group practice. It may involve a limited or a comprehensive scope of medical services. If the plan provides for full payment of the costs to the provider of medical services, it is called a service plan. If the insurance payment is paid in cash to the beneficiary, it is referred to as an indemnity plan.

Health insurance should be distinguished from socialized medicine, which is usually financed as a public service wholly or predominantly from general tax revenues; doctors are employed, directly or indirectly, by a government agency on a full or part-time salaried basis; and health facilities are usually owned or operated by the government.

See also INSURANCE; INSURANCE: MISCELLANEOUS; SOCIAL SECURITY. (WR. J. C.)

HEALY, GEORGE PETER ALEXANDER (1813–1894), U.S. painter, known for his portraits of many prominent persons of his day, was born in Boston, Mass., July 15, 1813. In 1834 he went to study in Paris. His vigorous, facile style soon secured for him a large and important clientele, and in his studios in Paris, Chicago and Rome he often painted as many as 50 portraits in a year. Among his subjects were Louis Philippe of France, Pope Pius IX, the princess of Rumania, John C. Calhoun, Henry Clay, Longfellow and a series of U.S. presidents from John Quincy Adams to Grant. He also depicted historical scenes; "Franklin Urging the Claims of the American Colonies Before Louis XVI" and "Daniel Webster's Reply to Hayne" (a monumental portrayal with scores of individuals delineated) are perhaps his best-known compositions. He was the author of *Reminiscences of a Portrait Painter* (1894).

Healy died in Chicago on June 24, 1894.

See Marie de Mare, G. P. *A. Healy, American Artist* (1954).

HEALY, TIMOTHY MICHAEL (1855–1931), Irish politician, was a leader in the fight for Home Rule and became the first governor general of the Irish Free State *(see* IRELAND; IRELAND, REPUBLIC OF). He was born at Bantry, Ire., on May 17, 1855, a son of the clerk of the Bantry union. With three uncles and two brothers who also became members of parliament, he formed the nucleus of the "Bantry band."

Healy began to earn his living at 13, and his early youth mas spent as a shorthand clerk in a railway office at Newcastle upon Tyne. There he became well known in Irish political and literary societies. In 1878 he moved to London. In 1879 Charles Stewart Parnell on his first mission to the U.S. found that he needed a secretary and wired for Healy, who was already known to him. In 1880, after Parnell had been elected chairman of the Irish party, a parliamentary vacancy occurred in Wexford city, and Healy mas elected.

From the first he slapped the house of commons in the face, but he attended very closely to all its business. In 1881 Gladstone's Land bill began the revolution which made the Catholic Irish owners of the land instead of being mere cultivators under landlords.

Gladstone said that, with the exception of three Irish law officers, only Healy understood it, and it is doubtful whether anybody but Healy understood the effect of the famous "Healy clause." Introduced as an amendment, this guaranteed that in the future rent should not be chargeable on tenants' improvements. When the bill became an act, Healy, called to the bar in 1884, defended the tenants' interests in innumerable cases that arose in its application. In 1883, when a Liberal seat became vacant in

County Monaghan, he was selected to make the first nationalist inroad on Ulster. He won.

At the general election of 1885 with the extended franchise Monaghan became a safe seat. Healy attacked South Derry and won the constituency by surprise tactics. In 1886, however, he was defeated, but was returned for North Longford.

His relations with Parnell now became less friendly, and he joined J. G. Biggar in opposing the candidature of Capt. W. H. O'Shea for Galway city. The opposition was overborne only by Parnell's personal intervention. But in 1889, when the divorce petition against Parnell was undefended, Healy drafted the resolution carried by the party in favour of Parnell's remaining at his post. "Parnell," he said, "is not a man, but an institution." Later, however, in face of Gladstone's declaration, he changed his mind, and from the time the split began, no speeches were so envenomed as Healy's.

He was twice publicly beaten, but no form of menace had ever the least effect on him. In 1892 he became member for North Louth, and, as a member of the anti-Parnellite party to which the large majority of Irish nationalists belonged, he was specially supported by the Catholic clergy. His rivals for leadership, William O'Brien and John Dillon, had more following among the laity, but Healy was always a priests' man. At this time he devoted less time to politics, for his practice at the bar was increasing, and in 1899 he became Q.C.

On the reunion of parties in 1900 he joined O'Brien in urging that Redmond, leader of the Parnellite minority, rather than John Dillon, leader of the anti-Parnellites, be chosen as chairman of the united body. But a long indulgence in the savage spirit of faction which followed the Parnell split had rendered Healy difficult to work with, and in 1902, on the motion of O'Brien, he was expelled from the Un ted Irish league, though he retained the support of the Catholic hierarchy and of Murphy's influential newspaper.

In 1906 O'Brien, having split away from Redmond's main body with a few followers, made a working alliance with his former adversary and his brother Maurice, member for Cork city. In 1910, when Healy was beaten in North Louth, O'Brien provided him with a constituency in northeast Cork.

Healy joined the English bar in 1903 and took silk in 1910. He was unceasingly employed on English cases, more especially of a political character, and defended many suffragettes. In parliament no speaker was more able to draw a crowded house, and his wit and eloquence were specially popular with the Tories, because he said more biting things of the Nationalist party than Englishmen could invent. With O'Brien he opposed the budget of 1909 which led to the clash with the house of lords; and on the Home Rule measure of 1912, while giving it general support, he furiously opposed partition.

In 1914 he was a vigorous supporter of Britain in World War I, but the course of events from 1916 onward, culminating in the introduction of conscription, drove him finally to side with Sinn Fein, and in 1918 he resigned his seat to allow an imprisoned Sinn Feiner to be returned.

Little was publicly heard of him during the years of turmoil which followed until, at the close of 1922, the constitution of the Irish Free State having been made law by the Irish parliament, and subsequently by the British, the office of governor general had to be filled. When Healy's name was first mentioned for the post there was general incredulity, but the appointment soon commended itself to Irishmen of all sections. The Free State government, speaking through the mouth of Healy's nephew, Kevin O'Higgins, defended the choice of "an old man of the people," while others realized that Healy. though an extreme nationalist, had in many respects a most conservative mind. Those who feared the worst from a tongue and a temper which he had never before governed were surprised by the result; for during his continuance in office as the representative of King George Healy in no way added to the government's difficulties, while he did more perhaps than any other person to cultivate the good will of the Protestant minority.

He resigned office at the end of his three years' term, in Dec. 1927. In 1928 he published a volume of memoirs, *Letters and Leaders of My Day*.

See Liam O'Flaherty, ***Life*** of ***Tim*** Healy (1927). (S. G.)

HEAPE, WALTER (1855–1929), English zoologist, was a striking example of those amateurs of independent means who have made outstanding contributions to science. He was born in London on April 29, 1855. His formal education was finished early, and until 1879 he was engaged in business. He had an aptitude for scientific pursuits, however, and under the influence of Francis Maitland Balfour (*q.v.*) took up the study of embryology.

Settling in Cambridge in 1879, he assisted Adam Sedgwick in bringing out a new edition of Sir Michael Foster and F. M. Balfour's *Elements of Embryology* (1893). He was demonstrator in animal morphology (1882–8j) and superintendent of the Marine Biological association (1886–88). In 1886 he joined Trinity college and in the same year the honorary degree of M.A. was conferred upon him. In 1890 he was elected to the Balfour studentship. but after three years devoted himself to research, giving intermittent attention to his many business interests, including the Heape and Grylls rapid cinema machine. His earliest original work was on the development of the mole (1886), but it was his elaborate papers on the menstrual cycle in monkeys (*Philosophical Transactions*, 1894–97) that made his name famous. In further papers he dealt with the successful transplantation of fertilized ova, artificial insemination, fertility in sheep and sex determination.

His other works included an important memoir on the "Sexual Season of Mammals" (*Quarterly Journal of Microscopical Science*, 1900) and books on *The Breeding Industry* (1906), *Sex Antagonism* (1913) and *Preparation for Marriage* (1914). Heape was elected a fellow of the Royal society in 1906. He died at Tunbridge Wells on Sept. 10, 1929. (W. J. Bp.)

HEARING is the sense by which an animal is able to perceive sound. All the higher vertebrates, and many more primitive animals, possess a specialized organ, the ear, for the reception of sound waves. In its simpler forms this organ has a particular biological value in mating, as it enables the sexes to find one another, but its most general adaptive function lies in its service in warning of impending danger. In the birds and mammals, hearing is particularly developed for communication, and in man it attains its highest utility in articulate speech and the art of music.

This article is divided into the following sections:

I. PARTS OF THE EAR AND THEIR FUNCTIONS

As treated in detail in the article Ear, Anatomy of, the ear is considered in three parts, the outer, middle and inner ear. The outer ear receives aerial waves; the middle ear conducts them inward; and the inner ear, through its receptor cells, translates their effects into patterns of nerve impulses which are sent through the auditory nerve to the brain centres and finally give

rise to auditory perceptions.

1. The Outer Ear.—The visible portions of the ear include an expanded flap called the auricle or pinna and a short tube, the external auditory meatus. The auricle in man serves no important acoustic purpose. It is too small to deflect sounds into the ear, for to modify the paths of sound a surface must be large with respect to the wave lengths, and this condition is scarcely satisfied even for the highest audible tones. Animals with larger and funnellike pinnas, especially if they are sensitive to sounds still higher than man is, are aided by these members, and have well-developed muscles for moving them.

The meatus is a slightly curved tube about one inch in length, ending at the eardrum. It serves as the path of entrance for aerial waves.

2. The Middle Ear.—Beyond the eardrum is the middle ear cavity, an irregularly shaped, air-filled space in the temporal bone. A chain of three small bones, the auditory ossicles, bridges this space and provides a mechanical link between the drum and the oval window, which forms the entrance to the inner ear.

The drum is broadly conical in form, with its apex directed inward. The outer ossicle, the malleus, is attached at the apex and along one radius. The second ossicle, the incus, links the malleus with the third, the stapes, whose innermost part, the footplate, nearly fills the oval window. The ossicles are interconnected and suspended in the cavity by a number of ligaments. There are two tympanic muscles which act upon the ossicular chain; one, the tensor tympani muscle, is applied to the malleus, and the other, the stapedius muscle, to the stapes.

The function of the middle ear is the efficient transmission of sound energy. The drum presents a large surface on which the air particles impinge, and their total force is applied through the ossicular chain to the smaller surface covered by the footplate; the result is a magnification of pressure. The efficiency of transmission is about 28%, which, though far from perfect, is remarkable in comparison with an estimated one-tenth of one per cent that would obtain if the middle ear mechanism were absent. The difference is apparent in a person who by accident has lost the drum and outer ossicles, for such a person is unable to hear conversation unless people shout or speak directly into his ear.

The tympanic muscles connect the ossicular chain with points of anchorage in the walls of the middle ear cavity, and work together as a protective mechanism. They add to the strength of the ossicular chain and prevent displacements of excessive amplitude. When a loud sound stimulates the ear, a strong reflex contraction is produced which reduces sharply the transmission of the vibrations, and so the inner ear is protected against excessive stimulation. This protection, however, is limited. and a person who must expose himself to intense sounds of either an explosive or a lasting character will need to take extra precautions to guard the ears. He may wear a helmet that covers the ears or use plugs that fit snugly in the meatus to exclude the sounds.

3. The Inner Ear.—The bony labyrinth is a complex space in the temporal bone, two divisions of which, the vestibule and semicircular canals, are concerned with bodily equilibrium; a third division, the cochlea, serves for hearing. The cochlea is shaped like a snail's shell, from which it gets its name; it is a spiral organ, which in man has about two and one-half turns, and if straightened out (fig. 1) would be about one and one-half inches long.

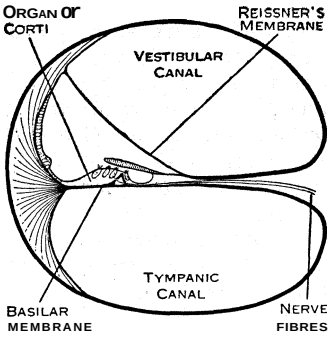

FIG. 2.— CROSS-SECTIONALVIEW OF THE COCHLEA

A partition divides the cochlea into vestibular and tympanic canals, which connect at the tip of the cochlea and contain a fluid, the perilymph. At the basal end each canal has an opening in the bony wall separating it from the middle ear cavity. The opening for the vestibular canal is the oval window, fitted with the footplate of the stapes as already described; that for the tympanic canal is the round window, covered only by a thin membrane.

The partition is made up in part of a fibrous membrane, the basilar membrane, upon which lies a complex structure, the organ of Corti, in which the auditory receptor cells, the hair cells, are imbedded. Around the bases of the hair cells are the ends of the auditory nerve fibres, which run inward toward the axis of the cochlear spiral to form the auditory nerve. This sensory portion of the inner ear is bathed in a separate fluid, the endolymph in the cochlear duct, which is kept from mingling with the perilymph by a thin membrane, Reissner's membrane.

When under the influence of an aerial sound the footplate of the stapes is momentarily pressed inward, the pressure exerted on the fluid of the inner ear is relieved mainly by an outward bulging of the round window membrane. As the footplate moves outward the pressure is reversed, and the membrane is displaced inward. The varying pressures are transmitted from vestibular to tympanic canals and to the cochlear duct by way of the basilar membrane, and in the process the sensory cells are excited. From the hair cells the excitation passes to the auditory nerve fibres, and from there to the higher nerve centres, and a sensation of hearing is produced.

The ear may be stimulated also by bone conduction. If a vibrating body is brought into contact with the bones of the skull the movements are conducted to the inner ear fluids and finally to the hair cells. The sensory effects are the same as in air conduction, but the efficiency is much less since the larger part of the energy is lost in vibrating the massive substance of the head.

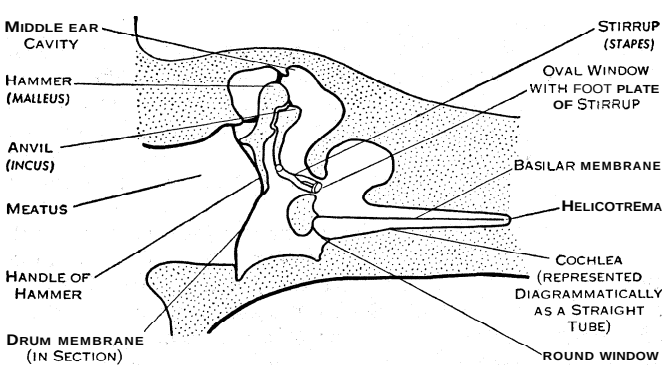

FIG. 1.— DIAGRAM OF SECTION THROUGH MIDDLE AND THE INTERNAL EAR

The drum membrane picks up the sound waves from the air in the meatus, and transmits them through the chain of small bones to the cochlea, where they are analyzed and transformed into stimulations of the nerve of hearing

II. SOUND AND ITS ANALYSIS

Sounds, physically considered, consist of rapid variations in the density of a medium, usually the air. Most often these variations have some uniformity of pattern, in that the same or nearly the same changes occur over and over; such sounds are periodic. Other sounds, which lack any repetitive character, are aperiodic. The periodic sounds are heard as tones, the aperiodic ones as noises. Many sounds have an intermediate quality, and are called noisy tones or pitched noises according to the dominating feature.

The periodic sounds vary in four ways: in frequency, intensity, wave form and phase. Frequency designates the rapidity of recurrence of the pattern; intensity, the energy of the disturbance; and wave form, the nature of the pattern. Phase refers to the particular aspect of the pattern presented at a given instant. Frequency is stated in cycles per second. The simplest wave form is sinusoidal, represented mathematically by a sine (or cosine) function, and special efforts are necessary to produce it; the tuning fork gently struck gives such a wave form. Other waves, like those of the singing voice and most musical instruments, are compound. In simple tones the phase is not perceived. but when two or more tones interact their phase relations become important.

A basic principle of physical acoustics, known as Fourier's law, is that any compound wave may be regarded as the sum of a series of simple waves whose frequencies bear to one another the

ratios 1, 2. 3, 4, 5 and so on. The component of lowest frequency, corresponding to the ratio number 1, is called the fundamental; the others are overtones. For example, the note known as middle C, when produced on the piano, is compound, and consists of a fundamental of 264 cycles; a first overtone of 528 cycles; a second overtone of 792 cycles; and so on. Generally speaking, the earlier members of the series are the most important. and the magnitudes of the higher overtones diminish and finally become negligible.

The resolution of a compound tone into a fundamental and a series of overtones, with indication of the relative magnitudes and perhaps also of the phase relations of the components, may be accomplished by mathematical methods, or by a mechanical device called a harmonic analyzer.

This type of analysis can be achieved also by the ear; this is Ohm's law of hearing. After suitable training a person can recognize that a sound, like the note of a violin, is made up of a fundamental and several overtones, and he can indicate, at least in a general way, how the components vary in strength. This analytic capacity is a remarkable feature of the functioning of the ear, and upon it depends much of the peculiar value of hearing.

1. Distortion. — The ear obeys Ohm's law in a general way, but it does not do so exactly. In some degree it imposes its own characteristics upon sounds as they are heard. The changes in the sound patterns produced within the ear constitute auditory distortion, and take two forms, frequency distortion and nonlinear distortion. Frequency distortion is a reflection of the fact that the ear is limited in range, and fails to respond to sounds below and above certain limits, and the further fact that the sensitivity varies greatly within that range. Therefore, certain components of a complex sound will be favoured, and others will be discriminated against.

Nonlinear distortion represents a failure of the ear's response to correspond in a simple way to the energy of the stimulating sound. It gives rise to a number of peculiar phenomena. One of these is aural overtones. A tone, although physically simple, if it stimulates the ear at anything greater than a very moderate intensity, will produce a compound effect: it is heard as a fundamental with a series of overtones. These overtones are subjective, in that they have their origin within the ear itself. Further phenomena, including the combination tones discussed below, likewise have their origin in the ear through nonlinear distortion. In experiments using human subjects and lower animals, the nature and origin of subjective overtones and combination tones have been carefully studied. It seems clear that the principal seat of nonlinear distortion is the inner ear.

III. PHENOMENA OF HEARING

Auditory experiences vary in three fundamental respects: pitch, loudness and timbre.

1. Pitch. — Tones vary in pitch according to the frequency of the sound vibrations. Slow frequencies give deep or low tones, like the bray of a foghorn. while rapid frequencies give shrill or high tones, like the chirp of a cricket. The normal range of audibility for man covers about 10½ octaves, from a lower limit of about 15 cycles per second to an upper limit of somewhat more than 20.000 cycles. Tones below the lower limit affect the ear, but they give noisy effects and not distinct pitches. Tones above the upper limit are altogether inaudible. Some young persons can hear tones as high as 23,000 cycles, but generally with advancing age the limit becomes lower and lower, so that few persons over 60 years of age are able to hear tones beyond 8,000 cycles.

2. Loudness. — The loudness of a sound depends upon both its energy and its frequency. Generally speaking, two tones of equal energy but different frequency will not seem equally loud; this is true because the ear's sensitivity varies over its range. Sensitivity is greatest for the middle high tones, those of frequencies from about 1,000 to 4,000 cycles, and it falls off progressively for the lower tones and with great rapidity for the higher tones. For the middle frequencies the amount of energy necessary barely to stimulate the ear is almost incredibly small, and it appears that man has developed. for this region, the maximum sensitivity that it is practical to possess, for if the ears were any keener they would respond to the unceasing molecular motions of the air particles themselves. The maximum loudness of sounds is governed by the intrusion of pain and the liability of the ear to damage by excessive stimulation. The amount of energy that becomes dangerous to the ear seems small when measured by ordinary standards, yet it is large compared with that which is just perceptible. Thus the ear operates over a wide energy range, a range of nearly 2,000,000,000,000 times.

Though the physical range of the ear is great, the perceived loudness is less extensive. The ear may be said to compress the intensity dimension, as indeed all our senses do. Within limits, the ear adheres to a general principle of sensation known as Weber's law, which states that an energy change, in order to be perceptible, must be a constant fraction of the original energy level. This means that a smaller energy change is necessary for a faint sound than for a loud one; and more generally that the perceived magnitude of a sound varies as the logarithm of its energy.

3. Timbre. — Two sounds may have the same fundamental frequency. and also may contain the same overtones, but if the distribution of energy among the overtones is different they will seem different to the ear. Such a difference, arising from the relative magnitudes of the components, is called the timbre of a sound.

Timbre is also used more widely to include variations of an aperiodic character, such as the thumps or scrapings incidental to the production of notes on most musical instruments. All instruments, because of their forms of construction and the ways in which they are played, produce sounds of characteristic timbre, through which they may be recognized. Similarly, the voices of singers who are executing the same note may be identified by their individual peculiarities of timbre.

4. Deafness. — Through accident and disease, the ear suffers alterations of its functions which produce deafness in various forms and degrees. Sometimes sensitivity to sounds is lost altogether, but more often the loss is only partial. An impairment may be extensive. in that all tones to be heard must be raised well beyond their usual intensity, or it may be only for certain tones. In general, high tones are more liable to impairment than low tones.

IV. INTERACTION OF TONES

When two tones are presented to the ear at the same time there appear three types of phenomena: beats, combination tones and masking.

1. Beats. — If the two tones differ but little in frequency, and have approximately equal intensities, the result of their simultaneous action is a peculiar periodic variation in the loudness known as beats. The rate of the beats is equal to the frequency difference of the tones; thus two tones of 1,000 and 1,005 cycles will produce five beats a second. The character of the experience changes with the beat frequency. As the frequency of the beats is varied from zero upward, the experience is at first a slow waxing and waning of sound, then changes to an impressive surging or pounding, and finally to an unpleasant roughness, which then fades and finally disappears.

The phenomenon of beats represents a limitation of the ear's powers of analysis; rather, it indicates a kind of synthesis. The two stimulating waves are added, and the beats represent the periodic changes between a maximum when they agree in phase and a minimum when they are opposed in phase. If the ear obeyed Ohm's law perfectly, the two waves would be separated and no beats would be heard.

2. Combination Tones. — When the two tones stimulating the ear are fairly strong, and differ in frequency by 50 cycles or more, other tones may be heard besides the primary pair. These are the combination tones, of which there are two types, difference tones and summation tones. The difference tones are so called because they represent frequency differences between one of the stimulating tones or its multiples and the other tone or its multiples. Similarly, the summation tones represent the sums of these frequencies. These relationships are most simply shown by for-

mulas. If the frequencies of the two stimuli are indicated by h and l, and any simple integers by m and n, the difference tones are derived as $D=mh-nl$, and the summation tones as $S=mh+nl$.

When m and n both are unity the difference and summation tones are of the first order. These are usually the strongest and most easily noticed. The first order difference tone is best heard when its frequency is well below that of either stimulus. For example, tones of 2,000 and 2,500 cycles will give a difference tone of 500 cycles, which is readily recognized. On the other hand, a difference tone is difficult to observe if its frequency lies between the two stimuli; thus 1,000 and 2,500 cycles give a difference tone of 1,500 cycles, which only careful observation will reveal. In general, the combination tones will usually go unnoticed when their frequencies lie close to the stimulating tones, as a result of masking by these tones as explained in the following section.

While only a few combination tones are ordinarily noticeable, special procedures demonstrate a great many. They are a product of nonlinear distortion in the ear, and are accounted for in the same way as the aural overtones, as a transformation of a portion of the stimulus energy into new frequencies. Like the overtones, they originate principally in the inner ear.

3. Masking — Everyone has experienced the difficulty of hearing in the presence of loud noises. Faint sounds, like the sounds of speech, are drowned out or masked, and conversation becomes possible only by vigorous shouting. A study of this phenomenon with simple tones shows that the masking effect is greatest for tones whose frequencies are close to the disturbing tone, and it falls off rapidly for more distant frequencies. Thus a loud tone of 1,000 cycles will have a profound effect upon 900 cycles, but practically none upon 100 cycles.

When either objective or subjective overtones are present (and the subjective overtones at least are inevitable when the tone is loud), there will be masking not only in the area of the fundamental but in the areas of the overtones as well. Since this is true, the masking effect of a given tone is generally greater in the frequency region above it than in that below. The low-pitched noises incidental to most industrial operations are far more disturbing of speech than high-pitched squeakings and hissings of equal loudness.

V. LOCALIZATION OF SOUNDS

We commonly perceive a sound as coming from some particular place in the environment, yet experience has taught that such perceptions are not altogether trustworthy, and we are often confused and misled. Actually our judgments of sound location are determined only in a limited way by the auditory cues, and to a considerable extent they include other signs, especially visual, together with our general knowledge of the surroundings. We look for reasonable sources of the sounds we hear, and infer their locations on the basis of previous experience.

The auditory limitations have both a physical and an anatomical basis. Sounds do not travel in direct lines as light rays do, but bend around obstacles and reflect from broad surfaces, so that their terminal paths are often no proper indication of their true courses. Moreover, the single ear has no way of discerning the paths of the waves that strike it, but can signal only the intensity and character of the effects. Significant cues can be obtained as the head is moved, and, most important, since we have two ears, from differences in the binaural stimulation.

1. The Binaural Cues.—The position of a sound with reference to the right-left dimension is indicated by four types of binaural difference: the relative intensity, time of incidence, phase and complexity. A sound on the right — barring complex reflections —will be stronger in the right ear, both because its path is shorter and because the other ear is somewhat in a shadow cast by the head.

The shadow effect is insignificant for the low tones, because these bend around the head readily, but becomes important around 512 cycles and increasingly so for frequencies above. Because its path is shorter, the sound will reach the right ear sooner; and this temporal cue operates at the onset of the sound, at its cessation, and at any sudden alteration in its character. For simple tones a phase difference is present, as the longer time of travel to the farther ear allows the waves to get out of phase. The phase cue is most important for low tones, but becomes confusing for high tones since these have wave lengths that are of the order of the distance between the two ears, and under such conditions a phase difference may be lacking or even reversed in direction.

Complexity operates as a cue only for compound tones and noises, but for these it is most useful. Because the sound shadow effect is selective, the ear that is screened by the head receives the sound with its high-frequency components greatly attenuated, and a timbre difference results.

The ease and accuracy of localization varies for different kinds of sound because the cues operate differently. For high tones the binaural differences are mainly of intensity; for low tones, chiefly of phase; and for complex tones and noises, they include intensity, time and timbre. Accordingly, the high tones are localized with difficulty, the low tones more readily and noises with comparative ease.

Positions up and down or in front and behind, and the distance away, are not discriminated by the binaural conditions, and are indicated only by secondary cues, such as head movements, or inferred from the general conditions. By turning the head we may change, for example, the relative intensity at the two ears, and by grosser movements, which lead us toward or away from the source, we may change the intensity level. Such exploratory movements give a more certain localization than is possible with the binaural cues alone. At the same time, judgments are formed which include visual cues and our general experience. If the sound is familiar we look for its source in a reasonable place: the cricket's chirp leads us to scan the turf at our feet, and the bird's song to examine the branches overhead. (E. G. W.)

VI. THEORIES OF HEARING

Historically, the so-called theories of hearing that have been proposed have been concerned primarily with anaylsis of sound by the end organ of hearing, the cochlea. They have been theories of cochlear function. A true theory of hearing must take into account not only events within the cochlea but also the patterns of activity set off in the auditory nerve by these events and the changes in the patterns of neural activity during transmission to higher centres of the central nervous system.

1. Place Theory. — According to a place theory of hearing, receptors in a given part of the cochlea are stimulated by a given frequency of sound (or by a narrow band of frequencies), and, in turn, impulses are set off in the particular nerve fibres supplying the receptors. The ability to discriminate between sounds of different frequency depends then upon which receptors and nerve units are excited. When one particular group is activated, a low tone is heard; when another group, a high tone.

In 1857 Hermann von Helmholtz proposed a theory of hearing called the resonance theory. This was a place theory. It stated that the cochlea contained a series of tuned resonators, the transverse fibres of the basilar membrane, and that a given frequency of sound striking the ear caused to vibrate those resonators that were tuned to that frequency. Complex sounds were likewise analyzed, the appropriate resonators being activated by the Fourier components of the sound.

Later research led investigators to conclude that the cochlea does not contain a series of tuned resonators. Experiments done by G. von Békésy showed that the basilar membrane, which stretches from base to apex of the cochlea and upon which the receptor cells lie, is under very weak and approximately equal tension in both its transverse and longitudinal directions and could not be made up of a series of tuned-string resonators. It does differ in elasticity from base to apex in a ratio of about 1:100. This is sufficient to provide for some frequency analysis.

Observation under the microscope of the movements of intracochlear structures when the ear is stimulated by sound, testing of hearing before and after experimental damage to parts of the

intracochlear structures, recording of electrical activity from electrodes implanted at different points within the cochlea, and a number of other experimental techniques were used to accumulate evidence showing quite clearly that, within the cochlea, sounds are analyzed according to frequency. The highest perceptible frequencies at weak intensities set into motion a small part of the basilar membrane near the basal end of the cochlea. The receptor cells on this part of the membrane are stimulated, and they in turn, by some process not clearly understood, cause the firing of impulses in the nerve fibres that supply them. As intensity of the high-frequency sound is increased, there is some spread of activity along the basilar membrane and consequently more receptor cells and their nerve fibres are excited. For these highest frequencies the amount of spread of excitation within the cochlea is not great. Even at very high intensities, it appears that excitation is confined to the basal region of the cochlea. With tones of lower frequency, a wider region of the basilar membrane and the receptor cells it supports are set into motion by near-threshold intensities of the tones, and with increase in intensity the extent of spread of the region of excitation is greater than it is for higher frequencies. There is considerable evidence that tones in the lowest range (500 to 1,000 cycles per second [c.p.s.] and below) at moderate to high intensities may stimulate receptors throughout most of the cochlea.

2. Frequency Theory. — In opposition to place theory, it was early suggested that frequency analysis might not take place in the cochlea but that the latter might act like a telephone transmitter, simply transmitting to the nervous system the same frequencies imposed upon it by sound waves impinging upon the ear. William Rutherford (1886) is usually given credit for this theory, which was appropriately named a telephone theory.

Experiment provided evidence not only in support of a place theory, as noted, but also suggesting that frequency theory may be partly correct. When electrophysiological methods were used to record activity in the auditory nerve, it was found that bursts of impulses in the whole nerve, which is made up of thousands of nerve fibres, were synchronous in frequency with a pure tone applied to the ear; that is, for each cycle per second of the sound wave there was a burst of nerve impulses. This synchronism occurred for frequencies in the lower range only, up to 4,000 to 5,000 c.p.s. For higher frequencies, synchronism between nerve response and stimulus could not be observed.

Since it is known that individual nerve fibres in the auditory nerve of the mammals that were used in these experimental studies do not fire at rates much above 300 per second, a volley principle was advanced to explain the firing of the total nerve in regularly spaced bursts at frequencies of 4,000 or more per second. The volley principle assumes that impulses in some individual nerve fibres are elicited by the first wave of a stimulating tone, others by the second, and so on, the result being that, by the alternate firing of different groups of nerve fibres, the end result of synchronism between total nerve discharge and frequency of the sound stimulus is achieved. There is experimental evidence that the volley principle does hold for response of the auditory nerve. It was suggested by some investigators, therefore, that discrimination of frequencies in the low range of frequencies (1,000 c.p.s. or perhaps 4,000 c.p.s. and below) is based partly on frequency; for example, a tone of 100 c.p.s. is heard when the frequency of nerve impulses in the auditory nervous system is 100 per second, and a tone of 200 c.p.s. is heard as having a higher pitch because the frequency of impulses is 200 per second.

3. Central Neural Mechanisms. — After the early 1940s, increasing attention was given to the events that take place in the central nervous system when the ear is stimulated by sound. It was found that there is topographic projection of the cochlea upon the higher centres in the auditory nervous system. Activity aroused in a small part of the cochlea produces neural excitation in a somewhat restricted part of each auditory pathway and each auditory centre. Since the cochlea does a frequency analysis of the sounds it receives, it follows that the auditory pathways and centres have a tonotopic organization; *i.e.*, a tone of a given frequency produces neural activity in a limited part of a pathway or centre. This evidence of tonotopic organization lent support to a place explanation of frequency discrimination.

Records made of the nerve impulses in higher centres of the auditory nervous system usually indicate that the synchronism between frequency of nerve impulses and frequency of sound stimulating the ear is progressively lost as the nervous system is ascended. Newer methods of recording and analyzing the electrical activity of the auditory system may reveal that the synchronism is maintained, at least in certain parts of the pathways and centres, and is being masked by other neural activity.

4. Conclusions. — It seems clear that both place and frequency principles must be considered in explaining discrimination of differences in frequencies of sound. In addition, auditory theory must account for discriminations that involve other dimensions of sound stimuli. For pure tones — and current theories are restricted almost entirely to dealing with discriminations of pure tones — the other primary dimension of the physical stimulus is intensity.

As noted above, increase in intensity of a pure tone presented to the ear results in spread of activity within the cochlea. More receptor cells along the basilar membrane are excited and nerve impulses are set off in more of the nerve fibres leading from the receptor cells into the central nervous system. In addition, experiments showed that there is an increase in the rate of firing of nerve fibres that are already active. The result is a greater total flow of nerve impulses per unit time as intensity of the stimulus is increased. This relationship between stimulus intensity and rate of flow of nerve impulses appears to be true for higher centres of the auditory nervous system as well as at the periphery.

A theory of hearing needs also to consider the neural events underlying localization of sound in space. Experimentation on this problem has been limited, but both the temporal and intensity differences noted above as being important in sound localization are reflected by temporal and amplitude differences in the nerve responses recorded in higher centres of the auditory system.

(W. D. N.)

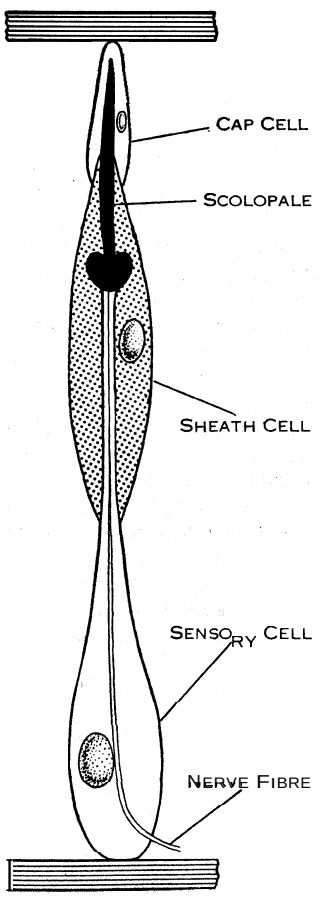

FIG. 3.—A SCOLOPHORE ORGAN (DIAGRAMMATIC)

VII. EVOLUTION OF HEARING

The evidence of comparative biology shows that twice in the course of animal evolution the problem of hearing has been solved, once by the insects and again by the vertebrates. In each case the ear was derived from a more primitive form of mechanical sensibility, but otherwise the two developments were distinct.

1. The Hearing of Invertebrates. — Among the invertebrates hearing is known to exist only in certain species of insects. It is possessed by those few insects that are notable for sound production: the katydids, crickets and grasshoppers among the orthopterans, the cicadas and the water boatmen; and in addition by certain moths which are largely dumb.

The ear of an insect is an elaboration of a simple sensory structure, the scolophore organ, which is widely distributed in insect bodies. In its simplest form (*see* fig. 3), this organ consists of three cells arranged in a column: a sensory cell, a sheath cell and a

cap cell. The sensory cell contains a chitinous rod, the scolopale, which projects out of the cell at one end, where it is snugly enclosed by the sheath cell and surmounted by the cap cell. A nerve fibre, arising from a ganglion cell nearby, enters the sensory cell and ends in or about the scolopale. This columnar structure is usually found stretched across a portion of the body cavity from one point of the integument to another. and bv its form and arrangement seems to be fitted for response to mechanical deformations of the body surface.

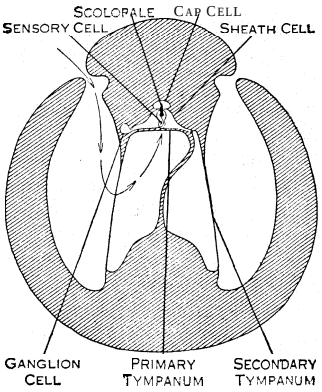

FIG. I.—THE EAR OF THE KATYDID (CROSS SECTION)

Aerial waves take a path indicated by the arrows, passing first through the secondary tympanum before striking the primary tympanum on which the scolophore organ rests

In the particular insect forms mentioned, the scolophore organ has become associated with a thin chitinous diaphragm or tympanic membrane. thereby forming a tympanal organ, which is the insect ear. This organ is situated in different places in the insects: in katydids and crickets on the forelegs; in the water boatman and some moths on the metathorax; and in other moths: grasshoppers. and cicadas on the abdomen—everywhere, indeed, but on the head where it would be expected.

The outer surface of the tympanic membrane is usually, as in grasshoppers. exposed directly to the external sounds, but sometimes. as in katydids. it faces an internal air chamber. in which case there is a secondary drum through which the sound waves first must pass. On the inner surface of the membrane lie the scolophores. with their scolopales pointing away and anchored against some relatively fixed structure.

It is well established that the tympanal organ is an auditory receptor. It is used generally in the process of mating, in which the male produces sounds and the female seeks him out. The most extensive observations have been made on crickets. A normal female let loose in a field was found to make straight for a cage containing a number of chirping males: but when her tympanal organs were destroyed this reaction ceased. Similar seeking behaviour was observed even when the chirp was conveyed over a telephone; here the orientation was to the receiver of the instrument. These experiments prove not only that the insects hear, but that the tympanal organ is the responsible structure.

Detailed results on sensitivity have been obtained only in certain orthopterans by recording the electrical impulses set up in the tympanal nerve during acoustical stimulation. In these the ear was found to be remarkably sensitive to high tones, some and perhaps all forms being superior to man in this respect. In the middle range of frequencies. where the human ear is most sensitive, the insect ear is poor in acuity, and responds only to sounds that to man are uncomfortably intense. From this it follows that the insect's world of sound is vastly different from man's.

2. The Hearing of Vertebrates.— The sensory portion of the vertebrate ear is a side development of the labyrinthine sense, whose primary function is the maintenance of bodily equilibrium (see EQUILIBRIUM. ANIMAL). The whole is a differentiation from the lateral line organ, a sensory apparatus found in adult form only in fishes and some amphibians, and whose function though not fully understood seems to relate to the perception of water currents or slow wave movements.

In fishes, amphibians and the lower reptiles, the endings for hearing are found in the saccule, one of the two main divisions of the labyrinth. In higher forms this auditory part of the saccule is expanded outward to become the cochlea. Evidence for hearing has been obtained in certain species of fishes and in representatives of all the higher vertebrate classes.

While fishes possess the saccular organ, they lack external and middle ears, and can be stimulated only by a process akin to bone conduction in higher animals. Those forms in which hearing is most assured are equipped with a special apparatus, the Weberian ossicles, which takes the place of the middle ear of higher forms.

Many fishes show disturbance from sounds produced in the water in their vicinity, but are largely unaffected by aerial sounds since these fail to penetrate the liquid surface. The clearest evidence of hearing is obtained in experiments in which the fish are trained to obtain food in response to an auditory signal. Sensitivity is shown for fairly rapid vibrations, and there are indications of some ability to discriminate sounds. That the saccule is responsible for the reactions is proved by tests in which this organ or its nerve is interfered with, or impulses are recorded from the nerve.

The amphibians have a middle ear of simple form, but no external ear. Some, like the frog, have an eardrum, which lies flush with the surface beneath the skin of the head. The frog's ear is fairly sensitive to low tones, but poor for high tones.

In the reptiles, the ear has undergone considerable differentiation. Some forms, like the tortoises and turtles, are little better equipped than their amphibian ancestors. Others, like the alligators, have a well-developed middle ear and a true cochlea. The alligators respond to sounds over a wide frequency range, up to 4,000 cycles or more.

The birds, as their songs proclaim, are keen of hearing and have an extensive range. In the pigeon both behavioural and auditory nerve studies indicate a hearing range up to 10,000 cycles.

In mammals the principal advance over lower forms is their further acquisition of range, though possibly there is greater acuity also. Most mammals that have been tested adequately have shown superiority to man in the hearing of high tones. Particularly notable here is the bat, which responds to tones far above man's upper limit, according to some evidence more than two octaves above.

The hearing of the cat has been carefully tested. For frequencies below 2,000 cycles per second its hearing is about like that of man. Above 2,000 cycles per second its sensitivity is much greater than that of man, and it responds to tones at least up to 60,000 cycles per second. The hearing of the dog is similar to that of the cat.

Over most of the hearing range the acuity of the monkey and chimpanzee is similar to man's, but in the high-frequency region they are definitely superior. The upper limit for the chimpanzee extends to about 30,000 cycles.

See also DEAFNESS AND IMPAIRED HEARING; EAR, ANATOMY OF; EAR, DISEASES OF; NOISE AND ITS CONTROL; SOUND.

(E. G. W.)

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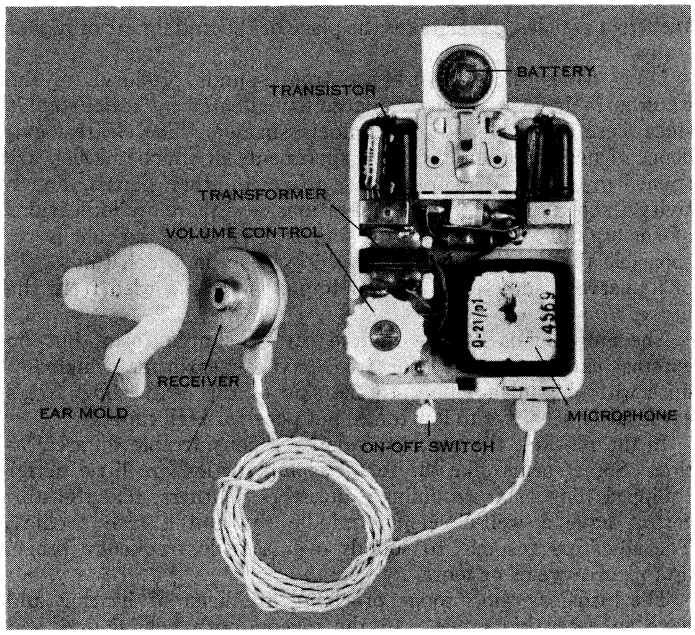
HEARING AID is a sound amplifier: a device that increases the loudness of sounds in the ear of the nearer. The earliest hearing aid was the ear trumpet. Ear trumpets have taken many forms, but they all have a large mouth at one end so as to collect the sound energy from a large area; the sound collected is led through a gradually tapering tube to a narrow orifice which can be inserted in the ear. Ear trumpets, then, amplify sounds simply by collecting the sound energy from a larger area than is possible by means of the unaided ear, and all the sound energy delivered to the ear originates from the sound source. This is fundamentally different from the operation of all later types of hearing aid, in which the energy of an electrical battery is used to boost the original sound.

There are two main classes of electrical hearing aid: the carbon aid and the electronic aid. The carbon aid was used from the beginning of the 20th century up to the early 1930s. It consisted of



BY COURTESY OF MULTITONE ELECTRIC CO LTD

PARTS OF A TRANSISTOR HEARING AID

a carbon microphone, a battery and a magnetic earphone, as in an ordinary telephone. The main difference between the carbon hearing aid and a telephone was that in the aid the electrical arrangement was such that the sound delivered by the earphone was substantially louder than the sound reaching the microphone.

The development of the radio valve made the electronic aid possible. The principal components of the electronic aid are (1) the microphone which converts sound into electric voltage; (2) the amplifier which amplifies this voltage; and (3) the earphone which reconverts the amplified voltage into amplified sound. In some aids a "bone conduction receiver" is used instead of the earphone, and this stimulates the hearing mechanism by vibrating the bones of the skull rather than by generating a sound wave in the external ear.

A typical hearing aid, as used between about 1930 and 1950, had a crystal microphone, a three-valve electronic amplifier and a magnetic earphone. The valve amplifier required two batteries, one supplying anything from 1 j v. to 45 v. and the other 1½ v. or 3 v. In the 1930s the magnetic earphone took the form of a disk of up to two inches in diameter held in place by a headband. In the 1940s this external receiver was gradually replaced by the insert receiver, uhich is only ½ in. to ¾ in, in diameter and is held on the ear by being clipped onto an individually molded plastic insert in the external ear.

In the early 1950s transistors replaced the valves in the amplifier. Transistors are smaller than valves and need only one battery of 1½ v. or 3 v. At the same time smaller, magnetic microphones also became available. All these factors made possible the construction of much smaller aids. While a typical valve aid of the 1940s measured 4½ x 2½ x ¾ in., the modern transistor aid is often as small as 2 x 1 x ½ in., and can even be built into a spectacle frame.

Hearing aids may have widely differing characteristics, and the selecting of the most suitable aid for the needs of a particular user has been extensively investigated. The two characteristics of a hearing aid which influence the understanding of speech most are, first, the amplification of the various components of speech sounds and, second, the intensity at which the sounds are heard by the wearer. As regards the first characteristic, speech sounds contain many components, each of a different frequency, and a hearing aid amplifies each of these components to a varying extent depending on its frequency; the variation of amplification uith frequency is called the frequency response of the aid. Experiments shon that hearing aids with one particular type of frequency response are best for all deaf people. This optimum frequency response (for details see Bibliography) shows that an aid need only amplify sounds within the frequency range 400 cycles per second to 4,000 cycles per second, although the components of speech cover a much wider range. When the aid is used in noise or in very reverberant surroundings, reduced amplification of the low-frequency sounds is preferable. Some hearing aids offer a choice of frequency response, the switch that determines which of the alternatives is selected being called the tone control.

As regards the second characteristic — the intensity at which the sounds are heard — too loud a sound can be as difficult to understand as one that is too quiet; the intensity range over which speech is understood best is wide for some deaf people but narrow for others, and can be narrower than the variations in intensity of normal speech. Hearing aids with automatic volume control (AVC) help in some of these cases by smoothing out the intensity variations. The AVC device varies the amplification of the aid automatically so that the output intensity is kept constant whatever the variations of the input.

Even with an aid with the optimum frequency response and supplying the most suitable output intensity, the user will rarely understand speech as well as people with normal hearing. In some people, deafness produces only a straightforward reduction of auditory sensitivity, and this can be compensated for fairly successfully by the extra amplification provided by the aid. Many deaf people, however, suffer a loss not only of sensitivity but also of auditory discrimination. Such persons. when using an aid, hear sounds more loudly but still find it difficult to distinguish one speech sound from another. Even if the aid does not enable its user to follow a conversation. however, it may still be useful by making him more aware of events around him.

A binaural hearing aid consists of two separate aids, one for each ear. Such an arrangement can, under some circumstances, materially benefit certain classes of deaf users.

In schools for the deaf group hearing aids are common. The group aid consists of a single central amplifier that amplifies the sounds picked up by microphones in different parts of the room. The amplified sounds are heard through earphones by the pupils.

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HEARN, LAFCADIO (1850–1904), writer, translator and teacher in Japan, was born June 27, 1850, on Santa Maura, one of the Ionian Islands, west of Greece. He was the son of Surgeon Rlajor Charles Bush Hearn. of Anglo-Irish descent, and Rosa Antonia Cassimati, a Greek native of one of the islands off Greece. Christened Patrick Lefcadio Hearn, he dropped the first name and changed the second to Lafcadio when he came to the United States. In 1856 his father had his marriage annulled in Ireland. Both his parents left the country and each remarried, and Hearn never saw his parents again. Left in charge of a grandaunt, a widow, Sarah Holmes Brenane. before he reached his teens he was enrolled in a Roman Catholic school in Normandy. He then spent four years at St. Cuthbert's college, Ushaw, County Durham. His early schooling led to his developing a hostility to Roman Catholicism. At St. Cuthbert's his left eye was damaged either by the knotted end of a rope flung at him, or as he believed, punched out by a blow from a fist. He lost the sight of this eye. Financial difficulties of his grandaunt forced him to leave college in Oct. 1867. He spent most of 1868 in extreme distress and abject poverty in London. Finally in 1869 he was shipped off to Cincinnati, O., which he reached after a brief period in New York.

He suffered many hardships in Cincinnati. working at odd jobs and often sleeping in the streets. He soon met Henry Watkin, a printer, who exerted a great influence upon him. Watkin taught him the rudiments of his trade, and Hearn became a proofreader. Meanwhile he began to write, and in 1870 and 1871 contributed five articles on freethought under the pseudonym "Fiat Lux" to the Boston Investigator. By 1873 he was on the staff of the Cincinnati *Enquirer,* where both his scholarly and gruesome articles, written in a masterly poetic style, attracted attention. He was dismissed in the summer of 1875 either because of a marriage ceremony with

a Negro woman with whom he had been living or because of political pressure. He was soon taken on the *Cincinnati Commercial* where his articles won even greater acclaim. He wrote about the Negroes and the Jews, continuing to praise and defend the latter for many years. He also began his first translations from the French, of Gautier and Flaubert.

Anxious to visit the south he left for New Orleans, La., in Oct. 1877. He sent back to his paper articles signed "Ozias Midwinter," mostly containing his earliest impressions of New Orleans. In 1878 he became, after penniless months, assistant editor of the *New Orleans Item*. For the next three and a half years he contributed editorials on numerous topics, scientific and literary articles, "fantastics" or prose poems, sketches of life among the Creoles, and a few translations from the French and Spanish. In May 1880 he also began contributing translations to the *New Orleans Democrat*. There appeared the first English translations of De Maupassant and Pierre Loti.

The newly merged *New Orleans Times-Democrat* engaged Hearn in Dec. 1881. For the next five and a half years he contributed translations from French and Spanish writers almost every Sunday. He also published stories and sketches in poetic prose, and adapted from foreign literatures many tales that made up his two earliest works *Stray Leaves From Strange Literature* (1884) and *Some Chinese Ghosts* (1887). He wrote essays and articles on Buddhism, on Hebrew and Arabic subjects, and on French and Russian literature. His editorials ranged over the scientific field from astronomy to archaeology. He also contributed to the *Century Magazine, Harper's Weekly* and *Harper's Bazaar*. In New Orleans he met Elizabeth Bisland, who became his biographer.

His first novel, *Chita,* occupied an issue of *Harper's New Monthly* magazine and appeared in book form in 1889. In 1887 Henry Mills Alden, the editor, encouraged him to go to the French West Indies. Hearn spent the following two years there, and wrote his finest book before he went to Japdn, *Two Years in the French West Indies* (1890). In the tropics he also obtained material for his second novel, *Younza* (1890). He spent the summer of 1889 in Philadelphia, living with George M. Gould. From Oct. 1889 to March 1890, Hearn lived in New York city. There he translated Anatole France's *The Crime of Sylvestre Bonnard* (1890). There he saw much of Henry E. Krehbiel, the musical critic.

Hearn went to Japan on a tentative assignment for *Harper's New Monthly* magazine, arriving at Yokohama, April 4, 1890. He broke with *Harper's* in May. He spent some time living in temples and making pilgrimages. Through the intervention of Capt. Mitchell McDonald to whom he brought a letter of introduction from Elizabeth Bisland and who became his closest friend and literary executor, and two others, one being Basil H. Chamberlain, he obtained a position as a teacher in the ordinary middle school at Matsue in the province of Izumo, beginning his duties Sept. 2, 1890. Through one of the fellow members of the English faculty, he met his future wife, Setsu Koizumi, a Japanese lady of high Samurai rank, whom he married in Jan. 1891.

In Sept. 1891, his articles on Japan began appearing in the *Atlantic Monthly,* while some appeared in Feb. 1892 in the *New Orleans Times-Democrat* and were syndicated in other newspapers. These essays and others were subsequently collected and published in two volumes as *Glimpses of Unfamiliar Japan* (1894). Late in 1891 he had himself transferred to the government college at Kumamoto in Kyushu, where he remained for three years. He was not happy there and began feeling disillusioned about Japanese officialdom. In the late summer or early fall of 1895 he became a Japanese subject in order to protect his wife's citizenship, the legality of their marriage and their rights of property.

Out of the East appeared in 1895 and *Kokoro* in 1896. In the summer of 1896 through the influence of Chamberlain he was invited to teach in the English department of the Imperial university of Tokyo. He moved into Ushigome, a suburb of Tokyo, where he lived for the next six years. These years constituted his most prolific and brilliant period. There he wrote *Gleanings in Buddha-Fields* (1897), *Exotics and Retrospectives* (1898), *In Ghostly Japan* (1899), *Shadowings* (1900) and *A Japanese Miscellany* (1901). He was occupied with themes that had attracted him in the United States — insects, proverbs, names, songs — but they now received a Japanese setting.

About the spring of 1902 Hearn purchased a house at 266, Nishi Okubo where he lived until his death. His next book, *Kottō,* appeared in the fall of 1902. His lectures as taken down by his students were published in the United States (1915–17), edited by John Erskine, as *Interpretations of Literature* (2 vol.), *Appreciations of Poetry* and *Life and Literature*. More complete editions of these lectures have been published in Japan. Also published in Japan, and based on his lectures was *A History of English Literature,* 2 vol. (1927).

In the spring of 1903 Hearn left his position and prepared a series of lectures intending to deliver them at Cornell university, Ithaca, N.Y., but the university withdrew an offer it had previously made. These undelivered lectures became the material for his best-known book on Japan, *Japan: An Attempt at an Interpretation* (1904). Another book, *Kwaidan,* mainly stories, had appeared earlier in the year. In the spring of 1904 he was invited to teach English at Waseda university. Under strain and anxiety he died from a heart attack on Sept. 26, 1904. Though a professed agnostic and not a Buddhist in religion, his funeral was in accordance with Buddhist rites, and his ashes were interred at Zoshigaya cemetery.

Hearn is notable not merely as a writer who revealed an idealized Japan to the western world, but also for his manifold interests. He was a devoted student of fairy tales, folklore and legends that unfolded the mental strata of entire peoples. He sought out kindly and generous emotions, high conceptions of duty and examples of self-sacrifice among the lowly, and delineated them in his unique and at times flowery prose, excelling especially in descriptive writing. He had philosophical preoccupations; he tried to find a linking bond between the doctrine of Karma in Buddhism, *i.e.,* prebirth conduct in one's ancestors, and the role of heredity in the theory of evolution. He dwelt much on race memories as manifested in the individual. He was, however, a rationalist and not a mystic. He was also a profound literary critic. While leaning toward Victorian standards, he leavened these with his proclivities for French romanticism and occasional realism. He was a great admirer of the Russian novelists and Henry James before interest in these writers became common.

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HEARNE, SAMUEL (1745–1792), English explorer who played an important part in ascertaining the relations between Hudson bay and the Arctic ocean by his exploration of the Coppermine river. Born in London in 1745, he served in the navy and then joined the Hudson's Bay company in 1766. He was sent northward from Churchill to explore the coast and investigate the possibilities of a whale fishery. Unreliable guides and equipment twice (1769 and 1770) caused his failure to reach a copper mine

whose existence was rumoured by Indians. On his third journey (1770–72), Hearne came to the Coppermine river, which he traced to its mouth (Coronation gulf), saw the copper mine and took a lump of copper, returning to Churchill by way of Great Slave lake and Chipewyan territory. In 1774 he was sent to establish Cumberland house on the Saskatchewan, subsequently returning to command Churchill, which had been rebuilt and named Prince of Wales's fort. There he was captured by J. F. La Pérouse in 1782 and brought to Europe. After release to publish his account of his journey, the company sent him back to command again at the fort. Hearne was recalled to England in 1787 and died there in 1792.

Hearne's *Journey From Prince of Wales's Fort in Hudson's Bay to the Northern Ocean* was published posthumously in 1795.

(E. E. RH.)

HEARNE, THOMAS (1678–1735), English antiquary, was born in July 1678 at Littlefield Green. White Waltham. Berkshire, son of the parish clerk. Educated at St. Edmund Hall, Oxford, he became in 1699 assistant keeper of the Bodleian library, where he worked on the catalogue of books, and in 1712 he was appointed second keeper. As a nonjuror he refused to take the oaths of allegiance to King George I, and early in 1716 he was deprived of his librarianship. He continued to reside in Oxford, and occupied himself in editing the English chroniclers. He died on June 10, 1735.

Hearne's most important work was done as editor of many of the English chroniclers, and until the appearance of the "Rolls Series" his editions were in many cases the only ones extant. Very carefully prepared, they are still of the greatest value to historical students. Perhaps the most important of a long list are Benedict of Peterborough (Benedictus Abbas), *De vita et gesta Henrici II et Ricardi I* (1735); John of Fordun, *Scotichronicon* (1722); the monk of Evesham, *Historia vitae et regni Ricardi* (1729); Robert of Gloucester, *Chronicle* (1724); the *Vita et gesta Henrici V*, wrongly attributed to Thomas Elmham (1727); Titus Livy, *Vita Henrici V* (1716); Walter of Hemingburgh, *Chronicon* (1731); and William of Newburgh, *Historia rerum Anglicarum* (1719). He also edited John Leland, *Itinerary* (1710–12), and *Collectanea* (1715); *W.* Camden, *Annales rerum Anglicarum et Hibernicarum regnante Elizabetha* (1717); Sir John Spelman, *Life of Alfred* (1709); and W. Roper, *Life of Sir Thomas More* (1716). Among his other compilations may be mentioned *Reliquiae Bodleianae* (1703).

Hearne left his manuscripts to William Bedford, who sold them to Richard Rawlinson, who in his turn bequeathed them to the Bodleian. Two volumes of extracts from his voluminous diary were published by Philip Bliss (1857), and afterward an enlarged edition in three volumes appeared (1869). A large part of his diary entitled *Remarks and Collections, 1705–1714,* ed. by C. E. Doble and D. W. Rannie, was published by the Oxford Historical Society (1885–98). *Bibliotheca Hearniana,* excerpts from the catalogue of Hearne's library, was ed. by B. Botfield (1848).

See *Impartial Memorials of the Life and Writings of Thomas Hearne by Several Hands* (1736); *W.* D. Macray, *Annals of the Bodleian Library* (1890). Hearne's autobiography was published in W. Huddesford, *Lives of Leland. Hearne and Wood* (1772). T. Ouvry, *Letters Addressed to Thomas Hearne,* was privately printed (1874).

HEARSAY, a legal term signifying facts given in evidence derived from indirect information, the circumstances under which such evidence is admitted being subject to considerable limitations. *See* EVIDENCE.

HEARSE, a vehicle for the conveyance of the coffin at a funeral. In funeral ceremonies a "herse" or "hearse" seems first to have been a harrow-shaped framework of wood, to hold lighted tapers and decorations placed on a coffin; this developed into a pagoda-shaped erection of woodwork or metal for the funerals of royal or other distinguished persons. It held banners, candles, armorial bearings and other heraldic devices. An elaborate hearse was designed by Inigo Jones for the funeral of James I. The hearse is also found as a permanent erection, of iron or other metal, over tombs.

HEARST, WILLIAM RANDOLPH (1863–1951), U.S. publisher, whose methods profoundly influenced U.S. journalism, was born in San Francisco, Calif., on April 29, 1863. The son of George Hearst, a California pioneer who amassed a large fortune in ranch and mining lands and who served as U.S. senator from 1886 to 1891, he entered Harvard in 1882 and remained two years. Becoming interested in journalism, he visited Boston newspaper offices, studied newspapers from all parts of the country and paid special attention to the success of the *New York World* under Joseph Pulitzer.

On his return to California he first took partial and later, in 1887, complete control of the *San Francisco Examiner,* which the elder Hearst had bought for political reasons. Within two years he made it pay, and with an efficient staff used it for many newspaper experiments.

Hearst invaded New York journalism in Sept. 1895 by buying the unsuccessful *Morning Journal,* which he made a one-cent newspaper of highly popular type. To it he brought many able workers, including Julian Hawthorne, E. W. Townsend, Stephen Crane, Julian Ralph and the cartoonist Homer Davenport, while he immediately raided the *New York World* for the best members of Pulitzer's Sunday staff, including R. F. Outcault, the inventor of the modern coloured comic pictures. By the use of numerous illustrations, coloured magazine sections and glaring headlines, by sensational articles on crime and pseudoscientific topics, and by a jingo policy in foreign affairs, the *Journal* (an evening edition was started in 1896) shortly reached an unprecedented circulation. On the day after the election in 1896 it printed 1,506,000 copies of its several editions.

Under Hearst's control the *Journal* attacked England in the Venezuela affairs, supported William Jennings Bryan in 1896, demanded war with Spain in 1897–98, launched a series of attacks against municipal "franchise grabs" and supported Bryan again in 1900, bitterly assailing William McKinley and Mark Hanna as tools of the trusts. An editorial statement in April 1901 that "if bad institutions and bad men can be got rid of only by killing, then the killing must be done," led Theodore Roosevelt in his first message after McKinley's assassination to denounce "exploiters of sensationalism" in words which he later (1906) declared he meant for Hearst.

The success of the *Journal* led Hearst to establish the *Chicago American* in 1900, the *Chicago Examiner* in 1902 and the *Boston American* in 1904. Other newspapers were purchased in 1912, and in 1917 he launched an energetic policy of expansion, so that by 1925 he owned newspapers in cities of every section of the United States. After 1904, when he supported Alton B. Parker, he paid decreasing attention to editorial leadership. He opposed U.S. entrance into World War I; he waged unremitting warfare against the League of Nations, and demanded payment of the war debts in full. Late in 1916 the British and French governments denied Hearst the use of their mails and cables. But in 1927 he suddenly emerged as the champion of a bond of close friendship and practical co-operation among all English-speaking countries. Meanwhile, he had embarked in other publishing enterprises. He purchased the *Cosmopolitan* monthly in 1905, the *World To-day* in 1911, and *Harper's Bazaar* and other magazines, including *Nash's Magazine* in England, at later dates. He published books, chiefly fiction, and later in his career produced motion pictures on a large scale.

His holdings just after World War I were enormous, but living on a princely estate at San Simeon, Calif., and buying antiques and art on a munificent scale, he strained even his huge income. The long depression beginning in 1930 endangered his empire.

First he had to pool some of his most valuable newspapers in a company which raised $50,000,000 by selling preferred stock; then in 1937 he had to assign control of his chief holding company, American Newspapers, Inc., to a banking-house trustee for ten years. Weak newspapers were ruthlessly sold or consolidated with stronger units. A great part of his collection of furniture, paintings, tapestries and other treasures was sold through department stores in 1941. But during the boom of World War II, 1941–50, his newspaper properties again became profitable; his holdings still included newspapers scattered from Baltimore, New York city and Boston in the east to Los Angeles, San Francisco, and Seattle on the west coast, and several magazines, of which *Cosmopolitan, Good Housekeeping, Motor* and *Town and Country* enjoyed large circulations. He died at Beverly Hills, Calif., on Aug. 14, 1951.

Hearst's role in politics was ambitious but unsuccessful. While serving two inactive terms in the U.S. house of representatives

(1903–07), he ran in 1905 for mayor of New York on an anti-Tammany municipal ownership ticket, and came within 3,000 votes of winning; and the following year, as Democratic nominee for governor of New York he was defeated by Charles E. Hughes. A heavier defeat for mayor of New York followed in 1909, and, though he was later frequently suggested for mayor or governor until his quarrel with Alfred E. Smith in 1924 destroyed his Democratic following, he was never again nominated.

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HEART, ANATOMY OF. The human heart, a double muscular pump, lies within the thorax, rests upon the diaphragm, is between and partly covered by the lungs. Each side (pump) has two chambers: the one (atrium) receives, the other (ventricle) expels blood. Together, these four chambers have the shape of a flattened cone, a little larger than the fist, which is covered by a double-walled sac, the pericardium. (See COELOM AND SEROUS MEMBRANES.) The innermost layer is tightly adherent to the cardiac muscle. Between the layers is a small amount of lubricating fluid. The heart of an average-sized adult weighs about 300 g. The ratio of heart weight to body weight is less in adults than in children.

The base of the heart, formed by the atria and great vessels, faces the backbone. Between the fifth and sixth ribs, halfway across the left chest, lies the apex (formed by the left ventricle).

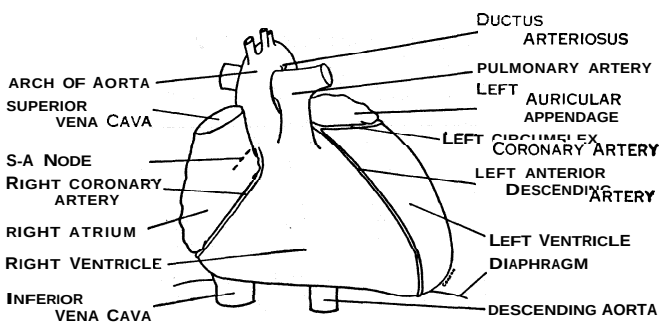


FIG. 1.— FRONT VIEW OF HEART

Seen from the front, the right border of the heart may extend one centimetre to the right of the edge of the breastbone (sternum). The right atrium forms this border but occupies only a finger's breadth of the front (ventral) surface. A similar band of left ventricle forms the left border. These strips of right and left ventricle account for one-third of the ventral surface. The rest is occupied by the right ventricle, which forms almost the entire lower (inferior) edge.

The pulmonary artery is seen at the upper curved edge of this chamber (*see* fig. 1). The inferior (diaphragmatic) surface is composed two-thirds of left, one-third of right ventricle. Separating atria from ventricles is a deep groove containing fat and blood vessels, the atrioventricule (A–V) groove. A shallow groove (interventricular, I–V) containing blood vessels marks the partition between the ventricles (the septum).

Seen from the side, the right atrium lies between the ventricle and the backbone (fig. 2). Entering the upper atrial edge is the superior vena cava, bringing venous blood from the head, arms and upper thorax. The inferior vena cava, draining the lower body, penetrates the diaphragm and immediately enters the lower right atrium. A shallow furrow lying between these veins contains a deep nest of unique cells, the sinoatrial (S–A) node (fig. 1). Within this chamber, the mouth of the superior vena cava is in the upper part and that of the inferior cava is below. The latter is partly surrounded by remnants of the Eustachian valve, which, in the embryo, directed blood from right to left atrium through an opening called the foramen ovale. After birth two membranes, lying in apposition, close the foramen. On the adult septum a depression (fossa ovalis) marks this spot. Near the Eustachian valve is the opening from the coronary sinus, which also has a valve. This sinus is a vein which drains the heart muscle; it runs

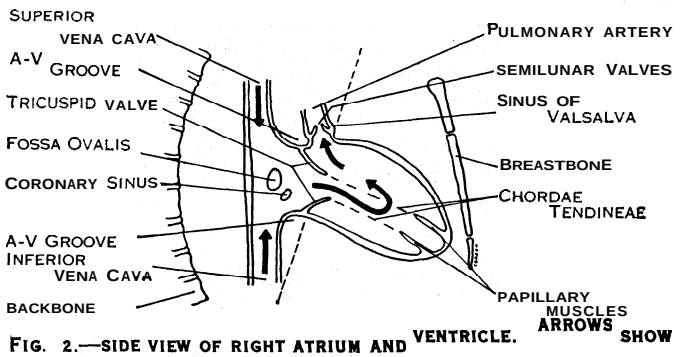


FIG. 2.—SIDE VIEW OF RIGHT ATRIUM AND VENTRICLE. ARROWS SHOW DIRECTION OF BLOOD FLOW

around the inferior A–V groove. Near the coronary sinus opening is another nest of unique cells called the A–V node. Atrial walls are thin enough to be translucent when distended. The inner surface has fine columnar ridges called musculi pectinati. Arrows in fig. 2 show the direction of blood flow from right atrium to ventricle.

The passageway between these chambers is the A–V or tricuspid orifice. A membranous curtain (tricuspid valve) attaches to the cartilagenous ring which surrounds this orifice (fig. 3A). The free edge, serrated to form three cusps, is attached by fibrous bands, chordae tendineae, to the ventricular muscle. When the ventricle is relaxed, the cusps take the position shown in fig. 2. When the filled ventricle begins to contract, the cusps float up to close the opening, thus preventing backflow to the atrium (fig. 3A).

In cross section the right ventricular cavity is crescentic, and partly enfolds the circular base of the left ventricle (fig. 3B). Certain muscular bands, together with the convexity of the septum, give the cavity the shape of a V lying on its side (>). The horizontal arm is the inflow tract from the atrium, the vertical arm the outflow tract to the pulmonary artery (fig. 2). A valve having three semilunar cusps is attached to the inner surface of the artery.

When the ventricle is empty, the cusps fill with blood and drop back to block the artery (fig. 3A). When the ventricle is expelling blood, the emptied cusps are pushed into small dilatations of the arterial wall called sinuses of Valsalva (fig. 2). The wall of the right ventricle has a maximum thickness of four millimetres. Its contraction forces blood through the pulmonary artery to the lungs and thence to the left atrium.

The left atrium lies to the left and back of the right atrium. Between it and the backbone are the left bronchus, the and the descending aorta. The pulmonary veins, two from each lung, return oxygenated blood to it. The endocardia1 (smooth inner) lining is thick, making the colour seem pale. There are no musculi pectinati. The fossa ovalis appears on the septum. Blood flowing horizontally and to the left passes the A–V orifice, which also has a circular membrane, the mitral valve, attached to its periphery. The free border has two flaps which are attached by the chordae tendineae to anterior and posterior projections of the muscular wall (papillary muscles). The cavity of the cone-shaped left ventricle is divided by the large aortic flap of the mitral valve into inflow (atrial) and outflow (aortic) tracts. The aorta has three semilunar valves (see AORTA AND AORTIC VALVES;

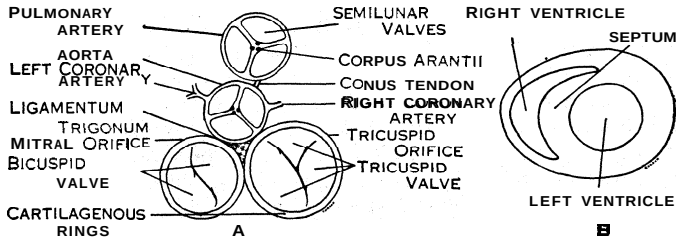


FIG. 9.— (A) CROSS SECTION OF VENTRICULAR BASE: DOTTED LINES SHOWN ON FIG. 2 INDICATE LEVEL. (B) CROSS SECTION (NEARER APEX THAN A) TO SHOW RELATIVE SHAPES AND SIZES OF RIGHT AND LEFT VENTRICLES

ARTERIES). Mouths of the two coronary arteries, which nourish the heart itself, are seen in two of the sinuses of Valsalva. Both septal and lateral walls of this ventricle are thick at the base 10–12 mm.) (fig. 3B). At the apex, between the papillary muscles, the wall is very thin (one millimetre). The I–V muscular septum is absent at the root of the aorta, where a thin tough membrane (membranous septum) separates the ventricles.

Contraction of the left ventricle forces blood through the aorta and to the entire body.

The walls of the atria and of the ventricles are made up of superficial and deep layers. In the ventricles the thin superficial layer attaches to the cartilagenous A–V rings and to the ligaments (fig. 3A). That part attached to the left ring is called bulbospiral (fig. 4A). and that attached to the right sinospiral. Together they cover the entire ventricular surface, spiraling from left to right and from base to apex. At the apex of each ventricle the bands become compact and turn inward so that they come to line the cavities. The leftward spiral is continued as the fibres run to the base and attach to the same rings from which they originated. Some of the innermost (subendocardial) fibres of these superficial muscles are called by special names; *e.g.,* columnae carneae, papillary muscles. Fibrous strands, the chordae tendineae, are replacements of primitive muscle fibres that have degenerated. These serve to attach the papillary muscles to the

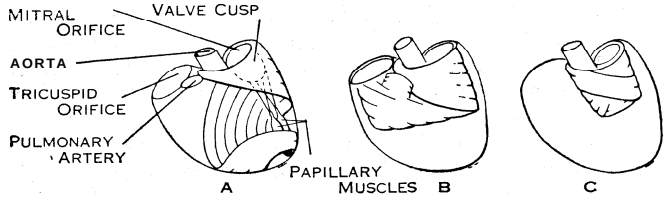


FIG. 4.— (A) SUPERFICIAL BULBOSPIRAL MUSCLE: THIS. TOGETHER WITH ITS COUNTERPART ON THE RIGHT (SUPERFICIAL SINOSPIRAL, SHOWN HERE AS A SPACE). COVERS THE ENTIRE HEART'S SURFACE. (B) DEEP SINOSPIRAL. A CUFFLIKE MUSCLE ENFOLDING BOTH VENTRICLES AND FORMING PART OF THEIR SEPTUM. (C) DEEP BULBOSPIRAL MUSCLE ENCIRCLES THE AORTA AND THE MITRAL ORIFICE

valve cusps. These superficial muscles fix the valve leaflets so they cannot invert back into the atrium when the rest of the ventricle contracts.

A deeper layer of muscle, the deep sinospiral, extends two-thirds the distance from base to apex (fig. 4B). Its fibres are transverse to the long axis of the heart and course through the septum as well as encircle both ventricles. The deficiency, facing the apexes, is entirely filled in by the papillary muscles. Still another heavy muscle band forms a cuff around the mitral orifice and the aorta (fig. 4C). It extends one-third the distance from base to apex. When this muscle, the deep bulbospiral, contracts, it squeezes the last of the ventricular blood into the aorta (see ARTERIES). When it relaxes, the semilunar valves fall into position. Considering these functions, it is obvious that the superficial bands must contract somewhat earlier than the middle layer, and especially before the cuff muscle.

No muscle is continuous from the atria to the ventricles; nevertheless, atrial contraction precedes ventricular in orderly sequence. The stimulus for contraction arises in the S–A node (see above). Later the A–V node is excited. From this node, a band of unique cells, the bundle of His, passes toward the ventricle. This specialized conducting tissue provides for co-ordinated excitation of the muscle areas. Within a few millimetres it enters the membranous septum, where it lies between its two layers, following the lower curved edge. Next it lies on top the muscular I–V septum for 12–15 mm. and then divides into right and left branches. Numerous smaller branches go directly to the septum. The branches divide and subdivide until they penetrate every area of ventricular muscle. (Other expansions of this tissue spread through the atria.) Eventually the cells of this tissue undergo end to end transition into ordinary heart muscle cells. Microscopic sections of heart muscle, stained to show connective tissue, establish that the muscle does not form a syncytial structure (*i.e.,* it consists of isolated units). Lozenge-shaped masses of muscle are wrapped in connective tissue which insulates one area from another. Each such lozenge receives at least one strand from the bundle of His. Electron microscope photographs confirm the absence of syncytial connections even between fibrils.

Nerves supplying the heart are the vagus (parasympathetic, cholinergic) and the cardiac branches of the cervical and upper thoracic ganglia (sympathetic, adrenergic). Superficial and deep plexuses are formed by these nerves. (See also NERVE; NERVOUS SYSTEM.)

Evolution of the Heart.— In the lancelet, a fishlike lower chordate, there is no heart, but only a contractile area where the hepatic veins, the ducts of Cuvier and the ventral aorta meet. The simplest heart is a tube, an enlarged vein with muscular walls. The ends of this tube are fixed; the intermediate part continues to grow, and hence is forced to bend. The curvature is to the right but finally becomes S-shaped. Constrictions divide the tube into four chambers.

The most posterior (footward) is the thin-walled sinus venosus, which receives the systemic veins. The second thin-walled area, the atrium, has lateral bulges. The third chamber, the ventricle, has thick walls and is partly filled with spongy musculature. The most anterior (headward) chamber, the conus arteriosus, is tubular with moderately muscular walls. During the development of the conus four longitudinal ridges form on the inside. Three of these persist and form rows of little pockets, which are the distinguishing characteristic of the conus. Beyond the conus is the aorta. Because of the S-bend, the ventricle is brought near the sinus and the atrium near the conus. Hearts of most fishes are of this type: a continuous tube carrying venous blood, which is oxygenated in the gills.

In vertebrates with four limbs (tetrapods; *e.g.,* newts, salamanders and tailed amphibia) the heart is even more compressed, and the atria bulge around the conus. One edge of the ventricular curve has grown faster than the other, thus causing fusion of the short arms of one S-bend. This gives the ventricle its characteristic shape. Within the atrium a septum has appeared, dividing it into right and left parts. The sinus has twisted anteriorally to lie near the right atrium. Tetrapods have functioning lungs; therefore, two circulations are necessary. Venous blood still comes from the systemic veins to the sinus venosus and the right atrium, and thence to the right ventricle. The pulmonary arteries take the blood to the lungs. Pulmonary veins have developed which bring blood back from the lungs to the left atrium; it passes from there to the left ventricle, thence to the conus and the aorta.

Within the atria, the septum lies between the two streams of blood. Although the two streams are not separated by tissue in the ventricle, they do not mix to any extent. In the conus one of the four ridges (see above) persists and helps to separate the streams. Only one class of fishes, the Dipnoi, have a circulation as advanced as this.

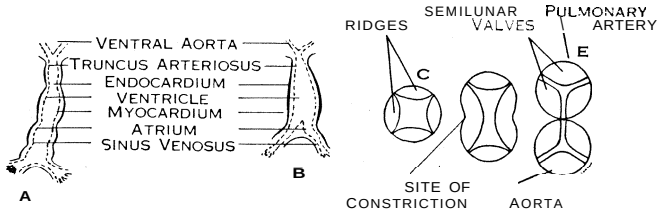
In reptiles the heart is even more crowded together; the sinus venosus is smaller and more anterior; thus the ends of the great veins are brought nearer to the beginning of the large arteries. There are two atria, and a muscular band forms a partial I–V septum. Among reptiles, only crocodiles have a complete I–V septum. The conus is now divided by a spiral structure into three trunks, each having a semilunar valve at the point where it leaves the ventricle. The circulation, though better separated by the new septum and by the valves, is the same as in amphibia.

The similarity of the hearts of birds and mammals is an example of parallel development from a common reptilian ancestor. The sinus venosus has become part of the right atrial wall; the S–A node (see above) is its residuum. Complete septa divide both atria and ventricles, forming four chambers. The great veins empty directly into the right atrium; the pulmonary artery connects to the right, the aorta to the left ventricle. This has come about by the splitting of the conus. Cross section of the rudimentary conus is almost circular and, as stated above, four ridges are within (fig. 5C, D, E). Later an external constriction occurs. The lateral ridges are divided into two portions and the conus into two channels, each having three ridges. Where the two chan-

nels (aorta, pulmonary artery) leave the ventricles, persistent portions of these ridges form the semilunar valves (figs. 3A and 5C, D. E). The arterial and venous blood have become entirely separated and circulate as described for the adult heart.

Embryology. — The heart begins in two areas lying on either side of the coelom well away from the midline (see EMBRYOLOGY). In each of these, two kinds of tissue are found: one eventually hollows out to form an inner lining tube (endocardium); the other develops into muscular and outer covering (epimyocardium). When the originally flat embryo curls under and the edges grow together, these areas are brought into the midline where they fuse to form a single tube having endocardium inside and an epimyocardial mantle outside. This tube is reminiscent of the fish heart (fig. 5A, B), but in the human embryo the constrictions are less evident. This tube does not grow all at once. nor does any one part precede another. Rather there are several areas developing simultaneously, moving toward the midline and fusing.

The developing heart pushes into the small pericardium which



FROM ORIGINAL OF FIG. 3; PATTEN & KRAMER, "AMERICAN JOURNAL OF ANATOMY," 53:356

FIG. 5. — SCHEMATICREPRESENTATION OF (A) FISH HEART. (B) TUBULAR HEART OF HUMAN EMBRYO. (C) CROSS SECTION OF CONUS TO SHOW FOUR RIDGES WHICH WILL EVOLVE INTO SEMILUNAR VALVES; (D) BEGINNING OF LATERAL CONSTRICTION; (E) SEPARATION INTO TWO VESSELS. PULMONARY AND AORTA. EACH HAVING THREE VALVES

is to envelop it. The ends of this tube are fixed. Because the central part has to grow within this limited space, it twists and widens laterally. Not all points of the tube grow at the same rate; thus constrictions occur which delimit the various chambers. Where the constriction between the atria and ventricles occurs (atrial canal), anterior and posterior ridges (endocardia1 cushions) touch. fuse, form the septum intermedium and leave right and left A–V openings laterally. From the tip of the ventricle another septum grows up to meet the septum intermedium. This I–V septum is complete at the end of the second month (17–20 mm. embryo). Within the atrial chamber septa also develop. The first (septum primum) grows down from above to meet the fused endocardia1 cushions. The second septum, at the right of the first. is never complete; its curved edge surrounds the foramen ovale. Eventual closure of the foramen occurs when these two septa adhere. Division of the conus into two vessels, each having three semilunar valves, proceeds as described above (fig. 5C, D. E).

Because the developing heart is forced to rotate, the aorta and pulmonary artery are somewhat entwined in the adult. With further development the spongy muscular mass of the ventricle becomes somewhat hollowed out (one theory supposes this to be the result of pressure erosions or aneurysms). Some of this early muscle becomes transformed into fibrous tissue and persists as the A–V valves and the chordae tendineae. See also CIRCULATION OF BLOOD; HEART, COMPARATIVE PHYSIOLOGY OF; HEART, DISEASES OF THE; HEART AND LUNG, SURGERY OF; MUSCLE AND MUSCULAR SYSTEM.

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HEART, COMPARATNE PHYSIOLOGY OF. The bodies of all except the simplest animals contain fluids that circulate through the body in a constant direction. Such circulation requires a repeating pump to propel the fluid, and any such pumping device is called a heart. To keep the fluid moving in a constant direction the heart must either compress the fluid in a continuous progressing wave, or it must have valves to prevent backflow. Both systems are found in animal hearts, sometimes one or the other and sometimes both together. Propulsion by contractile waves is characteristic of worms, whereas rhythmic contractions with valves to prevent backflow characterizes arthropods, mollusks and vertebrates (including man).

The most characteristic feature of heart muscle tissue is its capacity for rhythmic contractions, a property that is also inherent in many nerve cells and in visceral muscles. Embryonic heart tissue is capable of spontaneous rhythmic contractions; in the early embryos of vertebrates the heart beats without anything regulating the contractions, and pieces of embryonic heart tissue cultured outside the body may develop rhythmic contractions. Such spontaneous contractions probably are a response of the muscle protoplasm to conditions of the cellular environment; perhaps the energy produced by intracellular oxidation builds up to a critical level. discharges, rebuilds to the critical level, etc., in an automatic cycle.

Adult heart muscle of all animals, however, seems to contract only as a result of stimulation. Heart muscle is extremely susceptible to stimulation. a great variety of artificial stimuli causing it to respond by contracting. As with other muscle tissue —skeletal muscle and smooth muscle—a stimulus must have a certain minimal intensity and a certain minimal duration in order to bring about a contraction. These values vary widely in different animals, and even from time to time in the same tissue as local conditions change. Like many other tissues, heart muscle also exhibits a refractory period, a brief period immediately followuing stimulation during which it is wholly unexcitable. The refractory period is not so clearly marked in invertebrates as in vertebrates. Each contraction of the vertebrate heart is maximal; *i.e*, the heart contracts in "all or none" fashion. and a stronger stimulation will not induce more powerful contraction. In invertebrates. on the contrary, a normal contraction of the heart is never maximal. (See ALL-OR-NONE LAW.)

The demands made upon the heart by the body are constantly changing; demands may be temporarily increased several hundred per cent in an athlete following a 100-yd. dash, for example. Simple animals with low metabolic rates and open circulatory systems require less regulation of the heart than do active animals with closed systems under high pressure; the heart of a clam, for example, need not be as efficient as the heart of a bird or mammal. Nevertheless. the behaviour of even the simplest hearts is regulated to conform to the changing requirements of the body. Such controls are largely chemical, although the heart also responds to variations in such physical factors as temperature and pressure.

Pacemakers. — In all adult animals a special tissue, called a "pacemaker," initiates each heart beat. The pacemaker is always located within the heart itself, and two very different kinds of pacemaker tissue occur in animals. In vertebrates and mollusks the beat originates in the heart muscle tissue itself, and these are called myogenic hearts. In vertebrates the pacemaker is localized in the muscle tissue of the sinus venosus (fishes and frogs) or the atrioventricular node (birds and mammals), which differ from the muscle of other regions of the heart in recovering excitability very rapidly after a contraction. In mollusks the pacemaker is less localized; the beat can originate in muscle at any point over the heart.

Mammals and birds have in addition a special conduction system that greatly increases the efficiency of the heart and appears to be an adaptation to high body temperatures. In these animals the wave of excitation originating in the atrioventricular node is first spread over the atria and then is spread over the ventricles through special rapidly conducting tissue (called Purkinje tissue)

that carries the wave to all parts of the ventricles at almost the same instant. In worms, arthropods and ascidians the beat originates in nerve cells located in or on the heart, and these are called neurogenic hearts. The two kinds of pacemaker tissue react very differently to certain drugs, notably acetylcholine, which inhibits myogenic hearts and accelerates neurogenic hearts. The striking differences in the two types of pacemaker mechanism indicate that they arose quite independently during the course of evolution. The myogenic pacemaker is more primitive than the neurogenic. *(See* CIRCULATION OF BLOOD: *Physiological Properties of the Heart.)*

Nervous Regulation of Hearts.— The heart rate of most animals is regulated by reflex nervous controls; and most hearts also respond to variations in blood pressure within the heart itself, the rate increasing when blood pressure falls and slowing when blood pressure rises.

In vertebrates, nerve fibres from the tenth cranial nerve (the vagus) pass from the brain to the heart, and stimulation of these fibres slows the heart and reduces the amplitude of its contraction. Fibres from the sympathetic nervous system reach the heart in all vertebrates except fishes; stimulation of these fibres accelerates the heart. Nerves seem to affect the heart rate by means of chemical mediators. Acetylcholine is associated with activity in the vagus; and sympathin, an adrenalinelike substance, is associated with activity in the sympathetic fibres. Acetylcholine inhibits vertebrate hearts, and adrenaline accelerates the hearts of both vertebrates and invertebrates.

In invertebrates various inhibitory and accelerator nerves pass from the central nervous system to the heart. These heart-regulating nerves form no consistent pattern among the various invertebrate groups, and the manner in which they affect heart rate is not well understood. *(See* also CIRCULATION OF BLOOD: *The Nervous Regulation of the Heart Beat.)*

Heart Rates.—Among warm-blooded vertebrates each species has a "normal" heart rate, the average rate at which the heart beats in a healthy individual at rest. In cold-blooded animals body temperature varies with environmental temperature, and the heart rate also varies with the temperature of the animal's environment. In all animals the rate of the heart beat varies widely with changes in bodily activity, with stress and with body temperature—in other words, the heart rate is directly related to the metabolic rate of the body. Therefore, statements of heart rate are almost meaningless unless the conditions under which the rates were counted are clearly stated. For example, the human heart normally beats about 72 times per minute, but disease, nervous tension, emotion and many other factors may increase the rate to 100 or more, and the rate may temporarily exceed 200 following violent physical exertion.

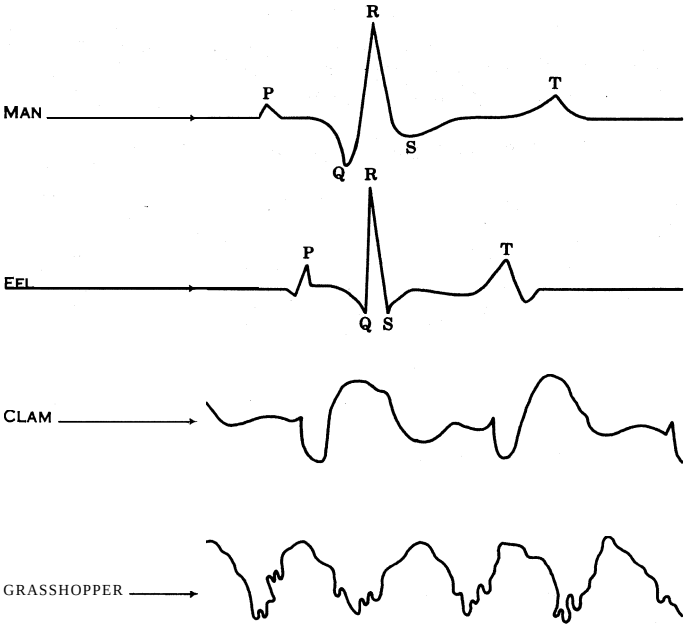
The requirements of the tissues of an animal's body vary from time to time, often from moment to moment. For any cardiovascular system to function efficiently, therefore, there must be a mechanism to increase or decrease heart rate. Since the heart muscle itself uses oxygen, however, an equilibrium point is soon reached beyond which the heart itself uses up the additional oxygen resulting from any further increase in heart rate.

In general, heart rate is faster in active animals than in sluggish animals. The heart rate is 40–80 per minute in squids, which are active mollusks, whereas in the much more sluggish clams and mussels it is only 2–20 per minute. This is not always true, however. In the hare the heart beats about 64 times per minute, whereas in the more sluggish rabbit the rate is about 200 per minute.

Heart rate is partly related to body size, large animals tending to have slower rates than small animals. In large mammals such as elephants and horses the heart beats 25–40 times per minute, whereas in rats and mice the rate is 300–500 per minute. In birds the heart rate is very high, and this is related at least in part to their high body temperatures. In the domestic fowl the rate is 150–180, and in small birds it is 200 or more per minute.

Electrocardiograms.— Activity of heart muscle. like that of many other tissues, is accompanied by changes in electrical potential, and such changes can be measured by suitable instruments. A heart beat consists of a succession of events, each involving a different part of the heart, and each with its own characteristic change in electrical potential. A recording of the sequence of these changes is called an electrocardiogram, which is therefore a graphic record of the varying electrical potential of the heart during one or more complete beats.

The electrocardiogram pattern is similar for all vertebrates, consisting of a series of slow waves representing positive and negative deflections. In the electrocardiograms shown in the figure, the patterns for man and the eel, both of which are vertebrates, are seen to be almost identical. There can be no doubt that the points of positive and negative deflection in these patterns



ELECTROCARDIOGRAMS ILLUSTRATING THE COMPARATIVE PHYSIOLOGY OF THE HEART

(to which the symbols P, Q, R, S, T are conventionally applied in man) relate to the same events in all vertebrates. Electrocardiograms from other myogenic hearts likewise consist of slow electrical waves, but the patterns are not the same as for vertebrates. The difference is evident in the electrocardiogram of a clam, an invertebrate with a myogenic heart, in the figure. Neurogenic hearts, such as those of arthropods, produce very different electrocardiograms, as is illustrated by the electrocardiogram of a grasshopper. Electrocardiograms from neurogenic hearts are "oscillatory"; *i.e.*, each wave is accompanied by numerous small deflections instead of being smooth as in myogenic hearts. It is believed that the oscillations in electrocardiograms from neurogenic hearts correspond to discharges from the pacemaker ganglion cells.

For a discussion of the physiology of the human heart, *see* CIRCULATION OF BLOOD. *See* also HEART, ANATOMY OF; HEART, DISEASES OF THE; HEART AND LUNG, SURGERY OF.

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HEART, DISEASES OF THE. Evidence for the existence of some forms of diseases of the heart was found in the oldest Egyptian mummies. Disordered heart action was recognized by the Greek physicians, although of course its significance was not understood. It was not until William Harvey discovered the true nature of the circulation of the blood in **1628** that the background for more understanding was established. Several important anatomical studies of diseases of the heart were made in the latter part of the 17th century. From then on, there were sporadic contributions to the pathology and pathological physiology of heart diseases, but antemortem diagnosis made little

progress until René Laënnec invented the stethoscope in 1819. Stephen Hales nas the first to measure arterial blood pressure. in 1733. Rudolf Virchow contributed most to knowledge of the pathology of the circulatory system. The discoveries of X-ray by Wilhelm Rontgen in 1895, and of electrocardiography by Willem Einthoven in 1903 also contributed greatly to increased precision in diagnosis of diseases of the heart.

Clinicians who added much to knowledge concerning the nature and treatment of heart disease were William Withering, William Stokes. Dominic Corrigan, John Cheyne, Robert Adams, James Mackenzie and Thomas Lewis. all of the English or Irish school. Austin Flint. Jacob DaCosta, William Osler and James B. Herrick were the principal contributors in the United States.

At mid-20th century, diseases of the heart and blood vessels accounted for approximately one-third of all the deaths in the western world. They had increased in frequency with the lengthening of life expectancy among adults in the older age groups. The following represent the more important forms of diseases of the heart.

Congenital Heart Disease.—Congenital heart disease is that form of heart trouble which is present at birth. There are several anatomical varieties, some incompatible with extrauterine life, some causing no trouble whatever and all gradations in between. The outlook for some of these patients was greatly improved by the perfection of surgical procedures, the first of which was successful in 1938.

Rheumatic Fever.—This affects all parts of the heart but is most likely to involve the valves of the left side. Its cause, and therefore means of preventing it. have not been discovered, although streptococcus infection of the nose and throat have been implicated. At mid-20th century it was the most important cause of death of children between the ages of 5 and 19. Sometimes the scars on the valves cause them to be incompetent and sometimes to be narrowed, and often both. The severity of the valvular damage largely determines the course of the disease. The patient may develop congestive heart failure early, or he may live to old age without further trouble from this source.

Subacute Bacterial Endocarditis.—This is an infection, usually with streptococcus, always superimposed on a pre-existing rheumatic valvular lesion or on a congenital heart defect. It was uniformly fatal until the introduction of treatment with large doses of penicillin in 1944.

Hyperthyroidism and Hypothyroidism.—These cause heart troubles of different kinds. Each can usually be successfully treated medically, and the former can be treated surgically if need be.

Cardiovascular Syphilis.—Cardiovascular syphilis affects chiefly the big artery which distributes blood from the left side of the heart (the aorta). It causes trouble in one of three ways or a combination thereof. The vessel may dilate to form an aneurysm. This may rupture. causing instant death. Syphilis may involve the aortic valve, making it insufficient. The mechanics of this lesion are quite similar to those of rheumatic aortic involvement. Syphilis may narrow the mouths of the coronary arteries, the blood vessels which supply the heart muscle itself with blood. In this case, there is usually severe chest pain. The incidence of cardiovascular syphilis in the white population has steadily diminished because of the improvement in its prevention and treatment. The introduction of penicillin in the treatment of syphilis in 1942 further curtailed this disease.

Anaemia.—Anaemia, from whatever cause, if of sufficient severity and duration may cause heart failure. This is because the heart has to overwork constantly and does not get sufficient oxygen and other nutriments. When properly treated it results in no permanent heart damage.

Obesity.---Obesity may, by itself, cause heart trouble but is far more often a complicating feature in other forms of heart disease. It causes difficulty because the heart has to supply blood to the extra tissue 24 hours a day, and the patient and his heart have to work harder whenever he attempts any form of exertion. Furthermore, there may be a deposit of fat between the heart muscle fibres in a way that interferes with their mechanical efficiency.

Hypertension (High Blood Pressure).—Hypertension is one of the commonest causes of disability and death. Its cause is unknown in most instances. although in a few, certain kinds of kidney disease may be held responsible. The course of the disease varies greatly from person to person. In some it is compatible with many years of active life without any symptoms whatever. In others it leads to death within a year of its discovery. The mechanism of death from high blood pressure is usually one of three: heart failure; a vascular accident in the brain; or kidney failure. Various forms of medical treatment had been tried by mid-20th century, as well as operations on the sympathetic nervous system. None of these were wholly successful, but in a given case one or more of them seemed to alleviate symptoms and to prolong life.

Arteriosclerosis.—This chiefly affects the heart through hardening of the coronary arteries. These may be either narrowed or actually occluded. In the latter instance, the vessel may be shut off by the hardening itself or, more often, by the development of a blood clot at the site. The chief symptoms are those of angina pectoris or coronary thrombosis. These consist in pains in the chest. frequently radiating to one or both arms or to the neck and teeth. In the former, the pain is usually of short duration, lasting no longer than 15 minutes, and usually caused by exertion or excitement. In the latter, the pain usually lasts more than an hour and may last for several days. The occlusion usually causes a withering of the portion of the heart muscle supplied by the occluded branch of the coronary tree. This muscle is replaced by scar tissue if the patient lives. Both of these are compatible with a reasonably active existence in many patients for many years. The freer use of oxygen, the discovery of heparin and dicumarol to retard the clotting of the blood and other measures improved the outlook considerably.

Psychoneurosis Affecting the Circulatory System.—This is usually one of two kinds. Neurocirculatory asthenia (effort syndrome) is primarily a psychiatric disorder. The heart does not respond well to exercise in patients with this difficulty, but that is because they will not exercise enough to keep it toned up. Of much more importance is the anxiety neurosis directed toward the heart in patients with or without organic heart disease. This may be produced in some patients by physicians who are alarmists. It causes needless incapacity and worry.

Arrhythmias.—They may accompany any form of heart disease or occur in an otherwise strictly normal heart. They vary in severity from those of no clinical importance. such as simple sinus arrhythmia, which nearly all children have, through ventricular fibrillation, which produces sudden death. Sinus arrhythmia merely means that the heart rate varies with the phases of respiration. Premature systoles (extra systoles) are usually of no importance. A heartbeat is touched off from either the top or the bottom part of the heart prematurely and usually replaces the next normal beat. Even when they occur frequently in an otherwise normal heart, they are in no way incapacitating. Paroxysmal tachycardia is usually harmless unless it occurs as a complicating feature of some other form of heart disease or in the elderly, or if it lasts a long time. It is characterized by attacks of very rapid regular heart action. beginning and ending suddenly, ranging in rate from 160 to 200 beats per minute and lasting from a few seconds to a few weeks.

Auricular flutter and auricular fibrillation are close cousins in which the top part of the heart (the auricles) is the primary seat of the disturbance. In flutter, the auricles beat very rapidly, usually around 300 times a minute, and the bottom part of the heart may be regular or have a regular irregularity with coupled beats. The ventricle rarely beats more than 150 times a minute in the presence of flutter. In auricular fibrillation, auricular activity is chaotic and the ventricles beat with a completely irregular rhythm. When uncontrolled by digitalis, the ventricular rate is usually well over 100. Both of these disturbances can occur in attacks, but more often auricular fibrillation becomes the established rhythm. Both can, but rarely do, occur in otherwise normal hearts. The paroxysmal variety may be prevented by the use of quinidine. Auricular fibrillation is compatible with years of active life in many instances but is to be regarded as a more serious arrhythmia than

the ones previously described.

Heart blocks of various degrees represent interference in some portion of the pathway over which the impulse to contract travels through the heart. They range from partial auriculoventricular block through intraventricular conduction defects, bundle branch blocks, to complete heart block. The first represents a delayed conduction from auricle to ventricle; the second, a slowing down of the impulse within the ventricular walls; the third, a block in the pathway on one or the other side of the heart; and the last, a complete dissociation of auricular contractions from ventricular ones, with each chamber establishing its own rate. Most forms of heart block are the result of a diffuse process going on in the heart muscle which happens to catch that portion of the conducting mechanism appropriate to the label of the block. Most forms of heart block represent signs of an alteration of the outlook for the worse.

Congestive Heart Failure. — Congestive heart failure may occur as a result of any of the types of organic heart disease. It represents a failure of the one function of the heart, namely, to pump blood adequately. This results in an increase in venous pressure and usually in a failure to deliver adequate amounts of oxygen to the tissues. The increase in venous pressure, plus some other factors, may result in swelling of the liver and ankles and congestion in the kidneys and intestinal tract. When the left side of the heart is chiefly at fault, the lungs may be the site of most of the congestion, with an outpouring of watery fluid into the air sacs. Congestive failure may be acute or chronic. The acute variety may cause death in a few minutes, and the chronic variety may last for many years. The proper use'of digitalis, the introduction of theophylline derivatives and mercurial diuretics, better knowledge of proper dietary regimens and especially of the importance of a low intake of sodium ion greatly improved the outlook in nearly all of these cases. (E. B. By.)

HEART AND LUNG, SURGERY OF. Surgery of the heart and great vessels developed particularly during the first half of the 20th century, with rapid and dramatic advances especially after 1939, and continued into the second half. Operations within the chest remained unsafe until the early 1930s. After that time rapid advances were made and the risk of removal of a portion of a lung was reduced to a minimum. Thus it was inevitable that removal of lung tissue eventually was applied in treatment of numerous pulmonary lesions.

SURGERY OF THE HEART AND GREAT VESSELS

Heart Wounds. — Traumatic injuries of the heart, either by a foreign body or by a sharp object, are usually fatal if both entrance and exit wounds are produced. Fatality more often results from filling of the pericardial cavity with blood (cardiac tamponade), thus interfering with heart function, than from loss of blood. If death does not immediately ensue, heart function may be maintained by aspiration (removal) of blood from the pericardial cavity, while preparations are being made for closing the defect by suture.

Although J. Roberts suggested closure of heart wounds by surgery in 1881, report of a successful operation by L. Rehn did not appear until 1896. More reports of successful cases soon followed and until 1940 it was thought that all wounds required closure by suture. In 1943 A. Blalock and M. M. Ravitch reported that many of these injuries could be satisfactorily managed by improving the return flow of blood to the heart through repeated aspiration of blood from the pericardial cavity. If bleeding continued, however, suture of the wound was required.

Traumatic injury to large vessels within the pericardial cavity is usually attended by immediate death, since this wound does not tend to seal as do wounds of the heart muscle, and cardiac tamponade becomes severe.

Foreign bodies may lodge in the heart muscle and remain for an indefinite period of time. If the blood supply to the heart through the coronary circulation is not materially affected, and the object is not large, it may cause no dysfunction. Larger foreign objects are apt to cause complications and should be removed. This removal usually can be accomplished without undue risk.

Congenital Cardiovascular *Defects.* — *Patent ductus arteriosus* is a persistence of the opening between the aorta and pulmonary artery, which is necessary before birth. The ill effects caused by this lesion result from increased work put on the heart by abnormal recirculation of blood through the lungs. In some cases an infection develops in the ductus, and a blood stream infection ensues. Occasionally an aneurysm may form in this communication, with eventual death from its rupture.

Although surgical obliteration of a patent ductus was first suggested by J. C. Munro in 1907, this operation was not successfully performed until 1939 by R. E. Gross. Many successful operations for this lesion have since been performed. By closing this shunt from the systemic to the pulmonic circulation, either through division and suture or ligation (tying) of the ductus, normal circulatory arrangements are re-established. Life expectancy is returned to normal unless irreparable damage to the heart has already occurred.

Tetralogy of Fallot is a congenital abnormality, the so-called blue baby disease. It consists of (1) stenosis (constriction) of the pulmonary artery; (2) a persistent defect in the wall between the ventricles; (3) an aorta so positioned (overriding) at the wall defect that it receives blood from both the right and left ventricles; and (4) thickening (hypertrophy) of the right ventricular walls. The epochal work of A. Blalock and H. Taussig, in 1945, on the operative treatment of this condition was one of the major advancements in this field of surgery. Ill effects of these lesions result chiefly from a deficient flow of blood through the lungs. The Blalock procedure produces a shunt from a systemic artery (subclavian) to a pulmonary artery, thus bypassing obstruction of the inlet of the main pulmonary artery. An operation similar in principle was reported by W. J. Potts, S. Smith and S. Gibson in 1946. This entailed uniting the aorta directly to a pulmonary artery by the use of a specially devised clamp.

The results of surgery in cases of tetralogy of Fallot are both dramatic and satisfactory; cyanosis (blueness of the skin) is relieved, exercise tolerance is greatly raised, and significant elevations of blood oxygen saturation levels are attained. The risk of the operation has been reduced to approximately 5% to 10%. Closure of the ventricular wall defect under direct vision under extracorporeal circulation gives more satisfactory permanent results but carries a greater risk. The results of surgery have been very gratifying in that many children suffering from this heart abnormality have been returned to a relatively normal way of life.

Pulmonic and infundibular stenosis are a narrowing of the pulmonic valve or of the entrance to the pulmonic valve, named the infundibulum. They may occur without other abnormalities within the heart. In many such patients there is an associated defect in the wall between the atria. The ill effects of this lesion are similar to those in tetralogy of Fallot, since insufficient blood passes through the lungs for oxygenation of the tissues. R. C. Brock of London, Eng., in 1948 devised a direct approach to this problem by cutting and dilating the constricted valve with a specially constructed knife. His operation was also used in some cases of tetralogy of Fallot in which the pulmonary artery was enlarged beyond a constricted valve. In the case of pulmonic stenosis, dramatic results are achieved by opening this constricted valve, thus allowing a normal flow of blood from the right heart through the lungs. Correction of these lesions under direct vision, after reducing the body temperature to a very low level, has given better results at little or no greater risk. If cyanosis has been present previously because of a defect in the wall between the atria, this condition immediately disappears and strain on the right heart is relieved.

Coarctation of the aorta consists of almost complete constriction of the thoracic aorta at the point where the ductus arteriosus unites the aorta with the pulmonary artery before birth. Constriction of the vessel causes the blood pressure in the upper extremities and head region to become much elevated, while that below the site of constriction is below normal. This condition occurs in spite of the development of considerable collateral circulation around the point of stricture. Excessive heart strain with failure, the production of aneurysms and cerebral hemorrhages are

common results of this lesion.

Until 1945, when C. Crafoord of Stockholm, Swed., corrected this condition by cutting out the constricted portion and uniting the cut ends by suture, the life span of patients with this lesion was much shortened. Crafoord's accomplishment was duplicated soon thereafter by R. E. Gross. The risk of operation is less than 5%.

Septal defects consist of a communication between the right and left sides of the heart, either between the atria or between the ventricles. The deformity results from a failure of completion of the septum, or wall, between the two sides. A septal defect between the ventricles is likely to produce more harmful effects and be more difficult to repair than one between the atria. The ill effects of these lesions are usually caused by added strain on the heart with ultimate heart failure.

Operative repair of these defects was still in the developmental stage in the late 19jos, although an increasing number of successful surgical results were being reported. A closed method of repair was devised and reported by C. P. Bailey and others in 1952 and by T. Sondergard, V. O. Bjork and Crafoord in 1953. Open or semiopen methods (under direct vision) were used by R. Gross and C. A. Hufnagel and by J. Gibbon. The results following surgical closure may be excellent. However, if insufficient tissue is available for closing the defect. the results are less satisfactory.

Factors that have been of help during these operations include (1) hypothermia or lowering of the body temperature to as low as 30° C.; and (2) extracorporeal circulation, in which the venous blood is removed from the body by a system of tubes and pumped into the arterial system after being reoxygenated (heart-lung bypass). Closure of ventricular septal defects under direct vision, using heart-lung bypass, became the method of choice in 1956.

Acquired Defects.—Aortic and Mitral *Insufficiency* or *Stenosis.*—Following an attack of rheumatic fever, infection of the aortic and mitral valves may ultimately lead to constriction of the valve opening or otherwise prevent it from functioning properly. The chief ill effect of this defect is increased work on the heart with ultimate failure.

Although clinical investigation of mitral stenosis, and an attempt to relieve this condition by surgery, was reported as early as 1922, sustained satisfactory results were not obtained until C. P. Bailey devised an operation known as commissurotomy in 1948. Dilatation of the valve, by either finger or instrument, in many instances leads to return of valvular function to such a degree that the patient achieves normal status. The risk of operation is largely dependent upon the status of the valve and the heart at the time of surgery. For early cases mortality is less than 5%; however. for persons who have developed the severe stage of the disease, the risk may be 25% or more.

Surgical treatment of mitral insufficiency and aortic stenosis and insufficiency was still in the developmental stage in the late 1950s. Operative correction under direct vision using heart-lung bypass (see above) or hypothermia gave encouraging results. A plastic valve devised by C. Hufnagel benefited many patients with aortic insufficiency. Valves made of plastic, steel and other materials have been used in laboratory animals with varying degrees of success. In the late 1950s surgery of these valvular lesions by direct vision appeared more promising than did the use of artificial valves.

Constrictive *Pericarditis.*—In constrictive pericarditis, as the term indicates, the heart is tightly constricted by an envelope of scar tissue, which develops in the pericardial cavity as a result of chronic infection in that area. Rheumatic fever and tuberculosis are thought to be the commonest causes of this malady. The ill effects result from prevention of return flow of blood into the heart from the venous circulation. Removal of the constricting envelope of thickened pericardium and scar tissue was first proposed by E. D. Délorme of France in 1898. It was first successfully performed by L. Rehn of Germany in 1920 and resulted in complete relief of symptoms. In the United States E. D. Churchill in 1929 reported the first successful case. When the operation is properly performed, most patients who do not have irreparable heart damage are completely relieved and live out a normal life span. (See also HEART, DISEASES OF THE.)

SURGERY OF THE LUNGS

Cancer of the Lung.—This tumour constitutes approximately 10% of all malignant tumours. After 1925 it increased by at least 400%. Although the cause has not been proved, the irritating effects of certain chemicals on the lining of the air passages undoubtedly contributes to its etiology.

Cancer of the lung was a hopeless condition until 1933, when E. A. Graham and J. J. Singer reported the first successful removal of an entire lung (pneumonectomy) for this lesion. The patient, a physician, was living and free of evidence of tumour more than 2j years after the operation. Concentrated studies of both cancer of the lung and of surgical means of alleviation have been made. In some early cases, especially in older persons, removal of less than the entire lung has given highly satisfactory results with less risk. Early detection of tumour by mass X-ray mobile unit screening should greatly aid (1) in increasing the percentage of removable tumours; (2) in increasing the percentage of cures following surgery; and (3) in avoiding strain on the heart since less lung removal is necessary. In younger persons (under 50) the risk of pneumonectomy is less than 5%. The risk in older patients is approximately 15%. All available means for making an early diagnosis should be utilized. These include the use of bronchoscopy and of improved techniques of X-ray study and examination of the sputum for cancer cells.

Congenital Malformation of the Lung.—Cystic disease of the lung may be congenital. Abnormal development of the lung may lead to the formation of cysts, which may be single or multiple, large or small. This abnormality interferes with pulmonary function in one of two ways, either by infection of the cyst and the production of a condition somewhat like lung abscess or bronchiectasis, or by overdistention of the cystic space, thus collapsing the normal lung tissue. This congenital type of cystic condition should not be confused with the acquired type, which consists of emphysematous blebs and bullae which are not lined by respiratory epithelium. This latter type usually occurs in persons over the age of 40 or 50, whereas the congenital type is seen at any age. After resection of lung tissue became safe in 1931, this therapy was applied to cystic disease of the lung. Removal of involved portions while sparing all possible functioning lung tissue is the object of surgical treatment. Since in most patients the disease is limited to less than one-fourth the entire lung, removal of the involved part returns the person to practically normal status.

Congenital malformation of the lung may involve chiefly the vascular elements. A common form of this is a fistula (communication) between the arterial and venous sides of the circulation within the lung. Since this condition returns unoxygenated blood directly to the left heart, the ill effects of the lesion are produced by lowering arterial blood oxygen saturation. These fistulas tend to increase progressively in size and may rupture, causing a fatal hemorrhage. Treatment consists of the surgical removal of the involved part. In an otherwise normal person, the risk of operation is less than 5%.

Pulmonary Tuberculosis.--One of the greatest contributions of chest surgery has been in the field of pulmonary tuberculosis. Before 1940, because of its safety and effectiveness, collapse of the chest wall by the removal of several ribs was the surgical procedure of choice. This operation (known as thoracoplasty) was first attempted in Europe by de Cerenville in 188j. L. Brauer (1909), L. P. Friedrich (1911) and F. Sauerbruch contributed to the development of the operation. Collapse therapy by a modified type of thoracoplasty in one stage with removal of only a small portion of one rib and using a paraffin prosthesis has been most useful in selected cases.

Resection (or excision of part) of the lung for tuberculosis made little progress until antituberculosis drugs became available. The risk of resection in 1942 was approximately 45% for pneumonectomy and 26% for lobectomy. With the development of the antimicrobial agents streptomycin in 1944, para-aminosalicylic acid in 1946 and isonicotinic acid hydrazide in 1952, surgical resection became much safer and could be applied to many more

severely involved patients. Also, with the use of these drugs, better control of the disease was obtained, and therefore lesions of a much lesser magnitude were presented for therapy. In addition to pneumonectomy (which was seldom performed after 1955) and lobectomy, segmental resection was added and is applicable in a high percentage of patients requiring surgical therapy. Of even greater importance is the marked improvement that may be anticipated from surgical therapy. In 1942 the results following pneumonectomy were satisfactory in only 41% and following lobectomy in 69%. whereas by 1955 excellent results could be anticipated in 95% of cases of segmental resection or lobectomy and in 85% to 90% of pneumonectomy.

Bronchiectasis.—Bronchiectasis, meaning dilatation of the bronchus, is the infection and destruction of the wall of the air passage with resultant dilatation and infection of the surrounding lung. After 1930 when resection of the lung had become a safe procedure, treatment was almost entirely surgical, and after 1945 the risk of operation was less than 2%. Removal of only the involved portion of the lung along segmental lines is usual. Since the disease is not infrequently bilateral, portions of either lung may be removed in stages with very satisfying results.

Lung Abscess.—With the development and use of antibiotics and the sulfonamides, the incidence of lung abscess decreased markedly. Furthermore, with various surgical advances, the occurrence of lung abscess following operations about the mouth, nose and throat became infrequent. A high percentage of these lesions respond to medical management. Those which resist this form of treatment may be managed either by simple drainage or by resection of that portion of the lung. The risk of operation is slight (5% or less), and highly satisfactory results may be expected.

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HEARTH, the part of a room where a fire is made. usually of stone, bricks. tiles, etc., having a chimney above, the fire being lighted either on the hearth itself or in a receptacle placed there for the purpose.

The word is also applied to the fire and cooking apparatus on board ship; the floor of a smith's forge; the floor of a reverberatory furnace on which the ore is exposed to the flame; and the lower part of a blast furnace through which the metal goes down into the crucible. An open-hearth furnace is a regenerative furnace of the reverberatory type used in making steel; hence open-hearth steel process (*q.v.; see* also IRON AND STEEL).

The term is also used as equivalent to the home or household. (For the tax in England based on hearths, *see* HEARTH TAX.)

HEARTH TAX. This impost was a tax imposed in England at a rate of 2*s.* for each hearth: it was levied upon all houses unless the occupier (1) was exempt from paying church or poor rates, or (2) was certified as living in a tenement under the value of 20*s.* per annum, and not having land to that value, nor possessing goods to the value of £10. It was first levied in 1662, but because of its unpopularity it was repealed in 1689, although it was producing £170,000 a year. The principle of the tax was not new in the history of taxation. for in Anglo-Saxon times the king derived a part of his revenue from a *fumage*, or tax of smoke, levied on all hearths except those of the poor. It appears also in the hearth-penny or tax of a penny on every hearth.

HEARTS, a game of cards which appeared in the United States about 1880, possibly a descendant of reversis as played in the 18th century. In all variants. the chief object is to avoid winning any hearts in tricks. The full pack of 52 cards is used. and all the cards are dealt out. With more or less than four players (the usual number), some small cards are discarded from the pack to equalize the hands. Eldest hand makes the opening lead, and the rules of play are as in whist, but there is no trump suit. Other hands must follow suit to a lead if able; the highest card of the suit led wins the trick; the winner of a trick leads to the next.

In the simplest form of the game, each heart counts one point against the player winning it in a trick. A running total score is kept for each individual, and final settlement of stakes is made on the difference of totals—the lowest score of course being best. It is usually preferred to make settlement after every deal, on the Howell plan. Equal numbers of chips are distributed to the participants at the outset. After play of a deal, each player pays into a pool as many chips for each heart he has taken as there are players in the game other than himself. He then takes out of the pool one chip for every heart out of 13 that he did not win. The pool is thus exhausted with every deal. Another alternative is "sweepstake" settlement. The pool is built up in the same way, but can be won only by a player who was "clear" (won no hearts) or split by two who were clear. In all other cases the pool is a "jack" and remains to be won with the ensuing pool.

In *Spot Hearts* the penalty value of each heart depends on its rank; the ace costs 14, king 13, queen 12, knave 11, others their pip value. In *Joker Hearts*, the joker is added to the pack and the deuce of hearts is discarded. The joker ranks as a heart, between the knave and the ten. It may not be played by discard, unless a higher heart has previously been discarded upon the same trick. Where each other heart costs the winner one chip, the joker costs five.

The basic game has largely been supplanted by variants that have borrowed features from other games (polignac, reversis, French whist). Most played is *Black Lady Hearts*. Besides the hearts, each counting one, the penalty cards include the queen of spades, counting 13. Prior to the opening lead, each player passes any three cards of his original hand to his right (or left) neighbour. *Omnibus Hearts* adds two more rules: the ten (or knave) of diamonds counts 10 *plus* for the player winning it in a trick, and if a player captures all the hearts, the queen of spades, and the ten of diamonds, he scores plus 26 instead of minus 16.

In *Domino Hearts* each hand is dealt only six cards. The balance of the pack is placed face down in the centre. In the early play, discarding is not permitted. A player unable to follow suit must draw cards from the top of the pack until he can. Discarding is allowed after the pack is exhausted. Each hand drops out of play on getting rid of his last card, and the last survivor must add his remaining cards to his tricks. Usually only the hearts are counted as "minus" cards.

Other variants are adaptations of the game to more or less than four players. In a two-hand version, each is dealt 13 cards. The rules of play are as usual, but after each trick the winner and then his opponent draws one card from the top of the pack. When the pack is exhausted, the 13 cards remaining in each hand are played out. The queen of spades is usually counted against the winner, as well as all hearts.

In *Cancellation Hearts*, for six to ten players, two packs are shuffled together and dealt out into equal hands. Odd cards remaining are put in a widow, which goes to the winner of the first trick. When two identical cards fall on the same trick, they cancel each other—neither can win the trick. When an entire trick is thus cancelled out, it remains on the table and goes to the next winner of a trick. Usually the hearts and the queen of spades are the only cards counted in scoring.

HEAT is a general term. applied to that branch of physical science which deals with the effects produced by heat on material bodies, the laws of transference of heat and the transformations of heat into other kinds of energy.

In this broad field of science, little progress was made until the early 19th century. In line with the division of the elements by the ancient Greek philosophers into earth, air, fire and water, heat was generally believed to be a separate, although weightless. substance. A body was supposed to be hot or cold in proportion to the quantity of this substance with which its pores were permeated. When an object became hot under hammering, it was explained that

the impact had forced the imponderable substance, which was named "caloric," to the surface. (See *The Nature* of *Heat*, below.) The phenomenon of combustion was similarly explained; an object burned rapidly or with difficulty in accordance with the amount of another mythical substance, named "phlogiston," that it contained.

Even after the "phlogiston" theory had been upset and the real nature of combustion had been established by Antoine Laurent Lavoisier in 1775, belief in "caloric" persisted. Lavoisier himself listed it among the simple substances, or elements, in his *Traité élémentaire de chimie,* published in *1789. (See* CHEMISTRY: *History* of *Chemistry.)*

The object here is to indicate the relation of the different branches of the science of heat and their historical development, which are discussed in greater detail in separate articles. Advances in the theories of the influence of heat on the properties of matter are discussed under QUANTUM MECHANICS.

For developments in the measurement of the effects of heat and applications in various fields of science and engineering *see* under THERMODYNAMICS, THERMOMETRY and HEATING AND VENTILATION.

This article is divided into the following sections:

I. DEFINITIONS

The term heat is employed in ordinary language in a number of different senses. This makes it a convenient term to employ for the general title of the science, but the different meanings must be carefully distinguished in scientific reasoning. For the present purpose, omitting metaphorical significations, we may distinguish four principal uses of the term: (1) sensation of heat; (2) temperature, or degree of hotness; (3) quantity of thermal energy; (4) radiant heat, or energy of radiation.

(1) From the sense of heat, aided in the case of very hot bodies by the sense of sight, we obtain our first rough notions of heat as a physical entity, which alters the state of a body and its condition in respect of warmth, and is capable of passing from one body to another. By touching a body we can tell whether it is warmer or colder than the hand, and, by touching two similar bodies in succession, we can form a rough estimate, by the acuteness of the sensation experienced, of their difference in hotness or coldness over a limited range. If a hot iron is placed on a cold iron plate, we may observe that the plate is heated and the iron cooled until both attain appreciably the same degree of warmth; and we infer from similar cases that something which we call "heat" tends to pass from hot to cold bodies, and to attain finally a state of equable diffusion when all the bodies concerned are equally warm or cold. Ideas such as these derived entirely from the sense of heat, are, so to speak, embedded in the language of every nation from the earliest times.

(2) From the sense of heat, again, we naturally derive the idea of a continuous scale or order. expressed by such terms as summer heat, blood heat, fever heat, red heat, white heat, in which all bodies may be placed with regard to their degrees of hotness, and we speak of the temperature of a body as denoting its place in the scale, in contradistinction to the quantity of heat it may contain.

(3) The quantity of heat contained in a body obviously depends on the size of the body considered. Thus a large kettleful of boiling water will evidently contain more heat than a teacupful, though both may be at the same temperature. The temperature does not depend on the size of the body, but on the degree of concentration of the heat in it; *i.e.,* on the quantity of heat per unit mass, other things being equal.

It may be taken as axiomatic that a given body in a given state under given conditions must always contain the same quantity of heat, and that different quantities of the same substance in the same state under the same conditions must contain quantities of heat proportional to their several masses, except for the effect of shape on vibrational heat, normally not detectable. But it is for experiment to determine how the heat content varies for any given substance in different states, or for different substances in similar states and how it is affected by variations of temperature and pressure in each case.

(4) It is a matter of common observation that rays of the sun or of a fire falling on a body warm it and it was in the first instance natural to suppose that heat itself somehow traveled across the intervening space from the sun or fire to the body warmed, in much the same way as heat may be carried by a current of hot air or water. But we now know that energy of radiation is not the same thing as heat, though it is converted into heat when the rays strike an absorbing substance. The term radiant heat, however, is generally retained, because radiation is commonly measured in terms of the heat it produces and because the transference of energy by radiation and absorption is the most important agency in the diffusion of heat.

II. TEMPERATURE

1. Evolution of the Thermometer.— The first step in the development of the science of heat was necessarily the invention of a thermometer, an instrument for indicating temperature and measuring its changes. The first requisite in the case of such an instrument is that it should always give, at least approximately the same indication at the same temperature.

The air thermoscope of Galileo, illustrated in fig. 1, which consisted of a glass bulb containing air, connected to a glass tube of small bore dipping into a coloured liquid, though very sensitive to variations of temperature, was not satisfactory as a measuring instrument, because it was also affected by variations of atmospheric pressure.

The French doctor Jean Rey describes in a letter dated 1631 a

thermometer in which the expansion of water itself was used to indicate temperature, but it is not clear from his description whether the thermometer tube was left open or closed.

The type of thermometer familiar at the present time, containing a liquid hermetically sealed in a glass bulb with a fine tube attached. was first brought into general use by the grand duke Ferdinand II of Tuscany and he is said to have possessed such instruments as early as 1654. They were much employed by the members of the Accademia del Cimento founded under his protection at Florence, and were long known as Florentine thermometers.

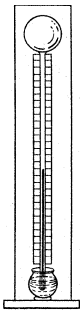

FIG. 1.—GALILEO'S AIR THERMOSCOPE

Alcohol was the liquid first employed and the degrees, intended to represent thousandths of the volume of the bulb, were marked with small beads of enamel fused on the stem, as shown in fig. 2, which represents two thermometers as depicted in the Saggi *di naturali esperienze* published by the Accademia del Cimento in 1667.

In order to render the readings of such instruments comparable with each other, it was necessary to select a fixed point or standard temperature as the zero or starting point of the graduations. Instead of making each degree a given fraction of the volume of the bulb, which would be difficult in practice, and would give different values for the degree with different liquids, it was soon found to be preferable to take two fixed points, and to divide the interval between them into the same number of degrees. It was natural in the first instance to take the temperature of the human body as one of the fixed points. In 1701 Sir Isaac Newton proposed a scale in which the freezing point of water was taken as zero, and the temperature of the human body as 12°. About the same date (1714) Gabriel Daniel Fahrenheit (for biographies of scientists mentioned in this article, see individual articles under their names) proposed to take as zero the lowest temperature obtainable with a freezing mixture of ice and salt. and to divide the interval between this temperature and that of the human body into 12°. To obtain finer graduations the number was subsequently increased to 96°.

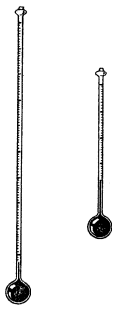

FIG. 2.—EARLY FLORENTINE THERMOMETERS, 1667

Alcohol in glass, graduated with enamel beads on stem

The freezing point of water was at that time supposed to be somewhat variable, because as a matter of fact it is possible to cool water several degrees below its freezing point in the absence of ice. Fahrenheit showed, however, that as soon as ice began to form the temperature always rose to the same point, and that a mixture of ice or snow with pure water always gave the same temperature. At a later period he also showed that the temperature of boiling water varied with the barometric pressure, but that it was always the same at the same pressure, and might therefore be used as the second fixed point (as Edmund Halley and others had suggested) provided that a definite pressure, such as the average atmospheric pressure, were specified. The freezing and boiling points on one of his thermometers, graduated as already explained, with the temperature of the body as 96°, came out in the neighbourhood of 32° and 212° respectively, giving an interval of 180° between these points. Shortly after Fahrenheit's death (1736) the freezing and boiling points of water were generally recognized as the most convenient fixed points to adopt, but different systems of subdivision were employed. Fahrenheit's scale, with its small degrees and its zero below the freezing point, possesses undoubted advantages for meteorological work, and is still retained in most English-speaking countries. For general scientific purposes, however, the centigrade system. in whirh the freezing point is marked 0° and the boiling point 100°, is now almost universally employed, on account of its greater simplicity from an arithmetical point of view. For work of precision the fixed points have been more exactly defined (see THERMOMETRY), but no change has been made in the fundamental principle of graduation.

2. Comparison of Scales Based on Expansion. — Thermometers constructed in the manner already described will give strictly comparable readings, provided that the tubes be of uniform bore, and that the same liquid and glass be employed in their construction; but they possess one obvious defect from a theoretical point of view, namely, that the subdivision of the temperature scale depends on the expansion of the particular liquid selected as the standard. A liquid such as water, which, when continuously heated at a uniform rate from its freezing point, first contracts and then expands, at a rapidly increasing rate, would obviously be unsuitable; but there is no a priori reason why other liquids should not behave to some extent in a similar way. As a matter of fact, it was soon observed that thermometers carefully constructed with different liquids, such as alcohol, oil and mercury, did not agree precisely in their indications at points of the scale intermediate between the fixed points, and diverged even more widely outside these limits. Another possible method. proposed in 1694 by Carlo Renaldini (1615–1698), professor of mathematics and philosophy at Pisa. would be to determine the intermediate points of the scale by observing the temperatures of mixtures of ice-cold and boiling water in varying proportions. By this method, the temperature of 50° C. would be defined as that obtained by mixing equal weights of water at 0° C. and 100° C.; 20° C., that obtained by mixing 80 parts of water at 0° C. with 20 parts of water at 100° C. and so on. Each degree rise of temperature in a mass of water would then represent the addition of the same quantity of heat. The scale thus obtained would, as a matter of fact, agree very closely with that of a mercury thermometer, but the method would be very difficult to put into practice, and would still have the disadvantage of depending on the properties of a particular liquid. namely, water, which is kno n to behave in an anomalous manner in other respects.

At a later date, the researches of Joseph Gay-Lussac (1802) and Henri Regnault (1847) showed that the laws of the expansion of gases are much simpler than those of liquids. Whereas the expansion of alcohol between 0° C. and 100° C. is nearly seven times as great as that of mercury, all gases (excluding easily condensable vapours) expand equally, or so nearly equally that the differences between them cannot be detected without the most refined observations. This equality of expansion affords a strong a priori argument for selecting the scale given by the expansion of a gas as the standard scale of temperature, but there are still stronger theoretical grounds for this choice, which will be indicated in discussing the absolute scale (see in *Mechanical* Theory of Heat, below). Among liquids mercury is found to agree most nearly with the gas scale, and is generally employed in thermometers for scientific purposes on account of its high boiling point and for other reasons.

The differences of the mercurial scale from the gas scale having been carefully determined, the mercury thermometer can be used as a secondary standard to replace the gas thermometer within certain limits, as the gas thermometer would be very troublesome to employ directly in ordinary investigations.

For certain purposes, and especially at temperatures beyond the range of mercury thermometers, electrical thermometers, also standardized by reference to the gas thermometer, have been generally employed in recent years; while for still higher temperatures beyond the range of the gas thermometer. thermometers based on the recently established lams of radiation are the only instruments available. For a further discussion of the theory and practice of the measurement of temperature, see the article THERMOMETRY.

III. CHANGE OF STATE

Among the most important effects of heat is that of changing the state of a substance from solid to liquid. or from liquid to vapour. All substances, with the exception of some unstable compounds, are known to be capable of existing in each of the three states under suitable conditions of temperature and pressure.

The transition of any substance, from the state of liquid to that of solid or vapour under the ordinary atmospheric pressure, takes place at fixed temperatures, the freezing and boiling points, which are very sharply defined for pure crystalline substances, and serve in fact as fixed points of the thermometric scale. A change of state cannot, however, be effected in general without the addition or subtraction of a certain definite quantity of heat. If a piece of ice below the freezing point is gradually heated at a uniform rate, its temperature may be observed to rise regularly until the freezing point is reached. At this point it begins to melt, and its temperature ceases to rise. The melting takes a considerable time, during the whole of which heat is being continuously supplied without producing any rise of temperature, although if the same quantity of heat were supplied to an equal mass of water the temperature of the water would be raised to the extent of nearly 80° C.

Heat thus absorbed in producing a change of state without rise of temperature is called latent heat, a term introduced by Joseph Black, who was one of the first to study the subject of change of state from the point of view of heat absorbed.

When a substance may be found in two or more characteristically different states which will continue to maintain their separate existence while in contact with each other, these states are called the phases of the system; thus a vessel containing ice and liquid water, with an atmosphere of water vapour above the surface provides a system of three phases, and is said to have one component since it is made up of only one basic substance. It is possible to have systems of two or more components which also exhibit several different phases; thus a solution of salt and water can provide three phases in coexistence. When heat is added or withdrawn so that some of the substance is converted from one phase to another phase, the process is known as a phase change of the first order.

In 1933 P. Ehrenfest pointed out that phase changes also are found in which the latent heat is theoretically of zero magnitude and the significant change lies in the values of the heat capacity above and below the transition point; he suggested the term second order phase change for such processes. There are also certain exceptional classes of phase changes which take place over a temperature interval rather than at a point. The mathematical and statistical theory of the different kinds of phase changes was critically reviewed by H. N. V. Temperly in 1956.

1. General Phenomena of Fusion. — There are two chief varieties of the process of fusion, crystalline and amorphous, which are in many ways distinct, although it is possible to find intermediate cases which partake of the characteristics of both. The melting of ice may be taken as a typical case of crystalline fusion. The passage from rigid solid to mobile liquid occurs at a definite surface without any intermediate stage or plastic condition. The change takes place at a definite temperature, the fusing or freezing point, and requires the addition of a definite quantity of heat to the solid, which is called the latent heat of fusion. There is also in general a considerable change of volume during fusion, which amounts in the case of ice to a contraction of 9%.

Some typical cases of amorphous solidification are those of silica, glass, plastic sulfur, pitch, alcohol and many organic liquids. In this type the liquid gradually becomes more and more viscous as the temperature falls, and ultimately attains the rigidity characteristic of a solid, without any definite freezing point or latent heat. The condition of the substance remains uniform throughout. if its temperature is uniform; there is no separation into the two distinct phases of solid and liquid, and there is no sudden change of volume at any temperature.

The melting or freezing of a pure crystalline solid is characterized most clearly by the perfect constancy of temperature during the process. In fact, the law of constant temperature, which is generally stated as the first of the so-called laws of fusion, does not strictly apply except to this case. The constancy of the freezing point of a pure substance is so characteristic that change of the freezing point is often one of the most convenient tests of the presence of foreign material.

In the case of substances like ice, which melt at a low temperature and are easily obtained in large quantities in a state of purity, the point of fusion may be very accurately determined by observing the temperature of an intimate mixture of the solid and liquid while slowly melting as it absorbs heat from surrounding bodies. In the majority of cases, however, it is more convenient to observe the freezing point as the liquid is cooled. By this method it is possible to ensure perfect uniformity of temperature throughout the mass by stirring the liquid continuously during the process of freezing, whereas it is difficult to ensure uniformity of temperature in melting a solid, however gradually the heat is supplied, unless the solid can be mixed with the liquid. It is also possible to observe the freezing point in other ways, as by noting the temperature at the moment of the breaking of a wire, of the stoppage of a stirrer or of the maximum rate of change of volume, but these methods are generally less certain in their indications than the point of greatest constancy of temperature in the case of homogeneous crystalline solids.

The table contains some of the most recent values of fusing points of metals determined (except the last three) with platinum thermometers. These points are often utilized as fixed points on the thermometric scale, especially for the calibration of thermocouples.

2. Superfusion, Supersaturation. — It is generally possible to cool a liquid several degrees below its normal freezing point without a separation of crystals, especially if it is protected from agitation. which would assist the molecules to rearrange themselves. A liquid in this state is said to be "undercooled" or "superfused." The phenomenon is even more familiar in the case of solutions (*e.g.*, sodium sulfate or acetate) which may remain in the "metastable" condition for an indefinite time if protected from dust. The introduction into the liquid under this condition of the smallest fragment of the crystal, with respect to which the solution is supersaturated, will produce immediate crystallization, which will continue until the temperature is raised to the saturation point by the liberation of the latent heat of fusion. The constancy of temperature at the normal freezing point is due to the equilibrium of exchange existing between the liquid and solid. Unless both solid and liquid are present, there is no condition of equilibrium, and the temperature is indeterminate.

Fusion Points of Common Metals

Sodium	97.5	Silver	960.8
Tin	231.9	Gold	1063.0
Bismuth	271.0	Copper	1083.0
Cadmium	320.9	Nickel	1455.0
Lead	327.4	Palladium	1558.0
Zinc	419.5	Platinum	1769.3

It is important to see clearly that the undercooling of a pure (one component) liquid and the supersaturation of a liquid solution (two or more components) are phenomena sharing essentially the same mechanism. In either case, a component is retained in a liquid condition at a temperature at which it normally would change into the crystalline phase if perfect equilibrium were established. This also emphasizes the close relationship between melting and dissolving into solution.

3. Freezing of Solutions and Alloys. — The phenomena of freezing of crystalline mixtures may be illustrated by the case of aqueous solutions and of metallic solutions or alloys, which have been most widely studied. The usual effect of an impurity, such as salt or sugar in solution in water, is to lower the freezing point, so that no crystallization occurs until the temperature has fallen below the normal freezing point of the pure solvent, the depression of freezing point being nearly proportional to the concentration of the solution. When freezing begins, the solvent generally separates out from the solution in the pure state. This separation of the solvent involves an increase in the strength of the remaining solution, so that the temperature does not remain constant during the freezing, but continues to fall as more of the solvent is separated. There is a perfectly definite relation between temperature and concentration at each stage of the process, which may be repre-

sented in the form of a curve as AC in fig. 3, called the freezing point curve.

The equilibrium temperature, at the surface of contact between the solid and liquid. depends only on the composition of the liquid phase and not at all on the quantity of solid present. The abscissa of the freezing point curve represents the composition of that portion of the original solution which remains liquid at any temperature. If instead of starting with a dilute solution we start with a strong solution represented by a point N, and cool it as shown by the vertical line ND, a point D is generally reached at which the solution becomes "saturated." The dissolved substance or "solute" then separates out as the solution is further cooled, and the concentration diminishes with fall of temperature in a definite relation, as indicated by the curve CB, which is called the solubility curve. Though often called by different names, the two curves AC and CB are essentially of a similar nature.

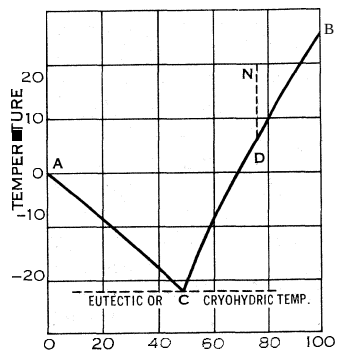

FIG. 3.— FREEZING POINT. OR SOLUBILITY CURVE: SIMPLE CASE

To take the case of an aqueous solution of salt as an example. along CB the solution is saturated with respect to salt, along AC the solution is saturated with respect to ice. When the point C is reached along either curve. the solution is saturated with respect to both salt and ice. The concentration cannot vary further. and the temperature remains constant while the salt and ice crystallize out together. maintaining the exact proportions in which they exist in the solution. The resulting solid was termed a cryohydrate by F. Guthrie, but it is really an intimate mixture of two kinds of crystals. and not a chemical compound or hydrate containing the constituents in chemically equivalent proportions. The lowest temperature attainable by means of a freezing mixture is the temperature of the freezing point of the corresponding cryohydrate. In a mixture of salt and ice with the least trace of water a saturated brine is quickly formed, which dissolves the ice and falls rapidly in temperature, because of the absorption of the latent heat of fusion. So long as both ice and salt are present, if the mixture is well stirred, the solution must necessarily become saturated with respect to both ice and salt, and this can only occur at the cryohydric temperature, at which the two curves of solubility intersect.

The curves in fig. 3 also illustrate the simplest type of freezing point curve in the case of alloys of two metals A and B which do not form mixed crystals or chemical compounds. The alloy corresponding to the cryohydrate, possessing the lowest melting point. is called the eutectic alloy, as it is most easily cast and worked. It generally possesses a very fine-grained structure, and is not a chemical compound. (See ALLOYS.)

4. Calorimetry by Latent Heat.—In principle, the simplest and most direct method of measuring quantities of heat consists in observing the effects produced in melting a solid or vaporizing a liquid. It was, in fact, by the fusion of ice that quantities of heat were first measured. If a hot body is placed in a cavity in a block of ice at 0° C., and is covered by a closely fitting slab of ice, the quantity of ice melted will be directly proportional to the quantity of heat lost by the body in cooling to 0° C. None of the heat can possibly escape through the ice, and conversely no heat can possibly get in from outside. The body must cool exactly to 0° C., and every fraction of the heat it loses must melt an equivalent quantity of ice.

Apart from heat lost in transferring the heated body to the ice block, the method is theoretically perfect. The only difficulty consists in the practical measurement of the quantity of ice melted. Black estimated this quantity by mopping out the cavity with a sponge which was weighed beiore and after the operation. But there is a variable film of water adhering to the walls of the cavity, which gives trouble in accurate work.

In 1780 Pierre Simon Laplace and Lavoisier used a double-walled metallic vessel containing broken ice, which was in many respects more convenient than the block, but aggravated the difficulty of the film of water adhering to the ice. In spite of this practical difficulty, the quantity of heat required to melt unit weight of ice was for a long time taken as the unit of heat. This unit possesses the great advantage that it is independent of the scale of temperature adopted.

At a much later date R. Bunsen in 1870, adopting a suggestion of Sir John Herschel's, devised an ice calorimeter suitable for measuring small quantities of heat, in which the difficulty of the water film was overcome by measuring the change in volume due to the melting of the ice. The volume of unit mass of ice is approximately 1.0920 times that of unit mass of water, so that the diminution of volume is 0.092 of a cubic centimetre for each gram of ice melted.

Since the ice calorimeter of necessity operates at 0° C., a temperature considerably below room temperature, there is always the necessity of taking precautions to prevent the unwanted leakage of heat from the room into the calorimetric vessel; this introduces both difficulties and inaccuracies into the procedure. In order to avoid this source of trouble, calorimeters have been built using diphenyl oxide instead of water as the calorimetric liquid. Since diphenyl oxide has a melting point of 27° C., and can be obtained easily in a high state of purity, this type of calorimeter is especially useful.

For measuring large quantities of heat, such as those produced by the combustion of fuel in a boiler, the most convenient method is the evaporation of water, which is commonly employed by engineers for the purpose. The natural unit in this case is the quantity of heat required to evaporate unit mass of water at the boiling point under atmospheric pressure.

5. Thermometric Calorimetry.— For many years the most accurate method for calorimetry was the observation of the rise in temperature of a known mass of water when the heat was introduced into it under suitable conditions which prevented unwanted heat leaks. This method was employed from a very early date by Count Rumford and was brought to a relatively high pitch of perfection by Regnault in his extensive calorimetric researches. It is still nidely used, especially in combustion calorimetry. After the first decade of the 20th century. however. this method was superseded by procedures based on the electrically heated vacuum calorimeter of Walter Nernst whenever the highest accuracy was desired, particularly in the measurement of heat capacity and of latent heats associated with phase changes.

A weighed sample of the substance to be studied is placed in a sealed sample container, usually a small thin-walled can of copper, plated with gold or some other metal which will resist corrosion. Attached in close thermal contact to this can are a heating coil of known electrical resistance and an electrical resistance thermometer. This unit is placed in a vacuum chamber and usually surrounded by a thermal shield, maintained at a temperature as close to that of the sample container as possible. If an electrical current of known strength is passed through the heater for a measured interval of time, one can calculate the heat introduced which is easily measurable with a precision of 0.01% or better. One can also measure the temperature increment with comparable accuracy. By means of the vacuum and the thermal shield, any unwanted leakage of heat into or out of the sample container can also be reduced to an amount so small in ratio to the electrical heat produced, that the heat capacity of the sample can be calculated with an accuracy of 0.1% to 0.01% depending on the extent of the precautions taken.

As carried out especially by W. F. Giauque and K. S. Pitzer and their collaborators at the University of California, Berkeley, by G. S. Parks and others at Stanford university. Calif., by H. M. Huifman and Guy Waddington at the U.S. bureau of mines Bartlesville (Okla.) station, by F. G. Brickwedde and his associates at the U.S. national bureau of standards and by other investigators especially in the U.S., this method produced a vast amount of thermodynamic data which is the cornerstone on which the understanding of the role of heat in chemistry is based.

6. Watt's Indicator Diagram; Work of Expansion. — The rapid development of the steam engine (see STEAM: *Steam Engine*) in England during the latter part of the 18th century had a marked effect on the progress of the science of heat. In the first steam engines the working cylinder served both as boiler and condenser, a very wasteful method, as most of the heat was transferred directly from the fire to the condensing nater without useful effect. The first improvement (about 1705) was to use a separate boiler, but the greater part of the steam supplied was still wasted in reheating the cylinder. which had been cooled by the injection of cold water to condense the steam after the previous stroke.

In a patent of 1769 James Watt showed how to avoid this waste by using a separate condenser and keeping the cylinder as hot as possible. In his earlier engines the steam at full boiler pressure was allowed to raise the piston through nearly the whole of its stroke. Connection with the boiler was then cut off, and the steam at full pressure was discharged into the condenser. Here again there was unnecessary waste, as the steam was still capable of doing useful work. He subsequently introduced "expansive working," which effected still further economy. The connection with the boiler was cut off when a fraction only. say $\frac{1}{4}$, of the stroke had been completed. the remainder of the stroke being effected by the expansion of the steam already in the cylinder with continually diminishing pressure. By the end of the stroke, when connection was made to the condenser, the pressure was so reduced that there was comparatively little waste from this cause. Watt also devised an instrument called an indicator, in which a pencil. moved up and down vertically by the steam pressure. recorded the pressure in the cylinder at every point of the stroke on a sheet of paper moving horizontally in time with the stroke of the piston. The diagram thus obtained made it possible to study what was happening inside the cylinder, and to deduce the work done by the steam in each stroke. The method of the indicator diagram has since proved of great utility in physics in studying the properties of gases and vapours.

Fig. 4 represents an imaginary indicator diagram for a steam engine. taken from one of Watt's patents. Steam is admitted to the cylinder when the piston is at the beginning of its stroke at S. ST represents the length of the stroke or the limit of horizontal movement of the paper on which the diagram is drawn. The indicating pencil rises to the point A, representing the absolute pressure of 60 lb. per square inch. As the piston moves outward the pencil traces the horizontal line AB, the pressure remaining constant until the point B is reached, at which connection to the boiler is cut off. After cutoff at B the steam expands under diminishing pressure, and the pencil falls gradually from B to C, following the steam pressure until the exhaust valve opens at the end of the stroke. The pressure then falls rapidly to that of the condenser, which for an ideal case may be taken as zero, following Watt. The work done during expansion is found by dividing the area under segment BC as shown. into a number of small rectangles.

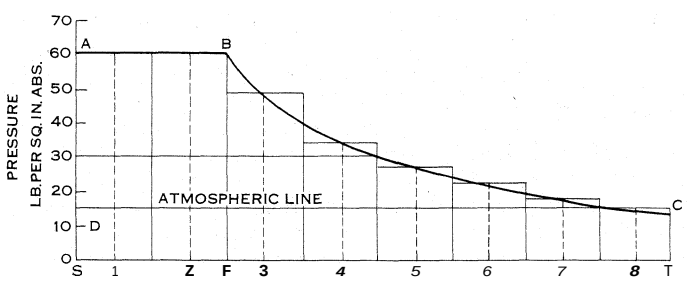

FIG. 4.— WATT'S INDICATOR DIAGRAM

The whole work done in the forward stroke is represented by the area ABCTSA, or by the average value of the pressure p over the whole stroke multiplied by the stroke l. This area must be multiplied by the area of the piston a in square inches to get the work done per stroke in foot-pounds.

7. Thermal Efficiency. — The thermal efficiency of an engine is the ratio of the work done by the engine to the heat supplied to it. According to Watt's observations, confirmed later by Clément and Desormes, the total heat required to produce 1 lb. of saturated steam at any temperature from water at 0° C. was approximately 6jo times the quantity of heat required to raise 1 lb. of water 1" C. Since one pound of steam represented on this assumption a certain quantity of heat, the efficiency could be measured naturally in foot-pounds (ft.lb.) of work obtainable per pound of steam, or conversely in the pounds of steam which are consumed per horsepower-hour.

In his patent of 1782 Watt gives the following example of the improvement in thermal efficiency obtained by expansive working. Taking the diagram already given, if the quantity of steam represented by AB, or 300 cu.in. at 60 lb. pressure, were employed without expansion, the work realized, represented by the area ABSF. would be $6{,}000/4 = 1{,}500$ ft.lb. With expansion to 4 times its original volume, as shown in the diagram by the whole area ABCTSA. the mean pressure (as calculated by Watt. assuming Boyle's law) would be 0.58 of the original pressure, and the nork done would be $6{,}000 \times 0.58 = 3{,}480$ ft.lb. for the same quantity of steam, or the thermal efficiency would be 2.32 times greater.

The advantage actually obtained would not be so great as this, on account of losses by condensation, back pressure, etc., which are neglected in Watt's calculation, but the margin would still be very considerable. Three hundred cubic inches of steam at 60 lb. pressure would represent about .0245 of 1 lb. of steam, or 28.7 B.T.U.. so that. neglecting all losses, the possible thermal efficiency attainable with steam at this pressure and four expansions ($ cutoff) would be 3480/28.7, or 121 ft.lb. per B.T.U.

About 1820. it was usual to include the efficiency of the boiler with that of the engine. and to reckon the efficiency or "duty" in foot-pounds per bushel or hundredweight of coal. The best Cornish pumping-engines of that date achieved about 70,000,000 ft.lb. per hundredweight, or consumed about 3.2 lb. per horsepower-hour. which is roughly equivalent to 43 ft.lb. per B.T.U. The efficiency gradually increased as higher pressures were used, with more complete expansion, but the conditions upon which the efficiency depended were not fully worked out until a much later date. Much additional knowledge with regard to the nature of heat. and the properties of gases and vapours, was required before the problem could be attacked theoretically.

IV. THE NATURE OF HEAT

In the early days of the science it was natural to ascribe the manifestations of heat to the action of a subtle imponderable fluid called caloric, with the power of penetrating. expanding and dissolving bodies, or dissipating them in vapour. The fluid was imponderable, because the most careful experiments failed to show that heat produced any increase in weight. The opposite property of levitation was often ascribed to heat, but it was shown by more cautious investigators that the apparent loss of weight because of heating was to be attributed to evaporation or to upward air currents. The fundamental idea of an imaginary fluid to represent heat was useful in helping the mind to a conception of something remaining invariable in quantity through many transformations, but in some respects the analogy was misleading, and tended greatly to retard the progress of science. The caloric theory was very simple in its application to the majority of calorimetric experiments. and gave a fair account of the elementary phenomena of change of state, but it encountered serious difficulties in explaining the production of heat by friction. or the changes of temperature accompanying the compression or expacsion of a gas.

The explanation which the calorists offered of the production of heat by friction or compression was that some of the latent caloric was squeezed or ground out of the bodies concerned and became "sensible." In the case of heat developed by friction, they supposed that the abraded portions of the material were capable of holding a smaller quantity of heat, or had less "capacity for heat," than the original material. From a logical point of view, this was a perfectly tenable hypothesis, and one difficult to refute. It was easy to account in this way for the heat produced in boring

cannon and similar operations, where the amount of abraded material was large.

To refute this explanation, Count Rumford in 1798 presented before the Royal society the results of his celebrated experiments with a blunt borer in one of which he succeeded in boiling by friction 26.5 lb. of cold water in 2 3 hr., with the production of only 4,145 g. of metallic powder. He then showed by experiment that the metallic powder required the same amount of heat to raise its temperature 1°, as an equal weight of the original metal, or that its "capacity for heat" (in this sense) was unaltered by reducing it to powder; and he argued that "in any case so small a quantity of powder could not possibly account for all the heat generated, that the supply of heat appeared to be inexhaustible, and that heat could not be a material substance, but must be something of the nature of motion."

Unfortunately Rumford's argument was not quite conclusive. The supporters of the caloric theory appear, whether consciously or unconsciously, to have used the phrase "capacity for heat" in two entirely distinct senses without any clear definition of the difference. The phrase "capacity for heat" might very naturally denote the total quantity of heat contained in a body. which they had no means of measuring, but it was generally used to signify the quantity of heat required to raise the temperature of a body one degree, which is quite a different thing, and has no necessary relation to the total heat.

In proving that the powder and the solid metal required the same quantity of heat to raise the temperature of equal masses of either one degree, Rumford did not prove that they contained equal quantities of heat, which was the real point at issue in this instance. The metal tin actually changes into powder below a certain temperature, and in so doing evolves a measurable quantity of heat. A mixture of the gases oxygen and hydrogen, in the proportions in which they combine to form water, evolves. when burned, sufficient heat to raise more than 30 times its weight of water from the freezing to the boiling point; and the mixture of gases may. in this sense, be said to contain so much more heat than the water. although its capacity for heat in the ordinary sense is only about half that of the water produced. To complete the refutation of the calorists' explanation of the heat produced by friction, it mould have been necessary for Rumford to show that the powder when reconverted into the same state as the solid metal did not absorb a quantity of heat equivalent to that evolved in the grinding; in other words that the heat produced by friction was not simply that attributed to the change of state of the metal from solid to powder.

Shortly afterward, in 1799, Humphry (later Sir Humphry) Davy described an experiment in which he melted ice by rubbing two blocks together. This experiment afforded a very direct refutation of the calorists' view, because it was a well-known fact that ice required to have a quantity of heat added to it to convert it into water, so that the water produced by the friction contained more heat than the ice. In stating as the conclusion to be drawn from this experiment that "friction consequently does not diminish the capacity of bodies for heat," Davy apparently uses the phrase capacity for heat in the sense of total heat contained in a body, because in a later section of the same essay he definitely gives the phrase this meaning, and uses the term "capability of temperature" to denote what we now term capacity for heat.

The delay in the overthrow of the caloric theory, and in the acceptance of the view that heat is a mode of motion. was no doubt partly due to some fundamental confusion of ideas in the use of the term "capacity for heat" and similar phrases. A still greater obstacle lay in the comparative vagueness of the motion or vibration theory. Davy speaks of heat as being "repulsive motion," and distinguishes it from light. which is "projective motion"; though heat is certainly not a substance—according to Davy in the essay under discussion—and may not even be treated as an imponderable fluid, light as certainly is a material substance, and is capable of forming chemical compounds with ordinary matter. such as oxygen gas. which is not a simple substance, but a compound, termed phosoxygen, of light and oxygen.

Accepting the conclusions of Davy and Rumford that heat is not a material substance but a mode of motion, there still remains the question, what definite conception is to be attached to a quantity of heat? What do we mean by a quantity of vibratory motion, how is the quantity of motion to be estimated and why should it remain invariable in many transformations? The idea that heat was a "mode of motion" was applicable as a qualitative explanation of many of the effects of heat, but it lacked the quantitative precision of a scientific statement, and could not be applied to the calculation and prediction of definite results. The state of science at the time of Rumford's and Davy's experiments did not admit of a more exact generalization. The way was paved in the first instance by a more complete study of the laws of gases, to which Laplace, John Dalton, Gay-Lussac, Pierre Louis Dulong and many others contributed both on the experimental and theoretical side. Although the development proceeded simultaneously along many parallel lines, it is interesting and instructive to take the investigation of the properties of gases, and to endeavour to trace the steps by which the true theory was finally attained.

V. THERMAL PROPERTIES OF GASES

The most characteristic property of a gaseous or elastic fluid, namely, the elasticity, or resistance to compression, was first investigated scientifically by Robert Boyle (1662), who showed that the pressure p of a given mass of gas varied inversely as the volume v, provided that the temperature remained constant. This is generally expressed by the formula $pv = C$, where C is a constant for any given temperature, and v is taken to represent the specific volume, or the volume of unit mass, of the gas at the given pressure and temperature. Boyle was well aware of the cffcct of heat in expanding a gas, but he was unable to investigate this properly as no thermometric scale had been defined at that date.

According to Boyle's law, when a mass of gas is compressed by a small amount at constant temperature, the percentage increase of pressure is equal to the percentage diminution of volume (if the compression is $v/100$, the increase of pressure is very nearly $p/100$). Adopting this law, Newton showed, by a most ingenious piece of reasoning, that the velocity of sound in air should be equal to the velocity acquired by a body falling under gravity through a distance equal to half the height of the atmosphere, considered as being of uniform density equal to that at the surface of the earth. This gave the result 918 ft. per second (280 m. per second) for the velocity at the freezing point. Newton was aware that the actual velocity of sound was somewhat greater than this, but supposed that the difference might be due in some way to the size of the air particles, of which no account could be taken in the calculation. The first accurate measurement of the velocity of sound by the French Académie des Sciences in 1738 gave the value 332 m. per second as the velocity at 0° C. The true explanation of the discrepancy was not discovered until nearly 100 years later.

The law of expansion of gases with change of temperature was investigated by Dalton and later by Gay-Lussac (1802), who found that the volume of a gas under constant pressure increased by $\frac{1}{267}$ of its volume at 0° C. for each 1° C. rise in temperature. This value was generally assumed in all calculations for nearly 50 years. More exact researches show that the precise value of the coefficient should be $\frac{1}{273.15}$. Thus in round numbers the value of the coefficient should be $\frac{1}{273}$. According to this law the volume of a gas at any temperature t° C. should be proportional to $273 + t$; *i.e.*, to the temperature reckoned from a zero 273° below that of the centigrade scale, which was called the absolute zero of the gas thermometer. If $T = 273 + t$, denotes the temperature measured from this zero, the law of expansion of a gas may be combined with Boyle's law in the simple formula

$$pv = RT \qquad (1)$$

which is generally taken as the expression of the gaseous laws. If equal volumes of different gases are taken at the same temperature and pressure, it follows that the constant R is the same for all gases. If equal masses are taken, the value of the constant R

for different gases varies inversely as the molecular weight or as the density relative to hydrogen.

Dalton also investigated the laws of vapours, and of mixtures of gases and vapours. He found that condensable vapours approximately followed Boyle's law when compressed, until the condensation pressure was reached, at which the vapour liquefied without further increase of pressure. He found that when a liquid was introduced into a closed space, and allowed to evaporate until the space was saturated with the vapour and evaporation ceased, the increase of pressure in the space was equal to the condensation pressure of the vapour, and did not depend on the volume of the space or the presence of any other gas or vapour provided that there was no solution or chemical action. He showed that the condensation or saturation pressure of a vapour depended only on the temperature, and increased by nearly the same fraction of itself per degree rise of temperature, and that the pressures of different vapours were nearly the same at equal distances from their boiling points. The increase of pressure per degree centigrade at the boiling point was about $\frac{1}{28}$ of 760 mm. or 27.2 mm., but increased in geometrical progression with rise of temperature. These results of Dalton's were confirmed, and in part corrected, as regards increase of vapour pressure, by Gay-Lussac, Dulong, Regnault and other investigators, but were found to be as close an approximation to the truth as could be obtained with such simple expressions.

More accurate empirical expressions for the increase of vapour-pressure of a liquid with temperature were soon obtained by Thomas Young. J. P. L. A. Roche and others, but the explanation of the relation was not arrived at until a much later date.

1. Specific Heats **of** Gases.—In order to estimate the quantities of heat concerned in experiments with gases, it was necessary in the first instance to measure their specific heats, which presented formidable difficulties. The earlier attempts by Lavoisier and others, employing the ordinary methods of calorimetry, gave very uncertain and discordant results, which mere not regarded with any confidence even by the experimentalists themselves. Gay-Lussac devised an ingenious experiment. which, though misinterpreted at the time, is very interesting and instructive. With the object of comparing the specific heats of different gases, he took two equal globes A and B connected by a tube with a stop-cock. The globe B was exhausted, the other A being filled with gas. On opening the tap between the vessels, the gas flowed from A to B and the pressure was rapidly equalized. He observed that the fall of temperature in A was nearly equal to the rise of temperature in B. and that for the same initial pressure the change of temperature was very nearly the same for all the gases he tried, except hydrogen, which showed greater changes of temperature than other gases. He concluded from this experiment that equal volumes of gases had the same capacity for heat, except hydrogen, which he supposed to have a larger capacity, because it showed a greater effect. The method does not in reality afford any direct information with regard to the specific heats, and the conclusion with regard to hydrogen is evidently wrong.

At a later date Gay-Lussac adopted A. Crawford's method of mixture, allowing two equal streams of different gases, one heated and the other cooled about 20° C., to mix in a tube containing a thermometer. The resulting temperature was in all cases nearly the mean of the two, from nhich he concluded that equal volumes of all the gases tried, namely. hydrogen, carbon dioxide, air, oxygen and nitrogen, had the same thermal capacity. This was correct, except as regards carbon dioxide, but did not give any information as to the actual specific heats referred to water or any known substance.

About the same time, F. Delaroche and J. E. Bérard made direct determinations of the specific heats of air, oxygen, hydrogen, carbon monoxide, carbon dioxide, nitrous oxide and ethylene, by passing a stream of gas heated to nearly 100° C. through a spiral tube in a calorimeter containing water. Their work was a great advance on previous attempts, and gave the first trustworthy results. With the exception of hydrogen, which presents peculiar difficulties, they found that equal volumes of the permanent gases, air, oxygen and carbon monoxide, had nearly the same thermal capacity, but that the compound condensable gases, carbon dioxide, nitrous oxide and ethylene, had larger thermal capacities in the order given. They were unable to state whether the specific heats of the gases increased or diminished with temperature, but from experiments on air at pressures of 740 mm. and 1,000 mm., they found the specific heats to be .269 and .245 respectively, and concluded that the specific heat diminished with increase of pressure. The difference they observed was really due to errors of experiment, but they regarded it as proving beyond doubt the truth of the calorists' contention that the heat disengaged on the compression of a gas was due to the diminution of its thermal capacity.

Dalton and others had endeavoured to measure directly the rise of temperature produced by the compression of a gas. Dalton had observed a rise of 50° F. in a gas when suddenly compressed to half its volume, but no thermometers at that time were sufficiently sensitive to indicate more than a fraction of the change of temperature.

Laplace was the first to see in this phenomenon the probable explanation of the discrepancy between Newton's calculation of the velocity of sound and the observed value. The increase of pressure because of a sudden compression, in which no heat was allowed to escape, or as we now call it an adiabatic compression, would necessarily be greater than the increase of pressure in a slow isothermal compression, on account of the rise of temperature. As the rapid compressions and rarefactions occurring in the propagation of a sound wave were perfectly adiabatic, it was necessary to take account of the rise of temperature because of compression in calculating the velocity. To reconcile the observed and calculated values of the velocity, the increase of pressure in adiabatic compression must be 1.410 times greater than in isothermal compression. This is the ratio of the adiabatic elasticity of air to the isothermal elasticity. It mas a long time, however, before Laplace saw his way to any direct experimental verification of the value of this ratio. At a later date he stated that he had succeeded in proving that the ratio in question must be the same as the ratio of the specific heat of air at constant pressure to the specific heat at constant volume.

2. Experimental Verification **of** the Ratio **of** Specific Heats.—This was a most interesting and important theoretical relation to discover, but unfortunately it did not help much in the determination of the ratio required, because it was not practically possible at that time to measure the specific heat of air at constant volume in a closed vessel. Attempts had been made to do this, but they had signally failed, on account of the small heat capacity of the gas as compared with the containing vessel. Laplace endeavoured to extract some confirmation of his views from the values given by Delaroche and Bérard for the specific heat of air at 1.000 and 740 mm. pressure. On the assumption that the quantities of heat contained in a given mass of air increased in direct proportion to its volume when heated at constant pressure, he deduced, by some rather obscure reasoning, that the ratio of the specific heats S and s should be about 1.5 to 1, which he regarded as a fairly satisfactory agreement with the value $\gamma = 1.41$ deduced from the velocity of sound.

The ratio of the specific heats could not be directly measured, but a few years later, N. Clément-Desormes succeeded in making a direct measurement of the ratio of the elasticities in a very simple manner. He took a large globe containing air at atmospheric pressure and temperature, and removed a small quantity of air. He then observed the defect of pressure p_0 when the air had regained its original temperature. By suddenly opening the globe. and immediately closing it, the pressure was restored almost instantaneously to the atmospheric, the rise of pressure p, corresponding to the sudden compression produced. The air, having been heated by the compression, was allowed to regain its original temperature, the tap remaining closed, and the final defect of pressure p_1 was noted. The change of pressure for the same compression performed isotherm'ally is then $p_0 - p_1$. The ratio $p_0/(p_0 - p_1)$ is the ratio of the adiabatic and isothermal elasticities, provided that p_0 is small compared with the whole atmospheric pressure. In this way he found the ratio 1.354, which is not

much smaller than the value 1.410 required to reconcile the observed and calculated values of the velocity of sound.

Gay-Lussac and J. J. Welter repeated the experiment with slight improvements, using expansion instead of compression, and found the ratio *1.375.* The experiment has often been repeated since that time, and there is no doubt that the value of the ratio deduced from the velocity of sound is correct, the defect of the value obtained by direct experiment being due to the fact that the compression or expansion is not perfectly adiabatic. Gay-Lussac and Welter found the ratio practically constant for a range of pressure 144 to *1.460* mm., and for a range of temperature from $-20°$ to $+40°$ C. The velocity of sound at Quito, Ecuador, at a pressure of *544* mm. was found to be the same as at Paris at *760* mm. at the same temperature. Assuming on this evidence the constancy of the ratio of the specific heats of air, Laplace showed that. if the specific heat at constant pressure was independent of the temperature, the specific heat per unit volume at a pressure p must vary as $p^{1/\gamma}$ according to the caloric theory. The specific heat per unit mass must then vary as $p^{1/\gamma-1}$ which he found agreed precisely with the experiment of Delaroche and Bérard already cited. This was undoubtedly a strong confirmation of the caloric theory. S. D. Poisson by the same assumptions obtained the same results, and also showed that the relation between the pressure and the volume of a gas in adiabatic compression or expansion must be of the form $pv^\gamma =$ constant.

P. L. Dulong, adopting a method attributed to E. F. F. Chladni, compared the velocities of sound in different gases by observing the pitch of the note given by the same tube when filled with the gases in question. He thus obtained the values of the ratios of the elasticities or of the specific heats for the gases employed. For oxygen, hydrogen and carbon monoxide, these ratios were the same as for air. But for carbon dioxide, nitrous oxide and ethylene gas, the values were much smaller. showing that these gases experienced a smaller change of temperature in compression. On comparing his results with the values of the specific heats for the same gases found by Delaroche and Bérard, Dulong observed that the changes of temperature for the same compression were in the inverse ratio of the specific heats at constant volume, and deduced the important conclusion that "Equal volumes of all gases under the same conditions evolve on compression the same quantity of heat." This is equivalent to the statement that the difference of the specific heats, or the latent heat of expansion R' per 1°, is the same for all gases if equal volumes are taken.

Assuming the ratio $\gamma = 1.410$, and taking Delaroche and Bérard's value for the specific heat of air at constant pressure $S = .267$, we have $s = S/1.41 = .189$, and the difference of the specific heats per unit mass of air $S - s = R' = .078$. Adopting Regnault's value of the specific heat of air, namely, $S = .238$, we should have $S - s = .069$. This quantity represents the heat absorbed by unit mass of air in expanding at constant temperature T by a fraction $1/T$ of its volume v, or by $\frac{1}{273}$ of its volume at 0° C.

If, instead of taking unit mass, we take a volume $v_0 = 22.301$. at 0° C. and *760* mm. being the volume of the molecular weight of the gas in grams, the quantity of heat evolved by a compression equal to v/T will be approximately 2 cal., and is the same for all gases. The work done in this compression is $pv/T = R$, and is also the same for all gases, namely, *8.3* joules. Dulong's experimental result. therefore, shows that the heat evolved in the compression of a gas is proportional to the work done. This result had previously been deduced theoretically by Nicolas Sadi Carnot *(1824).* At a later date it was assumed by Julius Mayer, Rudolf Clausius and others, on the evidence of these experiments, that the heat evolved was not merely proportional to the work done, but was equivalent to it. The further experimental evidence required to justify this assumption was first supplied by James Joule.

VI. CARNOT: ON THE MOTIVE POWER OF HEAT

A practical and theoretical question of greatest importance was first answered by Nicolas Carnot about this time in his *Réflexions sur* la *puissance motrice du feu (1824).* How much motive power (defined by Carnot as weight lifted through a certain height) can be obtained from heat alone by means of an engine repeating a regular succession or "cycle" of operations continuously? Is the efficiency limited, and, if so, how is it limited? Are other agents preferable to steam for developing motive power from heat?

In discussing this problem, we cannot do better than follow Carnot's reasoning which, in its main features. could hardly be improved. Carnot points out that in order to obtain an answer to this question, it is necessary to consider the essential conditions of the process, apart from the mechanism of the engine and the working substance or agent employed. Work cannot be said to be produced from heat alone unless nothing but heat is supplied, and the working substance and all parts of the engine are at the end of the process in precisely the same state as at the beginning.

For instance a mass of compressed air, if allowed to expand in a cylinder at constant temperature, will do work, and will at the same time absorb a quantity of heat which, as we now know, is the thermal equivalent of the work done. But this work cannot be said to have been produced solely from the heat absorbed in the process, because the air at the end of the process is in a changed condition, and could not be restored to its original state at the same temperature without having work done upon it precisely equal to that obtained by its expansion. The process could not be repeated indefinitely without a continual supply of compressed air. The source of the work in this case is work previously done in compressing the air, and no part of the work is really generated at the expense of heat alone, unless the compression is effected at a lower temperature than the expansion.

1. Carnot's Axiom. — Carnot here, and throughout his reasoning, makes a fundamental assumption, which he states as follows: "When a body has undergone any changes and after a certain number of transformations is brought back identically to its original state. considered relatively to density, temperature and mode of aggregation, it must contain the same quantity of heat as it contained originally." Clausius and others have misinterpreted this assumption, and have taken it to mean that the quantity of heat required to produce any given change of state is independent of the manner in which the change is effected, which Carnot does not here assume.

Heat, according to Carnot. in the type of engine we are considering, can evidently be a cause of motive power only by virtue of changes of volume or form produced by alternate heating and cooling. This involves the existence of hot and cold bodies to act as boiler and condenser, or source and sink of heat, respectively. Wherever there exists a difference of temperature, it is possible to have the production of motive power from heat; and conversely, production of motive power, from heat alone, is impossible without difference of temperature. In other words the production of motive power from heat is not merely a question of the consumption of heat, but always requires transference of heat from hot to cold. What then are the conditions which enable the difference of temperature to be most advantageously employed in the production of motive power, and how much motive power can be obtained with a given difference of temperature from a given quantity of heat?

2. Carnot's Rule for Maximum Effect. — In order to realize the maximum effect, it is necessary that, in the process employed, there should not be any direct interchange of heat between bodies at different temperatures. Direct transference of heat by conduction or radiation between bodies at different temperatures is equivalent to wasting a difference of temperature which might have been utilized to produce motive power. The working substance must throughout every stage of the process be in equilibrium with itself (*i.e.,* at uniform temperature and pressure) and also with external bodies, such as the boiler and condenser, at such times as it is put in communication with them. In the actual engine there is always some interchange of heat between the steam and the cylinder, and some loss of heat to external bodies. There may also be some difference of temperature between the boiler steam and the cylinder on admission, or between the waste

steam and the condenser at release. These differences represent losses of efficiency which may be reduced indefinitely, at least in imagination, by suitable means, and designers had even at that date been very successful in reducing them. All such losses are supposed to be absent in deducing the ideal limit of efficiency, beyond which it would be impossible to go.

3. Carnot's Description of His Ideal Cycle.—Carnot first gives a rough illustration of an incomplete cycle, using steam much in the same way as it is employed in an ordinary steam engine. After expansion down to condenser pressure the steam is completely condensed to water, and is then returned as cold water to the hot boiler. He points out that the last step does not conform exactly to the condition he laid down, because although the water is restored to its initial state, there is direct passage of heat from a hot body to a cold body in the last process. He points out that this difficulty might be overcome by supposing the difference of temperature small, and by employing a series of engines, each working through a small range, to cover a finite interval of temperature. Having established the general notions of a perfect cycle, he proceeds to give a more exact illustration, employing a gas as the working substance. He takes as the basis of his demonstration the well-established experimental fact that a gas is heated by rapid compression and cooled by rapid expansion, and that if compressed or expanded slowly in contact with conducting bodies, the gas will give out heat in compression or absorb heat in expansion while its temperature remains constant. He then goes on to say:

This preliminary notion being settled, let us imagine an elastic fluid, atmospheric air for example, enclosed in a cylinder *abcd* (fig. 5) fitted with a movable diaphragm or piston *cd*. Let there also be two bodies A, B, each maintained at a constant temperature, that of A being more elevated than that of B. Let us now suppose the following series oi operations to be periormed:

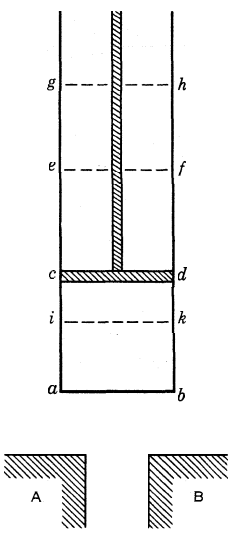

FIG. 8.—CARNOT'S CYLINDER (see TEXT)

1. Contact of the body A with the air contained in the space *abcd*, or with the bottom of the cylinder, which we will suppose to transmit heat easily The air is now at the temperature of the body A, and *cd* is the actual position oi the piston.

2. The piston is gradually raised, and takes the position ef. The air remains in contact with the body A, and is thereby maintained at a constant temperature during the expansion. The body A furnishes the heat necessary to maintain the constancy of temperature.

3. The body A is removed and the air no longer being in contact with any body capable of giving it heat, the piston continues nevertheless to rise, and passes irom the position *ef* to gh. The air expands without receiving heat and its temperature falls Let us imagine that it falls until it is just equal to that of the body B At this moment the piston is stopped and occupies the position *gh*.

4. The air is placed in contact with the body B; it is compressed by the return of the piston, which is brought from the position *gh* to the position *cd*. The air remains meanwhile at a constant temperature, because of its contact with the body B to ahich it gives up its heat.

5. The body B is removed, and the compression of the air is continued. The air being now isolated. rises in temperature. The compression is continued until the air has acquired the temperature of the body A. The piston passes meanwhile irom the position *cd* to the position ik.

6. The air is replaced in contact with the body A, and the piston returns from the position ik to the position *ef*, the temperature remaining invariable.

7. The period described under (3) is repeated, then successively the periods (4), (5), (6); (3), (4), (5), (6); (3), (4), (5), (6); and so on.

Durinr these operations the air enclosed in the cylinder exerts an effort more or less great on the piston. The pressure-of the air varies both on account of changes of volume and on account of changes of temperature; but it should be observed that ior equal volumes, that is to say, for like positions of the piston, the temperature is higher during the dilatation than during the compression. Since the pressure is greater during the expansion, the quantity of motive power produced by the dilatation is greater than that consumed by the compression. We shall thus obtain a balance of motive power, which may be employed for any purpose. The air has served as working substance in a heat-engine; it has also been employed in the most advantageous manner possible, since no useless re-establishment of the equilibrium of heat has been allowed to occur

All the operations above described may be executed in the reverse order and direction. Let us imagine that after the sixth period, that is to say, when the piston has reached the position *ef*, we make it return to the position ik, and that at the same time we keep the air in contact with the hot body A; the heat furnished by this body during the sixth period will return to its source, that is, to the body A, and everything will be as it was at the end oi the fifth period. If now we remove the body A, and if we make the piston move from ik to *cd*, the temperature of the air will decrease by just as many degrees as it increased during the fifth period, and will become that of the body B. We can evidently continue in this way a series of operations the exact reverse oi those which were previously described; it suffices to place oneself in the same circumstances and to execute for each period a movement of expansion in place of a movement oi compression, and vice versa.

The result of the first series oi operations was the production of a certain quantity of motive power, and the transport of heat from the body A to the body B; the result of the reverse operations is the consumption of the motive power produced in the first case, and the return of heat from the body B to the body A, in such sort that these two series of operations annul and neutralize each other.

The impossibility of producing by the agency of heat alone a quantity of motive power greater than that which we have obtained in our first series of operations is now easy to prove. It is demonstrated by reasoning exactly similar to that which we have already given. The reasoning will have in this case a greater degree of exactitude; the air of which we made use to develop the motive power is brounht back at the end of each cycle of operations precisely to its initial state, whereas this was not quite exactly the case for the vapour of water, as we have already remarked.

4. Proof of Carnot's Principle.—Carnot considered the proof too obvious to be worth repeating, but, unfortunately, his previous demonstration. referring to an incomplete cycle, is not so exactly worded that exception cannot be taken to it. We will therefore repeat his proof in a slightly more exact form.

Suppose that a reversible engine R, working in the cycle above described, takes a quantity of heat Q from the source in each cycle, and performs a quantity of useful work W_r. If it were possible for any other engine S, working with the same two bodies A and B as source and refrigerator, to perform a greater amount of useful work W, per cycle for the same quantity of heat Q taken from the source, it would suffice to take a portion W_s of this motive power (since W_s is by hypothesis greater than W_r) to drive the engine R backward, and return a quantity of heat Q to the source in each cycle. The process might be repeated indefinitely. and we should obtain at each repetition a balance of useful work $W_s - W_r$, without taking any heat from the source, which is contrary to experience. Whether the quantity of heat taken from the condenser by R is equal to that given to the condenser by S is immaterial. The hot body A might be a comparatively small boiler, since no heat is taken from it. The cold body B might be the ocean, or the whole earth. We might thus obtain without any consumption of fuel a practically unlimited supply of motive power, which is absurd.

5. **Carnot's** Statement of His Principle.— If the foregoing reasoning be admitted, we must conclude with Carnot that the motive power obtainable from heat is independent of the agents employed to realize it. The efficiency is fixed solely by the temperatures of the bodies between which, in the last resort, the transfer of heat is effected. "We must understand hare that each of the methods of developing motive power attains the perfection of which it is susceptible. This condition is fulfilled if, according to our rule. there is produced in the body no change of temperature that is not due to change of volume, or in other words, if there is no direct interchange of heat between bodies of sensibly different temperatures."

It is characteristic of a state of frictionless mechanical equilibrium that an indefinitely small difference of pressure suffices to upset the equilibrium and reverse the motion. Similarly in thermal equilibrium between bodies at the same temperature, an indefinitely small difference of temperature suffices to reverse the transfer of heat.

Carnot's rule is therefore the criterion of the reversibility of a cycle of operations as regards transfer of heat. It is assumed

that the ideal engine is mechanically reversible, that there is not, for instance, any communication between reservoirs of gas or vapour at sensibly different pressures, and that there is no waste of power in friction. If there is equilibrium both mechanical and thermal at every stage of the cycle, the ideal engine will be perfectly reversible. That is to say, all its operations will be exactly reversed as regards transfer of heat and work, when the operations are performed in the reverse order and direction. On this understanding Carnot's principle may be put in a different way, which is often adopted, but is really only the same thing put in different words: The efficiency of a perfectly reversible engine is the maximum possible, and is a function solely of the limits of temperature between which it works. This result depends essentially on the existence of a state of thermal equilibrium defined by equality of temperature, and independent, in the majority of cases, of the state of a body in other respects. In order to apply the principle to the calculation and prediction of results, it is sufficient to determine the manner in which the efficiency depends on the temperature for one particular case, since the efficiency must be the same for all reversible engines.

Carnot endeavoured to test his results by calculating the amount of work obtainable from an engine on his cycle, using steam as a working substance, and comparing the result with an engine performing a similar cycle, using air as the working substance. He found, using the experimental data available at that time, that the work to be obtained from 1,000 g.cal. of heat was roughly independent of the working substance, being about 1.13 kilogram-metre per kilocalorie per 1° fall at 100° C.; *i.e.*, when the limits of temperature of the cycle are 101° C. and 100° C. He was able to show that the efficiency per degree fall probably diminished with rise of temperature, but the experimental data at that time were too inconsistent to suggest the true relation. He took as the analytical expression of his principle that the efficiency W/Q of a perfect engine taking'in heat Q at a temperature $t°$ C., and rejecting heat at the temperature 0° C., must be some function Ft of the temperature t, which would be the same for all substances. The efficiency per degree fall at a temperature t he represented by F't, the derived function of Ft. The function F't would be the same for all substances at the same temperature, but would have different values at different temperatures. In terms of this function, which is generally known as Carnot's function, the results obtained in the previous section might be expressed as follows:

The increase of volume of a mixture of liquid and vapour per unit-mass vaporized at any temperature, multiplied by the increase of vapour-pressure per degree, is equal to the product of the function $F't$ by the latent heat of vaporization.

The difference of the specific heats, or the latent heat of expansion for any substance, multiplied by the function F't, is equal to the product of the expansion per degree at constant pressure by the increase of pressure per degree at constant volume.

Since the last two coefficients are the same for all gases if equal volumes are taken, Carnot concluded that: "The difference of the specific heats at constant pressure and volume is the same for equal volumes of all gases at the same temperature and pressure."

Taking the expression $W = R T \log, r$ for the whole work done by a gas obeying the gaseous laws $pv = R T$ in expanding at a temperature T from a volume 1 (unity) to a volume r, or for a ratio of expansion r, and putting $W = R \log, r$ for the work done in a cycle of range 1°, Carnot obtained the expression for the heat absorbed by a gas in isothermal expansion.

$$Q = R \log, r/F'(t) \qquad (2)$$

He gives several important deductions which follow from this formula, which is the analytical expression of the experimental result already quoted as having been discovered subsequently by Dulong. Employing the above expression for the latent heat of expansion, Carnot deduced a general expression for the specific heat of a gas at constant volume on the basis of the caloric theory. He showed that if the specific heat mas independent of the temperature (the hypothesis already adopted by Laplace and Poisson) the function $F'(t)$ must be of the form

$$F'(t) = R/C\ (t + t_0) \qquad (3)$$

where C and t_0 are unknown constants. A similar result follows from his expression for the difference of the specific heats. If this is assumed to be constant and equal to C, the expression for $F'(t)$ becomes R/CT, which is the same as the above if $t_0 = 273$. Assuming the specific heat to be also independent of the volume, he shows that the function $F'(t)$ should be constant. But this assumption is inconsistent with the caloric theory of latent heat of expansion, which requires the specific heat to be a function of the volume. It appears in fact impossible to reconcile Carnot's principle with the caloric theory on any simple assumptions. As Carnot remarks: "The main principles on which the theory of heat rests require most careful examination. Many experimental facts appear almost inexplicable in the present state of this theory."

Carnot's work was subsequently put in a more complete analytical form by B. P. E. Clapeyron, who also made use of Watt's indicator diagram for the first time in discussing physical problems. Clapeyron gave the general expressions for the latent heat of a vapour, and for the latent heat of isothermal expansion of any substance, in terms of Carnot's function, employing the notation of the calculus. The expressions he gave are the same in form as those in use at the present time. He also gave the general expression for Carnot's function, and endeavoured to find its variation with temperature; but having no better data, he succeeded no better than Carnot.

Unfortunately, in describing Carnot's cycle, he assumed the caloric theory of heat, and made some unnecessary mistakes, which Carnot (who, we now know, was a believer in the mechanical theory) had been very careful to avoid. Clapeyron directs one to compress the gas at the lower temperature in contact with the body B until the heat disengaged is equal to that which has been absorbed at the higher temperature. He assumes that the gas at this point contains the same quantity of heat as it contained in its original state at the higher temperature, and that, when the body B is removed, the gas will be restored to its original temperature, when compressed to its initial volume. This mistake is still attributed to Carnot, and regarded as a fatal objection to his reasoning by many writers.

W. Thomson (Lord Kelvin) stated in 1852 that "Carnot's original demonstration utterly fails," and he introduced the "corrections" attributed to James Thomson and Clerk Maxwell respectively. In reality Carnot's original demonstration requires no correction.

VII. MECHANICAL THEORY OF HEAT

According to the caloric theory, the heat absorbed in the expansion of a gas became latent, like the latent heat of vaporization of a liquid, but remained in the gas and was again evolved on compressing the gas. This theory gave no explanation of the source of the motive power produced by expansion. The mechanical theory had explained the production of heat by friction as being the result of transformation of visible motion into a brisk agitation of the ultimate molecules, but it had not so far given any definite explanation of the converse production of motive power at the expense of heat. The theory could not be regarded as complete until it had been shown that in the production of work from heat, a certain quantity of heat disappeared, and ceased to exist as heat; and that this quantity was the same as that which could be generated by the expenditure of the work produced. The earliest complete statement of the mechanical theory from this point of view is contained in some notes written by Carnot, about 1830, but published by his brother in 1878. Taking the difference of the specific heats to be .078, he estimated the mechanical equivalent at 370 kilogram-metres. But he fully recognized that there were no experimental data at that time available for a quantitative test of the theory, although it appeared to afford a good qualitative explanation of the phenomena. Carnot therefore planned a number of crucial experiments such as the porous plug experiment, to test the equivalence of heat and motive power.

His early death in 1832 put a stop to these experiments, but many later were made independently by other observers.

The most obvious case of the production of work from heat is in the expansion of a gas or vapour, which served in the first instance as a means of calculating the ratio of equivalence, on the assumption that all the heat which disappeared had been transformed into work and had not merely become latent. Marc Séguin, in his *De l'influence des chemins de fer* (1839), made a rough estimate in this manner of the mechanical equivalent of heat, assuming that the loss of heat represented by the fall of temperature of steam on expanding was equivalent to the mechanical effect produced by the expansion. He also remarks that it was absurd to suppose that "a finite quantity of heat could produce an indefinite quantity of mechanical action, and that it was more natural to assume that a certain quantity of heat disappeared in the very act of producing motive power." J. R. Mayer in 1842 stated the equivalence of heat and work more definitely, deducing it from the old principle, *causa aequat effectum* ("cause equals effect").

Assuming that the sinking of a mercury column by which a gas was compressed was equivalent to the heat set free by the compression, he deduced that the warming of 1 kg. of water 1° C. would correspond to the fall of a weight of 1 kg. from a height of about 365 m. But Mayer did not adduce any fresh experimental evidence. and made no attempt to apply his theory to the fundamental equations of thermodynamics. It has since been urged that the experiment of Gay-Lussac (1807), on the expansion of gas from one globe to another (see *Thermal Properties of Gases: Specific Heat of Gases*, above), was sufficient justification for the assumption tacitly involved in Mayer's calculation. But Joule was the first to supply the correct interpretation of this experiment, and to repeat it on an adequate scale with suitable precautions. Joule was also the first to measure directly the amount of heat liberated by the compression of a gas, and to prove that heat was not merely rendered latent, but disappeared altogether as heat, when a gas did work in expansion.

1. Joule's Determinations of the Mechanical Equivalent. — The honour of placing the mechanical theory of heat on a sound experimental basis belongs almost exclusively to Joule, who showed by direct experiment that in all the most important cases in which heat was generated by the expenditure of mechanical work, or mechanical work was produced at the expense of heat, there was a constant ratio of equivalence between the heat generated and the work expended and vice versa. His first experiments were on the relation of the chemical and electric energy expended to the heat produced in metallic conductors and voltaic and electrolytic cells; these experiments were described in a series of papers published in the *London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science*, 1840–43. He first proved the relation. known as Joule's law, that the heat produced in a conductor of resistance R by a current C is proportional to C^2R per second. He went on to show that the total heat produced in any voltaic circuit was proportional to the electromotive force E of the battery and to the number of equivalents electrolyzed in it. Michael Faraday had shown that electromotive force depends on chemical affinity. Joule measured the corresponding heats of combustion, and showed that the electromotive force corresponding to a chemical reaction is proportional to the heat of combustion of the electrochemical equivalent. He also measured the electromotive force required to decompose water, and showed that when part of the electric energy EC is thus expended in a voltameter, the heat generated is less than the heat of combustion corresponding to EC by a quantity representing the heat of combustion of the decomposed gases.

Joule's papers so far had been concerned with the relations between electrical energy, chemical energy and heat which he showed to be mutually equivalent. The first paper in which he discussed the relation of heat to mechanical power was entitled "On the Calorific Effects of Magneto-Electricity. and on the Mechanical Value of Heat." In this paper in 1843 he showed that the heat produced by currents generated by magnetoelectric induction followed the same law as voltaic currents. By a simple and ingenious arrangement he succeeded in measuring the mechanical power expended in producing the currents, and deduced the mechanical equivalent of heat and of electrical energy. The amount of mechanical work required to raise 1 lb. of water 1° F. (1 B.T.U.), as found by this method, was 838 ft.lb. In a note added to the paper he states that he found the value 770 ft.lb. by the more direct method of forcing water through fine tubes.

In a paper in 1845 "On the Changes of Temperature produced by the Rarefaction and Condensation of Air," he made the first direct measurements of the quantity of heat disengaged by compressing air, and also of the heat absorbed when the air was allowed to expand against atmospheric pressure; as the result he deduced the value 798 ft.lb. for the mechanical equivalent of 1 B.T.U. He also showed that there was no appreciable absorption of heat when air was allowed to expand in such a manner as not to develop mechanical power, and he pointed out that the mechanical equivalent of heat could not be satisfactorily deduced from the relations of the specific heats, because the knowledge of the specific heats of gases at that time was so uncertain.

He attributed most weight to his later determinations of the mechanical equivalent made by the direct method of friction of liquids. He showed that the results obtained with different liquids, water, mercury and sperm oil, were the same, namely, 782 ft.lb.; and finally repeating the method with water, using all the precautions and improvements which his experience had suggested, he obtained the value 772 ft.lb., which was accepted universally for many years, and has only recently required alteration on account of the more exact definition of the heat unit, and the standard scale of temperature *(see* CALORIMETRY). The great value of Joule's work for the general establishment of the principle of the conservation of energy lay in the variety and completeness of the experimental evidence he adduced. It was not sufficient to find the relation between heat and mechanical work or other forms of energy in one particular case. It was necessary to show that the same relation held in all cases which could be examined experimentally, and that the ratio of equivalence of the different forms of energy, measured in different ways, was independent of the manner in which the conversion was effected and of the material or working substance employed.

As the result of Joule's experiments, we are justified in concluding that heat is a form of energy, and that all its transformations are subject to the general principle of the conservation of energy. As applied to heat, the principle is called the hrst law of thermodynamics, and may be stated as follows: When heat is transformed into any other kind of energy, or vice versa, the total quantity of energy remains invariable; that is to say, the quantity of heat which disappears is equivalent to the quantity of the other kind of energy produced and vice versa.

The number of units of mechanical work equivalent to one unit of heat is generally called the mechanical equivalent of heat, or Joule's equivalent, and is denoted by the letter J. Its numerical value depends on the units employed for heat and mechanical energy respectively.

The values of the equivalent in terms of the units most commonly employed are as follows:

778.	foot-pounds	= 1 B.T.U. (lb. deg. Fahr.)
1,401	foot-pounds	= 1 lb. deg. C. (lb.-calorie)
426.85	kilogram-metres	= 1 kilogram-deg. C. or kilocalorie
426.85	gram-metres	= 1 gram-deg. C.
4.1840	abs. joules or watt-seconds	= 1 or def. gram calorie
1.1628	watt-hours	= 1 def. kg. calorie
1.162	kilowatt-hours	= 1 ton calorie

The defined calorie above is based on the electrical equivalent of heat which is the most reproducibly measurable quantity of energy; it is closely equivalent to the amount of heat necessary to raise one gram of water from 14.5° to 15.5° C., one of the more common older definitions. The degree of temperature is based on the International Temperature scale adopted in 1948 by the International Committee of Weights and Measures. The acceleration of gravity used is 980.7 centimetre-gram-second (c.g.s.) units. For further details see CALORIMETRY.

The second law of thermodynamics is a title often used to denote Carnot's principle or some equivalent mathematical expression. In some cases this title is not conferred on Carnot's principle itself, but on some axiom from which the principle may be indirectly deduced. These axioms, however, cannot as a rule be directly applied, so that it would appear preferable to take Carnot's principle itself as the second law.

It may be observed that, as a matter of history. Carnot's principle was established and generally admitted before the principle of the conservation of energy as applied to heat, and that from this point of view the titles, first and second laws, are not particularly appropriate.

2. Combination of **Carnot's** Principle With the Mechanical Theory. — R. J. E. Clausius and W. J. M. Rankine were the first to develop at mid-19th century the correct equations of thermodynamics on the mechanical theory. When heat was supplied to a body to change its temperature or state, part remained in the body as intrinsic heat energy E, but part was converted into external work of expansion W and ceased to exist as heat. The part remaining in the body was always the same for the same change of state, however performed, as required by Carnot's fundamental axiom, but the part corresponding to the external work was necessarily different for different values of the work done. Thus in any cycle in which the body was exactly restored to its initial state, the heat remaining in the body would always be the same, or as Carnot puts it, the quantities of heat absorbed and given out in its diverse transformations are exactly "compensated," so far as the body is concerned. But the quantities of heat absorbed and given out are not necessarily equal. On the contrary. they differ by the equivalent of the external work done in the cycle. Applying this principle to the case of steam, Clausius deduced a fact previously unknown, that the specific heat of steam maintained in a state of saturation is negative, which was also deduced by Rankine about the same time.

In applying the principle to gases Clausius assumes (with Mayer and C. H. A. Holtzmann) that the heat absorbed by a gas in isothermal expansion is equivalent to the work done, but he does not appear to be acquainted with Joule's experiment, and the reasons he adduces in support of this assumption are not conclusive. This being admitted, he deduces from the energy principle alone the propositions already given by Carnot with reference to gases, and shows in addition that the specific heat of a perfect gas must be independent of the density.

W. Thomson (Lord Kelvin) in a paper "On the Dynamical Theory of Heat" published in *1852,* gave a very clear statement of the position of the theory at that time. He showed that the value $F't = J/T$, assumed for Carnot's function by Clausius without any experimental justification, rested solely on the evidence of Joule's experiment, and might possibly not be true at all temperatures. Assuming the value J/T with this reservation, he gave as the expression for the efficiency over a finite range t_1° to t_0° C., or $T_1°$ to $T_0°$ *K.*, the result,

$$W/Q = (t_1 - t_0)/(t_1 + 273) = (T_1 - T_0)/T_1 \qquad (4)$$

which, he observed, agrees in form with that found by Rankine.

3. The Absolute Scale of Temperature. — Since Carnot's function is the same for all substances at the same temperature, and is a function of the temperature only, it supplies a means of measuring temperature independently of the properties of any particular substance. This proposal was first made by Lord Kelvin in *1848,* who suggested that the degree of temperature should be chosen so that the efficiency of a perfect engine at any point of the scale should be the same, or that Carnot's function *F't* should be constant. This would give the simplest expression for the efficiency of the caloric theory, but the scale so obtained, when the values of Carnot's function were calculated from Regnault's observations on steam, was found to differ considerably from the scale of the mercury or air thermometer. At a later date, when it became clear that the value of Carnot's function was very nearly proportional to the reciprocal of the temperature *T* measured from the absolute zero of the gas thermometer, he proposed a simpler method in *1854,* namely, to define absolute temperature *T* as proportional to the reciprocal of Carnot's function. On this definition of absolute temperature, the expression $(T - T_0)/T$ for the efficiency of a Carnot cycle with limits *T* and T_0 would be exact. and it became a most important problem to determine how far the temperature by gas thermometer differed from the absolute temperature. With this object he devised a very delicate method, known as the porous plug experiment (see THERMOMETRY), of testing the deviation of the gas thermometer from the absolute scale. The experiments were carried out in conjunction with Joule, and finally resulted in showing in *1862* that the deviations of the air thermometer from the absolute scale as above defined are almost negligible, and that in the case of the gas hydrogen the deviations are so small that a thermometer containing this gas may be taken for all practical purposes as agreeing exactly with the absolute scale at all ordinary temperatures. For this reason the hydrogen thermometer has since been generally adopted as the standard.

VIII. AVAILABILITY OF HEAT OF COMBUSTION

Taking the value of 1.13 kilogram-metres per kilocalorie for *1°* C. fall of temperature at 100° C., Carnot attempted to estimate the possible performance of a steam engine receiving heat at 160° C. and rejecting it at 40° C. Assuming the performance to be simply proportional to the temperature fall, the work done for 120° fall would be 134 kilogram-metres per kilocalorie. To make an accurate calculation required a knowledge of the variation of the function *F't* with temperature. Taking equation (4) above the work obtainable is *118* kilogram-metres per kilocalorie, which is *28%* of *426.* the mechanical equivalent of the kilocalorie in kilogram-metres. Carnot pointed out that the fall of 120° C. utilized in the steam engine was only a small fraction of the whole temperature fall obtainable by combustion, and made an estimate of the total power available if the whole fall could be utilized, allowing for the probable diminution of the function *F't* with rise of temperature. His estimate was 3,900,000 kilogram-metres per kilogram of coal. This was certainly an overestimate. but was surprisingly close, considering the scanty data at his disposal.

In reality the fraction of the heat of combustion available, even in an ideal engine and apart from practical limitations, is much less than might be inferred from the efficiency formula of the Carnot cycle, by taking the temperature obtainable by the combustion of the fuel as the upper limit of temperature in the formula. For carbon burned in air at constant pressure without any loss of heat, the products of combustion might be raised 2,300° C. in temperature, assuming that the specific heats of the products were constant and that there was no dissociation. If all the heat could be supplied to the working fluid at this temperature, that of the condenser being 40° C., the possible efficiency by equation (4) above would be 89%. But it is obvious that this could not be done even under the most ideal conditions. The heat given up by the products of combustion in cooling to atmospheric temperature could not be received by the boiler at 2,300° but at intermediate temperatures from 2,300° to 40°, which would reduce the mean effective temperature of heat reception from 2,300° to 1,640°, and the ideal efficiency from *89%* to *62%.* This, however, assumes a perfect regenerative boiler in which the working fluid leaves the boiler at a temperature of 2,300°, although the mean temperature of heat reception cannot exceed 1,640°. Carnot foresaw that there would be further limitations in the case of the steam engine owing to the properties of the working fluid.

The greater part of the heat required for generating steam in a boiler is the latent heat of vaporization, which is necessarily received by the steam at the saturation temperature corresponding to the pressure at which the boiler is designed to work. Thus at a pressure of *680* lb. per square inch, the latent heat of vaporization, amounting to about *400* cal.. would be received at a temperature of only 260° C. (500° F.) permitting an ideal efficiency of 41% for the conversion of this part of the heat. But if the feed water from the condenser at 40° is pumped directly into the boiler. to heat it to 260°. the heat required, amounting to about *230* cal., would be received by the feed water at intermediate temperatures, and could not be so efficiently utilized. Rankine

in 1854 was the first to show how the work obtainable from this part of the heat could be calculated. His formula gives an ideal efficiency of conversion of 25% for heat supplied in equal instalments between 40" and 260°. This would reduce the efficiency of an engine using the Rankine cycle with saturated steam at 680 lb. pressure to 35% as compared with 41% for the Carnot cycle, in terms of the heat actually received by the steam. If the temperature of the boiler were further raised to 360° C.. corresponding to a pressure of 2,700 lb. (nearly four times as great as at 260°), the ideal efficiency of the Carnot cycle would be just over 50%, or half the latent heat could be utilized by a perfect engine. But the latent heat at 360° is only 177 cal., and is less than half the heat required for feed heating, which amounts to 400 cal.. so that the corresponding efficiency of the Rankine cycle is only 38%, nhich is very near the limit theoretically attainable in this cycle with saturated steam.

1. Advantages of Internal Combustion. — As Carnot pointed out, the chief advantage of using atmospheric air as a working fluid in a heat engine lies in the possibility of imparting heat to it directly by internal combustion. Even with internal combustion. however. the full range of temperature is not available. because the heat cannot in practice be communicated to the working fluid at constant temperature, owing to the large range of expansion at constant temperature required for the absorption of a sufficient quantity of heat. Air engines of this type, such as the Rev. R. Stirling's or John Ericsson's, taking in heat at constant temperature, though theoretically the most perfect, are bulky and mechanically inefficient.

In practical engines the heat is generated by the combustion of an explosive mixture at constant volume or at constant pressure. The heat is not all communicated at the highest temperature. but over a range of temperature from that of the mixture at the beginning of combustion to the maximum temperature. The earliest instance of this type of engine is the lycopodium engine of M. M. Niepce. discussed by Carnot, in which a combustible mixture of air and lycopodium powder at atmospheric pressure was ignited in a cylinder. and did work on a piston. The early gas engines of E. Lenoir (1860) and N. Otto and E. Langen (1867) operated in a similar manner nith illuminating gas in place of lycopodium. Combustion in this case is effected practically at constant volume. and the maximum efficiency theoretically obtainable is $1 - \log_e r/(r - 1)$. where r is the ratio of the maximum temperature T to the initial temperature T,. In order to obtain this efficiency it would be necessary to follow Carnot's rule. and expand the gas after ignition without loss or gain of heat from T down to T_0, and then to compress it at T_0 to its initial volume. If the rise of temperature in combustion were 2 300° C., and the initial temperature were 0° C. or 273° K.. the theoretical efficiency would be 73.3%, which is much greater than that obtainable with a boiler. But in order to reach this value. it would be necessary to expand the mixture to about 270 times its initial volume, which is obviously impracticable.

Because of incomplete expansion and rapid cooling of the heated gases by the large surface exposed. the actual efficiency of the Lenoir engine was less than 5%, and of the Otto and Langen, nith more rapid expansion, about 10%.

Carnot foresaw that in order to render an engine of this type practically efficient, it would be necessary to compress the mixture before ignition. Compression is beneficial in three nays: (1) it permits a greater range of expansion after ignition; (2) it raises the mean effective pressure, and thus improves the mechanical efficiency and the power in proportion to size and neight; (3) it reduces the loss of heat during ignition by reducing the surface exposed to the hot gases. In the modern gas or gasoline motor compression is employed as in Carnot's cycle, but the efficiency attainable is limited not so much by considerations of temperature as by limitations of volume. It is impracticable before combustion at constant volume to compress a rich mixture to much less than one-fifth of its initial volume, and. for mechanical simplicity, the range of expansion is made equal to that of compression.

The cycle employed was devised in 1862 by Alphonse Beau de Rochas, but was first successfully carried out by Otto (1876). It differs from the Carnot cycle in employing reception and rejection of heat at constant volume instead of at constant temperature. This cycle is not so efficient as the Carnot cycle for given limits of temperature, but, for the given limits of volume imposed, it gives a much higher efficiency than the Carnot cycle. The efficiency depends only on the range of temperature in expansion and compression, and is given by the formula $(T_1 - T_2)/T_1$, where T_1 is the maximum temperature, and T_2 the temperature at the end of expansion. The formula is the same as that for the Carnot cycle with the same range of temperature in expansion. The ratio T_1/T_2 is $r^{\gamma-1}$ where r is the given ratio of expansion or compression. and γ is the ratio of the specific heats of the working fluid. Assuming the working fluid to be a perfect gas mith the same properties as air, we should have $\gamma = 1.41$. Taking $r = 5$ the formula gives 48% for the maximum possible efficiency. The actual products of combustion vary with the nature of the fuel employed, and have different properties from air, but the efficiency is found to vary with compression in the same manner as for air. For this reason a committee of the Institution of Civil Engineers in 1905 recommended the adoption of the air standard for estimating the effects of varying the compression ratio, and defined the relative efficiency of an internal combustion engine as the ratio of its observed efficiency to that of a perfect air engine with the same compression.

2. Effect of Dissociation and Increase of Specific Heat, —One of the most important effects of heat is the decomposition or dissociation of compound molecules. Just as the molecules of a vapour combine with evolution of heat to form the more complicated molecules of the liquid, and as the liquid molecules require the addition of heat to effect their separation into molecules of vapour, so in the case of molecules of different kinds which combine with evolution of heat, the reversal of the process can be effected either by the agency of heat, or indirectly by supplying the requisite amount of energy by electrical or other methods. Just as the latent heat of vaporization diminishes with rise of temperature, and the pressure of the dissociated vapour molecules increases. so in the case of compound molecules in general the heat of combination diminishes with rise of temperature, and the pressure of the products of dissociation increases. There is evidence that the compound carbon dioxide, CO_2, is partly dissociated into carbon monoxide and oxygen at high temperatures. and that the proportion dissociated increases with rise of temperature.

There is a very close analogy between these phenomena and the vaporization of a liquid. The laws which govern dissociation are the same fundamental laws of thermodynamics. but the relations involved are necessarily more complex on account of the presence of different kinds of molecules, and present special difficulties for accurate investigation in the case where dissociation does not begin to be appreciable until a high temperature is reached.

It is easy, however, to see that the general effect of dissociation must be to diminish the available temperature of combustion, and all experiments go to show that in ordinary combustible mixtures the rise of temperature actually attained is much less than that calculated above by Carnot on the assumption that the whole heat of combustion is developed and communicated to products of constant specific heat. The defect of temperature observed can be represented by supposing that the specific heat of the products of combustion increases with rise of temperature. This is the case for CO_2 even at ordinary temperatures, according to Regnault, and probably also for air and steam at higher temperatures. Increase of specific heat is a necessary accompaniment of dissociation, and from some points of view may be regarded as merely another may of stating the facts. It is the most convenient method to adopt in the case of products of combustion consisting of a mixture of CO, and steam with a large excess of inert gases, because the relations of equilibrium of dissociated molecules of so many different kinds would be too complex to permit of any other method of expression.

Although Carnot's principle makes it possible to calculate in

every case what the limiting possible efficiency would be for any kind of cycle if all heat losses were abolished. it is very necessary, in applying the principle to practical cases, to take account of the possibility of avoiding the heat losses which are supposed to be absent, and of other practical limitations in the working of the actual engine. An immense amount of time and ingenuity has been wasted in striving to realize impossible margins of ideal efficiency, which a close study of the practical conditions would have shown to be illusory. As Carnot remarks at the conclusion of his essay: "Economy of fuel is only one of the conditions a heat-engine must satisfy; in many cases it is only secondary. and must often give way to considerations of safety, strength and wearing qualities of the machine, of smallness of space occupied, or of expense in erecting. To kno how to appreciate justly in each case the considerations of convenience and economy, to be able to distinguish the essential from the accessory, to balance all fairly, and finally to arrive at the best result by the simplest means, such must be the principal talent of the man called on to direct and co-ordinate the work of his fellows for the attainment of a useful object of any kind."

IX. TRANSFERENCE OF HEAT

There are three principal modes of transference of heat, namely (1) convection, (2) conduction and (3) radiation:

(1) In convection, heat is carried or conveyed by the motion of heated masses of matter. The most familiar illustrations of this method of transference are the heating of buildings by the circulation of steam or hot water, or the equalization of temperature of a mass of unequally heated liquid or gas by convection currents, produced by natural changes of density or by artificial stirring.

(2) In conduction, heat is transferred by contact between contiguous particles of matter and is passed on from one particle to the next without visible relative motion of the parts of the body. A familiar illustration of conduction is the passage of heat through the metal plates of a boiler from the fire to the water inside, or the transference of heat from a soldering bolt to the solder and the metal with which it is placed in contact.

(3) In radiation, the heated body, through the thermal vibratory motion of its atoms, radiates out into space vibratory waves of an electrodynamic nature. these waves being visible light (in part) if the body is at a sufficiently high temperature (e g, red-hot); if the body is at a lower temperature, the waves are so called infrared radiation (invisible) which is similar in nature to light but contains just enough less energy per unit (photon) so that it cannot excite the optic nerve and be perceived by the human eye. But these waves can be absorbed by matter on nhich they impinge and can be reconverted into heat; *i.e.*, into thermal vibrations of the atoms.

The different modes of transference are subject to different laws, and the difficulty of disentangling their effects and subjecting them to calculation is often one of the most serious obstacles in the experimental investigation of heat. In space void of matter, we should have pure radiation, but it is difficult to obtain so perfect a vacuum that the effects of the residual gas in transferring heat by conduction or convection are inappreciable. In the interior of an opaque solid we should have pure conduction, but if the solid is sensibly transparent in thin layers there must also be an internal radiation, while in a liquid or a gas it is very difficult to eliminate the effects of convection. These difficulties are well illustrated in the historical development of the subject by the experimental investigations which have been made to determine the lans of heat transference, such as the laws of cooling, of radiation and of conduction.

1. Newton's Law of Cooling.—There is one essential condition common to all three modes of heat transference, namely, that they depend on difference of temperature, that the direction of the transfer of heat is always from hot to cold and that the rate of transference is, for small differences, directly proportional to the difference of temperature. Without difference of temperature there is no transfer of heat. When two bodies have been brought to the same temperature by conduction, they are also in equilibrium as regards radiation, and vice versa. If this were not the case. there could be no equilibrium of heat defined by equality of temperature.

A hot body placed in an enclosure of lower temperature. *e.g.*, a calorimeter in its containing vessel, generally loses heat by all three modes simultaneously in different degrees. The loss by each mode will depend in different ways on the form, extent and nature of its surface and on that of the enclosure, on the manner in nhich it is supported. on its relative position and distance from the enclosure and on the nature of the intervening medium. But provided that the difference of temperature is small, the rate of loss of heat by all modes will be approximately proportional to the difference of temperature, the other conditions remaining constant. The rate of cooling or the rate of fall of temperature will also be nearly proportional to the rate of loss of heat, if the specific heat of the cooling body is constant, or the rate of cooling at any moment will be proportional to the difference of temperature.

This simple relation is commonly known as Newton's law of cooling, but is limited in its application to comparatively simple cases such as the foregoing. Newton himself applied it to estimate the temperature of a red-hot iron ball, by observing the time which it took to cool from a red heat to a known temperature, and comparing this with the time taken to cool through a known range at ordinary temperatures. According to this law if the excess of temperature of the body above its surroundings is observed at equal intervals of time, the observed values will form a geometrical progression with a common ratio. Supposing. for instance, that the surrounding temperature were 0° C., that the red-hot ball took 25 min. to cool from its original temperature to 20° C., and 5 min. to cool from 20° C. to 10° C.. the original temperature is easily calculated on the assumption that the excess of temperature above 0° C. falls to half its value in each interval of 5 min. Doubling the value 20° at 25 min. five times, we arrive at 640° C. as the original temperature. No other method of estimation of such temperatures mas available in the time of Newton, but, as we now know, the simple law of proportionality to the temperature difference is inapplicable over such large ranges of temperature. The rate of loss of heat by radiation, and also by convection and conduction to the surrounding air, increases much more rapidly than in simple proportion to the temperature difference, and the rate of increase of each follows a different law.

At a later date Sir John Herschel measured the intensity of solar radiation at the surface of the earth, and endeavoured to form an estimate of the temperature of the sun by comparison with terrestrial sources on the assumption that the intensity of radiation was simply proportional to the temperature difference. He thus arrived at an estimate of several million degrees. which we now know would be about a thousand times too great. The application of Newton's lam necessarily leads to absurd results when the difference of temperature is very large, but the error will not in general exceed 2% to 3% if the temperature difference does not exceed 10° C., and the percentage error is proportionately much smaller for smaller differences.

2. Surface **Emissivity.**—Similar considerations apply to many attempts which have been made to determine the general value of the constant termed by Jean Fourier and early writers the "exterior conductibility," but now called the surface emissivity. This coefficient represents the rate of loss of heat from a body per unit area of surface per degree excess of temperature, and includes the effects of radiation, convection and conduction. As already pointed out, the combined effect will be nearly proportional to the excess of temperature in any given case provided that the excess is small, but it is not necessarily proportional to the extent of surface exposed except in the case of'pure radiation. The rate of loss of heat by convection and conduction varies with the form of the surface, and. unless the enclosure is very large compared with the cooling body. the effect depends also on the size and form of the enclosure. The effects of conduction and radiation may be approximately estimated if the conductivity of the gas and the nature and forms of the surfaces of the body and enclosure

are known, but the effect of convection in any case can be determined only by experiment. It has been found that the rate of cooling by a current of air is approximately proportional to the velocity of the current, other things being equal. It is obvious that this should be the case, but the result cannot generally be applied to convection currents. Values which are commonly given for the surface emissivity must therefore be accepted with great reserve. They can be regarded only as approximate, and as applicable only to cases precisely similar to those for which they were experimentally obtained. There cannot be said to be any general law of convection. The loss of heat is not necessarily proportional to the area of the surface, and no general value of the coefficient can be given to suit all cases. The laws of conduction and radiation admit of being more precisely formulated, and their effects predicted, except in so far as they are complicated by convection.

X. CONDUCTION OF HEAT IN SOLIDS

The transference of heat in the interior of a solid body formed one of the earliest subjects of mathematical and experimental treatment in the theory of heat. The law assumed by Fourier was of the simplest possible type, but the mathematical application, except in the simplest cases, was so difficult as to require the development of a new mathematical method. Fourier succeeded in showing how, by his method of analysis, the solution of any given problem with regard to the flow of heat by conduction in any material could be obtained in terms of a physical constant, the thermal conductivity of the material, and that the results obtained by experiment agreed in a qualitative manner with those predicted by his theory. But the experimental determination of the actual values of these constants presented formidable difficulties which were not surmounted until a later date.

The law of conduction, which forms the basis of the mathematical theory, although seldom explicitly stated as an experimental law, should really be regarded in this light, and may be briefly worded as follows: "The rate of transmission of heat by conduction is proportional to the temperature gradient." The rate of transmission of heat is here understood to mean the quantity of heat transferred in unit time through unit area of cross section of the substance, the unit area being taken perpendicular to the lines of flow. It is clear that the quantity transferred in any case must be jointly proportional to the area and the time. The "gradient of temperature" is the fall of temperature in degrees per unit length along the lines of flow.

The thermal conductivity of the substance is the constant ratio of the rate of transmission to the temperature gradient. To take the simple case of the "wall" or flat plate considered by Fourier for the definition of thermal conductivity, suppose that a quantity of heat Q passes per second through an area A of a plate of conductivity k and thickness x, the sides of which are constantly maintained at temperatures t_1 and t_2. The rate of transmission of heat is Q/A, and the temperature gradient, supposed uniform, is $(t_1 - t_2)/x$, so that the law of conduction leads at once to the equation

$$Q/A = k(t_1 - t_2)/x$$

This relation applies accurately to the case of the steady flow of heat in parallel straight lines through a homogeneous and isotropic solid, the isothermal surfaces, or surfaces of equal temperature, being planes perpendicular to the lines of flow. If the flow is steady, and the temperature of each point of the body invariable, the rate of transmission must be everywhere the same. One of the simplest illustrations of the rectilinear flow of heat is the steady outflow through the upper strata of the earth's crust, which may be considered practically plane in this connection. This outflow of heat necessitates a rise of temperature with increase of depth. The corresponding gradient is of the order of 1° C. in 100 ft., but varies inversely with the conductivity of the strata at different depths.

A different type of problem is presented in those cases in which the temperature at each point varies with the time, as is the case near the surface of the soil with variations in the external conditions between day and night or summer and winter. The flow of heat may still be linear if the horizontal layers of the soil are of uniform composition, but the quantity flowing through each layer is no longer the same. Part of the heat is used up in changing the temperature of the successive layers. In this case it is generally more convenient to consider as unit of heat the thermal capacity c of unit volume, or that quantity which would produce a rise of 1° of temperature in unit volume of the soil or substance considered. If Q is expressed in terms of this unit in equation (5), it is necessary to divide by c, or to replace k on the right-hand side by the ratio k/c. This ratio determines the rate of diffusion of temperature, and is called the thermometric conductivity or, more shortly, the diffusivity. The velocity of propagation of temperature waves will be the same under similar conditions in two substances which possess the same diffusivity, although they may differ in conductivity.

1. Variable-flow Methods.—In these methods the flow of heat is deduced from observations of the rate of change of temperature with time in a body exposed to known external or boundary conditions. No calorimetric observations are required, but the results are obtained in terms of the thermal capacity of unit volume c, and the measurements give the diffusivity k/c, instead of the calorimetric conductivity k. Since both k and c are generally variable with the temperature, and the mode of variation of either is often unknown, the results of these methods are generally less certain with regard to the actual flow of heat. As in the case of steady flow methods, by far the simplest example to consider is that of the linear flow of heat in an infinite solid, which

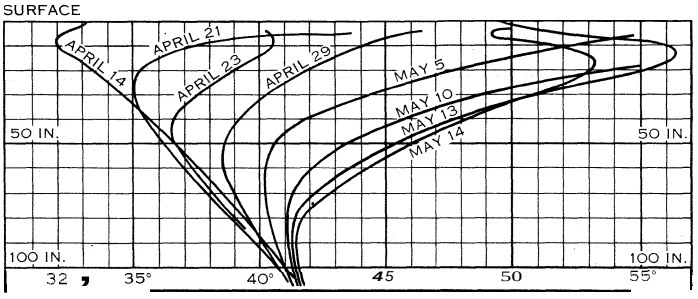

FIG. 6.—CURVES SHOWING THE VARIATION OF TEMPERATURE WITH DEPTH, AT VARIOUS DATES

is most nearly realized in nature in the propagation of temperature waves in the surface of the soil. One of the best methods of studying the flow of heat in this case is to draw a series of curves showing the variations of temperature with depth in the soil for a series of consecutive days. The curves given in fig. 6 were obtained from the readings of a number of platinum thermometers buried in undisturbed soil in horizontal positions at McGill university, Montreal.

The method of deducing the diffusivity from these curves is as follows: The total quantity of heat absorbed by the soil per unit area of surface between any two dates, and any two depths, x' and x'', is equal to c times the area included between the corresponding curves. This can be measured graphically without any knowledge of the law of variation of the surface temperature, or of the laws of propagation of heat waves. The quantity of heat absorbed by the stratum $(x'x'')$ in the interval considered can also be expressed in terms of calorimetric conductivity k. The heat transmitted through the plane x is equal per unit area of surface to the product of k by the mean temperature gradient (dt/dx) and the interval of time in seconds. The mean temperature gradient is found by plotting the curves for each day from the daily observations. The heat absorbed is the difference of the quantities transmitted through the bounding planes of the stratum. We thus obtain the simple equation.

$$k'(dt'/dx') - k''(dt''/dx'') = \text{c (area between curves)/time in sec.} \quad (6)$$

by means of which the average value of the diffusivity k/c can be found for any convenient interval of time, at different seasons of the year, in different states of the soil.

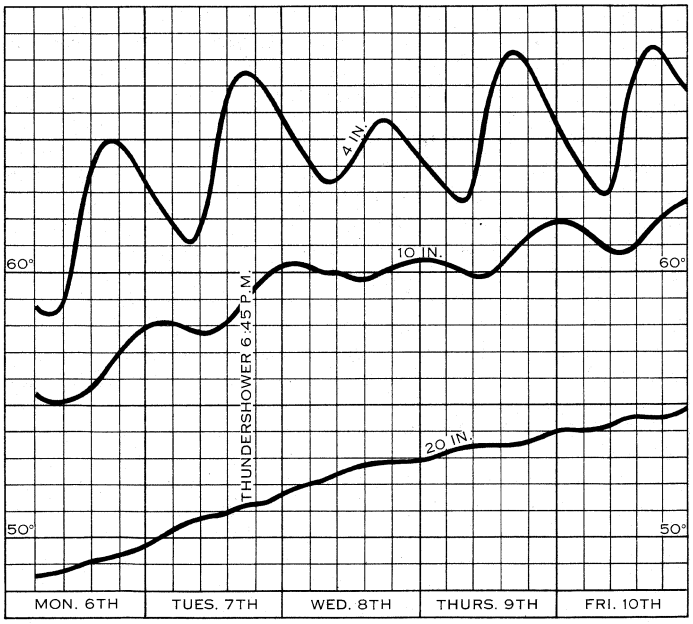

FIG. 7.— EXAMPLES OF DIURNAL SUBSURFACE TEMPERATURE VARIATIONS FOR DEPTHS OF 4, 10 AND 20 IN. (MONTH OF MAY)

For the particular soil in question it was found that the diffusivity varied enormously with the degree of moisture, falling as low as .0010 c.g.s. in the winter for the surface layers, which became extremely dry under the protection of the frozen ice and snow from December to March, but rising to an average of .0060 to .0070 in the spring and autumn. The greater part of the diffusion of heat was certainly due to the percolation of water. On some occasions, because of the sudden melting of a surface layer of ice and snow, a large quantity of cold water, percolating rapidly, gave for a short time values of the diffusivity as high as 0300. Excluding these exceptional cases, however, the variations of the diffusivity appeared to follow the variations of the seasons with considerable regularity in successive years. The presence of water in the soil always increased the value of k/c, and as it necessarily increased c, the increase of k must have been greater than that of k/c.

2. Periodic **Flow of** Heat.—The foregoing method is perfectly general, and can be applied in any case in which the requisite observations can be taken. A case of special interest and importance is that in which the flow is periodic. The general characteristics of such a flow are illustrated in fig. 7, showing the propagation of temperature waves caused by diurnal variations in the temperature of the surface.

The daily range of temperature of the air and of the surface of the soil was about 20° F. On a sunny day, the temperature reached a maximum about 2 P.M. and a minimum about j A.M. As the waves were propagated downward through the soil the amplitude rapidly diminished, so that at a depth of only 4 in. it was already reduced to about 6° F., and to less than 2° at 10 in. At the same time, the epoch of maximum or minimum was retarded, about 4 hours at 4 in., and nearly 12 hours at 10 in., where the maximum temperature was reached between 1 and 2 A.M. The form of the wave was also changed. At 4 in. the rise was steeper than the fall, at 10 in. the reverse was the case. This is due to the fact that the components of shorter period are more rapidly propagated. For instance, the velocity of propagation of a wave having a period of a day is nearly 20 times as great as that of a wave with a period of 1 year; but on the other hand the penetration of the diurnal wave is nearly 20 times less, and the shorter waves die out more rapidly.

3. Laboratory Methods.—Measurements of thermal conductivity present peculiar difficulties on account of the variety of quantities to be observed, the slowness of the process of conduction, the impossibility of isolating a quantity of heat and the difficulty of exactly realizing the theoretical conditions of the problem. The following are some of the special cases which have been utilized experimentally:

The "Wall" or Plate Method.—This method endeavours to realize the conditions of equation (5), namely, uniform rectilinear flow. Theoretically this requires an infinite plate, or a perfect heat insulator, so that the lateral flow can be prevented or rendered negligible. This condition can generally be satisfied with sufficient approximation with plates of reasonable dimensions. To find the conductivity, it is necessary to measure all the quantities which occur in equation (5) to a similar order of accuracy. The measurement of the temperature gradient in the plate generally presents the greatest difficulty. If the plate is thin. it is necessary to measure the thickness with great care, and it is necessary to assume that the temperatures of the surfaces are the same as those of the mediums with which they are in contact, since there is no room to insert thermometers in the plate itself. This assumption does not present serious errors in the case of bad conductors, such as glass or wood. but has given rise to large mistakes in the case of metals.

Tube Method.—If the inside of a glass tube is exposed to steam, and the outside to a rapid current of water, or vice versa, the temperatures of the surfaces of the glass may be taken to be approximately equal to those of the water and steam, which may easily be observed. If the thickness of the glass is small compared with the diameter of the tube, say one-tenth, equation (j) may be applied with sufficient approximation.

Forbes's Bar Method.—Observation of the steady distribution of temperature along a bar heated at one end was very early employed by Fourier, César Mansuète Despretz and others for the comparison of conductivities. Originated by James David Forbes, it is the most convenient method. in the case of good conductors, on account of the great facilities which it permits for the measurement of the temperature gradient at different points; but it has the disadvantage that the results depend almost entirely on a knowledge of the external heat loss or emissivity, or, in comparative experiments, on the assumption that it is the same in different cases.

Calorimetric Bar Method.—To avoid the uncertainties of surface loss of heat, it is necessary to reduce it to the rank of a small correction by employing a large bar and protecting it from loss of heat. The heat transmitted should be measured calorimetrically. and not in terms of the uncertain emissivity. The apparatus shown in fig. 8 was constructed by H. L. Callendar and J. T. Nicolson with this object. The bar was a special sample of cast iron, the conductivity of which was required for some experiments on the condensation of steam. It had a diameter of 4 in, and a length of 4 ft. between the heater and the calorimeter. The emissivity was reduced to one-quarter by lagging the bar like a steampipe to a thickness of 1 in. The heating vessel could be maintained at a steady temperature by high-pressure steam. The other end was maintained at a temperature near that of the air by a steady stream of water flowing through a well-lagged vessel surrounding the bar. The heat transmitted was measured by observing the difference of temperature between the inflow and the outflow, and

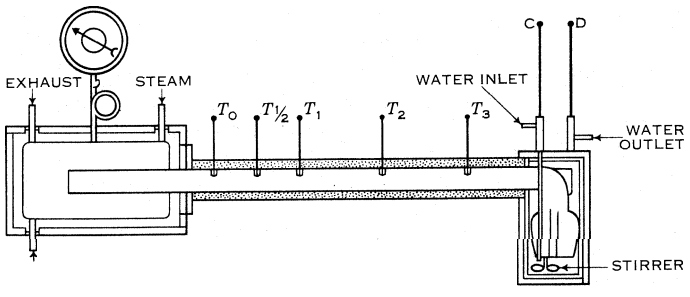

FIG 8 — CALORIMETRIC BAR METHOD IN WHICH HEAT FLOW IS MEASURED BY RISE OF TEMPERATURE OF COOLING WATER. GRADIENT IS MEASURED BY MERCURY THERMOMETERS

the weight of water which passed in a given time. The gradient near the entrance to the calorimeter was deduced from observations with five thermometers at suitable intervals along the bar. The results obtained by this method at a temperature of 40° C.

varied from .116 to .118 c.g.s. from observations on different days, and were probably more accurate than those obtained by the cylinder method. The same apparatus was employed in another series of experiments by the periodic flow method, but this involves a knowledge of c, and is very laborious.

4. Electrical Methods.—There are two electrical methods which have been usefully applied to the measurement of the conductivity of metals, (1) the resistance method, devised by Callendar, and applied by him, and also by R. O. King and J. D. Duncan, (2) the thermoelectric method, devised by Friedrich Kohlrausch, and applied by W. Jaeger and H. Dieselhorst. Both methods depend on the observation of the steady distribution of temperature in a bar or wire heated by an electric current. The advantage is that the quantities of heat are measured directly in absolute measure, in terms of the current, and that the results are independent of a knowledge of the specific heat. Incidentally it is possible to regulate the heat supply more perfectly than in non-electric methods.

(1) In the practice of the resistance method, both ends of a short bar are kept at a steady temperature by means of solid copper blocks provided with a water circulation, and the whole is surrounded by a jacket at the same temperature, which is taken as the zero of reference. The bar is heated by a steady electric current, which may be adjusted so that the external loss of heat from the surface of the bar is compensated by the increase of resistance of the bar with rise of temperature. In this case the curve representing the distribution of temperature is a parabola, and the conductivity k is deduced from the mean rise of temperature $(R - R_0)/aR_0$ by observing the increase of resistance $R - R_0$ of the bar, and the current C. It is also necessary to measure the cross section q, the length I and the temperature-coefficient a for the range of the experiment.

In the general case the distribution of temperature is observed by means of a number of potential leads. The differential equation for the distribution of temperature in this case includes the majority of the methods already considered, and may be stated as follows. The heat generated by the current C at a point x, where θ = excess temperature, is equal per unit length and time (t) to that lost by conduction $-d(qkd\theta/dx)/dx$, and by radiation $hp\theta$ (emissivity h, perimeter p), together with that employed in raising the temperature $qcd\theta/dt$, and absorbed by the Thomson effect $Cd\theta/dx$. We thus obtain the equation

$$C^2R_0(1 + a\theta)/l = -d(qkd\theta/dx)/dx + hp\theta + qcd\theta/dt + sCd\theta/dx \quad (7)$$

If C = o. this is the equation of Angstrom's method. If h also is zero, it becomes the equation of variable flow in the soil. If $d\theta/dt$ = o, the equation represents the corresponding cases of steady flow.

In the electrical method, observations of the variable flow are useful for finding the value of c for the specimen, but are not otherwise required. The last term, representing the Thomson effect, is eliminated in the case of a bar cooled at *both* ends, since it is opposite in the two halves, but may be determined by observing the resistance of each half separately. If the current C is chosen so that $C^2R_0a = hpl$, the external heat loss is compensated by the variation of resistance with temperature. In this case the solution of the equation reduces to the form

$$\theta = x(l - x)C^2R_0/2lqk \quad (8)$$

By a property of the parabola, the mean temperature is two-thirds of the maximum temperature; we have therefore

$$(R - R_0)/aR_0 = lC^2R_0/12qk \quad (9)$$

which gives the conductivity directly in terms of the quantities actually observed. If the dimensions of the bar are suitably chosen, the distribution of temperature is always very nearly parabolic, so that it is not necessary to determine the value of the critical current $C^2 = hpl/aR_0$ very accurately, as the correction for external loss is a small percentage in any case. The chief difficulty is that of measuring the small change of resistance accurately, and of avoiding errors from accidental thermoelectric effects. In addition to the simple measurements of the conductivity made at McGill university in the 1890s, some very elaborate experiments were made by King on the temperature distribution in the case of long bars with a view to measuring the Thomson effect. Duncan of McGill, using the simple method under King's supervision, found the conductivity of very pure copper to be 1.007 for a temperature of 33° C.

(2) The method of Kohlrausch. as carried out by Jaeger and Dieselhorst, consists in observing the difference of temperature between the centre and the ends of the bar by means of insulated thermocouples. Neglecting the external heat loss, and the variation of the thermal and electric conductivities k and k', we obtain, as before, for the difference of temperature between the centre and ends, the equation

$$\theta_{max} - \theta_0 = C^2Rl/8qk = ECl/8qk = E^2k'/8k \quad (10)$$

where E is the difference of electric potential between the ends. Lorenz, assuming that the ratio $k/k' = a\theta$, had previously given

$$\theta^2_{max} - \theta_0^2 = E^2/4a \quad (11)$$

which is practically identical with the preceding for small differences of temperature. The last expression in terms of k/k' is very simple, but the first is more useful in practice, as the quantities actually measured are E, C, I, q, and the difference of temperature. The current C was measured in the usual way by the difference of potential on a standard resistance.

The external heat loss was estimated by varying the temperature of the jacket surrounding the bar, and applying a suitable correction to the observed difference of temperature. But the method (1) previously described appears to be preferable in this respect, since it is better to keep the jacket at the same temperature as the end blocks. The variation of thermal conductivity with temperature is small and uncertain. whereas the variation of electrical conductivity is large and can be accurately determined, and may therefore be legitimately utilized for eliminating the external heat loss.

One of the chief objects of these experiments was to test the combined hypotheses of G. Wiedemann (1853) and L. Lorenz (1872), that the ratio of the thermal to the electrical conductivity was the same for all metals. and varied directly as the absolute temperature. This relation was strongly supported as a result of the development of the electron theory of conduction in metals by P. K. Drude (1900) and H. A. Lorentz (1905), and was approximately verified for some of the pure metals by Jaeger and Dieselhorst between o° and 100° C. But the ratio appears to be affected in a marked degree by the presence of impurities which reduce the electric conductivity, and the majority of alloys give much higher values than the pure metals. It has since been shown by the experiments of C. H. Lees (1908), H. Kamerlingh Onnes (1914) and W. F. Meissner (1920), that the remarkable increase of electric conductivity of some pure metals at very low temperatures does not extend to the thermal conductivity. Sir J. J. Thomson in his *Corpuscular* Theory of *Matter* (1907) had already pointed out that there were serious difficulties in the electron theory of Drude and Lorentz, and proposed an alternative theory which did not require the presence of a large number of free electrons in the metal. With the development of quantum mechanics in the decade following 1926 a much more penetrating understanding was achieved of the nature of both thermal and electrical conductivity. New statistical laws were proposed by Paul A. M. Dirac and independently by Enrico Fermi which accounted qualitatively, at least, for the values observed.

XI. CONDUCTION IN GASES AND LIQUIDS

The theory of conduction of heat by diffusion in gases has a particular interest, since it is possible to predict the value of the conductivity on certain assumptions, if the viscosity (*q.v.*) is known. On the kinetic theory the molecules of a gas are relatively far apart and there is nothing exactly analogous to friction between two adjacent layers A and B in relative motion. There is, however, a continual interchange of molecules between A and B, which produces the same effect as viscosity in a liquid. Faster-moving particles diffusing from A to B carry their momentum with

them, and tend to accelerate B; an equal number of slower particles diffusing from B to 4 act as a drag on A.

This action and reaction between layers in relative motion is equivalent to a frictional stress tending to equalize the velocities of adjacent layers. The magnitude of the stress per unit area parallel to the direction of flow is evidently proportional to the velocity gradient, or the rate of change of velocity per centimetre in passing from one layer to the next. It must also depend on the rate of interchange of molecules, that is to say, (1) on the number passing through each square centimetre per second in either direction, (2) on the average distance to which each can travel before collision (*i.e.*, on the "mean free path"), and (3) on the average velocity of translation of the molecules, which varies as the square root of the temperature. Similarly if A is hotter than B, or if there is a gradient of temperature between adjacent layers, the diffusion of molecules from A to B tends to equalize the temperatures, or to conduct heat through the gas at a rate proportional to the temperature gradient, and depending also on the rate of interchange of molecules in the same may as the viscosity effect.

Conductivity and viscosity in a gas should vary in a similar manner since each depends on diffusion in a similar way. The mechanism is the same, but in one case we have diffusion of momentum, in the other case diffusion of heat. Viscosity in a gas was first studied theoretically from this point of view by J. Clerk Maxwell, who predicted that the effect should be independent of the density within wide limits. This, at first sight, paradoxical result is explained by the fact that the mean free path of each molecule increases in the same proportion as the density is diminished, so that as the number of molecules crossing each square centimetre decreases. the distance to which each carries its momentum increases, and the total transfer of momentum, is unaffected by variation of density. Maxwell himself verified this prediction experimentally for viscosity over a wide range of pressure. By similar reasoning the thermal conductivity of a gas should be independent of the density. Maxwell predicted a value 0.00005j c.g.s. for the conductivity of air, and a value seven times greater for hydrogen on account of the greater velocity and range of its molecules. 4. Kundt and E. Warburg found that the rate of cooling of a thermometer in air between 150 mm. and 1 mm. pressure remained constant as the pressure was varied. At higher pressures the effectof conduction was masked by convection currents.

The question of the variation of conductivity with temperature is more difficult. If the effects depended merely on the velocity of translation of the molecules, both conductivity and viscosity should increase directly as the square root of the absolute temperature; but the mean free path also varies in a manner which cannot be predicted by theory and which appears to be different for different gases. Experiments by the capillary tube method have shown that the viscosity varies more nearly as $\theta^{\frac{3}{4}}$, but indicate that the rate of increase diminishes at high temperatures. The conductivity probably changes with temperature in the same way. being proportional to the product of the viscosity and the specific heat; but the experimental investigation presents difficulties on account of the necessity of eliminating the effects of radiation and convection, and the results of different observers often differ considerably from theory and from each other. The values found for the conductivity of air at 0° C. range from .000048 to .000057, and the temperature coefficient from .0015 to .0028.

Experimental determinations of the thermal conductivities of gases are still somewhat scarce and discordant because of the great practical difficulties, but are of special interest for the elucidation of the law of action between molecules. The hot-wire method of T. Andrews (1840) offers special facilities for relative measurements, such as the comparison of conductivities of different gases, or of the same gas at different temperatures, and has frequently been applied with this object in recent years. It has also been improved by introducing the usual compensation for end effects, and employing more accurate methods of electrical measurement, but it remains liable to the difficulties depending on the small dimensions of the wire and the elimination of the corrections for radiation. The determination of the thermal conductivities of gases gives a means of testing the value of the numerical coefficient f in the relation, $k = fgs$, between the conductivity k, the viscosity η, and the specific heat s at constant volume. According to the theoretical investigations of S. Chapman (1911) the value of the coefficient f should be 2.5 for a gas constituted of spherically symmetrical molecules. which agrees with Maxwell's theory based on the inverse fifth-power law of force, and also with experiment for monatomic molecules. Unfortunately the variation of viscosity with temperature does not satisfy the fifth-power law. which requires that the viscosity should be directly proportional to T. The conclusion is that monatomic gases may have spherically symmetrical molecules, but that the law of force is different. Theory gives no clear indication with regard to the appropriate value of f for other types of molecules. Experiment gives approximately a linear relation, $f = 2.816\gamma - 2.2$, between f and the ratio γ of the specific heats. This gives $f = 7/4$ for diatomic gases, which show fair agreement with each other. The experimental values for polyatomic gases are much less certain.

The thermal conductivity of liquids shows in one respect a remarkable contrast to that of gases, in that it has little or no relation to the viscosity. Excluding liquid metals, different liquids, such as water and glycerine. may vary widely in viscosity and yet differ little in conductivity. Most liquids show a very rapid diminution of viscosity nith rise of temperature, without any corresponding change of similar magnitude in conductivity. But the experimental evidence is very discordant, as in the case of gases. The conductivity of liquids has been investigated by similar methods. generally variations of the thin plate or guard-ring method.

The whole subject of heat conduction, both from the theoretical and experimental aspect, was reviewed critically in 1954 by L. R. Ingersoll, O. J. Zobel and A. C. Ingersoll. The subject has acquired a particularly intriguing facet through the discovery of heat conduction anomalies in the case of the so-called superfluids. Kamerlingh Onnes found in 1911 that certain metals lose all resistance to the flow of electricity when cooled to within a few degrees of the absolute zero of temperature (−273.15° C.). This appears to be caused by the shift of a certain number of electrons from the normal to the so-called superconducting state. These electrons can pass through the body of the metal without receiving or giving heat to their surroundings. Other apparently related anomalies have been found in the study of liquid helium. When cooled below −271° C., that is to within less than 2.2" of the absolute zero of temperature. some of the helium atoms can move freely through the body of the liquid without receiving or giving heat to their neighbours. See also LOW-TEMPERATURE PHYSICS (CRYOGENICS); SUPERCONDUCTIVITY.

XII. RADIATION

It was at one time supposed that there were three distinct kinds of radiation — thermal, luminous and actinic, combined in the radiation from a luminous source such as the sun or a flame. The first gave rise to heat, the second to light and the third to chemical action. The three kinds were partially separated by a prism, the actinic rays being generally more refracted, and the thermal rays less refracted than the luminous. This conception arose very naturally from the observation that the feebly luminous blue and violet rays produced the greatest photographic effects. which also showed the existence of dark rays beyond the violet, nhereas the brilliant yellow and red mere practically without action on the photographic plate. A thermometer placed in the blue or violet showed no appreciable rise of temperature, and even in the yellow the effect was hardly diicernible. The effect increased rapidly as the light faded toward the extreme red, and reached a maximum beyond the extreme limits of the spectrum (Sir Frederick William Herschel), showing that the greater part of the thermal radiation was altogether nonluminous.

It is now a commonplace that chemical action, colour sensation and heat are merely different effects of one and the same kind of radiation, the particular effect produced in each case depending on

the frequency and intensity of the vibration and on the nature of the substance on which it falls. When radiation is completely absorbed by a black substance, it is converted into heat, the quantity of heat produced being equivalent to the total energy of the radiation absorbed, irrespective of the colour or frequency of the different rays. The actinic or chemical effects, on the other hand, depend essentially on some relation between the period of the vibration and the properties of the substance acted on. The rays producing such effects are generally those which are most strongly absorbed. The spectrum of chlorophyll, the green colourinp matter of plants, shows two very strong absorption bands in the red. The red rays of corresponding period are found to be the most active in promoting the growth of the plant. The chemically active rays are not necessarily the shortest. Even photographic plates may be made to respond to the red rays by staining them with pinachrome or some other suitable dye. The action of light rays on the retina is closely analogous to the action on a photographic plate. The retina, like the plate, is sensitive only to rays within certain restricted limits of frequency. The limits of sensitiveness of each colour sensation are not exactly defined, but vary slightly from one individual to another, especially in cases of partial colour blindness. and are modified by conditions of fatigue. We are not here concerned with these important physiological and chemical effects of radiation, but rather with the question of the conversion of energy of radiation into heat. and with the laws of emission and absorption of radiation in relation to temperature. We may here also assume the identity of visible and invisible radiations from a heated body in all their physical properties.

It has been abundantly proved that the invisible rays, like the visible, (1) are propagated in straight lines in homogeneous mediums; (2) are reflected and diffused from the surface of bodies according to the same law; (3) travel with the same velocity in free space, but with slightly different velocities in denser mediums, being subject to the same law of refraction; (4) exhibit all the phenomena of diffraction and interference which are characteristic of wave motion in general; (5) are capable of polarization and double refraction; (6) exhibit similar effects of selective absorption.

These properties are more easily demonstrated in the case of visible rays because of the great sensitiveness of the eye. But with the aid of the thermopile or other sensitive radiometer, they may be shown to belong equally to all the radiations from a heated body, even such as are 30 to 50 times slower in frequency than the longest visible rays. The same physical properties have also been shown to belong to electromagnetic waves excited by an electric discharge. whatever the frequency, thus including all kinds of ethereal radiation in the same category as light.

1. Theory **of** Exchanges. — Pierre Prevost enunciated the theory of exchanges in 1791. Prevost's leading idea was that all bodies, whether cold or hot. are constantly radiating heat. Heat equilibrium. he says, consists in an equality of exchange. When equilibrium is interfered with, it is re-established by inequalities of exchange. If a refracting or reflecting body is introduced into a locality at uniform temperature. it has no effect in the way of changing the temperature at any point of that locality. A reflecting body, heated or cooled in the interior of such an enclosure, will acquire the surrounding temperature more slowly than would a nonreflector; it will less affect another body placed at a little distance: but will not affect the final equality of temperature. Apparent radiation of cold, as from a block of ice to a thermometer placed near it. is due to the fact that the thermometer being at a higher temperature sends more heat to the ice than it receives back from it. Although Prevost does not make the statement in so many words, it is clear that he regards the radiation from a body as depending only on its own nature and temperature, and as independent of the nature and presence of any adjacent body.

Heat equilibrium in an enclosure of constant temperature such as that postulated by Prevost. has often been regarded as a consequence of Carnot's principle. Since difference of temperature is required for transforming heat into work, no work could be obtained from heat in such a system, and no spontaneous changes of temperature can take place, as any such changes might be utilized for the production of work. This line of reasoning does not appear quite satisfactory, because it is tacitly assumed, in the reasoning by which Carnot's principle was established, as a result of universal experience, that a number of bodies within the same impervious enclosure, which contains no source of heat, will ultimately acquire the same temperature, and that difference of temperature is required to produce flow of heat. Thus although we may regard the equilibrium in such an enclosure as being because of equal exchanges of heat in all directions, the equal and opposite streams of radiation annul and neutralize each other in such a way that no actual transfer of energy in any direction takes place. The state of the medium is everywhere the same in such an enclosure, but its energy of agitation per unit volume is a function of the temperature, and is such that it would not be in equilibrium with any body at a different temperature.

2. "Full" and Selective Radiation. Correspondence **of** Emission and Absorption. — The most obvious difficulties in the way of this theory arise from the fact that nearly all radiation is more or less selective in character. as regards the quality and frequency of the rays emitted and absorbed. It was shown by J. Leslie, M. Melloni and other experimentalists that many substances such as glass and water. which are transparent to visible rays, are extremely opaque to much of the invisible radiation of lower frequency; and that polished metals, which are perfect reflectors, are very feeble radiators as compared with dull or black bodies at the same temperature. If two bodies emit rays of different periods in different proportions, it is not at first sight easy to see how their radiations can balance each other at the same temperature.

The key to all such difficulties lies in the fundamental conception, so strongly insisted on by Balfour Stewart, of the absolute uniformity (qualitative as well as quantitative) of the full or complete radiation stream inside an impervious enclosure of uniform temperature. It follows from this conception that the proportion of the full radiation stream absorbed by any body in such an enclosure must be exactly compensated in quality as well as quantity by the proportion emitted, or that the emissive and absorptive powers of any body at a given temperature must be precisely equal.

A good reflector, such as polished metal, must also be a feeble radiator and absorber. Of the incident radiation it absorbs a small fraction and reflects the remainder, which together with the radiation emitted (being precisely equal to that absorbed) makes up the full radiation stream. A transparent material, such as glass, absorbs part of the full radiation and transmits part. But it emits rays precisely equal in quality and intensity to those which it absorbs, which together with the transmitted portion make up the full stream.

A thin platinum tube heated by an electric current appears feebly luminous as compared with a blackened tube at the same temperature. But if a small hole is made in the side of the polished tube, the light proceeding through the hole appears brighter than the blackened tube, as though the inside of the tube mere much hotter than the outside, which is not the case to any appreciable extent if the tube is thin. The radiation proceeding through the hole is nearly that of a perfectly black body if the hole is small. If there were no hole the internal stream of radiation would be exactly that of a black body at the same temperature however perfect the reflecting power, or however low the emissive power of the walls, because the defect in emissive power mould be exactly compensated by the internal reflection.

Balfour Stewart gave a number of striking illustrations of the qualitative identity of emission and absorption of a substance. Pieces of coloured glass placed in a fire appear to lose their colour when at the same temperature as the coals behind them. because they compensate exactly for their selective absorption by radiating chiefly those colours which they absorb. Rock salt is remarkably transparent to thermal radiation of nearly all kinds. but it is extremely opaque to radiation from a heated plate of rock salt, because it emits when heated precisely those rays which it absorbs. A plate of tourmaline cut parallel to the axis absorbs almost

completely light polarized in a plane parallel to the axis, but transmits freely light polarized in a perpendicular plane. When heated its radiation is polarized in the same plane as the radiation which it absorbs. In the case of incandescent vapours, the exact correspondence of emission and absorption as regards wave length or frequency of the light emitted and absorbed forms the foundation of the science of spectrum analysis. Joseph von Fraunhofer had noticed the coincidence of a pair of bright yellow lines seen in the spectrum of a candle flame with the dark D lines in the solar spectrum, a coincidence which was afterward more exactly verified by W. A. Miller. Jean B. L. Foucault found that the flame of the electric arc showed the same lines bright in its spectrum, and proved that they appeared as dark lines in the otherwise continuous spectrum when the light from the carbon poles was transmitted through the arc. Sir George Stokes gave a dynamical explanation of the phenomenon and illustrated it by the analogous case of resonance in sound. G. R. Kirchhoff completed the explanation of the dark lines in the solar spectrum by showing in *1860* that the reversal of the spectral lines depended on the fact that the body of the sun giving the continuous spectrum was at a higher temperature than the absorbing layer of gases surrounding it.

Whatever be the nature of the selective radiation from a body, the radiation of light of any particular wave length cannot be greater than a certain fraction E of the radiation R of the same wave length from a black body at the same temperature. The fraction E measures the emissive power of the body for that particular wave length, and cannot be greater than unity. The same fraction, by the principle of equality of emissive and absorptive powers, will measure the proportion absorbed of incident radiation R'.

If the black body emitting the radiation R' is at the same temperature as the absorbing layer, $R = R'$, the emission balances the absorption, and the line will appear neither bright nor dark. If the source and the absorbing layer are at different temperatures, the radiation absorbed will be ER', and that transmitted will be $R' - ER'$. To this must be added the radiation emitted by the absorbing layer, namely ER, giving $R' - E(R' - R)$. The lines will appear darker than the background R' if R' is greater than R, but bright if the reverse is the case. The D lines are dark in the sun because the photosphere is much hotter than the reversing layer. They appear bright in the candle flame because the outside mantel of the flame, in which the sodium burns and combustion is complete. is hotter than the inner reducing flame containing the incandescent particles of carbon which give rise to the continuous spectrum. This qualitative identity of emission and absorption as regards wave length can be most exactly and easily verified for luminous rays, and we are justified in assuming that the relation holds with the same exactitude for nonluminous rays, although in many cases the experimental proof is less complete and exact.

3. Relation Between Radiation and Temperature.—Assuming, in accordance with the reasoning of Balfour Stewart and Kirchhoff, that the radiation stream inside an impervious enclosure at a uniform temperature is independent of the nature of the walls of the enclosure, and is the same for all substances at the same temperature, it follows that the full stream of radiation in such an enclosure, or the radiation emitted by an ideal black body or full radiator. is a function of the temperature only. The form of this function may be determined experimentally by observing the radiation between two black bodies at different temperatures. which will be proportional to the difference of the full radiation streams corresponding to their several temperatures. The law now generally accepted was first proposed by Joseph Stefan as an empirical relation.

John Tyndall had found that the radiation from a white-hot platinum wire at 1,200° C. was 11.7 times its radiation when dull red at 525° C. Stefan *(1879)* noticed that the ratio 11.7 is nearly that of the fourth powers of the absolute temperatures as estimated by Tyndall. On making the somewhat different assumption that the radiation between two bodies varied as the difference of the fourth powers of their absolute temperatures, he found that it satisfied approximately the experiments of Dulong and A. T. Petit and other observers. According to this law the radiation between a black body at a temperature T and a black enclosure or a black radiometer at a temperature T_0 should be proportional to $(T^4 - T_0^4)$. The law was very simple and convenient in form. but it rested so far on very insecure foundations. The temperatures given by Tyndall were merely estimated from the colour of the light emitted, and might have been some hundred degrees in error. We now know that the radiation from polished platinum is of a highly selective character, and varies more nearly as the fifth power of the absolute temperature.

The agreement of the fourth-power law with Tyndall's experiment appears therefore to be attributed to a purely accidental error in estimating the temperatures of the wire. Stefan also found a very fair agreement with J. W. Draper's observations of the intensity of radiation from a platinum wire, in which the temperature of the mire was deduced from the expansion. Here again the apparent agreement was largely the result of errors in estimating the temperature, arising from the fact that the coefficient of expansion of platinum increases considerably with rise of temperature.

So far as the experimental results available at that time were concerned, Stefan's law could be regarded only as an empirical expression of doubtful significance. But it received a much greater importance from theoretical investigations which were even then in progress. James Clerk Maxwell *(Electricity* and *Magnetism, 1873)* had shown that a directed beam of electromagnetic radiation or light incident normally on an absorbing surface should produce a mechanical pressure equal to the energy of the radiation per unit volume. A. G. Bartoli (1875) took up this idea and made it the basis of a thermodynamic treatment of radiation. P. N. Lebedev in *1899,* and E. *F.* Nichols and G. F. Hull in 1901, proved the existence of this pressure by direct experiments. L. Boltzmann *(1884)* employing radiation as the working substance in a Carnot cycle, showed that the energy of full radiation at any temperature per unit volume should be proportional to the fourth power of the absolute temperature.

The proof given by Boltzmann may be somewhat simplified if we observe that full radiation in an enclosure at constant temperature behaves exactly like a saturated vapour, and must therefore obey Carnot's or Clapeyron's equation *(see* THERMODYNAMICS). The radiation pressure at any temperature is a function of the temperature only, like the pressure of a saturated vapour. If the volume of the enclosure is increased by any finite amount, the temperature remaining the same, radiation is given off from the walls so as to fill the space to the same pressure as before. The heat absorbed when the volume is increased corresponds with the latent heat of vaporization. In the case of radiation, as in the case of a vapour, the latent heat consists partly of internal energy of formation and partly of external work of expansion at constant pressure.

Since in the case of full or undirected radiation the pressure is one-third of the energy per unit volume, the external work for any expansion is one-third of the internal energy added. The latent heat absorbed is, therefore, four times the external work of expansion. Since the external work is the product of the pressure P and the increase of volume V, the latent heat per unit increase of volume is four times the pressure. But by Carnot's equation the latent heat of a saturated vapour per unit increase of volume is equal to the rate of increase of saturation pressure per degree divided by Carnot's function or multiplied by the absolute temperature. Expressed in symbols we have,

$$T(dP/dT) = L/V = 4P \qquad (12)$$

where (dP/dT) represents the rate of increase of pressure. This equation shows that the percentage rate of increase of pressure is four times the percentage rate of increase of temperature, or that if the temperature is increased by 1%, the pressure is increased by 4%. This is equivalent to the statement that the pressure varies as the fourth power of the temperature, a result which is mathematically deduced by integrating the equation.

4. Experimental Verification of the Fourth-Power Law.—The verification of this law requires (1) a black body or bodies capable of emitting full radiation at a series of different tempera-

tures over an extended range, (2) a thermometer or thermometers capable of measuring these temperatures on the absolute scale, (3) a bolometer or thermopile (see below) capable of giving accurate relative values of the intensity of the radiation emitted in each case.

These conditions were approximately satisfied by the experiments of Schneebeli (1884), who employed an air thermometer heated to various temperatures in a furnace, and observed the radiation from the bulb through a small aperture in the walls of the furnace. With this arrangement the radiation observed would be nearly that of a black body, but the verification was rather rough in some respects. Measurements by J. T. Bottomley, A. Schleiermacher, L. C. H. F. Paschen and others, of the radiation from electrically heated platinum, failed to give results in agreement with the fourth-power law on account of variations in the quality of the radiation, but greatly extended and improved methods of measuring radiation in other respects.

The most complete series of experiments, covering the range of the gas thermometer at the time available. were those of O. R. Lummer and E. Pringsheim (1897). They used a black body heated by steam at 100° C., for standardizing their bolometer, and, as their radiator, a black body consisting of a copper sphere heated in a salt bath for the range zoo° to 600° C., and an iron cylinder heated in a gas muffle for the range 600° to 1,250° C. The temperatures were taken with a high-range mercury thermometer, and with thermocouples. corrected to the gas-scale by direct comparison with a gas thermometer up to 1,150° C. One of the chief experimental difficulties of this investigation is the wide range of variation of the intensity of the radiation to be measured, which is nearly 450 times as great at 1,250° C. as at 100° C. They employed a very sensitive form of bolometer. and a galvanometer capable of giving a deflection of 336 mm. under standard conditions. with a beam of radiation 16 mm. square at a distance of 633 mm. from the black body at 100° C. For the higher intensities it was necessary to reduce the sensitivity in a known ratio by varying the distance of the bolometer from the source, and the current in the bolometer circuit. The results for the relative intensities agreed on the average to about 1% with the fourth-power law over the nhole range of the observations. The law has since been verified up to 1,500° C. by extending the range of the gas thermometer and thermocouples, and down to −250° C. with bolometers.

5. Sensitive Radiometers. — The term radiometer may be applied to any instrument adapted for measuring radiation, but we are here concerned chiefly with those types which are equally sensitive to radiant energy of all the wave lengths present in the radiation from a hot body. We may therefore omit the selenium cell which is very sensitive to luminous radiation. and the photoelectric cell for actinic rays, since these are comparatively insensitive to the infrared rays. and do not satisfy the condition of measuring total energy irrespective of wave length. The instruments chiefly employed at the present time for measurements of heat radiation, are the thermopile and the bolometer. the action of which depends on the same principles as those involved in the construction and operation of the corresponding types of electrical thernzometers, namely the thermocouple and the electrical resistance thermometer, the theory of which is more fully discussed in the article THERMOMETRY.

The thermopile and bolometer are in fact essentially electrical thermometers, with sensitive receiving surfaces for the absorption of radiation, and especially designed for measuring the small differences of temperature thereby produced. The sensitivity and accuracy of these instruments depend to a great extent on the galvanometer and electrical measuring apparatus with which they are employed.

One of the oldest and most sensitive radiometers is the Melloni thermopile, the invention of which led to so many advances in the theory and measurement of radiation. Sensitivity is secured by using antimony and bismuth alloys (A and B), a single couple of which may give as much as 120 μv for a difference of temperature of 1° C. between the hot and cold junctions. With 100 couples connected in a continuous series **A–B–A–B–A** and so on, packed as usual in the form of a cube with alternate junctions on opposite faces, an electromotive force of 12 mv would be obtainable per 1° C. difference of temperature between the receiving surfaces of the pile. The chief defect of this type of instrument in practice is that it has a large thermal capacity because of its massive construction, and takes a long time to reach its maximum temperature. For many purposes quickness of action is quite as important as sensitivity in millivolts per degree, and the accuracy obtainable depends to a great extent on constancy of zero. In such cases the Melloni pile will be a most unsuitable instrument to employ, though it is still often used for demonstration purposes.

The conditions affecting quickness and constancy were first clearly elucidated by C. V. Boys (1888) in the construction of his radiomicrometer, in which the thermopile and galvanometer were combined in a single instrument. This was effected by attaching a very light A–B couple to a loop of copper wire suspended between the poles of a powerful magnet by means of a fine quartz fibre, which made it possible to combine the advantage of maximum deflection for weak sources of radiation with quickness of action and constancy of zero.

A similar arrangement was adopted some years later by W. Duddell in his thermogalvanometer, for measuring small alternating currents. The current to be measured is passed through a small heater fixed close below the suspended thermocouple, the deflections of which are approximately proportional to the square of the current. The radiomicrometer is essentially the same instrument except that the suspended thermocouple is heated by radiation incident on a blackened disk of copper or silver foil, and that its constant is determined by exposure to a known source of radiation, such as a standard candle at a considerable distance. The instrument must be set up like a sensitive galvanometer and carefully leveled on a good foundation in a permanent position, and the radiation to be measured must be brought to the receiver in a horizontal direction. In this respect the combination of the thermopile and sensitive galvanometer in a single instrument is less convenient in practice than the use of a separate thermopile in conjunction with a fixed galvanometer. since in the latter case the thermopile can be adjusted in any desired position independently of the galvanometer, and the sensitivity may easily be altered in a known ratio according to requirements by varying the resistance in the circuit without changing the position of either source or receiver.

The bolometer invented by S. P. Langley in 1878 depends for its action on change of electrical resistance. and consists essentially of a pair of grids of thin blackened foil of nearly equal resistance balanced one against the other in a Wheatstone bridge. Both are equally affected by changes in the temperature of the instrument, but if one grid is exposed to radiation while the other is screened, the resulting difference of temperature between them produces a current through the galvanometer approximately proportional to the intensity of the radiation. The whole exposed area of the grid constitutes the receiving surface, and extreme quickness of action can be secured by using very thin foil. The bolometer permits a wide range of variation of sensitivity since (in addition to other methods available with the thermopile) the current through the grids may be increased with a proportional increase in the deflection of the galvanometer. For this reason the sensitivity of a bolometer may considerably exceed that of a thermopile under othernise similar conditions. There is, however, a practical limit to the increase of sensitivity thus obtainable, because of the heating effect of the current which produces a rise of temperature in the grids proportional to the square of the current. When this becomes excessive. the zero is liable to wander and no further improvement in accuracy of measurement can be gained. One can obtain the greatest change of specific electrical resistance for a small increment of temperature and, as a consequence, the greatest bolometric sensitivity by the use of a strip of metal or alloy maintained at a temperature so low that the material is just within the superconducting state; under these conditions the thermal fluctuations (Brownian movement) are also reduced to a minimum.

A linear thermopile, in which all the sensitive junctions are arranged in a vertical line, is entirely free from this source of trouble and is generally superior to the bolometer in point of stability of zero. Fig. g illustrates the construction of the Moll linear thermopile which is probably the most perfect instrument of this type in respect to constancy of zero as well as quickness of action. There are 20 thermocouples arranged with their hot junctions in a vertical line behind the centre of the slit. The metals employed are the alloys constantan and manganin, both of which possess the property that their resistance does not vary appreciably with temperature. These alloys have the required mechanical properties and can be rolled into very thin strips, which afford excellent receiving surfaces and respond with extreme quickness. One half of each strip consists of constantan and the other half of manganin. The strips are connected in a continuous series, C–M–C–M–C and so on, the cold junctions on either side being soldered to copper studs fixed in insulating blocks at right angles to the plane of the strips. The function of these studs is to keep the cold junctions at a uniform temperature as nearly as possible the same as that of the enclosing case. Great constancy of zero and steadiness of deflection is thus obtained. Thus although the thermoelectric power of a single constantan-manganin couple is only about 40 μv per degree, or less than a third of that obtainable with the antimony-bismuth alloys (which are brittle and difficult to work) the superior quickness and constancy and facility of construction of the constantan-manganin pile make the latter a more accurate and convenient instrument in practice

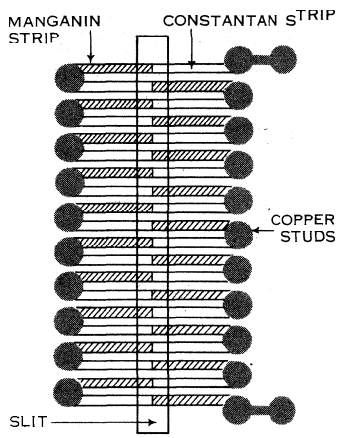

FIG. 9.—MOLL LINEAR THERMOPILE

Thermocouples of manganin and constantan strips with alternate junctions in a vertical line

In measuring the intensity of radiation at a distance from the source, where there is no restriction on the area of the beam received, the bolometer has the advantage that it can easily be made of any desired area, and that increase of area permits an increase of sensitivity. This condition cannot be satisfied easily in practice with a thermopile since the multiplication of couples involves a corresponding increase of resistance; but in dealing with images, such as spectral lines, of limited area, the thermocouple has the advantage that its sensitive receiving surface can be made to coincide with that of the image to be measured, as in the coronal pile for observing the sun's corona. Thus in the extreme case of a point image, such as that of a star, the single couple has a great advantage over the bolometer, which could not easily be made of the required size.

By using very small single couples enclosed in a vacuum to reduce external loss of heat. W. W. Coblentz (Lick observatory, 1915) succeeded in obtaining remarkably accurate measurements of the relative thermal intensities of star images in a large reflecting telescope. The vacuum thermopile devised by Moll, with a differential pair of junctions enclosed in a vacuum, would probably be well suited for this kind of work, as the effect of sky radiation would be compensated very accurately.

The Crookes' radiometer, with a delicately suspended vane in a vacuum of about 0.02 mm., as improved by Nichols, can be made nearly equal in sensitivity to the radiomicrometer of Boys, but has the disadvantage of requiring the radiation to be introduced through a window, which may in many cases give rise to uncertainty because of selective absorption, in addition to the difficulty of maintaining a constant vacuum.

During World War II there arose a military need for fast and sensitive devices for detecting infrared radiation, a need which stimulated the development of several new types of radiometric methods marking an advance in this field. It was found possible to produce thin ribbons of semiconductors which had a remarkably high change of electrical resistance for a small increment in temperature caused by impinging heat radiation; the term thermister has been used to designate these units. Marcel Golay and his associates developed a thermopneumatic cell in which the heat radiation caused a small amount of gas to expand, thereby moving a thin diaphragm with a mirror surface and deflecting a visible light beam across a photoelectric cell; this came to be generally spoken of as the "Golay detector" and has had wide use, especially in infrared spectrographs where extremely sensitive and fast detection is required.

D. H. Andrews and his associates built an infrared detector, using as the receiver a ribbon of niobium nitride. maintained in the intermediate zone between the normal and the superconducting state. The very low temperature (−258° C.), necessary to get this special kind of electrical conduction, is produced by a mixture of liquid and crystalline hydrogen kept under a partial vacuum in a small vacuum-jacketed copper vessel called a cryostat. The ribbon of niobium nitride (5 mm. long, 0.3 mm. wide and 0 006 mm. thick) is cemented to the top of a small copper post with a plastic adhesive and located in the vacuum chamber behind a rock-salt window which permits the heat radiation from the object under observation to pass from the atmosphere into the vacuum chamber and onto the receiver. Since very low heat capacity and very low thermal noise are associated with the temperature region near absolute zero in which the device is operated, both speed and sensitivity of detection are extremely high. The rate of change of electrical resistance with temperature is about 10 ohms per degree centigrade; and a change of temperature of as little as one ten-millionth of a degree in the receiver can be detected. This means that an amount of heat as little as one ten-million-millionth of a calorie can be observed in a single pulse of heat radiation falling on the bolometer. The instrument responds in less than one thousandth of a second. Because of this it is possible to use the device as a receiver in infrared television, a special kind of television by which the images of distant moving objects can be detected in complete darkness by means of the invisible heat radiation which they emit; the objects are scanned by an oscillating mirror and the images are presented to the observer on a fluorescent screen, similar to that used in standard television. This type of heat receiver is commonly referred to as a superconducting bolometer.

These devices developed during World War II are described in the *Journal of the Optical Society of America* (1946) together with a critical evaluation of their respective speed and sensitivity by Bell, Buhl, Nielsen and Nielsen. The superconducting bolometer appears to have the highest figure-of-merit of any detector of heat radiation developed by the late 1950s; *i.e.*, the best combination of sensitivity and speed. It was subsequently used by R. D. Fowler, M. C. Williams and D. H. Andrews to detect the heat pulse produced by the impact of a single helium atom (alpha particle) ejected by a radioactive polonium atom (1949).

6. Absolute Measurement of Radiation. — The absolute measurement of the constant of radiation a in the fourth-power law

$$R = \sigma(T^4 - To^4) \qquad (13)$$

is required for estimating the quantity of radiation R emitted per second per unit area by a black surface at the absolute temperature T. The law having been verified qualitatively, as previously described, by observing relative values at different temperatures, it suffices for the determination of the constant σ to select one particular temperature of the source, and to observe the intensity of the radiation received at a known distance with a receiver capable of giving the result in absolute measure, such as watts per second.

It is first necessary that the temperature of the emitter should be uniform and accurately known. For this reason a black body enclosure at 100° C. or T = 373.1 is commonly selected. The objection to this is that the intensity of the radiation is comparatively feeble and the quantity of heat to be measured inconveniently small as compared with accidental errors. A high temperature such as T = 1273° gets over this difficulty, but such

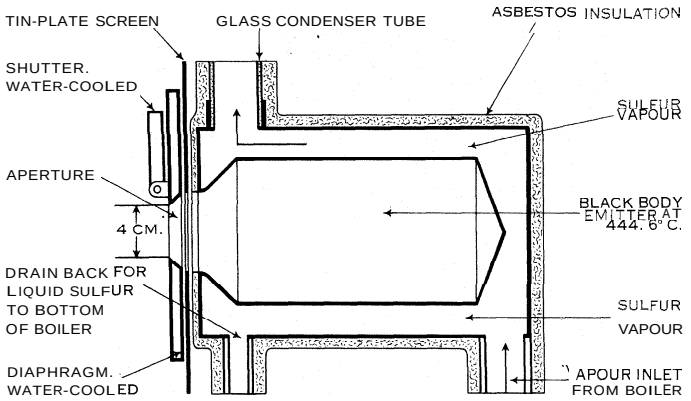

FIG. 10.— BLACK BODY EMITTER HEATED BY SULFUR VAPOUR. FOR MEASURING INTENSITY OF FULL RADIATION FROM A SOURCE AT A TEMPERATURE OF 444.6° C., THE BOILING POINT OF SULFUR

temperatures are not known with sufficient accuracy, and are not easily regulated with the necessary uniformity and constancy. It appears best to select an intermediate temperature, such as the boiling point of sulfur (S.B.P.) at 444.6° C. or $T = 717.6°$, which has been determined with great care, and is easily maintained constant.

Fig. 10 shows the essential points of a black body emitter employed for this purpose. The black body consists of a double-walled enclosure constructed of sheet iron with brazed or welded joints, which must be absolutely tight to prevent any escape of the vapour. The sulfur is boiled in an iron boiler located in a fume cupboard at a lower level, and the vapour is brought up to the apparatus through a long iron tube to avoid any possibility of superheating. When the sulfur boils, the heavy brown vapour soon makes its appearance in the glass condenser tube at the top of the apparatus. This tube is open at the top, and is exposed without lagging for a height of two or three feet. The boiler flame is regulated to keep the level of the vapour constant about halfway up the tube. The condensed liquid flows back through a small tube to the bottom of the boiler, and the apparatus will work for days with hardly any attention. The actual temperature inside the enclosure is observed occasionally with a long platinum thermometer, and is always a few tenths of a degree lower than that of the vapour because of loss by radiation. The inside of the enclosure is usually blackened in the first instance with platinum black, but soon becomes coated in any case with a protecting film of black oxide of iron, which is generally black enough for the purpose. The emitted beam is defined by an accurately turned aperture in a blackened diaphragm, cooled by a copious circulation of water at or near the atmospheric temperature.

The method of taking an observation consists in exposing the receiver, at a distance d from the diaphragm along the axis of the aperture, to the full normal beam of radiation, and taking a reading of the heat received. The aperture is then closed by the water-cooled shutter shown in the figure, and a zero reading is taken. The effect of closing the shutter is to substitute for the beam of full radiation at the temperature T of the enclosure, a beam from an exactly equal area of the shutter at the temperature T_0, which is the same as that of the diaphragm. The observed diiference between the two readings gives the value of $u(T^4 - T_0^4)$ as required in the equation, and eliminates any accidental stray radiation, which may affect the zero of the receiver, but is not altered by closing the shutter. If $T = 717.6°$ and $T_0 = 290°$, the correction for T_0^4 is less than 1.6%, so that a defect of 5% in the effective blackness of the diaphragm or shutter would give an error of less than ▮ in 1000 in the result for the constant σ, and it is not necessary to know the value of T_0 with great accuracy. The case is quite different, however, in using a black body at 100° C. or 373.1° K. in the same manner. The correction for T_0 mould then amount to nearly 37%, or 23 times larger, and a defect of 5% in the blackness of the shutter might produce an error of nearly 2% in the result.

This fact, in addition to the other difficulties above mentioned, has often led to appreciable errors in the use of a black body at 100° C. for purposes of reference, and is one of the chief reasons why it is desirable to use a black body at a reasonably high temperature for the determination of the constant σ. Accidental errors of this kind, resulting from invisible reflections and stray radiation, are most perfectly avoided by completely enclosing the receiver in a water-cooled aluminum casting (aluminum for lightness and high conductivity) at the same temperature as the diaphragm and shutter. The casting has a removable lid permitting easy access for preliminary measurements and adjustments of distance, etc., but this method is so elaborate that it has seldom been attempted. It is also essential to exclude products of combustion such as CO, CO_2 and SO_2 which are highly absorbent for infrared radiation.

7. Absolute Radiometers. — The measurement of the radiation in absolute units is a more difficult part of the problem than that of securing a good approximation to full radiation at a known temperature. Instruments designed for absolute measurement were first developed for measuring the intensity of solar radiation. and were called pyrheliometers. The usual method, as first employed in C. S. M. Pouillet's pyrheliometer, was to receive the solar radiation on a blackened disk of known area and thermal capacity and to observe the rise of temperature produced in. a given time. The original apparatus was rather sluggish in action, and the correction for heat loss somewhat uncertain. The method was improved by Sir G. G. Stokes, J. Violle and A. Crova, by using disks of small thermal capacity and high conductivity, protected from stray radiation by an enclosure at constant temperature. It is still largely employed for solar radiation, but is much less suitable for weak sources, such as are generally used in laboratory experiments, for which some electrical method of compensation is more convenient and accurate.

Angstrom *Pyrheliometer*.—One of the oldest and best of these compensation methods was first devised by K. Angstrom (1893) for measuring solar radiation. His pyrheliometer is illustrated in figs. 11 and 12, and depends on balancing the radiation by electric heating.

The front view, fig. 11, shows the pair of blackened strips of very thin manganin, 2 cm. long and 2 mm. wide, one of which is exposed to the radiation to be measured while the other is heated to the same temperature by an electric current. In this case the heat received from the radiation by one strip would evidently be equal to that generated by the current in the other, provided that the two were alike in all respects. Thus if R^1 is the radiant heat absorbed per square centimetre, b the breadth of the strip, C the current in amperes and r the resistance in ohms per centimetre, the value of R^1 in watts per square centimetre is given by the simple relation, $R^1 = C^2 r/b$. The ebonite block carrying the strips and their connecting terminals is fitted in a brass tube the front of which is closed by a cap with two slits corresponding in position with the strips. A swiveling shutter behind the cap permits the screening of either strip. The current is turned on the screened strip by the switch at the back and is adjusted by the rheostat until the galvanometer connected to the thermocouple indicates equality of temperature by absence of deflection. The thermocouple consists of a loop of fine constantan wire, the ends of which are connected to strips of copper foil attached to the backs of manganin strips as indicated in the diagram of connections (fig. 12). Each copper strip is attached as closely as possible to its manganin strip. but is insulated from it by thin silk paper and shellac. The copper strips provide a reliable attachment for the two junctions of the couple and help to equalize the temperature of the strip.

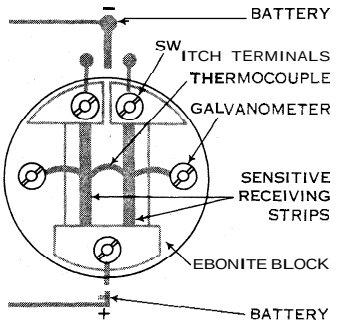

FIG. 11.—ÅNGSTRÖM PYRHELIOMETER, SHOWING FRONT VIEW OF STRIPS

Radiation received by one strip is measured by heating the other with an electric current to same temperature, as indicated by a thermocouple

The object of balancing one strip against the other is to make the reading as sensitive as possible and to eliminate any disburbances depending on changes of temperature of the case, which would affect both strips equally. To eliminate small differences between the strips, the reading is repeated with the second strip screened and heated by the current while the first is exposed to radiation. The mean of the results is free from errors resulting from want of symmetry, provided that such errors are small. In this balance method of observation the result is practically independent of the accuracy of the galvanometer, but an error of 1% in the current C as measured by the ammeter would give an error of 2% in the result: since it depends on C^2. The result also depends on the breadth of the strip b and on its resistance r per centimetre, both of which are difficult to measure accurately, more especially when the strip is blackened with smoke, which makes the edge somewhat ill-defined. In any case the value of R, representing the heat actually absorbed, will depend on the coefficient of absorption of the smoke film, which is generally taken as 98% but may vary somewhat for different wave lengths and different smoke films.

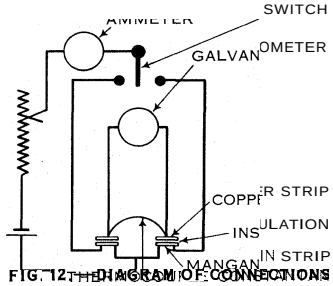

FIG. 12.—DIAGRAM OF CONNECTIONS OF THE ÅNGSTRÖM PYRHELIOMETER
Shown are ammeter circuit and insulated copper strips for attachment of thermojunctions

Kurlbaum's bolometric method can be applied to any sensitive bolometer of suitable construction, and avoids some of the difficulties of measurement inherent in Angstrom's method, but introduces others which make it less convenient for solar radiation. The method consists in observing the deflection D of the galvanometer when the bolometer is exposed to the radiation to be measured and is traversed by the small current c usually employed. The grid is then screened from radiation, and the current is increased to a larger value C such that the galvanometer gives the same deflection D because of the additional heat generated by the current in the grid. The intensity of the radiation R^1 in watts per square centimetre is given in terms of the resistance r per square centimetre of the grid by the formula, $R^1 = r(C^2 - c^2)C/c$. The difficulty of measuring the width of the strips may be avoided by using a pair of similar grids, adjusted in such a way that the strips of the second are behind the spaces between the strips of the first. The whole area of the grid may thus be utilized, and r is the whole resistance in ohms divided by the area in square centimetres. The factor C/c is required in the formula to allow for the fact that the deflection D of the galvanometer for a given increase of resistance of the grid is directly proportional to the current. The accuracy of measurement of the currents C and c is rather more important than in Angstrom's method, but the bolometric method avoids the measurement of b and makes that of r very easy. On the other hand it is necessary to balance the bolometer against manganin resistances which are not appreciably affected by the current C. This makes it impossible to compensate for changes in the temperature of the surroundings in the usual way (by balancing the receiving grid against a precisely similar grid) since both would be equally heated by the current C. F. Kurlbaum employed a black body at 100° C. as source, and the actual rise of temperature of the grid due to the incident radiation with the small current c was only about a tenth of 1° C. The rise of temperature caused by increasing the current from c to C would be less than this in the ratio c/C. The successive observations of radiation and current heating would be unequally affected by any change in the surrounding conditions, and the difficulties of the method make it unsuitable for employment except in the laboratory with weak sources under very steady conditions.

Employing this method Kurlbaum (1898) found the value $\sigma = 5.32 \times 10^{-5}$ ergs per square centimetre per second, or 5.32×10^{-12} w. per square centimetre, but this rested on a somewhat doubtful estimate of the absorption coefficient of the bolometer employed, and was raised at a later date (1912) from 5.32 to 5.45. L. C. Paschen and W. Gerlach (1912) employed a modification of Angstrom's method, but with a single strip (in place of a pair of strips) of measured area and resistance, which was alternately exposed to the radiation to be measured and heated by a measured electric current. The rise of temperature of the strip was indicated, and adjusted approximately to the same value in either case, by observing the deflection of a galvanometer connected to a linear pile fixed in position close behind the strip but not in contact with it.

The method is inferior in some respects to Angstrom's, especially in the absence of a balancing strip, and in its dependence on the accurate observation of successive deflections. On the other hand the single strip employed by Paschen and Gerlach is easier to make than the compound strip employed by Angstrom, and the measurement of its breadth b and resistance r per centimetre should be more accurate. They used a linear thermopile equal in length to the strip, and deduced the value of r per centimetre from measurements of the whole length and resistance, whereas Angstrom measured r by observing the potential difference between a pair of needlepoint potential terminals fixed at a distance of 1 cm. apart, and brought into contact with the central portion of the strip while a measured current was passing through it. This was a delicate operation, but was necessitated by the fact that he used a single couple at the centre of the strip, and that there might be some uncertainty about the resistance of the contacts at the end of the strip, since the compound strip could not be soldered satisfactorily to the terminal plates.

Gerlach's later measurements (1916), in which corrections were applied for the imperfect blackness of platinum black and for atmospheric absorption, gave a final value $\sigma = 5.80 \times 10^{-12}$ w. per square centimetre which, though appreciably lower than his original uncorrected value, 5.85, was still nearly 7% higher than Kurlbaum's final value 5.45 by the bolometric method. It was suggested that these discrepancies might be because of inequalities of temperature resulting from loss of heat by conduction from the ends of the strip. Coblentz and Emerson (1916) endeavoured to avoid this difficulty by attaching potential terminals to the strip at a short distance from the ends. These terminals tend to cool the strip locally, but they estimate the cooling effect as only about 0.35%. Comparing a number of different receivers of this type they found variations amounting in some cases to 2%, with a probable order of 1% for the accuracy of the mean. They gave a final value 5.73 for the constant after applying corrections for imperfect blackness and atmospheric absorption.

The radio balance, employed by H. L. Callendar (1910), was the first serious attempt to eliminate uncertain coefficients of absorption (which depend on the wave length of the radiation as well as on the blackness and conductivity of the film) by employing a black body receiver, designed to give complete absorption with an error of less than 0.1%. The construction of this receiver which can be used in any position, is illustrated in fig. 13, on an enlarged scale. The radiation to be measured is admitted through an optically worked aperture of 2 mm. diameter (which is com-

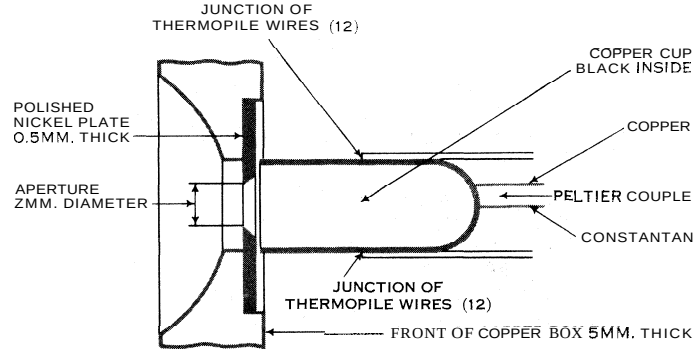

FIG. 13.— BLACK BODY RECEIVER OF RADIO BALANCE
The radiation to be measured is received in a blackened copper cup giving practically complete absorption, and is balanced by heat absorbed in a Peltier thermojunction

paratively easy to measure with the requisite degree of accuracy) and falls on the bottom of a small copper cup, where it is directly compensated by the absorption of heat arising from the Peltier effect in a thermojunction formed between the cup and a constantan wire through which a suitable current is passed. Any change of temperature of the cup is indicated by a sensitive galvanometer, connected to a thermopile in which the cup is mounted as shown in fig. 14. The junctions of the pile are insulated from the cup by thin silk paper and paraffin wax, which is nonhygroscopic, and are bound firmly round the cup aith a lapping of fine silk. The pile wires are iron and constantan, each 0.2 mm. in diameter and are sufficiently stiff to hold the cup securely in place. The cold junctions of the pile are similarly fixed to a copper cylinder screwed to the base of the copper box 5 mm. thick, enclosing the sensitive parts of the apparatusat a uniform temperature, which is indicated by a delicate mercury thermometer with its bulb inserted between the two piles. Since it is always desirable to take observations by a balance method (most especially in measuring strong sources of radiation, such as 1 cal. per square centimetre per minute, or 0.07 w. per square centimetre, which would give unbalanced deflections of the galvanometer of the order of 7,000 mm.) the cup exposed to radiation is balanced against a similarly mounted cup, as indicated in the diagram of connections in fig. 15, the piles in which the cups are mounted being connected in opposition in the galvanometer circuit. This method gives perfect elimination of external disturbances because of the small size and high conductivity of the copper box in which the two piles are enclosed.

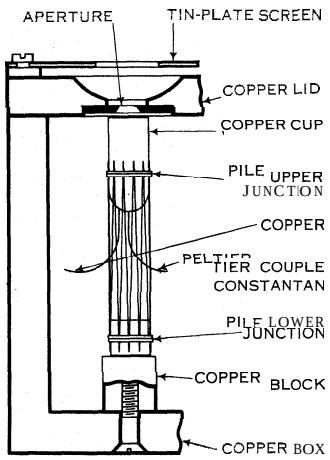

FIG. 14.—CUP AND PILE OF RADIO BALANCE, SHOWING MOUNTING OF CUP IN SENSITIVE THERMOPILE WITH 12 JUNCTIONS INSIDE COPPER BOX

The advantage of using the Peltier effect for the absolute measurement of radiation, in place of the more familiar Joule effect employed in other instruments such as the Ångström pyrheliometer, is that heat reception can be directly compensated by heat absorption, and that the heat absorbed is proportional to the current C (instead of to C^2) and changes sign when the current is reversed. The value of the Peltier coefficient P for a single copper-constantan junction as here employed is approximately 12 my, which when multiplied by the current C in amperes gives the heat absorption PC in milliwatts. Thus with an aperture of .2 mm. in diameter the current required to compensate radiation of intensity 0.07 w. per square centimetre, which is near the mean for sunshine, is about 200 milliamperes with a single couple. In actual practice the same current C is passed through the Peltier junctions of both cups so that the exposed cup is cooled while the screened cup is heated. This doubles the effect and requires a current of 100 milliamperes only, in the case above given, and makes it possible to measure strong sources up to 0.4 w, per square centimetre, without changing the 2 mm. aperture.

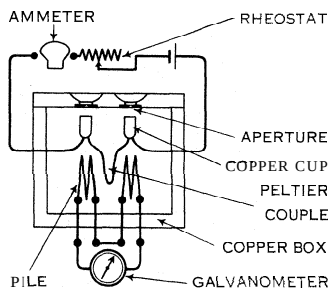

FIG. 15.— DIAGRAM OF CONNECTIONS FOR RADIO BALANCE
Both cups, with circuit of Peltier junction separate from that of piles and galvanometer, are shown

In taking readings by this method, one cup is exposed to radiation while the other is screened, and the current is adjusted to reduce the deflection of the galvanometer to zero. After reading the current, the radiation is switched over to the other cup (by moving a shutter close in front of the aperture and behind the tin-plate screen in fig. 14) and the current is simultaneously reversed without altering its value. This procedure has the effect of exactly eliminating any small heating effect in the wires conveying the current to the cups, and gives the simple formula $R' = 2PC/a$, for the intensity R' of the radiation received in terms of the aperture a in square centimetres. If the radiation is variable, as is usually the case with sunshine even on the clearest day, it is preferable to keep the current constant and to observe the small residual deflections of the galvanometer, which are readily translated into milliamperes by observing the deflection produced by reversing a small current when both cups are screened. If the piles are not accurately balanced, or if the areas of the apertures are not exactly equal, the appropriate value of the balancing current will be different for the two cuPs. Any small differences of this kind may be treated in the same way by observing galvanometer deflections, but should not exceed a small fraction of 1%.

The value of the coefficient P is most easily determined by observing the thermoelectric power p of a junction made of the same wires, and multiplying by the absolute temperature T. Both factors in the product Tp increase with temperature, so that it is necessary to know the temperature to 0.2° C. in order to secure an order of accuracy of 0.1% in R', since the temperature coefficient of P is usually in the neighbourhood of 0.5% per 1° C. A more direct method is to balance the Peltier effect in each cup against the heating effect in a resistance coil fitting the cup. This method affords the most simple and accurate verification of the thermodynamic theory, and measures the effect under working conditions for the actual couples employed. To find the value of σ by observing the radiation emitted from a black body such as that illustrated in fig. 10, with a water-cooled aperture of radius b, it is necessary to adjust the aperture a of the receiver to be coaxial with that of the emitter and to measure the distance d between their planes. The normal intensity R' as measured by the receiver is given in terms of the black body intensity R in formula (13) by the simple relation $R' = Rb^2/(d^2 + b^2)$, which may be found in most textbooks of geometrical optics.

Observations taken with a radio balance in conjunction with the black body illustrated in fig. 10, by N. L. Jones gave a mean result $a = 5.690 \times 10^{-12}$ w. per square centimetre. The observations were taken at night under favourable conditions, but no correction was applied for atmospheric absorption, as the distance (20 to 33 cm.) was not varied sufficiently. Later observations made by Callendar using a black body at 100° C. with the same instrument, in which the distance d was varied from 6 to j6 cm. under similar conditions, gave a result 5.752 when corrected for atmospheric absorption. The Peltier couple in this instrument was tested by the thermoelectric method using samples of the same wires, iron and constantan respectively. Another balance, with a copper-constantan couple, tested by both methods with consistent results, and corrected for atmospheric absorption in the same way, gave a slightly higher result, 5.766. The differences between observations taken on different days averaged about 0.2% and appeared to depend mainly on variations of atmospheric absorption, the correction for which doubled the time and labour of taking observations. The percentage absorbed varies to some extent with the quality of the radiation as determined by the temperature of the emitter as well as the state of the atmosphere, and is not simply proportional to the distance traversed as commonly assumed. The observations with the black body at 444.6' C., when corrected by reference to hygrometric records, using the coefficient found at 100° C., were raised from a mean value 5.690 to 5.804, which suggests that the absorption correction should be smaller for radiation at 444.6' C. than at 100° C. The mere presence of an observer radiating heat and exhaling variable quantities of CO_2 is a source of uncertainty in absolute measurements. Apart from atmospheric absorption, the instrument appeared to be capable of an order of accuracy of at least 0.1%. It was accordingly decided to enclose the receiver in a water-cooled metal casting from which absorbing gases could be excluded. Unfortunately at this stage the work was interrupted by World War I; no favourable opportunity subsequently occurred for making the final corrections for absorption. It appears,

however, that the result would probably be intermediate between those of Gerlach and Coblentz by the Angstrom method. The range was further extended in 1942 to the region just beyond 100μ with the aid of a superconducting bolometer and a source of radiation which was maintained at temperatures between 24° and 54° Kelvin. Some experienced observers have found values as high as 6.5, but there are many most insidious sources of error in these difficult experiments.

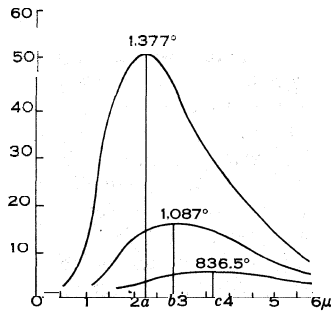

FIG. 16.— DISTRIBUTIONOF ENERGY IN THE SPECTRUM OF A BLACK BODY

8. Wien's Displacement Law.---Assuming that the fourth-power law gives the quantity of full radiation at any temperature, it remains to determine how the quality of the radiation varies with the temperature, since as we have seen both quantity and quality are determinate. This question may be regarded as consisting of two parts. (1) How is the wave length or frequency of full or "black" radiation changed when its temperature is altered? (2) What is the form of the curve expressing the distribution of energy between the various wave lengths in the spectrum of full radiation, or what is the distribution of heat in the spectrum? The researches of Tyndall, Draper, Langley and other investigators had shown that while the energy of radiation of each frequency increased with rise of temperature, the maximum of intensity was shifted or displaced along the spectrum in the direction of shorter wave lengths or higher frequencies. W. Wien (1898), applying Doppler's principle to the adiabatic compression of radiation in a perfectly reflecting enclosure, deduced that the wave length of each constituent of the radiation should be shortened in proportion to the rise of temperature produced by the compression, in such a manner that the product AT of the wave length and the absolute temperature should remain constant. According to this relation, which is known as Wien's displacement law, the frequency corresponding to the maximum ordinate of the energy curve of the normal spectrum of full radiation should vary directly (or the wave length inversely) as the absolute temperature, a result previously obtained by H. F. Weber (1888). Paschen, Lummer and Pringsheim verified this relation by observing with a bolometer the intensity at different points in the spectrum produced by a fluorite prism. The intensities were corrected and reduced to a wave length scale with the aid of Paschen's results on the dispersion formula of fluorite (1894). The curves in fig. 16 illustrate curves obtained by Lummer and Pringsheim (1899) at three different temperatures, namely, 1,377°, 1,087° and 836.5' K., plotted on a wave length base with a scale of microns or millionths of a metre. The wave lengths *Oa*, Ob, *Oc*, corresponding to the maximum ordinates of each curve, vary inversely as the absolute temperatures given. The constant value of the product AT at the maximum point was found to be 2,920. Thus for a temperature of 1,000° K. the maximum is at wave length 2.92,~at 2,000° the maximum is at 1.46,~.

9. Distribution of Energy in the Spectrum.— Assuming Wien's displacement law, it follows that the form of the curve representing the distribution of energy in the spectrum of full radiation should be the same for different temperatures with the maximum displaced in proportion to the absolute temperature, and with the total area increased in proportion to the fourth power of the absolute temperature.

Observations taken with *a* bolometer along the length of a normal or wave length spectrum would give the form of the curve plotted on a wave length base. The height of the ordinate at each point would represent the energy included between given limits of wave length, depending on the width of the bolometer strip and the slit. Supposing that the bolometer strip had a width corresponding to .01μ and were placed at 1.0μ in the spectrum of radiation at 2,000° K., it mould receive the energy corresponding to wave lengths between 1.00 and 1.01μ. At a temperature of 1,000° K. the corresponding part of the energy, by Wien's displacement law, would lie between the limits 2.00 and 2.02μ, and the total energy between these limits would be 16 times smaller. But the bolometer strip placed at 2.0μ would now receive only half of the energy, or the energy in a band .01μ wide, and the deflection would be 32 times less. Corresponding ordinates of the curves at different temperatures will therefore vary as the fifth power of the temperature, when the curves are plotted on a wave length base. The maximum ordinates in the curves already given are found to vary as the fifth powers of the corresponding temperatures.

The equation representing the distribution of energy on a wave length base must be of the form

$$E = C\lambda^{-5} F(\lambda T) = CT^{5}(\lambda T)^{-5}F(\lambda T) \qquad (14)$$

where $F(\lambda T)$ represents some function of the product of the wave length and temperature, which remains constant for corresponding wave lengths when T is changed. If the curves were plotted on a frequency base, because of the change of scale, the maximum ordinates would vary as the cube of the temperature instead of the fifth power, but the form of the function F would remain unaltered. Reasoning on the analogy of the distribution of velocities among the particles of a gas on the kinetic theory, which is a very similar problem, Wien was led to assume that the function F should be of the form $e^{-c/\lambda T}$, where e is the base of Napierian logarithms, and c is a constant having the value 14,600 if the wave length is measured in microns. This expression was found by Paschen to give a very good approximation to the form of the curve obtained experimentally for those portions of the visible and infrared spectrum where observations could be most accurately made. The formula was tested in two ways: (1) by plotting the curves of distribution of energy in the spectrum for constant temperatures as illustrated in fig. 17; (2) by plotting the energy corresponding to a given wave length as a function of the temperature. Both methods gave very good agreement with Wien's formula for values of the product AT not much exceeding 3,000.

A method of isolating rays of great wave length by successive reflection was devised by H. Rubens and E. F. Nichols (1897). They found that quartz and fluorite possessed the property of selective reflection for rays of wave length 8.8μ and 24μ to 32μ respectively, so that after four to six reflections these rays could be isolated from a source at any temperature in a state of considerable purity. The residual impurity at any stage could be estimated by interposing a thin plate of quartz or fluorite which completely reflected or absorbed the residual rays, but allowed the impurity to pass. H. Beckmann, under the direction of Rubens, investigated the variation with temperature of the residual rays reflected from fluorite employing sources from −80° to 600° C., and found the results could not be represented by Wien's formula unless the constant c were taken as 26,000 in place of 14,600. In their first series of observations extending to 6μ, O. R. Lummer and E. Pringsheim (1899) found systematic deviations indicating an increase in the value of the constant c for long waves and high temperatures. In a theoretical discussion of the subject, Lord Rayleigh (1900) pointed out that Wien's law would lead to a limiting value $C\lambda^{-5}$, of the radiation corresponding to any particular wave length when the temperature increased to infinity, whereas according to his view the radiation of great wave length should ultimately increase in direct proportion to the temperature. Lummer and Pringsheim (1900) extended the range of their observations to 18μ by employing a prism of sylvine in place of fluorite. They found deviations from Wien's formula increasing to nearly 50% at 18μ, where, however, the observations were very difficult on account of the smallness of the energy to be measured. Rubens

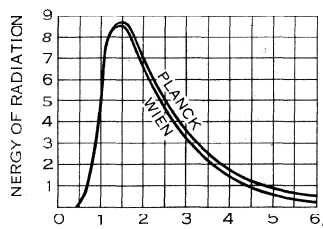

FIG. 17.— DISTRIBUTION OF ENERGY IN THE SPECTRUM OF FULL RADIATION AT 2,000° K., ACCORDING TO FORMULAS OF PLANCK AND WIEN

and F. Kurlbaum (1901) extended the residual reflection method to a temperature range from −190° to 1,500° C.. and employed the rays reflected from quartz 8.8μ, and rock salt 51μ, in addition to those from fluorite.

It appeared from these researches that the rays of great wave length from a source at a high temperature tended to vary in the limit directly as the absolute temperature of the source, as suggested by Lord Rayleigh, and could not be represented by Wien's formula with any value of the constant c. The formula now generally accepted is that proposed by Max Planck (1901) namely,

$$E = C\lambda^{-5}(e^{c/\lambda T} - 1)^{-1} \qquad (15)$$

which agrees with Wien's formula when T is small, where Wien's formula is known to be satisfactory, but approaches the limiting form $E = C\lambda^{-4}T/c$, when T is large, thus satisfying the condition proposed by Lord Rayleigh. The accepted value of the constant c in Planck's formula was 1.4385 cm.-deg. In order to compare Planck's formula graphically with Wien's, the distribution curves corresponding to both formulas are plotted in fig. 17 for a temperature of 2,000° K., with a scale of wave length in microns. The curves in fig. 18 illustrate the difference between the two formulas for the variation of the intensity of radiation with temperature for a fixed wave length 30μ which is five times as long as the limit 6μ of the curves in fig. 17. But at 2,000° K. the energy to be measured at 30μ is about ten thousand times less than at the maximum of the curve in fig. 18.

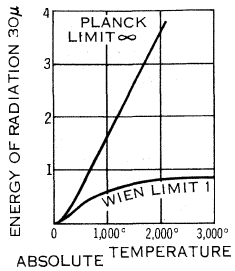

FIG. 18.—VARIATION OF ENERGY OF RADIATION CORRESPONDING TO WAVE LENGTH 30μ WITH TEMPERATURE OF SOURCE

Assuming Wien's displacement law, the curves may be applied to find the energy for any other wave length or temperature, by simply altering the wave length scale in inverse ratio to the temperature, or vice versa. Thus to find the distribution curve for 1.000° K.. it is only necessary to multiply all the numbers in the wave length scale of fig. 17 by 2; or to find the variation curve for wave length 60μ the numbers on the temperature scale of fig. 18 should be divided by 2. The ordinate scales must be increased in proportion to the fifth power of the temperature, or inversely as the fifth power of the wave length respectively in figs. 17 and 18 if comparative results are required for different temperatures or wave lengths.

XIII. THE NATURE OF HEAT IN MATTER

1. Classical Theory of Heat.—Following the proof that heat was essentially motion or energy and not a mysterious caloric fluid, the next major step in the understanding of its nature came out of the study of the relation of heat to the principles of probability. Many lines of evidence showed that the thermal motion of the atoms in a gas like helium could be thought of as something like the motions of a large number of small round shot violently agitated in a closed jar. Thus the shot (atoms) fly through the air in straight lines except when colliding with each other or the walls of the jar. Conceivably under these circumstances the atoms might all move with the same speed, but actually it has been proved that they move with a great variety of speeds, some very fast! some very slow and many at the various speeds in between, grouped about an average or mean velocity. Again, if one were to watch a single particular atom it would be seen continually changing its speed at each collision with other atoms or the walls. Occasionally after a collision it would be found moving very fast, occasionally very slowly, thus covering over a length of time the whole gamut of speeds, which one had seen at a single instant distributed among the entire assembly of atoms when observing the gas as a whole at a single glance. Similarly if one observed at a single instant the positions of the atoms in the vessel, they would be found to be almost evenly distributed throughout the entire space inside the jar; or if one were to observe, over a period of time, the wanderings of a single particular atom it would be found to pass through roughly every part of the jar, spending about equal lengths of time in each part in the course of its travels.

One can see the relation of space distribution to probability by means of an example, such as two helium atoms, which we will label respectively A and B, existing in the gaseous state confined within a small box. We postulate that we can see the positions of the two atoms as they bounce back and forth in the box colliding with the walls and with each other, executing the motions which constitute the heat they possess; in particular, we can distinguish uhen each atom is in the left half or in the right half of the box. There are four possibilities of distribution between the two halves of the box. (1) A and B may both be in the left half of the box; (2) A may be in the left half and B in the right half; (3) B may be in the left half and A in the right half; and (4) A and B may both be in the right half. We note that this parallels the possible distribution of "heads" and "tails" if one were to toss two coins, A and B: (1) both may come up "heads"; (2) A may be "heads" and B "tails"; (3) B may be "heads" and A "tails"; or (4) A and B both may come up "tails." Thus, one may expect that there is twice the chance of throwing one "heads" and one "tails," case (2) or (3), as there is of throwing both "heads," case (1); and in the same way one might conclude that there is twice the chance of finding the atoms distributed evenly through the box, case (2) or (3), as there is of finding both atoms in the left side, case (1).

Now, the law of probability states that if the coins are identical in every respect, the chance of throwing "heads" is exactly the same as the chance of throwing "tails," the 50–50 chance, each 50% or one-half of the total probability taken as 100% or one. And the statistical theory of heat asserts that under uniform conditions there is an equal chance of finding atom A in the left half of the box or in the right half; of course, the same holds for atom B. Thus we conclude that, just as the case of "one heads and one tails" is twice as probable as "both heads," the case of uniform distribution of the atoms, one "right" and one "left" is twice as probable as "both left." This seemingly simple principle has been extended in application throughout the complex domain of the motions which constitute heat, not only in the gaseous state of matter but in liquids and solids as well, and has resulted in an exact and profound understanding of the vast and complicated phenomena of physical and chemical equilibriums and changes of state. Since the addition or subtraction of heat is certainly one of the most universal means of bringing about changes and of producing varieties of matter and interactions between matter, this principle and its applications constitute a cornerstone of the foundations of all science. And the story of the evolution of these ideas is a fascinating chapter in the history of thought.

It was largely the result of the work of J. Clerk Maxwell and Luduig Boltzmann that the relation between heat and probability was first made plain They showed the plausibility of the concept that each distribution of atoms with respect to space and matter properly specified was equally probable; in our example, each of the four distributions of the two atoms A and B between the two halves of the box was equally probable. In order to extend the mathematical analysis to much more complicated situations, use was made of the concept of multidimensional space; i *e* , space of more, in this case vastly more, than the three dimensions, length. breadth and height, of the ordinary space in which we instinctively feel we live and move and have our being.

At first thought, the idea of even conceiving of such a space as an imaginary entity seems to have been deeply repellent to the human mind. It was so profoundly different from natural space and so boundless in its potential for generating further strange and novel forms. possibly of a monstrous nature, that to admit even the logic of the idea was to open a door which led out of the comfortable security of a familiar garden into a limitless *terra* ***incognita*** that seemed to be almost a domain for the mad.

The credit for taking this first almost inconceivably bold step in thought certainly should go to H. G. Grassman (1809–1877) although the possibility was suggested previously in the work of W. R. Hamilton; the application to heat was first made clear in detail by W. Gibbs who immediately followed Grassman's pioneering adventure. In Gibbs's phase space we conceive of the motion

of a single point in a space of $6n$ dimensions, where n is the number of elementary particles with which we are concerned. In our example of two helium atoms, $n = 2$ and this imaginary space would have 6×2 or 12 dimensions. The first three represent the position of atom A in the box with respect to the Cartesian co-ordinate system X, Y, Z or the length, width and height of the box.. The second set of three provides similarly a way of representing the position of atom B. The third set of three provides a way of representing the momentum of atom A (in effect its speed, since momentum is the product of speed or velocity times mass). The faster the atom is moving lengthwise in the box (direction x) the further to the right of the centre or zero point of the co-ordinate system will be the phase point or dot which tells by its position in the 12 dimensional space where our atoms are and how they are moving. Similarly, the position of the point with respect to the fourth set of three dimensions tells the velocity of atom B.

The fact that these two atoms are confined in the box means that the phase point must lie within a volume of space on the first three dimensions corresponding to the volume of the box and within a similar volume on the second three dimensions. If our system possesses a fixed amount of energy, and we will assume it does, then the point will have to lie within a certain volume in the third set of dimensions and similarly in the fourth, defined by a so-called hypersphere in the six dimensions of momentum space.

The fundamental assumption is made that there are a certain number of positions possible for the point within this hypervolume in 12 dimensions, and that each one of these positions is equally probable. This assumption is the extension of the logic that each kind of throw of the two coins is equally probable and that each of the four space distributions of the atoms A and B between the two halves of the box is equally probable.

The effect of heat on matter is thus based on the laws of probability or statistics. From this chain of logic there evolved the Maxwell-Boltzmann law for the distribution of energy among the atoms of a gas and the generalizations of statistical thermodynamics which stem from the Gibbsian concept of multidimensional phase space. During the latter part of the 19th century when these theories were being worked out, it seemed logical to believe that there were an indefinite number of values of energy possible for each atom. There was no evidence for any atomization of energy; it seemed reasonable that the amount of energy could be varied by infinitesimally small amounts. and that the points in phase space representing the possible states of the system lay infinitesimally close together. This was the classical basis for the theory of heat.

One of the most important conclusions drawn from this classical theory was the principle of the equipartition of energy. For example, a gaseous atom like helium could move in three dimensions in physical space. It was said to have three degrees of freedom of motion. Moving in free space there was certainly no difference between motion along the X axis, lengthwise in the box, or motion along the Y axis, crosswise; likewise motion along the Z axis, or up and down should be no different from the other two; accordingly all were regarded as equally probable. According to the principle of equipartition, energy was then shared equally on the average among all three degrees of freedom of the so-called translational motion. Calculation showed that the amount in each should be $\frac{1}{2}RT$, where R is the gas constant with a value of roughly two calories per degree per gram molecule and T is the absolute temperature in degrees Kelvin. Since the heat capacity is the rate of increase of energy with temperature, it is clear that one should find the value $\frac{1}{2}R$ per degree of freedom, or $\frac{3}{2}R$ for the heat capacity of one gram molecule of a monatomic gas like helium when measured at constant volume. This value was precisely confirmed experimentally for a number of monatomic gases.

In the case of a diatomic gas such as nitrogen we have the two atoms joined together to make a kind of dumbbell-shaped molecule. In this case the dumbbell can rotate in space. This adds tno more degrees of freedom of rotation which summed with the three degrees of freedom of translation makes five in all; lve therefore expect and actually find experimentally a heat capacity of $\frac{5}{2}R$. In other words, although the two kinds of motion are superficially quite different — translation or straight-line motion across the box contrasted with rotation or spinning — the principle of equipartition of energy states that energy is still shared equally among all the degrees of freedom.

Suppose now that the atoms are cooled down and condense first into a liquid and finally freeze into crystalline form, how will the situation alter? In the crystal we expect that instead of moving freely through space as in a gas. the atom will vibrate back and forth about a mean position under the influence of forces of attraction and repulsion between it and its neighbouring atoms. It will now possess both kinetic energy of motion and potential energy because of the action of the forces. Classical mechanics tells us that under these conditions, with these two kinds of energy present, the total average energy per degree of freedom will be twice as much. and the heat capacity accordingly will be $3R$ per gram atom in the crystalline state as contrasted with $\frac{3}{2}R$ in the gaseous state for a monatomic substance like helium. Since most metals exist in the crystalline state as individual atoms, not joined to form molecular groups, one would expect the heat capacity of metals to be $3R$ per gram atom. This fact had been observed experimentally and was known as the rule of Dulong and Petit.

On the whole, by the end of the 19th century there were a large number of experimental observations to confirm the classical theory of heat, but a certain number of notable exceptions remained unexplained. For example, some of the light elements exhibited values of the heat capacity which fell farther and farther below $6R$ as temperature was lowered, for example, carbon, boron and silicon. With the increasing use of liquified gases such as oxygen, nitrogen and hydrogen to produce temperatures of 200° or more below 0° C., these anomalies became more and more striking. Sir James Deuar carried out a series of heat-capacity measurements at low temperatures, made possible by the invention of the "dewar" flask which provided the necessary thermal insulation to preserve liquid hydrogen for hours at a time, which provided quantitative proof of this deviation.

2. Einstein's Theory. — It was just at this time that Planck had challenged the classical idea of the continuous range of values of energy nith his quantum hypothesis, Albert Einstein was the first to see the connection between the quantum theory and the anomnlies in heat-capacity values at low temperatures. He pointed out that the atoms of carbon, for example, might be expected to vibrate in the crystalline state with a single frequency, each atom behaving pretty much like an independent oscillator. Planck's theory would lead one to believe that the energy in such an oscillator would not take on a range of continuous values but that only a number of discrete values would be possible. In phase space this meant that. in effect, only a discrete and relatively small number of regions. usually referred to as cells, could be occupied by the phase point. Retaining the idea of equal probability for distribution of the energy as a whole. but over this finite number of cells, one calculated an entirely different formula for the heat capacity. One found first of all a parametric temperature (usually given the symbol Θ. called the characteristic temperature and expressed on the absolute scale of temperature) which provided an index to the behaviour of the substance. For example, Θ for lead is approximately 100° while Θ for diamond (crystalline carbon) is approximately 2,000°. When heat capacity is measured at the characteristic temperature it will be $0.9 \times 3R$; at twice the characteristic temperature it will be almost exactly $3R$; but at a temperature of one-half the characteristic temperature it will fall to less than one-half the Dulong and Petit value of $3R$. The heavier the atom which vibrates, the lower will be the characteristic temperature. Thus lead will have a heat capacity close to $3R$ at room temperature (300° K.), which is three times its characteristic temperature, while diamond will have a heat capacity far below $3R$, since room temperature is only about one-sixth of the characteristic temperature of diamond.

Einstein's formula for the heat capacity s at constant volume per gram atom is given by the expression:

$$s = 3Rz^2e^z/(e^z - 1)^2;\ z = \frac{h\nu}{kT} \qquad (16)$$

where h is Planck's constant, k is Boltzmann's constant, v is the

characteristic frequency at which the atom vibrates and T is the temperature in degrees absolute. Einstein showed (1907) that the experimental results of H. F. Weber on the variation of the heat capacity of diamond from T = 222° to 1,258° K. were in good agreement with his formula. Taking the substances, calcium fluoride, sodium chloride, calcium carbonate and silicon dioxide for which the optical frequencies of absorption (ν_0) in the infrared were known. he pointed out that the values of ν required by his formula were in reasonable agreement with the values of ν_0 optically observed. This was a major triumph for the newly created quantum theory of Planck.

3. Debye's Theory. — The interest aroused by Einstein's theory of the heat capacity of solids led to an important series of measurements of heat capacity by W. Nernst, F. A. Lindemann (Lord Cherwell) and their collaborators. They studied a number of metals and salts for which the optical frequencies were known, extending the experiments to the lowest temperatures available with liquid hydrogen and making use of the precise calorimetric methods developed at their laboratory. The results showed that while the Einstein theory was satisfactory in explaining the results at the higher temperatures, it failed to account for the heat capacity at the lower end of the temperature scale; values were many times higher than the theory predicted.

The explanation of this anomaly was put forward by P. Debye (1912) who pointed out that one would not expect the atoms in the crystal lattice to vibrate independently as Einstein had postulated, but rather in joint modes of motion. In a cube-shaped crystal the longest mode would have a wave length twice the distance from one face of the cube to the opposite face. The shortest mode would have a wave length twice the distance between two neighbouring atoms. If the crystal were 1 cm. across, there would be a set of waves with the wave length varying about 100,000,000 times from the longest to the shortest value. While these waves contain in their motion the heat of the crystal, they also may be regarded as acoustic waves or sound; if sound waves in the air impinge on the crystal, elastic waves similar in type to the heat waves will be set up, carrying the sound through the crystal.

According to a theorem attributed to Lord Rayleigh (1877) the number of possible degrees of freedom of a system of N discontinuous mass points will be $3N$. According to another theorem by the same author (1900), the number of possible frequencies in a given volume of a continuous medium between the limits v and v + dv may be represented by $C\nu^2 d\nu$ where C is a constant dependent on the volume and on the velocity of propagation. The total number of possible frequencies from o up to a limit ν_m is $C'\nu_m^3/3$. If we equate this to $3N$, we find $C = \frac{9N}{\nu_m^3}$. Adopting Planck's expression for the energy of a harmonic oscillator with one degree of freedom as applying to each mode, we obtain the energy $(RT/N)Z/(e^z - 1)$ for each frequency. Multiplying by the number of frequencies and integrating from o to ν_m we can obtain the energy of a gram atom at T, and thence obtain the heat capacity by differentiation with respect to T. This yields a rather complicated expression which is similar to Einstein's in general form, being a function of Θ/T, but which has much higher values of the heat capacity precisely in the low-temperature region where Einstein's function is so unsatisfactory. This is because Debye's function takes into account the existence of the vibrational modes with long wave length which retain their heat at very low temperatures (the range where the short-wave vibrations, on which Einstein's theory was based, have effectively no heat at all). Debye's theory thus predicts that at very low temperatures the heat capacity will vary as the cube of the absolute temperature, a relationship which has been found experimentally to hold in dozens of cases. The major features of Debye's theory are thus experimentally substantiated and there is no doubt but that it marks an important step forward in our understanding of the nature of heat in solids.

One of the weakest points in the Debye theory lies in the use of the formula for the distribution of frequencies in a continuous medium while equating the total number of frequencies to $3N$ as expected in discontinuous lattice. Obviously, real crystals are made up of discontinuous sets of mass points; and the theory of such lattices has offered a challenge to investigators ever since the importance of crystal dynamics became apparent. M. Born and T. von Karman pioneered in working out mathematical methods for lattice problems (1912). Since 1935 M. Blackman has carried on a series of studies, improving the earlier methods and applying them to many substances. Starting in 1944, E. W. Montroll and his associates have made important contributions to clarify our understanding of the theory.

An especially interesting application of the mathematics of topology (*q.v.*) to the problem was suggested by L. van Hove (1953). All these developments were critically summarized by Blackman in 1955.

Thus, the investigations over this period have shown that, by and large, the Debye theory accounts with astonishing precision for the variation of heat with temperature in many varieties of crystalline substances, in spite of the doubtful assumption of the continuous distribution of frequencies which Debye himself clearly pointed out to be an approximation. On the other hand. if a new theory can be based strictly on the dynamics of discontinuous lattices, it is clear from the results already obtained that much more important information on the distribution of heat in crystals may be expected.

A still more complex problem is posed by molecular lattices made up of molecules, where groups of atoms are bound together in groups by the relatively strong forces of chemical bonds, while these groups are in turn bound to neighbouring groups in the rows of the crystal lattice by relatively weak forces. The lattice of crystalline benzene (C_6H_6) is of this sort, typical of organic compounds and of some inorganic ions such as SO_4^-. With considerable accuracy, the Debye theory even accounts for the heat contained in the vibration of these complex molecules against each other, as shown by R. C. Lord, J. E. Ahlberg and D. H. Andrews (1937). In this case there appear to be coupled torsional waves as well as the translational waves found in monatomic crystals.

The heat contained in the vibrations of the atoms within the molecule, however, must be calculated by an Einstein function, since the coupling between molecules is so weak that the individual molecules vibrate within themselves independently of each other. Consequently, the frequencies do not lie in a nearly continuous band as in the Debye case, but are a discrete set of 3n–6 values where n is the number of atoms in the molecule. Occasionally because of molecular symmetry, or similar factors, the values for different types of motion will be equivalent numerically and this reduces the number of distinct values below the number $3n–6$. The Einstein formula has been widely applied in calculating the heat capacity caused by these internal molecular vibrations, both for solids and for gases. Thus, although this formula has been completely supplanted by the Debye formula in the case of heat distribution in lattices, the case for which Einstein originally developed it, the applications for calculating the internal heat in molecules have made its uses ultimately far more numerous than those of the Debye formula. These applications are discussed in the final section of this article dealing with the heat capacity of gases.

4. Heat, Entropy and Information. — During World War II new and profound advances were made in understanding the basic nature of "information," so novel in fact as to constitute the beginning of a new field of science. This came about simultaneously in several related fields such as the improvement of radio and telephone communication, the making and breaking of secret codes and the development of various servomechanisms such as automatically controlled antiaircraft weapons. As the theory of information developed there appeared an astonishing parallelism to the theory of heat, because probability enters into the communication of information in much the same way that it enters into the equilibration of heat. The initial developments along these lines were attributed primarily to the work of C. E. Shannon; and the advances in the decade after the war were summarized by L. Brillouin in 1956.

The measure of information I is now generally defined by the

formula $I = K \ln P$ where I is the information of one outcome in a situation which had P possible outcomes all equally probable, K is an arbitrary constant, and ln means logarithm to the base *e*. The customary measure of the probability of a given heat distribution is, of course, the entropy S customarily defined by the Boltzmann expression: $S = k \ln W$, where k is the Boltzmann gas constant, and *W* is the number of microscopic ways in which the macroscopic state corresponding to *S* can be realized. The identity in form of these two expressions reveals a very profound relationship between the two fields.

The similarity of the theory of heat to the theory of information also is striking in many other ways. The second law of thermodynamics states that the entropy always increases in any spontaneous change; in the limit, entropy remains constant if the change takes place reversibly; and it never decreases spontaneously. Similarly, information always decreases as the result of being communicated; in the limit it remains constant as the communication becomes perfect; *i.e.,* when no randomness such as electrical noise is introduced in the act of communication; but information never increases as the result of communication. Thus entropy and information are strictly isomorphic quantities, though differing in "sign," the first increasing and the second decreasing when randomness occurs.

Now there is every reason to believe that our increasing knowledge about the nature of information will aid our understanding of the nature of thought itself. And since thermal energy or heat plays such a vital part in governing the course of chemical reactions, including biochemical processes, we may expect that advances in the theory of heat will help in our understanding of basic neurological action. Thus, at the common frontier where these two closely related fields meet in the physiological and epistemological aspects of the brain, one may expect important developments.

In this connection it should be pointed out that the representation of the phenomena associated with heat distribution by means of multidimensional space, as initiated by Gibbs, was the beginning of a trend of thought which has spread far since that time, a change in epistemological attitude which has shifted emphasis from the analytic to the synthetic. Thus Debye took into account the action of heat in the whole crystal, instead of treating it as atomized into independent oscillators as Einstein did. The mathematical structure of the new quantum mechanics (*q.v.*) has emphasized still further the "aspect of the whole" as representable in generalized space, a point frequently made by H. Weyl in his studies of the philosophy of mathematics and the physical sciences. In quantum mechanics we find probability in wave-clothing dominating the behaviour of elementary particles with a formalism isomorphic with the generalized Debye treatment of heat in crystals.

In the new information theory we find probability and generalized space again, once more closely isomorphic with fundamental aspects of the theory of heat. In all this we are surely glimpsing a profound change in our knowledge of the physical world and in knowledge itself.

The philosophical implications of this aspect of the whole were discussed by N. Bohr (1958) who stressed the importance of this point of view in interpreting the relationships between processes at the atomic level and at the biological level. The essential, characteristic feature of the living organism is dynamic stability. While the individual building blocks of the organism, the atoms, come and go by the trillion or more through respiration and metabolism, the structure of the organism retains its characteristic form relatively unchanged for a period of time billions or more times longer than the interval required for an individual atomic replacement.

We therefore must regard this characteristic form as a dynamic energy pattern which subtly combines change with invariance. Its dynamism is heat, the warmth of life, but because this heat embodies form, there emerges a stable entity of the whole, which in its survival through time possesses a reality that dominates and transcends its ephemeral and ever-changing material parts.

5. Heat Capacities of Gases.—Early attempts at understanding the nature of heat inside molecules like benzene were hampered by a lack of knowledge of the proper set of frequencies to use in the Einstein equation. The discovery of the new type of spectrum bearing his name, by Sir C. V. Raman in 1928, marked a major advance in providing adequate data for the thermal analysis of molecules.

Shortly after Raman's first work, E. B. Wilson and his collaborators began a long series of studies, combining quantum mechanics and the mathematical theory of groups to provide methods for the exact analysis of the thermal motions of molecules. The improvement of instrumental techniques in the study of infrared spectra also contributed greatly in making it possible to calculate accurately the internal heat capacity of molecules. Advances in this field were summarized by Wilson, J. C. Decius and P. C. Cross in 1955. At that time something like 50 molecules of considerable complexity had been subjected to precise vibrational analysis. This not only made possible the accurate calculation of heat capacities in the gaseous state, but, coupled with experimental measurements of thermal properties in the solid and liquid state, it provided thermodynamic data for quantities like entropy and free energy in a form which permitted calculations with regard to chemical behaviour under conditions such as high temperature, high pressure and complex composition where the direct experimental approach becomes difficult or impossible. This part of the theory of heat has yielded invaluable information to industry especially in the fields of petroleum chemistry and synthetic organic chemistry.

See CALORIMETRY; DIFFUSION; LATENT HEAT; LOW-TEMPERATURE PHYSICS; THERMODYNAMICS; THERMOMETRY; VAPORIZATION; HEATING AND VENTILATION; KINETIC THEORY OF MATTER.

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(H. L. C.; D. H. A.)

HEAT EXCHANGER. In many engineering applications it is desirable to increase the temperature of one fluid while cooling another. This double action may be economically accomplished with the aid of an apparatus called a heat exchanger, Some important applications are the cooling of one petroleum fraction while warming another, the cooling of air or other gases with water between stages of compression, and the preheating of combustion air supplied to a boiler furnace using hot flue gas as the heating medium. Others are the transfer of heat from liquid metals to high-pressure water in atomic power plants and the reclaiming of heat energy from the exhaust of a gas turbine by transferring heat to the compressed air on its way to the combustion chambers. There are also many other applications.

The primary function of a heat exchanger is to provide two paths of flow, one for the warm fluid and one for the cold, by means of which heat can be transferred through walls or partitions separating the fluids.

The quantity of heat transferred is governed by three factors, namely: (1) the amount and nature of the heat transfer surface area exposed to the two fluids; (2) the over-all coefficient of heat transfer from one fluid through the intervening wall to the other fluid; and (3) the mean temperature difference across the intervening wall from one fluid to the other.

Numerous flow arrangements and geometrical designs are possible. Perhaps the simplest is the concentric tube or double pipe heat exchanger in which one pipe is placed inside another. The fluids flow in the inner pipe and in the space between the two pipes. The flow may be either parallel (fig. 1) or counterflow (fig. 2) with temperature relations between fluids as illustrated. Concentric tube heat exchangers are built in several ways such as, for example, in the form of a coil or in straight sections placed

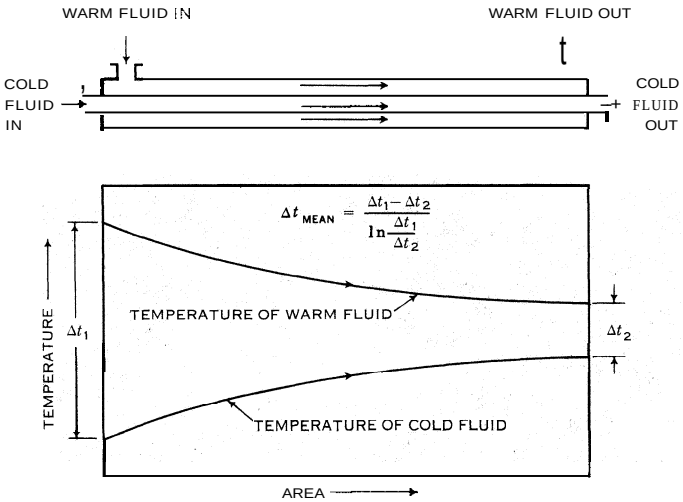

FIG. I.— PARALLELFLOW IN A CONCENTRIC TUBE HEAT EXCHANGER

side by side and connected in series.

The commonest type of heat exchanger is the shell and tube type illustrated in fig. 3. Here one fluid flows through tubes while the other flows back and forth across the tubes between baffles. Over-all direction of flow may be either parallel or counter, but is usually the latter.

Another commonly employed type heat exchanger is the regenerative type in which hot and cold gas streams flow in opposite directions through opposite halves of a rotating drum

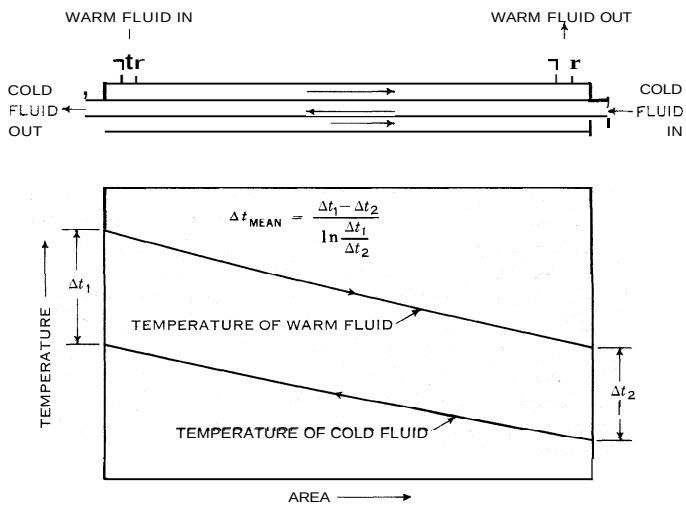

FIG. 2.— COUNTERFLOWIN A CONCENTRIC TUBE HEAT EXCHANGER

composed of honeycombed metal sections through which the gases can pass. As the drum slowly rotates the honeycombed metal alternately absorbs heat from the hot gas stream and surrenders it to the cold gas stream thus effecting the desired heat interchange between the two gases. This type exchanger is widely used in power plants for preheating combustion air while simultaneously reclaiming waste heat from the boiler flue gases.

See W *H* McAdams, *Heat Transmission,* 3rd ed (1954)

(RD A BR)

HEATH, NICHOLAS (*c.* 1501–1j78) archbishop of York and lord chancellor, was born in London He was educated at Oxford and at Christ's college. Cambridge. and after minor preferments he was appointed archdeacon of Stafford in 1534. He

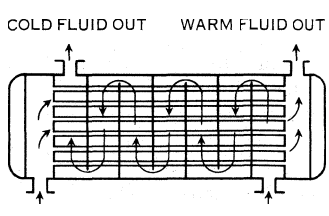

FIG 3.—SHELL AND TUBE HEAT EXCHANGER

then accompanied Edward Fox (*q.v.*), bishop of Hereford, on his mission to the Lutheran princes of Germany. In 1539 he was made bishop of Rochester and in 1543 succeeded Hugh Latimer at Worcester. He accepted the earlier reforms of Edward VI and the first Book of Common Prayer after it had been modified by the house of lords in a Catholic direction.

His definite breach with the Reformation occurred on the question of the Ordinal drawn up in 1550. Heath was one of the bishops appointed to prepare a form for ordination, but he refused to accept the version suggested by Archbishop Cranmer. He was imprisoned and in 1551 was deprived of his bishopric. On Mary's accession he was restored, made president of the council of the Marches and Wales, and in 1555 was promoted to the archbishopric of York. After the death of Stephen Gardiner he was appointed lord chancellor.

On Mary's death Heath as lord chancellor at once proclaimed Elizabeth I. Like Sir Thomas More, Heath held that it was entirely within the competence of the national state, represented by the parliament. to determine questions of the succession to the throne Although Elizabeth did not renew his commission as lord chancellor, he continued to sit in the privy council until the government had determined to complete the breach with the Roman Catholic Church. and as late as April 1559 he assisted the government by helping to arrange the Westminster conference and reproving his more truculent coreligionists.

Heath refused to crown Elizabeth because she would not have the coronation service accompanied with the elevation of the Host and ecclesiastical ceremonies and doctrine could not, in Heath's view, be altered or abrogated by any mere national authority. Hence he steadily resisted Elizabeth's acts of supremacy and uniformity, although he had acquiesced in the acts of 1534 and 1549. Like others of Henry's bishops, he had been convinced by the events of Edward VI's reign that Sir Thomas More was right and Henry VIII was wrong in his attitude toward the claims of the Roman Catholic Church.

Heath was therefore necessarily deprived of his archbishopric in 1j59, but he remained loyal to Elizabeth. After a temporary confinement, he passed the remaining 19 years of his life in peace and quiet. never attending public worship and sometimes hearing mass in private

HEATH, WILLIAM (1737–1814), American soldier, was born in Roxbury. Mass., on March 2, 1737 (old style). In 1765 he entered the Ancient and Honourable Artillery company of Boston, of which he became commander in 1770. In the same year he wrote to the *Boston Gazette* letters signed "A Military Countryman," urging the necessity of military training. He directed the pursuit of the British from Concord (April 19, 1775), was promoted to be provincial major-general on June 20, 1775, and two days later mas commissioned fourth brigadier-general in the Continenta! army.

He became major-general in 1776. In Jan. 1777 he attempted to take Ft Independence, near Spuyten Duyvil, but at the first sally of the Hessian garrison his troops became panic-stricken and a few days later he withdrew. Washington reprimanded him. In May 1779 he nas appointed a commissioner of the board of War. He nas placed in command of the troops on the east side of the Hudson in June 1779, and of other troops and posts on the Hudson in November of the same year. In July 1780, he met the French allies under Rochambeau on their arrival in Rhode Island; in October of the same year he succeeded Benedict Arnold in command of West Point and its degendencies: and in Aug. 1781, when Washington nent south to mket Cornwallis, Heath was 'left in command of the army of the Hudson to watch Clinton. After the war he nas a member of the Massachusetts convention which ratified the federal constitution in 1788.

Heath died at Roxbury Jan. 24, 1814.

HEATH, the English form of a name given in most Teutonic dialects to the common ling or heather (*Calluna vulgaris*), but now applied to all species of Erzca, an extensive genus of monopetalous plants. belonging to the family Ericaceae. The heaths are evergreen shrubs, with small narrow leaves, in whorls usually set rather thickly on the shoots; the persistent flowers have four

sepals, and a four-cleft campanulate or tubular corolla, in many species more or less ventricose or inflated; the dry capsule is four celled and opens, in the true heaths, in four segments, to the middle of which the partitions adhere, though in the ling the valves separate at the dissepiments. The plants are mostly of low growth, but several African kinds reach the size of large bushes, and a common south European species, *E. arborea,* occasionally attains almost the aspect and dimensions of a tree.

One of the best known and most interesting of the family is the common heath, heather or ling, *Calluna vulgaris,* placed by most botanists in a separate genus on account of the peculiar dehiscence of the fruit, and from the coloured calyx, which extends beyond the corolla, having a whorl of sepallike bracts beneath. This shrub derives some economic importance from its forming the chief vegetation on many extensive wastes in the more sterile lands of northern and western Europe, which are hence known as heaths. When growing erect to the height of three feet or more. as it often does in sheltered places, its purple stems, close-leaved green shoots and feathery spikes of bell-shaped flowers render it one of the handsomest of the heaths; but on more arid slopes it frequently rises only a few inches above the ground. In all moorland countries the ling is applied to many rural purposes; the larger stems are made into brooms, the shorter tied up into bundles that serve as brushes, while the long trailing shoots are woven into baskets. Pared up with the peat about its roots it forms a good fuel, often the only one obtainable on the drier moors.

The shielings (huts) of Scottish Highlanders were formerly constructed of heath stems, cemented together with peat mud worked into a kind of mortar with dry grass or straw; hovels and sheds for temporary purposes are still sometimes built in a similar way and roofed in with ling. Laid on the ground, with the flowers above, it forms a soft springy bed, the luxurious couch of the ancient Gael. The young juicy shoots and the seeds, which remain long in the capsules, furnish the red grouse of Scotland with the larger portion of its sustenance; the ripe seeds are eaten by many birds. The purple or Scotch heath, *E. cinerea,* one of the most beautiful of the genus, abounds on the lower moors and commons of Great Britain and western Europe, in such situations being sometimes more prevalent than the ling. The flowers of both these species yield much honey.

The genus contains about 500 known species, by far the greater part being indigenous to the western districts of south Africa, but it is also a characteristic genus of the Mediterranean region, while several species extend into northern Europe. No species is native in America, but ling occurs as an introduced plant on the Atlantic side from Newfoundland to New Jersey, and E. *tetralix* occurs on Nantucket. Five species occur in Britain: *E. cinerea, E. tetralix* (cross-leaved heath), both abundant on heaths and commons, E. *vagans* (Cornish heath): found also in western Europe, *E. ciliaris* in the west of England and Ireland and *E. mediiterranea* in Ireland. *E. arborea,* the white heath, found in southern France and elsewhere in the Mediterranean region, is known as *bruyère,* and its stout underground roots yield the "briarwood" used for pipes.

FLOWERING BRANCH OF THE LING OR HEATHER (CALLUNA VULGARIS) In flower, the small corolla is concealed by rose-coloured sepals' at base of which are four small green bracts

Among cultivated heaths the south African species excel, but only in the cool greenhouse or outdoors in California. Among the finest are *E. melanthera,* E. *verticillata* and *E. ventricosa.*

BY COURTESY OF NATIONAL PARK SERVICE

RED HEATHER FROM CRATER LAKE. ORE.

HEATHCOAT, JOHN (1783–1861), English inventor of lacemaking machinery, was born at Duffield near Derby on Aug. 7, 1783. After being apprenticed to a framesmith, he constructed in 1808 a machine to produce an exact imitation of pillow lace, which was the most expensive and complex textile apparatus then existing. A mill at Loughborough for the exploitation of the new process, owned by Heathcoat and his partner Charles Lacy, a Nottingham manufacturer, was attacked by the Luddites in 1816, and the 55 lace frames were destroyed. Heathcoat then constructed new and greatly improved machines at Tiverton, Devon. He followed his great invention by others, including contrivances for ornamenting net while in course of manufacture and for making ribbons and plaited and twisted net upon his machines, improved yarn spinning frames and methods for winding raw silk from cocoons. He also patented a steam plow and an improved process for extracting and purifying salt.

In 1832 Heathcoat was elected a member of parliament for Tiverton, where he died on Jan. 18, 1861.

See William Felkin, *A History of the Machine-Wrought Hosiery and Lace Manufactures* (1867). (K. R. G.)

HEATHER, a plant name properly applied only to *Calluna vulgaris,* also termed ling, but often used loosely to include the heaths *(Erica)* in addition.

See ERICACEAE; HEATH.

HEATH HEN *(Tympanuchus cupido cupido),* an extinct North American grouse, an eastern race of the prairie chicken (*q.v.*), which inhabited wooded districts. Once numerous, this choice game bird subsequently disappeared, as a result of overhunting and the opening of farm lands, from all parts of its range except the island of Martha's Vineyard, Mass., where, despite attempts to protect the race, only one bird was found in the spring of 1930.

HEATH RIVER rises on the lower slopes of the Cordillera Oriental, Bolivia, and flows northeast through heavily forested and sparsely inhabited country to its confluence with the Madre de Dios near Puerto Heath.

Along its 100 mi. length are numerous rapids making navigation possible only by small craft. The Heath is named for the American, Edwin Heath, whose explorations in 1879 revealed the wealth of the region, chiefly rubber. Col. P. H. Fawcett, employed on a 1910 boundary survey project by the Bolivian government, explored the Heath to its source. The river forms part of the

boundary between Bolivia and Peru. (J. L. TR.)

HEATING AND VENTILATION. These two branches of engineering are so closely interrelated that they usually are treated as a dual subject. Both are concerned with providing a required atmospheric environment within a space, the former with respect to heat supply to produce a desired temperature for maintaining comfort, health or efficiency of the occupants, the latter with regard to supply and removal of air, frequently with emphasis on contamination of the air. A third subject, air conditioning (*q.v.*), is closely related to both heating and ventilation.

HEATING

While the necessity for heat in cold climates seems self-evident, actually the matter is not so simple when the physiology of the human being is taken into account. The food and oxygen intake of the body is converted into energy, and the body dissipates this energy in the form of heat and work. Even on a cold day a person vigorously exercising is conscious of perspiring, so that he is losing heat by evaporation. Why, then, must the body require heat if it is losing heat?

The body of a healthy person is generally at a temperature of 98.6" F. and normally produces heat at a rate of from 300 to 2,000 B.T.U. per hour (a British thermal unit, or B.T.U., is the quantity of heat required to raise the temperature of one pound of water 1° F.). This heat must be dissipated at the same rate it is produced if the body temperature is not to rise or fall. If heat is lost too rapidly, the body temperature falls; when this happens, life is endangered.

The purpose of heating, then, is to prevent the too-rapid loss of heat from the body. By heating the ambient air or walls, ceiling or floor, the rate of heat loss from the body is controlled. When the rate of heat loss is properly controlled, the individual feels comfortable.

The output of heat, and consequently the degree to which heat must be supplied, depends on the degree of physical activity (see Table I). For example, when a man is engaged in heavy work he must dissipate from 1,400 to 1,600 B.T.U. per hour; for his body to do this, the atmospheric environment must be cool to allow the interchange of heat from his body to the surroundings. When he is relaxed in a chair, dissipating only 400 B.T.U. per hour, his environment must be warmer to provide for the lower rate of heat exchange.

How the Body Loses Heat. — Some concepts of heating were gradually changed as engineers obtained more precise knowledge about how the body loses heat. Insufficient attention formerly was paid to loss by radiation, which is the transmission of energy in the form of waves from a body to surrounding bodies at a lower temperature, independent of the air temperature between. The human being also loses heat by conduction (through his clothes) and convection, the latter by air currents past his skin or outside clothing surface, and also by evaporation of moisture from his skin (perspiration) and by respiration.

TABLE I.—Heat Output of Human Beings

Activity	Heat output, B.T.U. per hour	Activity	Heat output, B.T.U. per hour
Seated, relaxed	325–400	Light factory work	725–825
Office worker	425–500	Moderately heavy work	900–1,100
Walking	450–575	Heaw work	1,400–2,000

Note: Lower values for women, higher for men.

The loss by radiation depends on the temperature of the walls, floor and ceiling of the enclosure which the human being is occupying. The lower these temperatures are, the greater the loss by radiation. The mean radiant temperature (M.R.T.) is the weighted average of the various floor, wall and ceiling temperatures. When the M.R.T. is below 80° F., the average surface temperature of a normally clothed adult, the body loses heat by radiation to the surroundings; when the M.R.T. is higher than 80° F., the body is gaining heat by radiation. The effect of low M.R.T. on the comfort of room occupants was noticed as early as 1857, when the commissioners of the London board of health laid down a rule that for comfort the walls of an apartment should be warmer than the air.

Loss of heat by convection is dependent on air temperature and rate of air motion. The cooler the air in the room, the more the body heat loss by convection, and the greater the air motion, the greater the loss by convection.

Evaporation of moisture from the skin (and expired air) depends on the relative humidity, air movement and air temperature. Evaporation increases as the relative humidity of the air decreases and as air movement increases. Loss by evaporation decreases with increase of air temperature.

Heat can be lost from the body or gained by radiation or convection; evaporation always results in a heat loss. Consequently, it is not possible to indicate the proportions of these losses unless the specific conditions are stated. For the specific case of a nude person in a 76° F. air-and-wall-temperature environment, low relative humidity and no air motion, the heat loss is one-fifth by evaporation, less than two-fifths by radiation and more than two-fifths by convection.

Measures of Heating Effectiveness. — Within certain limits, it is possible to vary the heat loss by different means, increasing one and decreasing another, and still maintain a constant net loss and consequently, the same feeling of comfort. For example if, because of cold walls, the loss by radiation is high, the loss by convection and evaporation can be reduced by maintaining a higher air temperature. The result is that, since there are so many variables, there are many combinations of air temperature, mean radiant temperature, relative humidity and air movement that will result in a comfortable environment. Many attempts have been made to combine these variables into one scale of numbers or indexes which will define the environmental condition in terms of body heat loss as it relates to comfort.

Principal among these are the following:

Effective *Temperature.*—This scale is determined by subjective tests of the feeling of comfort under various combinations of air temperature, humidity and air motion, but without taking M.R.T. into account. This scale, devised by the American Society of Heating and Air Conditioning Engineers, Inc., applies only to the United States and only to still air (air movement not more than 25 ft. per minute). The effective temperature scale as applied to winter heating conditions is illustrated in fig. 1. Combinations of air temperature and humidity resulting in a 65° or 70" effective temperature (E.T.) were satisfactory to 85% of the subjects tested, while 95% were comfortable at 66° and 69" E.T. and 97% were comfortable at an E.T. of 67°. Most comfortable of all was an E.T. of 68°, at which 99% of the subjects were comfortable. The 68° E.T. curve is a plot of the combinations of temperature and humidity which were most, and equally, popular.

The chart in fig. 1 applies to convection (not radiant panel) heating systems of the central type only.

Equivalent Temperature. — This scale, developed in Great Britain, measures the combination of effects of radiation, air temperature and air motion but not humidity. It appears to be the best available index of warmth within the limit of 75° F., beyond which it does not apply.

Equivalent Warmth. — Also a British scale, this takes into account humidity, mean radiant temperature, air temperature and air motion. It is reported that it gives results very close to that of the resultant temperature, a scale developed in France. Neither of these scales is used in the U.S.

Operative Temperature. — A scale developed in the John B. Pierce Laboratory of Hygiene in New Haven, Conn., takes into account mean radiant temperature and air temperature. Since it applies only to moderate air movement, it can be said to take air motion into account within limits. Humidity is not included. For practical purposes, the mean between the air temperature and the mean radiant temperature can be taken as the operative temperature. Thus if the air temperature is 70" F. and the mean radiant temperature is 60° F., the operative temperature is 65°.

Environmental Standards. — All of the foregoing has considerable practical significance. For example, drafts (another term for air motion) increase the convection and evaporative heat loss

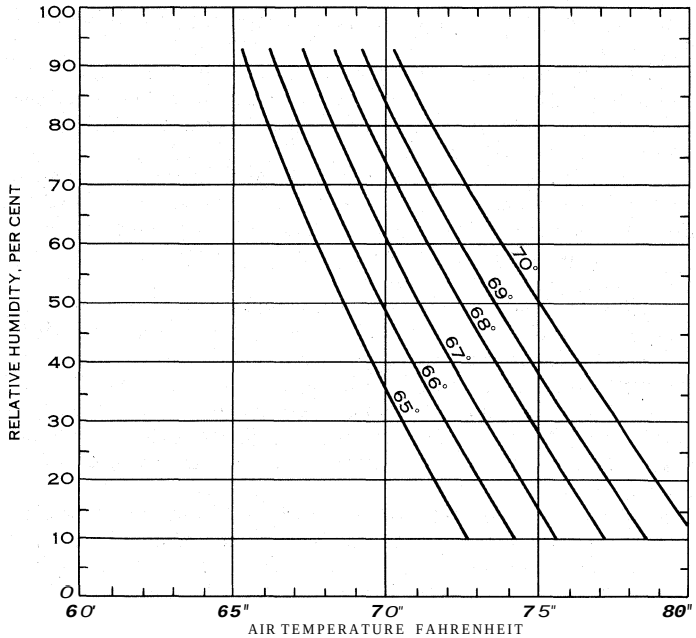

FIG. 1.— EFFECTIVE TEMPERATURE CURVES SHOWING COMBINATIONS OF TEMPERATURE AND RELATIVE HUMIDITY DEFINED BY THE AMERICAN SOCIETY OF HEATING AND AIR CONDITIONING ENGINEERS, INC., AS REPRESENTING RELATIVE SUBJECTIVE FEELINGS OF COMFORT. THE 68° F. EFFECTIVE TEMPERATURE LINE REPRESENTS THE MOST NEARLY IDEAL COMBINATIONS FOR MOST PERSONS

and may produce a feeling of chill. Less appreciated is the fact that when the walls are cold, the occupant can lose so much heat by radiation that he is cold, complains of drafts (which may not be present) and is uncomfortable even with a relatively high air temperature. This loss of heat by radiation is especially noticeable if a person is sitting next to a window when the glass is cold. At the same time another occupant who is not losing heat by radiation may feel quite comfortable. Such situations cause great irritation among occupants of homes and offices.

Since there is no universally accepted standard in regard to mean radiant temperature, relative humidity and air motion, air temperature is, in actual practice, the primary basis for design.

Other variables enter into the picture — quantity of clothes worn, age and sex of the individual, environment to which the individual is accustomed and state of health — but the heating system must be designed for the average case. The number of these variables involved is an indication of the difficulty in setting a precise standard.

In the United States an inside design temperature of 70° F. is commonly used for most buildings where the occupants are sedentary or even exercising lightly, with lower temperatures, from 55° to 65° F., employed for various industrial buildings. Actually, however, the temperature maintained is usually above 70° in residential, commercial and institutional buildings, depending on the amount of outside wall space. For rooms with one outside wall, 71° is nearly ideal, while 73° is common for rooms with two cold walls.

The effect of these cold walls is to increase the heat loss by radiation from the body; the higher air temperature reduces the loss by convection and evaporation and maintains the thermal balance.

In Great Britain, inside temperatures are usually much lower. British people feel very uncomfortable at the higher air temperatures maintained in American buildings, but are comfortable at temperatures from 60° to 65° F. The human body can in time adjust itself to the standards of either region.

Industrial buildings, gymnasiums and other buildings where the degree of activity is high, as compared with homes, maintain lower air temperatures, because the heat loss from the body is greater, and the lower air temperatures thus permit greater evaporation and convection losses to maintain the heat balance.

HEAT LOSS AND INSULATION

The determination of the capacity or size of the various components of the heating system is based on the fundamental concept that heat supplied to a space equals heat lost from the space.

The requisite capacity of the boiler or furnace and, in fact, of the whole heating system depends on the amount of heat to be supplied, and the equation shows that this equals the heat lost. Heat lost from the space is made up of two principal items of which the first is the heat lost through walls, roof, windows, doors and floors.

Heat Loss From Buildings. — To explain how heat is lost through walls, roofs and floors, it is necessary to have some understanding of how heat transfer takes place. Heat flows from a region of higher temperature to one of lower temperature, just as water flows downhill, and it does this in three ways: (1) by conduction, the flow of heat through matter unaccompanied by visible motion of the material, as in an iron rod. one end of which is held in a flame. (2) by convection, the transfer of heat by moving matter (in the case of buildings, air); when air is heated it becomes less dense and rises while the colder, denser air falls and displaces it, and in turn becomes heated. (3) finally, heat is transferred by radiation, the process by which energy is transferred through space, the energy being in the form of waves similar to light or radio waves, but longer. The energy is emitted from a hot or warm surface, is transmitted through the air or space, and when the waves fall on a cooler surface the energy is converted to heat. All three of these processes are involved in heat loss from buildings.

For example, in the simple wall of a house shown in fig. 2, heat flows in winter by conduction from the inside of the building through the plaster and the plasterboard. The warm surface transfers some of its heat by convection to the air in the air space, and this air, in turn, gives up some of its heat to the cooler surface. In addition, the warm surface emits radiant energy which flows in waves across the air space, and this is absorbed by the cooler surface and becomes heat. The heat then continues its flow by conduction through the sheathing and stucco, and finally this heat is transferred by convection to the cold outside air and by radiation to surrounding cold objects.

There is, therefore, a great deal more to be considered in the design of a wall or roof than making it aesthetically pleasing and rainproof. Its heat transfer properties are of the greatest importance and should be such that the heat transmitted will be at a minimum so that the quantity of fuel used also will be low. To accomplish this, wherever winters are other than mild, insulation is necessary.

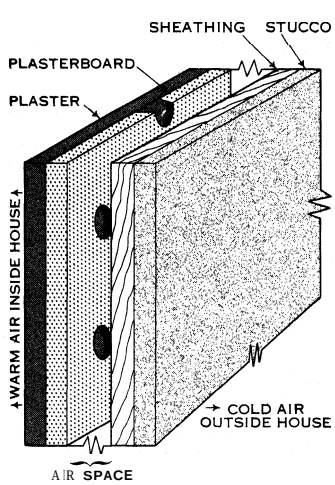

FIG. 2.— SECTION OF A SIMPLE HOUSE WALL

Characteristics of Insulating Materials. — Insulation does not completely stop heat flow, but rather reduces the flow. Broadly speaking, denser materials are better conductors of heat, so that stone walls, for example, lose heat rapidly. This can be overcome by making the walls or roof very thick, but except in the case of monumental buildings such as cathedrals this generally is impractical.

Conversely, less dense materials are better insulators in retarding heat flow by conduction. Usually, too, a material transmits more heat when it is damp than when it is dry.

The quantity of heat which flows through one square foot of a material one inch thick in one hour when the temperature is 1° F. higher on one side than the other is called the conductivity of that material. According to an arbitrary classification, when this conductivity is less than 0.5 the material is considered an insulator. The conductivities of some common building materials are given in Table II.

Since the figures given in Table II are per inch thickness they are not directly usable; for example, there is no such thing as a one-inch-thick brick wall. Furthermore, walls and roofs are always made up of a combination of materials. However, the figures in Table II do show the relative rate of heat transfer, and obviously the last five materials conduct far less heat than the first five.

TABLE 11.—*Conductivity of Common Building Materials*

(Figures are in B.T.U. per square foot per inch thickness per hour per 1° temperature difference)

Material	Conductivity	Material	Conductivity
Brick	4.6 to 9.9	Cork	0.27 to 0.35
Concrete	2.3 to 12.0	Glass fibre	0.22 to 0.33
Plaster	2.5 to 4.0	Mineral wool	0.25 to 0.33
Granite	19.0 to 20.5	Insulating board	0.33 to 0.40
Wood	0.6 to 1.1	Vermiculite	0.32 to 0.48

Types of Insulating Materials.—Some insulating materials are supplied in the form of boards or rigid sheets; these are termed insulating boards. Others, such as loose rock wool or vermiculite, can be poured into the air spaces between joists or studs. A third type is the bat, which is a more or less loose insulation held together in heavy paper which can be tacked onto wood joists or studs. Finally, and in a class by themselves, are the reflective insulators which do not insulate against conducted heat but against radiated heat.

The dense materials which are good conductors of heat*differ from the insulators in that in the latter there are tiny air spaces, and in ultrasmall spaces air is a very good insulator. However, when the air spaces are large, the heat transfer is aided by convection currents and the air space is not then a particularly good insulator. The conductivity of an air space (per inch) is 1.09. Above $\frac{3}{4}$ in., the addition of thickness of the air space is of little value in reducing conduction.

From fig. 2 and Table II, it becomes obvious that the use of an insulating board of low conductivity in place of the wood sheathing would reduce the heat transfer through the wall. Similarly, use of a mineral wool in the air space would sharply decrease the convection air currents and would eliminate the radiation across the space, since radiation takes place only across a space, so that the wool-filled wall would also be a good insulator. If both the insulating board and mineral wool were used, the wall would be improved even further.

Heat transfer by radiation across the air space can be retarded in still another way—by use of a reflective metal foil. This material, usually aluminum, reflects the radiant rays back to their source; only a very small amount of the energy is absorbed as heat by the foil and conducted to the outside. This type of insulation is useful on either the warm or cold side of an air space, or in an air space, inasmuch as it is not only a good reflector but also a poor radiator of heat energy.

Since the transfer of heat across an air space is aided by convection currents, the use of reflective foil insulation is of more value in winter for floors than for ceilings. This is because the warm surface is at the top of the air space and the foil below the air space in the case of the floor, so that there is virtually no convection. In the ceiling, the reverse is true, and convection is at a maximum. On the other hand, reflective insulations are especially good insulators in roofs in the summer to prevent heat entering the house.

Use of Insulating Materials.—Among the different types of insulation, each has its advantages and uses. The loose or bat type can be used to advantage in filling up air spaces to reduce both conduction and convection. On the other hand, such materials do not add to the strength and rigidity of the building as do the insulating boards, which can be used both as sheathing and as the plaster base or in place of plaster. Finally, the reflective type is advantageous in air spaces to retard heat flow; it may be used in conjunction with other insulating materials or by itself, especially in floors.

It is understandable that each additional increment of insulation yields less return in fuel savings than the first increment, so that there have been attempts to determine how much insulation is justified. Unfortunately, during periods of monetary inflation the cost of fuel may rise far above that contemplated originally, so that a few years later an originally accurate computation becomes highly unbalanced, and far more insulation would have been justified.

Similarly, a more expensive fuel may be employed at a later date, which would justify more insulation than was the case when a low-cost fuel was burned.

In general, then, for a new house it is well to consider the maximum possible use of insulation. For example, bats or loose fill between attic floor joists and reflective insulation on the attic roof; reflective insulation below floors exposed to unheated spaces, and edge insulation along slab floors laid on the ground; insulating board for sheathing and either loose fill or reflective insulation in the air spaces; sealed double windowpanes for all large windows and at least storm windows on others; storm doors on all doors; and windows weatherstripped.

Calculation of Heat Losses.—The heat lost from a building through the walls, windows, roofs, doors and floors is calculated from the equation

$$\text{Heat lost} = \text{coefficient of transmission} \times \text{temperature difference} \times \text{area.}$$

In this equation, heat lost is in terms of B.T.U. per hour; the coefficient is in B.T.U. per square foot of area per hour per degree difference in temperature between the inside and outside; temperature difference is that between the inside temperature and the outside design temperature in degrees (Table III); and area is the area in square feet of floor, roof, wall and window in the space involved. The coefficients can be found in engineering tables.

Thus the heat to be supplied increases (1) as the areas of walls, roofs, glass and doors increase; (2) as the temperature difference increases (in other words, the lower the outside design temperature. the greater the temperature difference and therefore the more heat necessary); and (3) as the heat transmission coefficient increases.

TABLE 111.—*Outside Design Temperatures for Various Cities*

City	Design temperature, °F.	City	Design temperature, °F.
Atlanta, Ga.	10	Jerusalem	30
Boston, Mass.	0	Johannesburg, U. of S. Af.	30
Chicago, Ill.	−10	London, Eng.	35
Denver, Colo.	−10	Manila, Phil.	60
Houston, Tex.	20	Melbourne, Austr.	35
Los Angeles, Calif.	35	Mexico City, Mex.	30
Minneapolis, Minn.	−20	Montreal, Que.	−15
New York, N.Y.	0	Moscow, U.S.S.R.	−40
Seattle, Wash.	15	Paris, France	10
Washington, D.C.	0	Rio de Janeiro, Braz.	55
Adelaide, Austr.	40	Rome, Italy	25
Berlin, Ger.	5	Stockholm, Swed.	0
Buenos Aires, Arg.	30	Sydney, Austr.	45
Cape Town, U. of S. Af.	35	Tokyo, Jap.	20
Glasgow, Scot.	30	Toronto, Ont.	−10
Hamilton, Bermuda	55	Vancouver, B.C.	10
Havana, Cuba	50	Vienna, Aus.	5
Honolulu, Hawaii	60	Winnipeg, Man.	−35

In addition to the heat lost by conduction through the building enclosing surfaces there is a second loss, that by infiltration. Cold air leaks into a building through cracks around doors and windows and through doors and windows when opened. All such air must be heated, adding to the heat lost, because for every cubic foot of air that enters, a cubic foot of warm air leaks out. The importance of infiltration is indicated by the fact that in a typical five-room house infiltration can account for as much as 37% of the total heat loss. The infiltration loss is calculated from the equation

$$\text{Heat lost by infiltration} = \text{air volume entering per foot of crack} \times .018 \times \text{temperature difference} \times \text{feet of crack.}$$

In this equation, heat lost is in B.T.U. per hour, air volume in cubic feet per hour is from engineering tables based on tests, temperature difference is as previously defined, the length of crack is as measured and .018 is the B.T.U. necessary to raise the temperature of one cubic foot of air one degree.

Similarly, for ventilation air, B.T.U. per hour is determined by

Heat lost by ventilation = volume of ventilation air × .018 × temperature difference.

Generally, for homes and apartments, the infiltration air is enough to supply ventilation. In public buildings the necessary quantity of ventilation air is considerable and the resulting heat load is more important than the infiltration loss.

Heat flows from a region of higher temperature to one of lower temperature in proportion to the difference in temperature. In a wall, for example, with room air on the inside at 70° and cold air on the outside at 0°, there will he 70 times as much heat flow through each square foot as when the inside is at 70° and the outside at 69°. In the former there is a 70° temperature difference, in the latter a 1° difference.

Outside design temperatures are based on the lowest temperature experienced in the locality. This outside design temperature is not the lowest temperature of record but ordinarily is the lowest temperature which occurs at least once every three to five years. Table III shows common values of outside design temperatures in a number of important cities.

In calculating the heat loss, each room is figured separately, then the totals added. Since there is no heat flow between rooms at the same temperature, usually only the outside walls have to be considered.

A special case in insulation is that of concrete slab floors laid directly on the ground. Since an important part of the heat lost through the slab is that around the edges, insulation should be applied around these outside edges.

Insulation and Secondary Effects.—The influence of insulation in reducing fuel consumption is so great that this aspect usually overshadows other important advantages of insulation. The temperature of the surface of the inside wall (or roof or floor) is greatly affected by the construction of the wall; and this temperature is higher with insulated than with uninsulated construction. It has been shown that the human body loses heat by radiation to cold surroundings. If the inside surfaces of the walls and windows are relatively cold, this radiation loss greatly affects the feeling of comfort of the occupants. To overcome this, the air temperature is maintained higher than would be the case if the walls were warmer. Since the occupants feel more comfortable when not losing too much heat by radiation, an advantage of the insulated room is that lower air temperatures can be maintained with equal feeling of comfort.

A second advantage concerns the staining of surfaces, especially ceilings. It is commonly believed that the alternating strips of light and dark on, for example, a wood lath and plaster ceiling are caused by the dust left when air passes through the plaster between the laths. This is not the case. Actually, this stain occurs because convection currents of air are created when there is a difference in temperature between the surface and the adjacent air. The surface friction of these currents generates a charge of static electricity of random polarity, the intensity of which depends upon the air velocity, which in turn is governed by the temperature difference between the surface and air. The dust particles suspended in the air have the same polarity as the air, usually negative. The surface, which usually has a charge of positive polarity, attracts the negative dust particles and discoloration results.

If the polarity of the surface and the air happens to be the same, the dust particles are repelled and a noticeably clean streak appears on the surface. Since the temperature difference between the surface and air is less with insulation (*i.e.*, in the areas backed by laths), the velocity of the convection currents is lower, the static charge is less, the attraction of the dust particles is weaker and less discoloration occurs.

With floors, perhaps more than with other surfaces, the effect of warmth or coolness is of great importance. A warm floor can be obtained directly by radiant heating in the floor. In this case it is important that the floor temperature be about 77° F., with 85° as a maximum (an exception is the bathroom floor, where a higher temperature may be pleasant). The floor frequently can be kept at a desirable temperature by use of insulation.

Insulation and Condensation.—The combination of rather high relative humidity in a house, especially when a humidifier is used, low outside temperature and insulation creates the problem of condensation within the wall or roof structure.

With a wall made up of different elements and with a high temperature on the inside and a low one on the outside, the temperatures of the inner surfaces will be somewhere between those of the outer surfaces. Air inside the building, when it has a high relative humidity, also has a high dew point temperature—the temperature at which the moisture in the air will begin to condense. Building materials are permeable to the vapour in the air, and when the temperature inside the wall is at or below the dew point, the moisture from inside the house will condense inside the wall and may cause damage.

To overcome this, the usual practice is to apply a vapour barrier on the warm side of the wall. In some cases this is a sheet of paper containing asphalt; in others the vapour-resistant material is applied to an insulating board. In either case, the resistant material should be continuous, with no openings through or around it. Also, it is important that the material he in the warm or inside portion of the wall. If placed on the outside it can make the problem worse.

Vapour barriers are more necessary with a high degree of insulation than with little or no insulation, more necessary the colder the climate and more necessary the greater the amount of moisture release inside the house from humidifier, cooking and washing. It is especially important that vapour barriers be well overlapped and tightly sealed so that the vapour cannot flow through leaks in the barrier.

Heating Load

The subject of heat loss thus far has been treated entirely on the design basis; that is, the maximum hourly heat loss that is anticipated for extremely cold days. Obviously this does not represent the average load, nor does it give much indication of the total load or fuel consumption for a whole winter.

In the early 1920s it was discovered that the gas consumption of a number of heating plants was proportional to the difference between 65° and the daily mean temperature when the latter was below 65°. This difference multiplied by 1 (day) gave the number of degree-days for that day. For example, on a day when the mean temperature is 42° there are 65 − 42 = 23 degree-days. The total number of degree-days from fall to spring in a given city is the degree-day total for that city for that heating season. A long-time average of such seasonal totals gives the normal number of degree-days for that city (see Table IV).

The degree-day has several uses. One is based on the fact that a building will consume fuel in any period at a rate in proportion to the number of degree-days in that period. For example, if in a winter having 5,000 degree-days a house used 2,000 gal. of oil, and if the next winter there were only 4,000 degree-days, the oil used in the second winter will be —— or 80% as much as in the first, or 1,600 gal. In short, use of the degree-day makes it possible to measure with precision the effect of a cold winter or a mild winter on fuel consumption.

Table IV.—Normal Number of Degree-Days per Heating Season in Typical U.S. and Canadian Cities

City	No. of degree-days	City	No. of degree-days
Atlanta, Ga.	2,811	Louisville, Ky.	4,279
Birmingham, Ala.	2,780	Minneapolis, Minn.	7,853
Boston, Mass.	5,791	Montreal, Que.	8,501
Chicago, Ill.	6,310	New Orleans, La.	1,175
Cleveland, O.	5,717	New York, N.Y.	5,050
Denver, Colo.	5,673	San Francisco, Calif.	3,069
Detroit, Mich.	6,404	Seattle, Wash.	4,438
Halifax, N.S.	7,608	Toronto, Ont.	7,322
Houston, Tex.	1,276	Vancouver, B.C.	5,465
Kansas City, Mo.	4,888	Washington, D.C.	4,258
Los Angeles, Calif.	1,451	Winnipeg, Man.	10,919

An ingenious use of the degree-day is to anticipate fuel usage. For example, at the end of three months the fuel oil supplier finds that a house used 600 gal. of oil and during that period there were 1,200 degree-days; the house is thus using 0.5 gal. of oil per degree-day. From past experience, he knows that the subsequent two months will have a probable 2,300 degree-days; therefore he

knows that the house will need 1,150 gal. of oil in that period. By this method he can predict when the oil tank will be nearly empty and deliver oil before the fuel supply runs out.

From the normal number of degree-days kept on a monthly basis for each city, it is possible also to predict reasonably well the average percentage of the total winter's fuel consumption which will be used each month (see Table V).

The degree-day on a 65° base is used in the U.S. and Canada. The degree-day is used also in the British Isles, but there, because

TABLE V.—*Heat Load* and *Fuel Consumption by Months in Percentage of Heating Season Total*

Month	Denver	Los Angeles	New Orleans	New York
September	2%	—	—	1%
October	8	3%	2%	5
November	12	8	12	11
December	17	16	25	18
January	17	20	26	19
February	15	17	21	18
March	14	15	11	15
April	9	11	3	9
May	5	8	—	3
June	1	2	—	1
Total	100%	100%	100%	100%

of lower inside temperatures, the base is 60°. The figure 4,200 is a good average seasonal total of such degree-days for England.

FUELS

Fuels commonly used for heating buildings include coal, oil, manufactured and natural gases and wood. There are two other not uncommon sources of energy for building heating: electricity, and steam or high-pressure, high-temperature water piped to groups of buildings from a remotely located generating plant. The latter is a special case, usually called district or institutional heating in the U.S.

Wood.—In early times this was the only important fuel and was burned in fireplaces and later in stoves designed for heating. It was gradually displaced by coal and by the 20th century had become a relatively unimportant fuel in North America and much of Europe.

Coal.—Bituminous (soft) coal, which contains not only carbon but hydrocarbons as well, is an important fuel for heating buildings, but rather more so for larger buildings than for homes. It can be fired by hand or by mechanical stokers, and it is the lowest-cost fuel in many areas. However, it is relatively dirty, ash removal is a task and even a mechanical stoker is not completely attention-free, so that its use has declined.

Anthracite (hard) coal is almost pure carbon and once ignited burns with less attention than soft coals. While cleaner than bituminous coals, its disadvantages are much the same, and in addition it is more expensive.

Oil.—Fuel oil was used first for building heating on the Pacific coast of the U.S. and became of some consequence in the early 1920s. By the end of that decade it had made important inroads on coal in the heating of houses and larger buildings, especially the former. Its primary advantage is that, being a liquid, it can be controlled more precisely and burned automatically under control of a room thermostat. In addition, and of great interest to home occupants, it is stored in a tank with no attendant dust, and it leaves no dirty ash which requires periodic removal. As a result of these advantages, and in spite of the higher price of oil during the early days, oil began seriously to displace coal as a heating fuel in the mid-1920s, and this trend continued unbroken except for wartime periods of shortage.

Gas.—Natural gas has long been used for building heating, but its use at first was confined to areas in close proximity to gas deposits, from which it was piped to buildings. Manufactured gas, made by a variety of processes from coal and oil and first widely used for illumination and later for cooking, was considered too expensive for heating, relatively, until about 1920, when it began to be burned in house-heating plants of persons with high incomes.

Gas has all the advantages of oil, plus a few of its own, including the fact that it is even easier than oil to burn and to control, the homeowner needs no storage tank and pays for the fuel after he has used it, the burner can be operated, if necessary, when electric service is interrupted because of storms, and fuel delivery is unaffected by snowstorms or forgetfulness. The apparatus needed is simpler than that required for oil and has few moving parts. The cost, however, is relatively high except in locations near gas deposits. After 1940 the commercial production and marketing of liquefied propane has greatly increased as a result of the popularity of gas fuel in districts isolated from natural-gas pipelines. (See also GAS INDUSTRY.)

Electricity.—This form of energy ranks highest in ease of control for heating and in simplicity of apparatus, but the cost in most cases is far too high for widespread use. Exceptions to this are areas near hydroelectric generating plants. Electricity also has a wide range of possible applications as a secondary or supplementary form of heat, as for bathrooms, buildings used only occasionally (such as churches), rooms with poor heating facilities where the cost of correcting the trouble would be high, and similar special cases.

Solar Heating.—Another source of heat with promise of greater importance at mid-20th century is energy from the sun. By careful orientation of the house with respect to the sun it is possible, with proper shading, to allow sunlight to enter the windows in winter when the sun is far to the south and to prevent it from entering in the summer when the sun is overhead. (See also SOLAR ENERGY, UTILIZATION OF.)

FUEL-BURNING EQUIPMENT

Among the more important types of self-contained heat sources are (1) the fireplace; (2) space heaters, room cabinets or stoves fired by coal, oil or gas; (3) radiant heaters, burning gas or containing electric resistance coils, and of either the portable or fixed type; and (4) convection unit heaters burning gas or containing electric resistance coils and equipped with a fan to blow air over the hot surfaces. All these are of the more or less self-contained type for individual room use.

For central heating, where the fuel is burned in one place—the basement or utility room—and from which steam, hot water or warm air is distributed to adjacent and remote spaces to be heated, there are (1) hand-fired coal furnaces and boilers; (2) stokers for automatically burning coal; (3) oil burners, oil furnaces and oil boilers; and (4) gas burners, gas furnaces and gas boilers.

History and Development of Heating **Equipment.**—At the beginning of the Christian era, the Romans had developed a central heating system which utilized conduction, convection and radiation. A furnace was constructed beneath the floor of a building or adjacent to it. The products of combustion were conveyed under the floor, up through flue panels in the walls, and finally discharged to the atmosphere. Several of these systems were uncovered in London after World War II, relics of the ancient Roman occupation. Similar systems are used in certain provinces in China and Japan.

While feudalism was reaching its crest during the 11th and 12th centuries, fortified castles were built. The castles were multiple-storied structures and the disposition of smoke from the fireplaces presented a problem. A solution was achieved by moving the fireplaces to niches in outside walls and providing sloping passages through the wall through which the smoke could escape. The chimney was not introduced until the 14th century.

The great halls or assembly rooms of the castles were provided with one or more large fireplaces, while the occupants of the smaller rooms depended for warmth on individual metal baskets or braziers, filled with coals. It is interesting to note that the interior walls opposite the great fireplaces were constructed of solid masonry of much greater thickness than was structurally necessary. These walls of tremendous thermal capacity absorbed radiation from the fireplaces and reradiated heat to the room long after the fires had burned low. This idea was retained and reappeared in the U.S. early in the 19th century. Many brick houses had two fireplaces on one side of the room while the opposite wall was constructed of solid brick masonry 27 in. or more in thickness.

The fireplace remained in wide use at mid-20th century. In England, although it was gradually giving way to central heating, the

fireplace was still an important source of heat in residences.

The earliest reported improvement in the fireplace was that of Louis Savot, who in 1624 developed for the Louvre a fireplace in which room air was drawn through passages under the hearth and behind the fire grate and then discharged into the room through a grille in the mantelpiece, so that occupants were warmed by convected as well as radiant heat. A century later there was introduced a fireplace which warmed air drawn from either the inside or outside of the building.

Fireplaces produce warmth principally by radiation from the fire and from hot bricks at the back and hearth. Air passes through the fire and up the chimney, carrying most of the heat outside, and cold outside air must be drawn into the room to replace the air thus exhausted. Consequently, the fireplace is only about one-third as efficient as a good stove.

Stoves.— The first stove of record was produced in 1490 at Alsace, France. It was constructed of brick and tile. The products of combustion escaped from the stove through a heavy brick and tile flue. Later developments resulted in the Scandinavian stove, which had a tall hollow iron flue containing iron baffles arranged to lengthen the gas travel, and the Russian stove, which had as many as six thick-walled masonry flues. This type of stove is in common use in the regions bordering the North sea. The stove is often built at the intersection of inside partition walls in such a manner that a portion of the stove and its flue is in each of four rooms. A fire is maintained until the stove and flues are thoroughly warmed; then the fire is extinguished and the flues are closed. The stored heat is delivered to the rooms by radiation and convection.

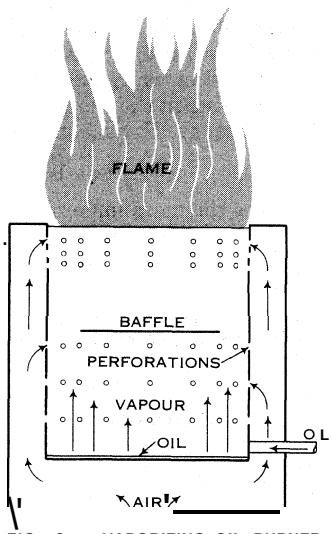

FIG. 3.— VAPORIZING OIL BURNER THE OIL BURNS AFTER BEING EVAPORATED TO GAS

The first manufactured cast-iron stove was produced at Lynn, Mass., in 1642. The stove had no grates and was simply a cast-iron box.

In 1744 Benjamin Franklin improved the stove which bears his name and which was used in conjunction with the fireplace. He also established basic principles of stove design. At about the same time (1792), William Strutt, in England, made a further advance by passing air from a stove through channels so that more remote rooms could be heated.

The first round cast-iron stoves with grates were manufactured at Philadelphia, Pa., in 1800 by Isaac Orr. The base-burner stove for burning anthracite coal was invented in 1833 by Jordan A. Mott.

Although petroleum was known and animal and vegetable oils were used in crude lamps during ancient times for warmth, it was not until the 19th century that oil-burning equipment was specifically designed for producing warmth.

Coal Burning Equipment.— The basic requirements for burning any form of coal efficientlyare (1) a grate on which the fuel is burned and through which air can pass to the fuel bed, and which can be shaken to drop ashes to a pit below; (2) means for carrying the products of combustion to the outside, usually a chimney; (3) means for providing a draft so that air will flow into the ashpit through the grate and provide the primary air necessary to allow sufficient oxygen to mix with the carbon in the coal during the combustion process; (4) means for admitting a secondary supply of air over the fire to supply oxygen for burning the volatile gases and hydrocarbons in the coal, this being of more importance in burning bituminous coal than anthracite; (5) a metal surface, over which the hot products of combustion pass, sufficiently large that heat is transferred to that surface, which in turn will heat water or air; and (6) a chamber of sufficient volume surrounding the grate to allow the air to mix with the fuel.

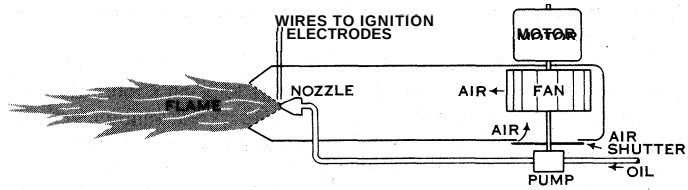

FIG. 4.— ATOMIZING OIL BURNER. BURNING OCCURS AFTER THE OIL HAS BEEN CHANGED TO A GAS BY BEING FORCED UNDER PRESSURE THROUGH A SMALL NOZZLE INTO AN AIR STREAM

All these requirements are fulfilled in hand-fired coal-burning furnaces and boilers, as well as in mechanical stokers, which, in addition to the above, provide means for feeding coal gradually and automatically to the grate and make the process of firing including the disposal of the ashes to a pit, a continuous one. Such stokers have wide application in industrial and commercial installations, but for residences the stoker, which had wide popularity during the 1930s and early 1940s, gradually lost ground because of the advantages of oil and gas.

Oil Burners.— Oil burners used in residences are of two principal types— vaporizing and atomizing. In burning oil, the liquid must be gasified to burn, and the vaporizing burner accomplishes this by evaporation, the oil being heated for this purpose.

In fig. 3 the principle of one type of vaporizing burner is illustrated. Oil is fed to the bottom of a bucket-shaped perforated vessel; vapour rises from the oil and is mixed with the primary air and finally, at the top, begins to burn, with a secondary supply of air fed to the flame through the perforation at the top. The heat of the flame itself causes more oil to vaporize, so that the process is continuous.

In the atomizing- or pressure-type burner, illustrated in fig. 4, the oil is atomized or broken up into small drops by pressure. The air pressure is supplied by a motor-driven fan, the air supply being regulated by a shutter. Oil is fed to a nozzle under pressure by a pump and is ejected from the nozzle in a cone-shaped spray into the air stream. This burner is also called a gun-type burner.

Another type of atomizing burner is the rotary burner. The rotary type employs a motor-driven cup or disk from which the oil is thrown off in a cone-shaped spray.

In large installations there is an increasing tendency to use burners so designed that they can burn either gas or oil, or pulverized coal, arranged for convenient change from one to the other. The advantage is that when one fuel becomes more expensive than another, or when one is in short supply, another may be used.

Gas Burners.— Gas burners are generally of simple design. Gas is supplied to the burner at a pressure sufficient to induce a supply of primary air to mix with it, the mixture then passing through orifices or ribbonlike openings over which secondary air is admitted. In the usual case this is all accomplished without a forced draft, so that the mechanism is simple and trouble-free.

Requirements for burning gas also include a combustion chamber and means of heat transfer and, finally, venting to the atmosphere for safety. The fuel used is completely independent of the method for transferring the heat to the rooms to be heated; that

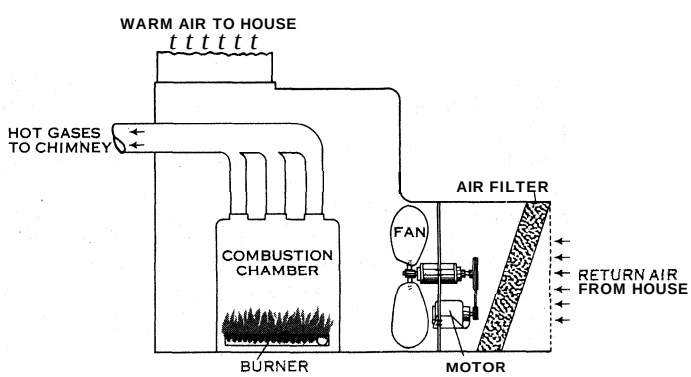

FIG. 5.— FORCED WARM-AIR FURNACE

is, whether the heating system utilizes warm air, steam or hot water, the fuel can be coal, oil or gas.

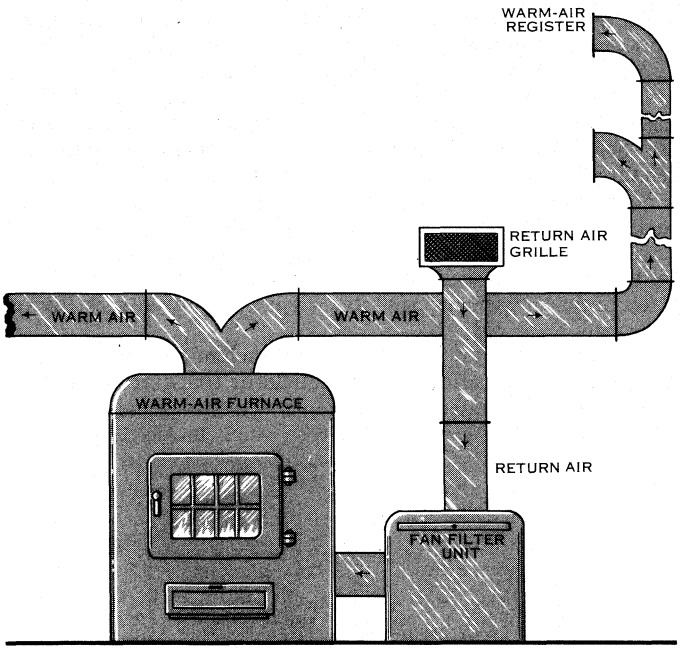

FIG. 6.— FORCED WARM-AIR SYSTEM. HEATED AIR IS BLOWN TO ROOMS BY A FAN. AND THE AIR RETURNS TO THE FURNACE FOR REHEATING

Electricity. — Although not a fuel, electricity is a form of energy used for heating, and the commonest method of converting the energy to heat is by coils or other. means of introducing resistance into the circuit, so that the heating elements become hot and directly heat air or water or, in other cases, emit radiant energy.

Heating Systems

Heat is generated by fuel burning either in a furnace, an arrangement by which air is warmed by contact with metal surfaces heated in turn by the hot gases of combustion, or in a boiler, a vessel containing water heated by contact with hot surfaces. The boiler can be either a steam or hot-water boiler and may be used with a steam or hot-water system.

Warm Air. — The principle of the warm-air furnace is illustrated in fig. 5. The furnace is conventionally made of steel, and the essential requirements are that (1) the combustion chamber and its connections to the flue must be gastight to prevent fumes from getting into the stream of air supplied to the house; (2) there must be sufficient metal surface to provide for the transfer of most of the heat of combustion to the air; (3) there must be a tight casing around the whole apparatus; and (4) the furnace should be compactly arranged. The drawing is simplified to show the principle; a centrifugal fan rather than a propeller fan usually is employed.

The warm air from a furnace, being lighter than the cooler air around it, can be carried by gravity in pipes or ducts to the room to be heated, and until about 1930 this was the usual method. A gravity system, however, required sheet metal ducts of 8 to 14 in. in diameter to reduce air friction, and this resulted in the basement's being filled with ductwork. The pressure, or head, resulting from the difference in density of the air is quite small, and for this reason rooms distant from the furnace, especially those to windward, frequently were underheated. Use of a motor-driven fan to move the air made possible the use of small, compact, rectangular ducts giving a neat installation and forcing heated air to the most remote rooms.

The heated air is introduced into the room through registers, grilles or diffusers in a variety of types, including arrangements resembling baseboards along outside malls. The heated air, after giving up its heat to the room, is returned to the furnace, usually through one or two return ducts, as shown in fig. 6. An advantage of this method of forced warm-air heating is that the air can be passed through filters and cleaned as it circulates through the system.

Hot-Water Heating. — Hot-water heating seems to have originated in France early in the 18th century and was used first in a greenhouse. An incubator for hatching chickens for the Paris market was heated by a hot-water circuit even before the French Revolution. Hot-water pipes were employed by Sir John Stone in 1792 to heat the Bank of England, but it was not until about 1840 that Robert Briggs began the installation of hot-water heating in the U.S.

A hot-water system consists of the boiler and a system of pipes connected to radiators suitably located in rooms to be heated, the principle being shown in fig. 7. The pipes, usually of steel or copper, feed hot water to radiators or convectors: which give up their heat to the room. The water, now cooled, is returned to the boiler for reheating. Two important requirements of a hot-water system are (1) provision to allow for the expansion of the water in the system, which fills the boiler, radiators and piping; and (2) means for allowing air to escape from each radiator by a manually or automatically operated valve.

Early hot-water systems, like warm-air systems, operated by gravity, the cool water, being more dense, dropping back to the boiler, forcing the heated lighter water to rise to the radiators. Neither the gravity warm-air nor gravity hot-water system could be used to heat rooms below the furnace or boiler. Consequently, motor-driven pumps or circulators introduced to supply positive means of circulating water made it possible to locate the boiler anywhere with regard to its elevation compared to the radiators—even in the attic if desired. As with warm air, smaller pipes can be used when the fluid is pumped than with gravity operation.

Steam Heating. — Steam heating on a practical scale was investigated by James Watt in 1784, and in 1791 a Halifax inventor patented a steam-heating method. Thomas Tredgold in 1824 employed cast-iron pipes to heat by steam a silk mill in Watford. Eng. Early Americans who contributed to the development of steam heating included John H. Mills, who in 1877 designed an overhead downfeed one-pipe steam system. Frederick Tudor in 1883 developed the modulating valve and in 1902 made improvements in a return line system vented to the atmosphere. In 1899 James A. Trane developed a vapour system. and in 1903 C. A. Dunham marketed a fluid-filled thermostatic trap for steam systems.

Steam systems are those in which steam is generated, usually at less than 5 p.s.i. in the boiler (fig. 8) and the steam is led to the

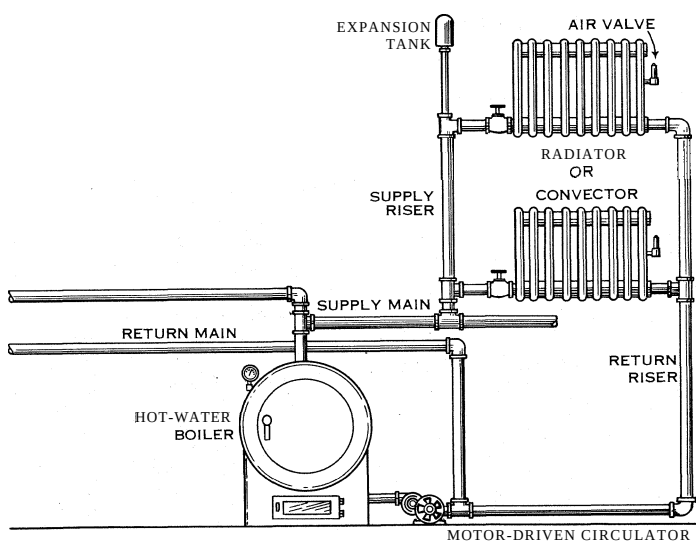

FIG. 7.— FORCED HOT-WATER SYSTEM. WATER IS DRIVEN THROUGH THE SYSTEM BY A CIRCULATOR

radiators through steel or copper pipes. The steam gives up its heat to the radiator and the radiator to the room, and the cooling of the steam condenses it to water. The condensate is returned to

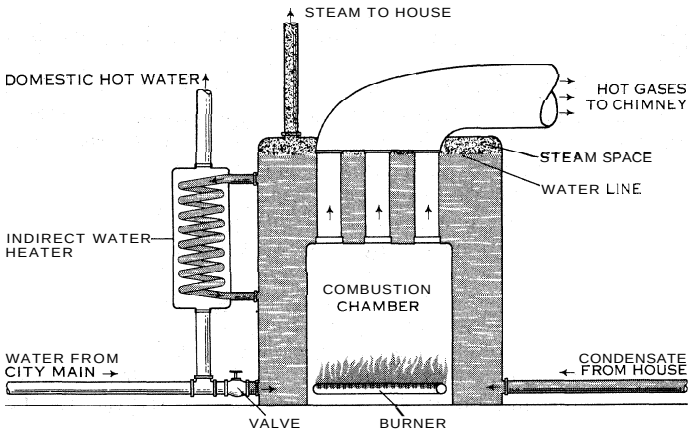

FIG. 8.— STEAM HEATING BOILER

the boiler either by gravity or by a pump. Arrangement of a simple one-pipe system is shown in fig. 9. The air valve on each radiator is necessary to allow air to escape. Otherwise it would prevent steam from entering the radiator.

The vapour system (fig. 10) differs from the one-pipe system in that (1) the condensed steam returns from the radiator through a return pipe to the boiler (instead of through the supply pipe); (2) a trap. a device which allows uater and air but not steam to leave the radiator, guards the return outlet; and (3) air is eliminated through a device at the boiler instead of through air valves on each radiator.

A system widely used in larger buildings is the vacuum system (fig. 11). A vacuum pump maintains a pressure below that of the atmosphere in the return lines, draws all the air and water to it, expels the air and pumps the water back into the boiler. A feature of this system is its ability to raise the condensate from a radiator below the boiler.

Much ingenuity has been applied to steam heating, including methods for controlling the steam temperature. By maintaining a vacuum in the radiator as well as in the return lines, the pressure inside the radiator can be reduced to such a point that water will boil at temperatures well below the 212° F. at atmospheric pressure. Consequently, on the coldest days no vacuum is applied, and the steam in the radiator is at 212°. The warmer the day, the more vacuum is applied. until at 65° outside a vacuum sufficient to cause boiling at below 100° will result in a lower radiator temperature, and so on through the whole range of outside temperatures expected. In this way, the radiator is constantly emitting heat in proportion to the demand and is not alternately heating and then cooling off.

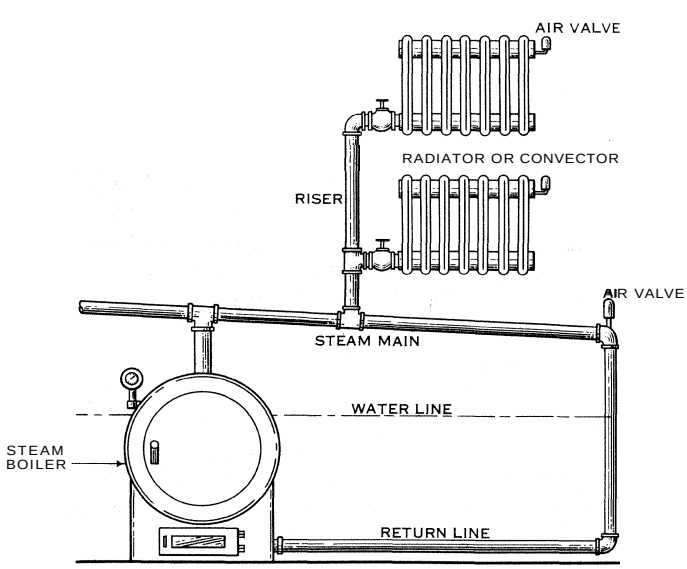

FIG. 9.— SIMPLE ONE-PIPE SYSTEM IN WHICH STEAM FLOWS UPWARD THROUGH A RISER TO THE RADIATORS, WHILE CONDENSATE FROM THE RADIATORS IS RETURNING DOWNWARD THROUGH THE SAME PIPE TO THE BOILER

The hot-water system differs from both warm-air and steam systems in an important respect—both warm air and steam, being gases, have a low mass as compared with hot water. As a result, with an intermittently fired fuel, such as oil or gas, in which the fuel is burning at one period and off the next, the hot-water system can "hold" heat for a longer period and not undergo the sharp temperature fluctuations of steam and warm-air systems.

To perform most efficiently. steam systems require more apparatus than hot-water or warm-air systems. As a result, warm air and hot water have largely replaced steam in house heating. On the other hand, in larger structures, such as office buildings, hotels and apartment houses, steam has such advantages that it is strongly preferred.

Heat Distribution Devices.—With each of the three systems there are many variations in the method of transferring the heat to the space to be heated. For example, with steam and hot water, an alternative to the common radiator (which: incidentally, is mis-

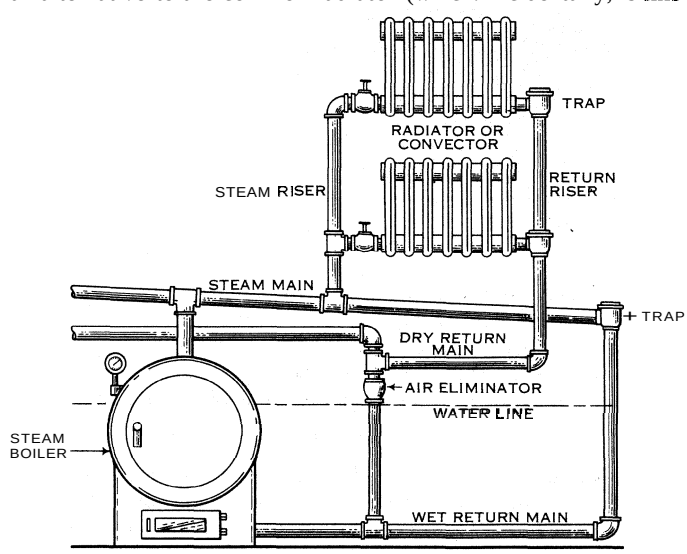

FIG. 10.—VAPOUR SYSTEM, IN WHICH THE AIR IS REMOVED FROM THE SYSTEM AT A CENTRAL ELIMINATOR RATHER THAN THROUGH VALVES ON EACH RADIATOR

named, because it emits much of its heat by convection) is the convector. an arrangement of finned pipes through which the heating fluid circulates at the base of an enclosure open at top and bottom; air flows upward over the heating surface and is discharged at the top of the enclosure; cooled air drops to the floor and re-enters the convector.

Still another arrangement is the baseboard radiator or convector, usually placed along the bottom of an outside wall to counteract the loss of heat through the walls.

Many industrial buildings are heated with a special form of heater called the unit heater, which consists of an arrangement of finned tubes through which hot water or steam circulates, and a motor directly connected to a fan which forces air over the tubes. Unit heaters are made both in suspended types, mounted above the floor (fig. 12), and in floor-mounted units. The forced convection results in a rapid rate of heat transfer.

There are many combination systems using steam and hot water aith warm air. called split systems. Many public buildings are heated by hot-blast systems in which steam is generated in a boiler and flows to large banks of heat-transfer surfaces over which air is blown by large fans; the warmed air is supplied to rooms through ducts. This type of system is often used for air conditioning, the heat-transfer surface being fed cold water in summer, steam in winter.

For residences there is an arrangement of hot water piped to small heat-transfer devices below the floor or in the walls; over them air is blown by fans and enters the room through grilles. In the summer, chilled water circulates to the heat-transfer units,

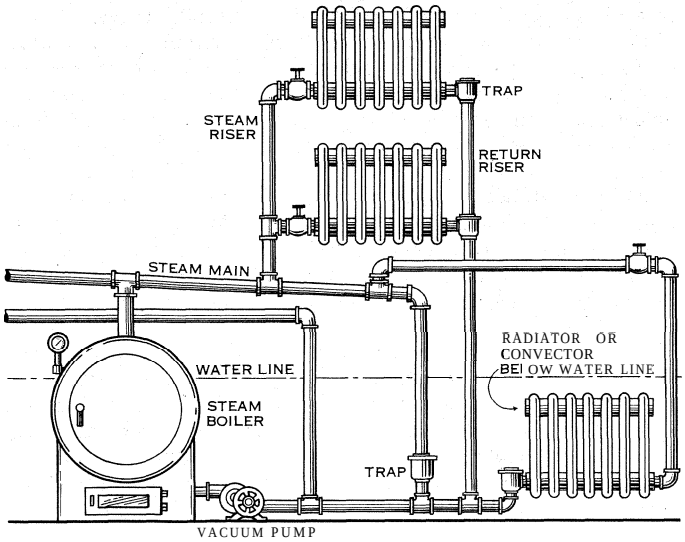

FIG. 11.— VACUUM SYSTEM IN WHICH CONDENSED STEAM IS PUMPED BACK INTO THE BOILER. THE SYSTEM OPERATES AT LESS THAN ATMOSPHERIC PRESSURE

which are located throughout the house so that no long runs of space-consuming ductwork are needed. All these methods are primarily convection types of heating, although there is some transfer by radiation.

Radiant Heating.— The Roman hypocaust system, in which a hollow wall or floor was heated by gases from a fire below and in turn radiated heat into a room, was the first application of what is now known as radiant or panel heating. This principle was ignored for centuries until 1908, when A. H. Barker of England observed the comfortable effect obtained from walls warmed by chimneys. He later patented several arrangements for heating floors, walls and ceilings, and many such systems were installed in England. The idea was first widely adopted in the U.S. not long before World War II.

Although there are many variations, radiant heating systems usually employ either (1) hot-water pipes embedded in the floor or ceiling (occasionally in the walls); (2) warm-air ducts embedded in the floor; or (3) some form of electrical resistance panels applied to ceiling or walls or, in some cases, the floor. The energy in the heated surface is transmitted through the air in the form of infrared rays, with practically no temperature effect on the air, and converted to heat when the rays impinge on solids, whether room surfaces, furniture or human beings. With many of these systems there is no visible heating equipment in the room, and this is an advantage in decorating. A disadvantage is the extent to which a ceiling or floor might be ruined in the case of trouble with corroded or faulty hot-water piping where this method is employed.

Heating Controls.— Oil and gas fuels never would have attained their great popularity had it not been for automatic operation of the heating plant. Automation was made possible principally by the thermostat, a device which, when the temperature in a space drops to a predetermined point, will actuate the heating plant until the demand for heat is satisfied.

Other important controls include (1) the limit control, which, when the air, water or steam temperature from the furnace or boiler reaches a point considered dangerous, will shut off the heating plant even if the thermostat still calls for heat; (2) boiler water level control, which either shuts off the burner or opens a valve to admit water to the boiler if the water level in the boiler has fallen to a dangerously low level; and (3) the flame control! which shuts off the fuel supply if the ignition system for lighting the oil or gas flame fails. Modern heating plants are so protected by such devices that nearly every conceivable circumstance which could be dangerous is anticipated and controlled.

Chimneys and Draft.— The products of combustion from oil, gas or coal must be vented to the air, and the chimney provided to carry them away must be of sufficient height to produce a certain minimum draft. The one-story house in particular presents a problem, because if the chimney is to be adequate its height may be out of proportion to the scale of the house.

Service Hot Water.— The heating of water for bathing, washing and other purposes is part of the over-all heating problem. In houses, formerly, a very small hand-fired coal boiler commonly was used for this purpose alone. This was largely superseded by (1) the separate gas, electric or oil water heater in which the heating burner or element is included in the same unit as the hot-water storage; when hot water is drawn off, cold water enters, affecting a thermostat which turns on the heat until the tank temperature again reaches the predetermined level; or (2) a heat exchanger of small size connected to the house-heating boiler and extracting heat from the boiler water to heat the service water (see fig. 8).

With the separately fired unit, the heating system and hot-water system are entirely independent of each other, an advantage in case of trouble and during seasons when the heating system is not needed. With the combination system, the heat used to heat the water is by no means all waste heat, and a larger boiler must be provided if an indirect heater is to be installed. On the other hand, some tests have indicated greater economy with the indirect heater. With a warm-air furnace the homeowner has little choice but to use a separate, direct-fired heater.

The total hot-water use ranges from 7 to 12 gal. per day per person on the average, although the range may be as much as 4 to 25 gal. per day per person, and some authorities even use a figure as high as 40 gal. per day per person. The figure varies widely with different families.

The trend is toward higher temperature hot water because of (1) the importance of killing bacteria in dishwashing, tests of which have demonstrated the need for temperatures of at least 180°; and (2) the desirability of very hot water for washing clothes Since it is impracticable to carry 180° water in the whole system and in fact actually dangerous because of possible scalding, dish-mashing machines are often equipped with electric heaters to raise the temperature of the water.

District Heating.— First put into practice in Lockport, N.Y., in 1877, the arrangement of piping steam (or hot water) from a steam plant to a number of buildings became fairly widespread. In many large cities, especially in the U S., the business became a sideline of electric utility companies, and the steam lines served the business districts of the city—the larger buildings; supplying private homes aith this service was not deemed profitable. On the other hand, there were hundreds of small towns served by municipally owned utilities whose principal function was residential heating.

Centrally located private plants serving a number of buildings are still commonplace in the U.S in two other cases: first, in large institutions, such as colleges and hospitals, and, second, in large housing projects. The former application has existed for decades. In the latter case, however, the practice began in the 1930s when the federal government sponsored or built many such plants

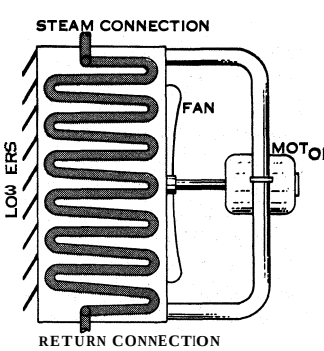

FIG 12 —UNIT HEATER THROUGH WHICH AIR IS BLOWN BY A FAN ADJUSTABLE LOUVERS DEFLECT HEAT IN DESIRED DIRECTION

VENTILATION

As early as 1553 a rotary fan was used by Georgius Agricola to ventilate a mine; and during the 18th century, French, English and Swedish inventors were concerned with improving the fan for mine and ship ventilation. The reason behind the need for ventilation, however, was a mystery: some investigators said it was excessive heat; others disputed this and said the reason mas inequality of temperature in the room or space In 1777 the French chemist Antoine Lavoisier suggested that the increase of carbon dioxide in an occupied space was the objectionable factor, but Max Joseph von Pettenkofer in 1363 showed that this was quantitatively too small (0.03% to 0.05%)

to explain the results observed. Similarly, the reduction of oxygen content was said to be small, from a normal 21% to about 20%.

In the late 19th century the French physiologist Charles Edward Brown-Séquard advanced the theory that the harmful effects of air in an occupied space were attributable to certain poisonous substances in the air called anthropotoxins or morbific matter.

All these theories were finally abandoned, as a result of the work of Karl Flugge in 1905, F. G. Benedict in 1907 and J. S. Haldane in 1907. Flugge showed that (1) chemical changes in the air in occupied spaces are not harmful; (2) headaches, nausea and dizziness in ill-ventilated space are solely due to deficient heat loss (from the body); and (3) the temperature, humidity and movement are far more important than chemical changes in the air.

Essentially this covers the theory subsequently adopted, although there are special cases including (1) factories where dangerous fumes are given off, or even homes where unvented gas appliances can result in dangerous conditions; and (2) situations in which the effect of odours is important. The modern theory can be summed up in the statement that for places of general assembly the purpose of ventilation is to carry away excess heat and odours, and that normally ten cubic feet per minute of outside air per person is sufficient to accomplish this objective. In buildings such as homes, the leakage of air through cracks around doors and windows is usually sufficient to meet this requirement.

Industrial Building Ventilation.— Industrial buildings often present special problems in ventilation. Certain processes are accompanied by the production of air-borne dust, fumes, toxic vapours and gases which are hazardous to the health of workers. Research has determined the limits of concentration permissible for human tolerance to prolonged exposure. The problem of industrial ventilation is also complicated by the hazards of fire and explosion of combustible dust and gases.

Successful methods have been developed for the control of the concentration of toxic gases and harmful dusts within safe limits for the health of the occupants of spaces, but the control of inflammable and explosive concentrations of gases and dusts is much more difficult and uncertain.

Three types of ventilating systems are in use for the control of dangerous gases and dusts: exhaust systems, dilution systems and combinations of the two. Exhaust systems require the least amount of air and are most effective when the contaminants originate at localized spots. The contaminated air is exhausted at high velocity from hoods which have sufficient entrance velocity to pick up the contaminants. Exhaust systems are least effective in the ventilation of bins, coal bunkers, etc.

The dilution method is used when the sources of contamination are not localized but are dispersed over a wide area. It is very effective but is seldom used to dilute heavy concentrations because of the large quantities of air required. The cost of heating the air is often prohibitive.

The third method of control by ventilation is a combination of exhaust and dilution, and is used when contaminants can be confined to and exhausted from booths. The development of air-cleaning devices and air-purification processes makes it possible in many cases to recirculate the air and greatly reduce the quantity of fresh air required, thus reducing the expense of operation.

Motor-driven fan systems are not always necessary, and natural forces — gravity and wind — may be used to facilitate air movement. In a building where the air temperature inside is higher than that outside, the difference in density can be employed as it is in a chimney. Any opening in the roof can be employed, and the warm, light air flows out, its place being taken by cooler air flowing in below. This method is crude, because rain can enter through the opening and because the air flow is very low when the difference between inside and outside temperatures is small.

Ventilating Apparatus.— To overcome these disadvantages, many types of roof ventilators have been designed. A typical gravity roof ventilator is designed so that wind rotates it into such a position that the flow of air past the ventilator draws room air through the ventilator and also so that rain or snow cannot enter. Motor-driven roof ventilators also are made to give air movement regardless of available wind and temperature differences.

In winter the exhausting of air from a building at any point necessarily results in cold outside air entering elsewhere, and this cold air can produce disagreeable drafts. Consequently make-up air-heating units are frequently employed to heat the outside air introduced so as to balance the warm air being exhausted. (See also FAN [MECHANICAL].)

Attic Ventilation.— A fan located in the attic may be so arranged in a house with open stairways that during the summer the fan operates at night when temperatures drop and, with open windows in the house, drams warm air from the house through the fan and discharges it to the outside, cool night air being drawn in through the open windows.

Fans which exhaust directly to the outside from the attic space should be located so that they discharge with and not against the prevailing wind. Those which exhaust into the attic from the space below should be located over a central hall. The discharge from the fan should be as far as possible from adjacent walls and chimneys. A minimum distance of six to eight feet should be maintained, if possible.

Air Sanitation.—Although ventilation was formerly concerned with the supply of fresh air (a misnomer for outside air) to and the removal of hot and contaminated air from the space, it gradually came to embrace — or at least to be associated with — what can be termed air sanitation, the cleaning of air, whether the contaminating substance be dust, toxic fumes, odours or bacteria.

Air pollution in large cities is caused by the dumping into the atmosphere of exhaust gases from gasoline and diesel engines and coal, oil and gas-fired boilers, and dusts and fumes from a wide variety of industrial operations. Of these the most attention formerly was paid to coal boiler operations, and the problem was generally believed to be a smoke problem. Perhaps the turning point in this viewpoint was the Donora, Pa., disaster in 1948, when smog, a combination of factors — fumes from an industrial plant, a natural fog, and a valley location isolated from breezes at the time — caused 20 deaths. This disaster coincided with a rapid decrease in the number of coal-fired steam locomotives, which were replaced by diesel engines, but which formerly were among the important smoke producers. As a result, there was an increasing tendency to look on air pollution as a problem comprising more factors than control of smoke-producing apparatus alone would eliminate. (See also SMOKE AND SMOKE PREVENTION.)

Dust can be removed from the air by four basic methods: (1) filters, mechanical devices of porous mediums through which dust-laden air is passed and in which the dust trapped by impinging upon or enmeshing in the filter medium, a common type being coated with a viscous substance to which the dust clings; (2) electrical precipitation, by which the dust particles are attracted and held by oppositely charged wires; (3) the wet method, or washing of the air by water sprays; and (4) dynamic precipitation, by which the dust is thrown off by centrifugal force in a mechanical device such as the so-called cyclone.

In general, air filters are used where the dust concentration is relatively low and does not exceed 4 gr. per 1,000 cubic feet of air. The dusts these filters remove can be termed temporary atmospheric impurities, including house dust and pollens. which are specific nuisances to persons allergic to them. The filtering medium varies, and glass fibre, wire screen, steel wool, animal hair and hemp fibres have all been employed.

Electric precipitators are of two types — one of the ionizing type in which dust particles are given a charge in passing through an ionizing zone, and the second variety having charged collectors by means of which the energized, collecting medium induces a charge on the particles. These machines are highly efficient in removing dusts so fine that they have no gravitational settling tendency. Precipitators are especially useful for removing smoke from the air.

There are a number of different types of wet collectors wherein the contaminant is brought into contact with water in order to remove the dust from the air stream. This type of dust collector is particularly adapted to high-temperature, moisture-laden gases. Generally, however, its use is in the industrial field rather than in

the field of comfort ventilation.

Dynamic precipitators are also of several types, of which the cyclone is widely employed for the removal of coarse dust from an air stream or as a separator to remove dust from industrial operations.

Indications are that in the future ultrasonic agglomerators may have wide application. High-intensity sound can be used to coagulate very fine aerosols such as smoke, fumes or fine dusts into particles large enough to be collected by one of the types of dust-collection equipment previously described. *(See* ULTRASONICS.)

About the only practical method for removing odours from air is adsorption of the odour by activated carbon. which is effective against cooking, body and tobacco odours. Some of the bacteria in contaminated air are removed by filters and electric precipitators; however, a better method is by ultraviolet irradiation. Propylene glycol mists also have been found effective against certain types of bacteria. However, the killing of bacteria and the removal of chemical fumes are both matters needing far more research. The impetus for this is expected to come from the demand by urban centres for lessening atmospheric contamination.

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HEATON, SIR JOHN HENNIKER, 1ST BART. (1848–1914), English postal reformer. was born at Rochester, Kent. on May 18, 1848, the only son of Lieut. Col. John Heaton. of Heaton, Lancashire. After studying at Kent House school and King's college, London, Heaton went to Australia in 1864 and spent several years in the bush. He then moved to Paramatta, New South Wales, where he joined the staff of the *Paramatta Mercury* and served a three-month appointment as town clerk. In the following years he worked on the *Goulburn Penny Post* and the *Australian and County Journal* (Sydney). In 1879 he published a reference work, *The Australian Dictionary of Dates and Men* of *the Time,* and in 1883 represented New South Wales at the Amsterdam exhibition. His first attempt at postal reform came in 1885 at the Berlin International Telegraphic conference nhen he succeeded in obtaining a rate reduction for cable messages to Australia.

Returning to England in 1884, Heaton was elected to parliament as a member for Canterbury the following year. In this post, which he held for the next 26 years. Heaton worked persistently for postal reform and particularly for the reduction of postal and telegraphic rates. Through his exertions, the telegraphic rates from England to various parts of the world were greatly reduced and in 1898 it became possible to send mail to any part of the British empire, except Australia, for a penny. In 1908, the penny post was extended to those letters destined for America, and between the years 1905 and 1911, Australia was gradually admitted to low-cost mail rates. After the election of 1892, Heaton was offered a baronetcy if he would give up his parliamentary seat to another member who had been defeated. Heaton refused. Three other times he rejected offers to make him a knight commander of St. Michael and St. George.

As the dissolution of parliament in 1910, Heaton retired because of ill-health. The following year, while he was visiting Australia, a baronetcy was conferred upon him and, upon his return to London, a public welcome was held under the auspices of the British Empire league. In Sept. 1914, while returning from Carlsbad, Bohemia, where he had gone for his health. Heaton was taken ill and died at Geneva. Switz., on Sept. 8. 1914.

See *Life and Letters of Sir John Henniker Heaton, Bart., by* his daughter, Mrs. Adrian Porter (1916).

HEATSTROKE: *see* SUNSTROKE AND HEATSTROKE.

HEAT-TREATMENT. The heat-treatment of metals and alloys is carried out to alter their mechanical properties. For industrial applications *see* ANNEALING. The following discussion of heat treatment is divided into three categories: (1) recovery and recrystallization, which are accomplished by heating a metal that has been plastically deformed at room temperature; (2) precipitation. or age hardening, which is characteristic of the alloys that have a decreasing solubility of one constituent in another with decreasing temperature; and (3) alloys which undergo a phase change in the solid state on heating or cooling through certain temperature ranges.

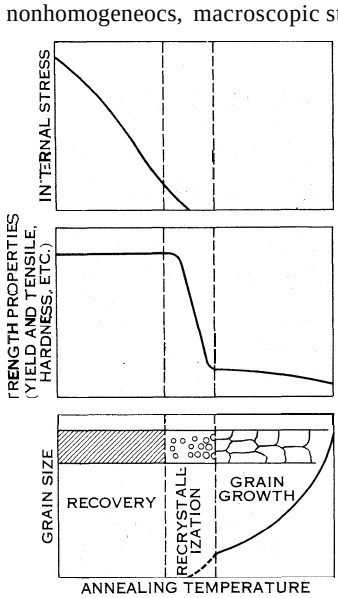
RECOVERY AND RECRYSTALLIZATION

The atoms of a metal crystal that is not strained or deformed are arranged in an orderly pattern. Two of the commoner atomic arrangements are those of the body-centred cube and the face-centred cube *(see* ALLOYS: *Structure of Alloys).* A crystal composed of the body-centred cubic arrangement would simply be a repetition of this arrangement to form the lattice structure of the crystals.

Metals and alloys used for engineering applications are not single crystals but are made up of many crystals. These crystals are called grains in the metal. When a metal is plastically deformed or cold-worked at a low enough temperature; *i.e.,* room temperature for most metals, the metal is strain-hardened. The strain hardening results from the fact that slip is occurring on the crystallographic planes of the grains and the orderly arrangement of atoms is replaced by a distorted lattice *(see* CRYSTALS, DISLOCATION OF).

The normal equiaxed grains of the unstrained material are replaced by elongated grains resulting from the plastic deformation. The plastic deformation is accompanied by an increase in the tensile strength, yield strength and hardness, and a decrease in ductility as measured by elongation and reduction of area in the tensile test. Obviously the cold working could be carried out to the point where fracture would occur.

Since the cold work as performed in commercial processes is nonhomogeneocs, macroscopic stresses are set up in the metal. A cold-drawn wire will have residual compressive stresses at the [illegible] and tensile stresses at the surface of the wire. In addition, there are microscopic stresses set up because of the slip that occurs on the atom planes during the cold working of the metal or material. These residual stresses may or may not influence the quality of the part.



FROM SACHS AND VAN HORN, "PRACTICAL METALLURGY"; REPRODUCED BY PERMISSION OF AMERICAN SOCIETY FOR METALS

FIG. 1.— DIAGRAMMATIC REPRESENTATION OF THE DIFFERENT TYPES OF CHANGES IN PROPERTIES PRODUCED BY ANNEALING A COLD WORKED METAL

If the residual stresses are in tension at the surface of the part, they are detrimental as far as fatigue and stress corrosion are concerned. If the residual stresses are in compression at the surface, they are beneficial as far as fatigue is concerned.

The heat treatment of a cold-worked part simply involves heating of the metal to some elevated temperature to allow diffusion; *i.e.,* atom movement. to take place. This tends to allow the atoms to again assume an orderly pattern. Two distinct processes occur on heating a cold-worked metal. The first! which is termed recovery, occurs at low temperatures and results primarily in relieving the residual stress without any appreciable change in hardness or microstructure. The elongated grains of the cold-worked metal are unaffected during the recovery period. Process equip-

ment, such as welded pressure vessels, is frequently subjected to a low-temperature anneal after welding in order to remove the residual stresses produced during the welding operation.

The second process is termed recrystallization and grain growth. When the temperature is increased to a sufficient degree, very small unstrained grains begin to replace the strained grains of the cold-worked metal; in other words, the metal is undergoing recrystallization. Grain growth is merely an enlargement of the recrystallized grains.

Recovery and recrystallization and growth are time dependent Increasing the temperature increases the rate at which both occur. and if the temperature is high enough both processes will proceed simultaneously. The temperature of recrystallization varies a great deal from metal to metal, and is also dependent on the amount of cold work applied to the metal, the grain size of the metal, composition of the alloy and purity of the metal.

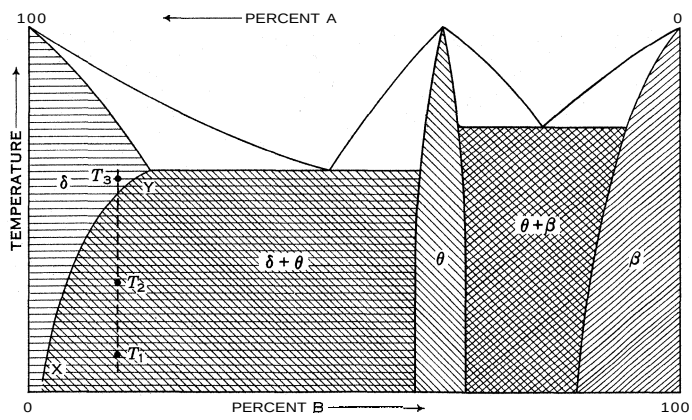
Recrystallization and grain growth are accompanied by a lowering of the strength of the cold-worked metal. This is shown schematically in fig. 1. It can be seen from this diagram that the residual stress is relieved to a great extent before any change in strength or microstructure occurs. Recrystallization occurs over a narrow temperature range for a constant time of annealing, and grain growth occurs on heating to higher temperatures.

Many commercial products are fabricated by cold-stamping or -drawing operations. In many instances it is necessary to subject the partially formed parts to annealing treatments so that recrystallization occurs which restores the ductility to the material and conditions it so that further cold-working operations may be carried out.

The manufacture of cartridge cases illustrates an operation of this type. Most of the cartridge cases are made of an alloy composed of 70% copper and 30% zinc. This alloy is a solid solution where the zinc atoms substitute for the copper atoms in the face-centred cubic lattice of the copper crystal. The manufacture of a cartridge case begins with a flat plate which is blanked into a circular disk and cold formed into a cup. The effect of the cold work resulting from cupping must be removed by annealing before any further cold forming can be carried out. In the production of the cartridge case it may be necessary to perform as many as seven annealing treatments depending upon the size of the cartridge case.

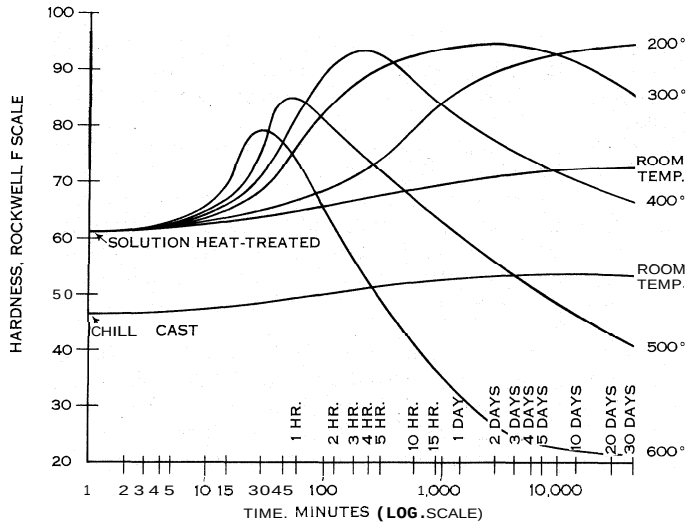
PRECIPITATION OR AGE HARDENING

Many of the useful alloys are heat-treated by precipitation or age hardening. The alloys which respond to this heat-treating process are in the alloy systems which have a decreasing solubility of one constituent in another constituent with decreasing temperature. This is illustrated schematically in fig. 2, which shows a phase diagram of alloys of metals A and B. The solubility of B in A is represented by the line xy. An alloy composition represented by the dotted line is composed entirely of a solid solution when heated to and maintained at temperature T_3. The solid solution δ consists of atoms of B dissolved in metal A. (At the opposite side of the diagram, solid solution β consists of atoms of A dissolved in metal B. the θ phase is discussed below.) Two types of solid solutions are possible, namely, substitutional and interstitial. The substitutional solid solution is formed by atoms of B substituting for atoms of A in the crystal lattice of the metal A. An interstitial solid solution is formed when atoms of B fit in between the atoms in the lattice of metal A. Practically all of the solid solutions useful for the age-hardening process are of the substitutional type.



BY COURTESY OF C. A SIEBERT

FIG. 2.— SCHEMATICPHASE DIAGRAM ILLUSTRATING CONDITIONS NECESSARY FOR AGE HARDENING



FROM M C SMITH, "ALLOY SERIES IN PHYSICAL METALLURGY", REPRODUCED BY PERMISSION OF HARPER & BROTHERS

FIG. 3.— EFFECTOF AGING TEMPERATURE UPON THE PRECIPITATION HARDENING OF AN ALLOY CONTAINING 95% ALUMINUM. 5% COPPER. WHICH WAS SOLUTION HEAT-TREATED AT 1,000° F. AND WATER QUENCHED

When the solid solution formed by heating to temperature T_3 is slowly cooled to room temperature T_1, a precipitate will form at the grain boundaries because the solubility of B in A is less at T_1 than at T_3. The line xy represents the saturation limit for the solubility of B in A at any given temperature. and on slow cooling precipitation begins as soon as the dotted line intersects the line xy. and continues as the temperature decreases to T_1. The precipitate formed is not the metal B, but is the next phase on the diagram, which is θ. This diagram shows θ as an intermetallic compound and these compounds are frequently assigned chemical composition formulas; *e.g.*, $CuAl_2$, Fe_3C, etc. In many instances the slowly cooled condition described above produces inferior mechanical and corrosion resisting properties.

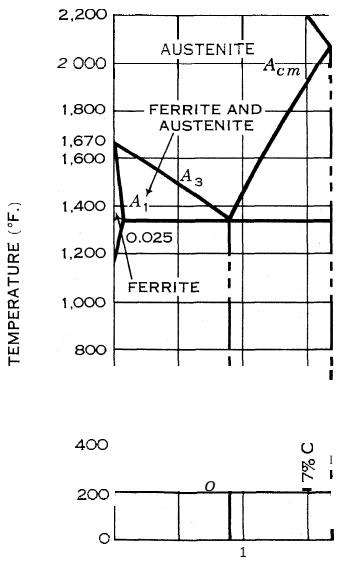
When the solid solution produced by heating to temperature T_3 is quickly cooled by quenching into water, the precipitation of the θ phase is prevented and the condition existing at temperature T_1 is a highly supersaturated solution of B in A. Reheating the quenched alloy to the temperature T_2 and holding for a period of time allows θ to precipitate from the supersaturated solid solution. However, the θ phase does not precipitate out at the grain boundaries as was the case in the slowly cooled condition, but precipitates out as minute particles in the crystal lattice on planes of cleavage of the solid solution. These particles are too small to be seen under the optical microscope, but their presence is detected by the changes in the mechanical and physical properties of the alloy which accompany the aging process. Not all of the useful industrial alloys require that the quenched alloy be reheated to a temperature of T_2 for the submicroscopic particles to form, since age hardening does occur on holding at room temperature in some of the alloys.

Subcooling—as by packing in dry ice—those alloys which age-harden at room temperature will prevent the age-hardening process from taking place. The precipitation of the submicroscopic particles in the lattice of the solid solution increases the hardness, tensile strength and yield strength and decreases the ductility of the alloy.

Many of the industrially important alloys are hardened by this heat-treating process. Among the more important of these age-

hardenable alloys are the aluminum and copper base alloys. The aluminum base copper alloy is selected to illustrate the general age-hardening process.

Copper is soluble in aluminum to the extent of 5.5% at 1,018° F. and to less than 1% at room temperature. An alloy of 5.0% copper when heated to 1,000° F. and auenched into water is a supersaturated solution of copper in aluminum. It will not age-harden to any great extent on holding at room temperature. However, on heating to various temperatures above room temperature, the age-hardening process will take place. Since this age-hardening process depends upon atom movements: *i.e.*, diffusion. and since the rate of diffusion is increased with increasing temperature, the increase in strength will be accomplished in shorter periods of time at higher temperatures than at lower temperatures. However, the precipitation and growth of the precipitated phases are not uniform and since an optimum particle size of the precipitated phase is necessary to produce the maximum increase in the hardness and strength of the alloy, the lower temperatures of aging are the ones that produce these conditions, although the time of aging is necessarily longer.



BY COURTESY OF C. A. SIEBERT

FIG. 4.—A PORTION OF THE IRON-CARBON EQUILIBRIUM DIAGRAM

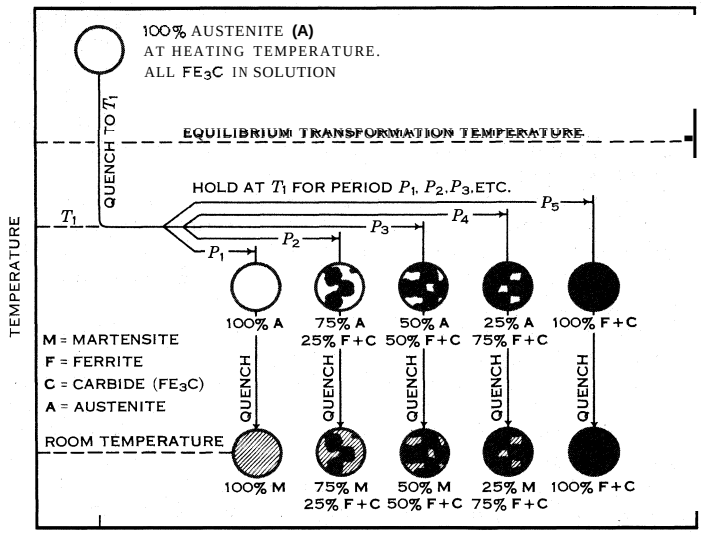
The lower temperatures of aging produce a greater number of nuclei, *i.e.*, centres for precipitated particles to form on and a greater number of small particles are formed than is the case at the higher temperatures. The increase in strength results from interference that these particles offer to plastic deformation. Therefore, the greater the number of these particles of an optimum size the greater the strength of the material. However, since diffusion continues at these higher temperatures with time, the particles of the precipitated phase continue to grow and therefore there are fewer particles of a larger size to offer resistance to plastic deformation.

The material decreases in strength and is considered overaged. This is illustrated for a 5% copper, 95% aluminum alloy in fig. 3. The increase in hardness above the as-quenched condition, which is an indication of the increase in strength, at room temperature after 30 days is approximately 8 Rockwell F. The increase in hardness after aging at 300° F. for approximately two days is 32 Rockwell F. On holding at 300° F. longer periods than two days, the alloy became softer, or overaged. The aging temperatures of 400°, 500°, and 600° F. show lower maximum hardness peaks and shorter times of overaging setting in with increasing temperatures. The actual time-temperature sequence which is used for a given alloy in an industrial application naturally depends upon economics. The strength level needed and the length of aging time required to produce it, and therefore the cost, become primary considerations.

HARDENING PHASE CHANGES

A number of alloys undergo hardening and therefore an increase in strength because of a phase change from one type of lattice structure to another occurs in the alloy with a change in temperature. When the equilibrium condition is disturbed by rapid cooling a whole new series of microstructures is produced, resulting in a whole new series of mechanical properties in these alloys. The most important alloys of this classification are the steels and their alloy modifications, and the heat-treatment of steel will be discussed to illustrate this process.

The metal iron has the atoms arranged in a body-centred cubic lattice from room temperature to 1,670° F., and in a face-centred



FROM W. CRAFTS AND J. LAMONT, "HARDENABILITY AND STEEL SELECTION"; REPRODUCED BY PERMISSION OF PITMAN PUBLISHING CORPORATION

FIG. 5.— HEAT-TREATING CYCLES EMPLOYED IN STUDIES OF ISOTHERMAL TRANSFORMATION

cubic lattice from 1,670° F. to 2,535° F. Carbon dissolves rather readily in the face-centred cubic lattice but only to a very slight extent in the body-centred cubic lattice. It is this difference in solubility of carbon in the two phases of iron which accounts for the fact that steel can be heat treated.

It is necessary to consider the equilibrium conditions of the iron-carbon system in order to appreciate the nonequilibrium conditions which exist in hardened steel. Fig. 4 shows a portion of the iron-carbon equilibrium diagram. There is a eutectoid (pearlite) at 0.83% carbon which forms from the solid solution of carbon in face-centred cubic iron (austenite) at a temperature of 1,333° F. Pearlite is a mechanical mixture of ferrite (solid solution of carbon in body-centred iron) and cementite (Fe_3C).

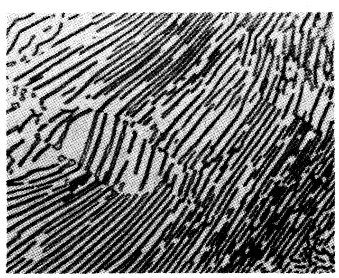


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FIG. 6.— COARSE PEARLITE FORMED AT 1,300° F. (MAGNIFIED 2,000 ×.)

An 0.5% carbon steel, heated to 1,600° F. has a microstructure of 100% austenite at that temperature. On very slow cooling the austenite would begin to reject ferrite when the temperature reached the A_3 line on the diagram (fig. 4) and would continue to do so until the temperature reached the A_1 line on the diagram. While the temperature was changing from the A_3 to the A_1 level and ferrite was being rejected, the carbon content of the austenite was increasing from 0.5% to 0.83%, the latter being the eutectoid composition. The A_3 line in fig. 4 represents the saturation limit of carbon in austenite. Therefore in steels having a carbon content greater than 0.83%, cementite would precipitate on cooling, and the carbon content of the austenite mould again approach 0.83% as the temperature approached 1,333° F.

The above illustrates the decomposition of austenite on slow cooling approaching equilibrium conditions. The nonequilibrium condition associated with the hardening of steel can best be illustrated by considering the isothermal decomposition of austenite at temperatures below 1,333° F.

Suppose a number of thin wafers of 0.83% carbon steel were heated to a high temperature where the microstructure was 100% austenite, and then quenched into a molten lead bath maintained at some temperature T_1 which is below 1,333° F. Individual specimens could then be removed from the lead bath after varying time intervals, and quenched into water. The process is illustrated in fig. 5. The time period P_1 was not long enough for the austenite

to begin to decompose into pearlite, so on subsequent quenching to room temperature it showed a structure of 100% martensite (the nature of martensite is discussed below). Time period P_2 was long enough for some austenite to transform to pearlite, and time periods P_3 and P_4 show an increasing amount of pearlite, while time period P_5 is long enough for all of the austenite to transform to pearlite.

It can be seen that the above process depends upon nucleation and diffusion, with the nuclei of pearlite (ferrite and cementite) forming at the austenite grain boundaries. As the temperature T_1 is lowered the pearlite becomes increasingly finer in texture, as shown in figs. 6 and 7.

Repeating the above experiment at various temperature levels would result in the accumulation of data for the beginning and ending of austenite decomposition at the various temperature levels. The data could then be plotted as a conventional time-temperature-transformation (T-T-T) diagram. The T-T-T diagram shown in fig. 8 is a schematic diagram for carbon steels and includes the proeutectoid line for ferrite and carbide, which applies to steels of less than or greater than 0.83% carbon respectively.

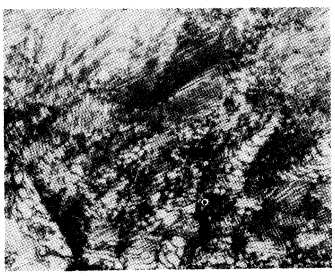

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FIG. 7.—FINE PEARLITE FORMED AT 1,185° F. (MAGNIFIED 2,000 ×.)

It should be noted that the proeutectoid line joins the beginning of pearlite transformation line at approximately 1,000° F. This means that only pearlite would be present when fully transformed at this temperature, regardless of the carbon content of the steel, and the carbon content of the pearlite in any steel other than 0.83% carbon can only have that value when transformed at 1,333° F.

The transformation of austenite by isothermal decomposition below the knee of the diagram (1,000° F.) results in the formation of a microstructure distinctly different from pearlite formed above 1,000° F., and this structure, called bainite, is shown in fig. 9. The degree of fineness of the bainite structure increases as the temperature of formation is lowered from 1,000° F. It is generally thought that pearlite is nucleated by cementite and bainite by ferrite.

As the temperature of the quenching bath is lowered, a temperature level is reached where austenite will undergo some transformation instantaneously on reaching that temperature. A period of inactivity when held at that temperature is followed by further decomposition to bainite for longer holding times. The microstructure formed immediately on reaching this temperature is martensite. Martensite will continue to form instantaneously as the temperature is lowered but will not form isothermally. The temperature at which the first martensite is formed is termed the M, temperature and the temperature for 100% martensite formation is called the M_f temperature. The M_s temperature depends upon the composition of the steel and can be estimated from the following formula:

$$M_s(^\circ \text{F.}) = 1{,}000 - (650 \times \%\ \text{C}) - (70 \times \%\ Mn) - (35 \times \%\ \text{Ni}) - (70 \times \%\ \text{Cr}) - (50 \times \%\ Mo)$$

The M_f temperature cannot be calculated from the composition of the steel.

The transformation of austenite to martensite does not depend upon nucleation and diffusion, as is the case for pearlite and bainite formation, but solely on reaching a temperature level where the face-centred cubic lattice tends to transform to a more stable type of lattice. The lattice formed is a tetragonal body-centred type with the carbon atoms trapped as an atomic dispersion in the interstices of this lattice.

The primary purpose of quenching a steel is to produce martensite. Therefore it is necessary to employ cooling rates fast enough to prevent the steel from dwelling in the higher temperature ranges where ferrite, pearlite and bainite will form. Alloying elements shift the T-T-T diagrams to the right; *i.e.,* to longer times for the beginning of transformation, which permits slower rates of cooling for the formation of 100% martensite.

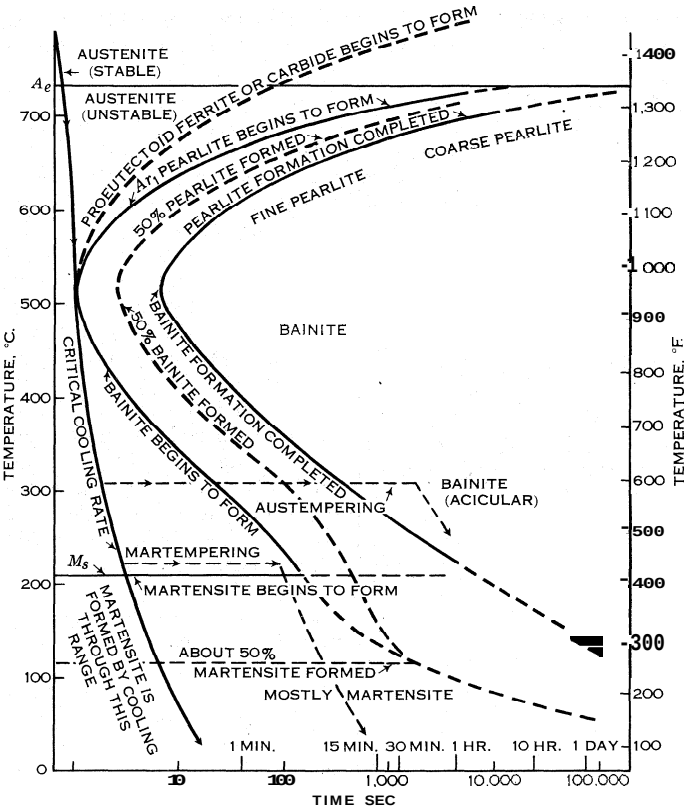

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FIG. 8 — SCHEMATICT-T-T DIAGRAM FOR CARBON-STEEL SHOWING CRITICAL COOLING RATE CURVE. M_s TEMPERATURE, AND TEMPERATURES FOR AUSTEMPERING AND MARTEMPERING

The above type of reactions illustrated with the iron-carbon alloys are also found in some of the nonferrous systems. Among these are the copper-aluminum alloys. the copper-zinc alloys and the titanium-chromium alloys.

See also ALLOYS; CAST IRON; HARDNESS TESTING; IRON AND STEEL; METALLURGY.

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FROM W. CRAFTS AND J. LAMONT, "HARDENABILITY AND STEEL SELECTION"; REPRODUCED BY PERMISSION OF PITMAN PUBLISHING CORPORATION

FIG. 9.—BAINITE FORMED AT ABOUT 700° F. (MAGNIFIED *2.000* ×.)

HEAVEN, the firmament or vaulting arch of spatial expanse surrounding the earth in which the sun, moon, planets and stars seem to be placed. In most of the religions of mankind heaven is considered to be the abode of deity, for as deity is "higher" than humanity, so the home of deity is high "above" the earth which is the home of man. Likewise, as the presence of deity exposes all evil and deceit, so heaven, being the eternal abode of deity, is the place of eternal light in contrast to the partial and total darkness of other regions in the cosmos. Consequently, heaven is thought to be forbidden territory for human beings except as they meet the terms set down by deity or are granted special admission by deity. Such humans are then said to have been "born from above" or to have been called "out of darkness into marvelous light."

Old Testament and Judaism. — In the Old Testament understanding of the structure of the universe, the heavens, *shamayim,* referred chiefly to the upper half of the universe in contradistinction to the other half, the earth. The phrase in Gen. i, 1, "the

heavens and the earth," literally comprehended the whole of creation. The earliest traditions of the Israelites associated Yahweh with the sky, but while Yahweh's abode was the heavenly regions, not even the heavens' heavens could contain him. It was he aho created the firmament and placed the heavenly bodies in it; from the heavens he looks down upon the inhabitants of earth and directs the destinies of men and nations, and therefore men pray toward the heavens.

It was not. until late Old Testament times that the Israelites began to regard heaven as being also the final abode of the righteous. Throughout most of the Old Testament period (c. 1750 B.C. to c. 587 B.c.) the Israelites thought of Sheol as the great democracy of all the dead. Sheol was located somewhere "under" the earth. When "the breath of life" had gone out of a man and returned to Yahweh from whom it originally came. and when his buried body had decomposed, the residue of his individuality slept in Sheol. The state of the dead was one of neither pain nor pleasure. Neither reward for the righteous nor punishment for the wicked was associated with Sheol. The good and the bad alike, tyrants and saints. kings and orphans, Israelites and gentiles—all slept together without awareness of one another in the lifeless existence of Sheol. The devout Israelite dreaded death and Sheol because these marked the end of his fellowship with Yahweh and not because they would confront him with a final judgment upon the quality of his life.

It was not until the 3rd or 2nd centuries before Christ that Jews in any number came to think of heaven as the destination of the righteous after death. As the hope increased and was formulated for the resurrection of the righteous and unrighteous to another bodily life of reward or punishment befitting the mortal life already lived. Jewish thought fixed on life with God in the heavens as the destiny of the righteous and external torture or second death as the destiny of the unrighteous. Jewish rabbinical and apocryphal literature occasionally refer to seven or ten heavens, with paradise being the third of seven or the seventh of ten. This paradise was thought to house all the treasures intended for the righteous, and some rabbis taught that the righteous dead themselves lodged there until the Last Judgment when God would resurrect them and translate them into his presence in the highest heaven. With reference to the unrighteous, consideration of natural death, during this period, was lost sight of in the greater consideration given to the final judgment of the human spirits subsequent to physical death. The horrors of this spiritual death are suggested in Jesus' figures of "outer darkness" and "weeping and gnashing of teeth" used to describe the lot of the unrighteous.

New Testament and **Christianity.**—In the New Testament heaven derives its significance and engages the attention of the writers from the fact that it is believed to be the place from which Christ came and to which he returned (Mark xvi, 19; Acts i, 11). Heaven is therefore the scene of his present life and activity. There, in the presence of God, he works in behalf of his followers (Heb. ix, 24) and there his glory is already apparent (John xvi, 24), whereas on earth his followers only dimly apprehend that glory (I John iii, 2 j. Heaven, however. is the destination of all his followers (John xiv, 2). In heaven the Holy Spirit, in company of the angels, searches out "the depths of God" and is sent to earth to reveal these mysteries to men (I Cor. ii, 10; I Pet. i, 12). In the New Testament there is also a current of thought that speaks of a renewal of the heavens as well as of the earth in the consummation God will bring about for his creation (II Pet. iii, 12–13; Rev. xxi, 1).

The New Testament uses the word paradise (Luke xxiii, 43; II Cor. xii, 3; Rev. ii, 7). This was originally a Persian word for a nobleman's park or garden. but coming as it does to the New Testament through Jewish and especially rabbinic usage, its use there reflects the influence of the Old Testament story of man's pristine innocence and community with God in the Garden of Eden.

(E. PE.)

The Christian idea of heaven never achieved great explicitness. As the early church resolved the meaning of its existence as a historical body with the realization that Christ's return to consummate the messianic promise would be delayed, sacramental acts, particularly the eucharistic mysteries, came to symbolize the union of the church with Christ in heaven. In the Eucharist and the other sacraments Christians already felt themselves to be partaking in the life above.

Nevertheless, in the Christian community in the post-apostolic period there may be found cosmological speculation, seeking to penetrate the unknown upper world. at the same time resisting the temptation to go as far as the Gnostics with their imaginative but unbiblical cosmologies. In the east Origen (for example in *Contra Celsum,* vi. *21* and *De Principiis,* ii, iii. 6). St. Basil (*Homiliae* I, 5; *Patrologia Graeca* XXIX. 13.) and other writers made comments about the number of "heavens"; on the belief that Christians, following the pattern of Christ, ascend to heaven; and about the relation of heaven to the observable upper world—stars, planets. etc. St. Augustine in the west attempted to avoid the pitfalls of the cosmological approach in conceiving of the heavenly city. the New Jerusalem. In the Old Testament this was prefigured in the vision of Ezek. xl ff. In the high middle ages the old science and the rediscovered tools of ancient'logic were united to devise. together with Christian revelation, St. Thomas Xquinas' monolithic edifice of ideas about the hierarchy of being. The poetic realization of Dante's ***Divine*** *Comedy* is a similar medieval expression. Piled layer upon layer, the reality of the material world. for them, blended into the splendours of the celestial realm and into the terrors of the inferno.

'Since the scientific revolution. cosmological theories about heaven have tended to be discredited as science has pushed the limits of space to an incomprehensible distance. In their place personalistic understandings of heaven. such as prevail in literature or common parlance? have often obscured the meaning of heaven in a religious sense. In the modern idiom heaven has come to signify various types of personal fulfillment. However, for Christians. emphasis upon the Bible and church tradition continues to help maintain the symbolic meaning of heaven as the counterpart of the liturgical and historical experience of the revelation of Christ. In essence the Christian view of heaven means the state of life with Christ. Since this ideal is believed to be reflected in the .church, it has been difficult to conceive of its transcendent meaning in other terms. (C. S. J. W.)

Other Religions — Anotion similar to that of the New Testament paradise is found in the Greek mythological Elysium or Elysian field. This latter, the home both of the pods and of those mortals upon whom the gods chose to confer a life of bliss. was thought to be located in the western ocean or in the lower world.

In Chinese religion. specifically the Confucian tradition, heaven. *T'ien,* is synonymous with the Divine Will. Heaven is the head of the cosmic family. of which nature and human society are the other two members. The popular Buddhism of China (Pure Land Buddhism) offered the Chinese a heavenly abode after death as alternative to the notion of the disembodied spirits of the ancestors remaining near the haunts of their mortal days. The literature of Pure Land Buddhism describes in vivid language the "western paradise" which is available to all those who receive the saving grace of Amitabha. the man who became a Buddha through his vow of salvation for every living creature.

Orthodox Buddhism does not regard paradises and heavens as ultimate. precisely because these notions preserve the conditions of distinctive existence. By definition; orthodox Buddhists maintain, any existence is conditioned and not ultimate and is therefore not capable of expressing unconditioned bliss; hence the monks in this tradition must strive for something beyond the life of the heavens. Nevertheless. these Buddhists believe that there are heavens and that men may be born into them. But emancipation from existence. nirvana, is something other than birth into either the sensual heaven where sexual pleasures exist, or the material heavens inhabited by gods liberated from sensual desires, or even the indescribable life of the nonmaterial heavens.

In Hinduism the conceptions of heaven are numerous and varied. Generally speaking, the heavens are conceived as distinct regions in a complex configuration of worlds, sometimes said to be 3 in number, and again 14. The three worlds are the earth, which is the land of mortals; the sky, which is the playground of the lumi-

naries; and the heavens, the residence of divinities and other immortals. The 14 worlds are believed to rise to seven tiers above the earth and descend to seven distinct depths below the earth. Whether 3 or 14. the intent is to represent the innumerable degrees of proximity to and distance from the perfection which is the destiny of every creature.

In the worship of Vishnu, the god of the masses of Hindus, heaven is understood in terms very similar to those of biblical religion. It is a locale or condition in which suffering, fear and death are completely absent and in which the glory of Vishnu is the eternal light.

The extremely explicit descriptions of heaven in Islam run the entire gamut of human aspiration. Suffice it to say that heaven is conceived as the Garden or Mansion of Eternity in which humans enjoy abundant fulfillment of all the physical, mental, moral and spiritual desires of mortal men. *See* also EDEN; MILLENNIUM. (E. PE.)

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HEAVISIDE, OLIVER (1850–1925), English physicist who, independently but shortly after A. E. Kennelly of Harvard, suggested the presence of a conducting layer in the upper atmosphere which prevents electromagnetic waves from spreading out into space. This layer, for many years called the Kennelly-Heaviside layer, became more commonly known as the ionosphere (*q.v.*). Heaviside was born in London on May 13, 1850. He was employed by the Great Northern Telegraph company, Newcastle. Increasing deafness forced him to retire in 1874, when he went to live in Devonshire and devoted himself to theoretical investigations on electricity.

Heaviside had some difficulty in getting his papers accepted for publication, probably because he made use of unusual methods of his own in solving his problems. Consequently, in 1892 he published his collected papers in two volumes under the title of *Electrical Papers.* In these papers he dealt with the theoretical aspect of a number of practical problems, such as quadruplex and multiplex telegraphy, electrostatic and electromagnetic induction between parallel wires, and the high-frequency resistance and inductance of a concentric main.

His work on the theory of the telephone made long-distance telephony practicable. His *Electromagnetic Theory* also dealt with a number of important problems. He worked out the theory of an electric charge moving with uniform velocity and predicted the change in the mass of such a charge when the velocity is large.

He died at Torquay on Feb. 3, 1925.

HEAVY WATER: *see* **DEUTERIUM** AND TRITIUM.

HEBBEL, (CHRISTIAN) FRIEDRICH (1813–1863), German poet and one of the greatest of German dramatists, was born, a Danish subject. March 18, 1813, in Wesselburen, Dithmarschen (Schleswig-Holstein). The son of a builder, he and his brother were brought up in great poverty, which in later life deeply influenced Hebbel's outlook. After his father's death in 1827 he spent seven years as clerk and messenger to a tyrannical parish bailiff. He founded a literary circle, and a local paper published the first of his poems. Others were printed by a Hamburg fashion magazine whose editor, Xmalie Schoppe (1791–1858), a popular journalist and writer of nursery tales, invited him to Hamburg in 1835 to enable him to prepare for the university. In March 1835 he started a diary which was to become a most revealing and valuable literary document. At this time Elise Lensing, a seamstress nine years his senior, provided Hebbel with both spiritual and material support. She sacrificed herself entirely for him in the difficult years that followed.

In 1830. with a small income provided by his patrons. he went to Heidelberg and studied law, but soon finding this uncongenial rnoved on to Munich, where he devoted himself to philosophy, history and literature. No one would publish his poems or stories and in 1839, without money or means of livelihood, he was forced to return to Hamburg on foot. Ill and exhausted, he was nursed by Elise. Although he lived with her and she bore him two children (b. 1840 and 1844), neither of whom lived long, he could not make up his mind to marry her.

His personal conflicts, however, did not affect his creative power. In 1840 the prose play, *Judith* (Eng. trans. 1914), was performed in Berlin and Hamburg. Its theme—a woman struggling for her rights—was to obsess him from this time. In 1841 he finished the broadly conceived poetic drama *Genoveva.* In 1844 *Maria Magdalena* was published, with a critical and philosophical preface. This realistic tragedy of lower middle class prejudice was first performed in 1846. Meanwhile need had driven Hebbel to Copenhagen, where he procured a traveling grant from the king which allowed him to spend one year in Paris and one in Italy.

On his return at the end of 1845 he met in Vienna the well-known actress Christine Enghaus. His marriage to her in 1846 was the turning point in his life which now ran a more tranquil course, though as a result of his privations he was permanently weakened by rheumatic fever. Through Christine's intervention he became reconciled with Elise. His marriage brought him a daughter and the theatrical tours on which he accompanied his wife gave him new stimulus.

After his marriage, besides some slighter plays of social criticism (*Ein Trauerspiel in Sizilien* and *Julia,* 1847) and the fairy tale comedy *Der Rubin* (1849), which was as unconvincing as the earlier *Der Diamant* (1841), Hebbel wrote the verse play *Herodes und Mariamne* (1848; performed 1849). This depicts the conflict between the oriental despot and his wife, who believes in the dignity of man. The prose tragedy *Agnes Bernauer* which he wrote in 1851 (performed 1852; Eng, trans. 1909) contains the central problem of Hebbel's philosophy—the clash between the necessities of the state and the rights of the individual. The poetic drama *Gyges und sein Ring* (1854), which praises the purity of woman and the dauntlessness of man, is probably the poet's most mature work. From 1855 to 1860 he worked on the dramatization of the Nibelung epic. The trilogy (performed in Weimar in 1861) consists of *Der gehornte Siegfried, Siegfrieds Tod* and *Kriemhilds Rache.* In 1855 he published a volume of Novellen and stories and in 1857, following the 1842 and 1848 collections of poems, his collected lyrics appeared. In many of these a fine balance is reached between feeling and reflection; the night poems and some of the more sombre ballads are among the best German lyrics. In 1859 came the narrative poem *Mutter und Kind,* a social and deeply human document.

Newspaper articles, notably those written in 1848 (he was a liberal conservative and a supporter of constitutional monarchy), many essays of literary criticism and an unfinished play on Demetrius complete the picture of Hebbel's achievement. On his 50th birthday he received many honours, including the Schiller prize. He died at Vienna on Dec. 13, 1863.

Hebbel's speculative ideas—the expression of the tensions of his own personality—circle round the relationship between the Ego and the universe. He depicts the tragic lot of the individual who, in the necessary process of world evolution! sets himself against the existing state of affairs in order to make possible further progress toward a humane system of morality.

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HEBBURN, an urban district in the Jarrow parliamentary division of County Durham. Eng., 44 mi. below Newcastle upon Tyne. Pop. (1961) 25,042. There are extensive shipbuilding and engineering works.

HEBDEN RQYD, an urhan district in the Sowerby parliamentary division of the West Riding of Yorkshire. Eng.. 8 mi. W.N.W. of Halifax. Pop. (1961) 0.109. The town. surrounded by moorland. is in a well-wooded steep-sided valley. at the confluence of Hebden water and the Calder river. The chief industry is the making of clothing; other manufactures include cotton, blankets and machine tools. There are large poultry farms.

The district, formed in 1937, combines the former urban districts of Hebden Bridge, and Mytholmroyd.

HEBE (Gr. "young maturity," "bloom of youth"), daughter of Zeus and Hera (*Odyssey,* xi, 603). In Homer. this divine princess, in accordance with the simple northern manners of the Achaean nobles, does housework, much as the human princess, Nausicaa. does the family washing. Therefore, she harnesses her mother's horses (*Iliad,* v, 722). bathes her brother Ares (ibid., 905) and pours the wine at table (iv, 2).

It is in her capacity as cupbearer to the gods that she is oftenest mentioned, and is sometimes said to have been superseded by Ganymede (*q.v.*). As goddess of youth. she is generally worshipped along with her mother, of whom indeed she may be regarded as a sort of emanation or specialized form. She is also combined. both in cult and in mythology. with Hercules (*q.v.*), whose bride she became when he was received into heaven (Odyssey, 1, c)

The most important seats of her worship were Phlius and Secyon nhere she was called Ganymeda and Dia (Pausanias, ii, 13. 3: Strabo, viii, 6, 24). (*See* Preller-Robert, i, 489. and the classical dictionaries.)

A Latin deity with whom she is sometimes identified is Iuventas, whom, however. Dionysius Halicarnassensis (iv, 15, 5) calls Neotes, not Hebe. The hellenized cult of Iuventas-Hebe dates from 218 B.C. (Livy, xxi. 62,9).

See Wissowa, *Religion und Kultur der Römer,* **p.** 135, and the classical dictionaries.

HEBER, REGINALD (1783–1826), English bishop, ,who made a distinctive contribution to the development of Anglican hymnody. Born at Malpas, Cheshire. April 21. 1783, he entered Braicnose college. Oxford, in 1800 and won prizes for a Latin poem (1800), an English poem. *Palestine* (1803; publ. 1807, set to music by W. Crotch. 1812) and an essay, *The Sense of Honour* (1805). Elected a fellow of All Souls (1805), he took orders in 1807 and was presented to a family living at Hodnet, Shropshire. A moderate high churchman of scholarly interests, he showed the direction of his sympathies by his concern at his own equivocal position as parish priest and lord of the manor. his provision of more and better services, and his attention to education, as well as by his Bampton lectures on *The Personality and Office* of the *Christian Comforter* (publ. 1816) and his edition of Jeremy Taylor (1822). At Hodnet he planned his collection, *Hymns Adapted to the Weekly Church* Services of *the Christian Year* (1827), writing 57 of them himself. This anticipated the work of John Keble (*q.v.*) in providing hymns suited for use in liturgical worship adapted to the plan of the Christian year.

His own hymns,—*e.g.,* "From Greenland's Icy Mountains," "Brightest and Best of the Sons of the Morning," "God that Madest Earth and Heaven" and "The Son of God goes Forth to War"—show vivid pictorial imagination, free treatment of rhythm and a loftiness of conception which indicate a real, if minor, poetic gift. and ensure their continued populsrity.

In 1823 Heber became bishop of Calcutta. His conscientious care of a vast diocese hastened his sudden death (at Trichinopoly. April 3, 1826), but he had made a deep impression by his gentleness and courtesy.

His introduction of prayers for the rajahs into church services, his insistence that the clergy learn Hindustani and his attempts to improve relations between missionaries and ministers to European congregations set the trend for future developments and his death from overwork led to much-needed administrative reforms.

HEBER, RICHARD (1773–1833). English book collector, the half-brother of Reginald Heber. was born in London on Jan. 5, 1773.

As an undergraduate at Brasenose college, Oxford, he began to collect a purely classical library, but. his taste broadening. he became interested in early English drama and literature and began his outstanding collection of rare books in those departments.

He attended continental hook sales. purchasing sometimes single volumes, sometimes whole libraries. Sir Walter Scott. whose intimate friend he was and who dedicated to him the sixth canto of *Marmion,* classed Heber's library as "superior to all others in the world"; he was described by Lord Campbell as "the fiercest and strongest of all the bibliomaniacs."

He did not confine himself to the purchase of a single copy of a work. "No gentleman," he remarked, "can be without three copies of a hook, one for show, one for use, and one for borrowers."

His library grew to such a size that it overran eight houses, some in England and some on the continent. It was estimated to have cost more than £100.000, and after his death the sale of that part of his collection stored in England realized more than £56,000. He was known to have owned 150.000 volumes and probably many more.

Heber was member of parliament for Oxford university. 1821–26. and was one of the founders of the Athenaeum club, London. He died in London, Oct. 4, 1833.

HÉBERT, JACQUES RENÉ (1757–1794), French political journalist who under the pen name of "le Père Duchesne" made himself the spokesman of the sans-culottes and of popular extremism during the French Revolution, was born in Alençon in Normandy of a good bourgeois family. His youth was rowdy. and he fell into trouhle in 1776. Going to Paris in 1780, he was for many years destitute or existed from hand to mouth (from 1786 to 1788 he was employed in the box office at the Théâtre des Variétés) and so became familiar with the conditions in which the common people lived.

Early in 1790 Hébert, enthusiastic for the Revolution. began his career as a journalist by collaborating on a pamphlet. La Lnnterne *magique, ou Fléau* des *aristocrates.* This was followed by Le Petit *Carême* de *l'abbé Maury,* and, in June. by Vie *privée* de *l'abbé Maury,* lively and ribald satires on the future cardinal (*see* MAURY, JEAN SIFFREIN). Having found his vocation. Hébert next took for himself a name which was already common property among publicists, that of "le Père Duchesne." a comic figure of the popular imagination, sententious. outspoken and coarse in his expressions but at the same time candid and jocular. His paper. Le *Père Duchesne,* first appeared in Nov. 1790. and by June 1792, when he broke with the original printer. Denis Tremblay, to work with J. C. Marquet. it had become an established success; Hébert was able to live in comfort with Françoise Goupil, the unfrocked nun whom he married on Feb. 7. 1792.

After Louis XVI's flight to Varennes (June 1791), Hirbert. who had previously concentrated his vituperation on the aristocracy, began to aim farther, and in the spring of 1792 he launched a virulent campaign against the court and the monarchy. Already an influential member of the club of the Cordeliers (*q.v.*), he represented the Bonne Nouvelle section of Paris in the insurrectionary commune of Aug. 10, 1792, which led to the fall of the monarchy; and he was elected acting procurator general of the Paris commune on Dec. 22.

A member also of the Jacobin club, he made his paper the mouthpiece of the sans-culottes. demanding the death sentence for Louis XVI, the elimination of the Girondins and the establishment of the Revolutionary government. In the last-named cause he did so much that the events of Sept. 4–5, 1793, which brought the Reign of Terror into full vigour and inaugurated the state-controlled economy. have been described as an "Hébertist" movement. The anti-Christian campaign of autumn 1793 was also largely inspired by Hébert. Once the Revolutionary government was in power, however, it found Hébert dangerous. Le *Père Duchesne* represented the opposition of the Cordeliers and had, moreover, too strong an appeal to the people.

In the winter of 1793–94 the popular movement for which Hébert had fought was brought to a halt. The committee of public safety strengthened its hand; and the "Indulgents," led by Danton and Camille Desmoulins, attacked the extremism of the Hébertists. now described as "Exagérés." When a food shortage was stimulating popular discontent, Hébert on 14 Ventôse (March 4, 1794) denounced the *modérantisme* of the Dantonists at the Cordeliers club, which declared itself for insurrection; but the sans-culottes did not respond, and on 24 Ventôse the Hébertists were arrested. Brought to trial on 1 Germinal (March 21). Hébert and his friends were convicted of conspiracy and executed three days later.

See F Rraesch, *Le Père Duchesne d'Hébert* (1938); *L*. Jacob, *Hébert, le Père Duchesne, chef des sans-culottes* (1960). (A So.)

HEBRA, FERDINAND VON (1816–1880), Moravian physician who founded the so-called New Vienna school of dermatology and whose concepts and teachings became the basis for modern dermatology. He was born in Brünn, Moravia, Czech., on Sept. 7, 1816, and received his medical degree from the University of Vienna in 1841. He was a disciple of Karl Rokitansky (1804–1878), the outstanding Austrian pathologist of the 19th century. Hebra applied his training in pathology to the classification of all skin diseases. This classification, published in 1845, gave a clarity to the understanding of the processes of diseases of the skin that compelled universal recognition. Basically this classification is still in use.

Von Hebra was a voluminous contributor to medical literature and his textbook of dermatology, *Lehrbuch der Hautkrankheiten*, published in 1860, is even now one of the most stimulating books in dermatology.

He died in Vienna on Aug. 5, 1880.

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HEBREO, LEÓN (LEONE EBREO; JUDAH ABRAVENEL) (*c.* 1460–*c.* 1521), Spanish philosopher, physician, and writer of the *Dialoghi di amore*, the fullest Renaissance exposition of a doctrine of love, which had great influence on Spanish literature and has been rediscovered in the 20th century as an important source for Spinoza's philosophy. The eldest son of Isaac Abrabenel (*q.v.*), he was born in Lisbon, *c.* 1460, and in 1483 fled to Seville with his father, who had been implicated in the duke of Braganza's conspiracy.

In 1492, when the Jews were expelled from Spain. the family went to Naples. where León Hebreo, who had become a doctor, nas appointed personal physician to the viceroy (1505). He became acquainted with the humanist and philosopher Giovanni Pontano. and, later, in Florence, with members of the Platonic academy. He is last heard of in 1521 and probably died soon after then, in Naples.

The *Dialoghi* (publ. Rome, 1535), reveal the synthesizing tendencies of the time in the effort to harmonize Mosaic, Aristotelian and Platonic viewpoints. Being cast in dialogue form, not embedded in a learned commentary. and more profound and far-reaching than other *trattati di amore*, the work appealed as both literature and philosophy. It was translated into Latin, French, Spanish and Hebrew, and every succeeding writer of a *trattato di amore* showed its influence, which was most fecund in the mystical and religious writers of Spain.

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HEBREW LANGUAGE. In the Old Testament, Hebrew is called *sĕphath Kĕna'an* "the lip of Canaan," or *Yĕhûdhîth*, "Jewish"; the later Jews designated it *lĕshôn haqqôdhesh*, "the sacred tongue"; the term *'ibhrith*, "Hebrew," was coined by the Rabbis of Palestine. The English name comes from the Greek ἑβραῖος, "Hebrew," whose adverb ἑβραϊστί, "in Hebrew," is applied to Biblical Hebrew in the Prologue to Ecclesiasticus (c. 130 B.C); this adjective is derived from the Aramaic *'ibhray*, "Hebrew."

Hebrew is a Semitic language *(see* SEMITIC LANGUAGES), and monuments in it range from the 9th or 10th centuries B.C. to the present day. It was a mixed speech, to whose composition elements from several Semitic languages contributed; further, a few primitive words may have come from a non-Semitic people who, archaeology shows, once inhabited Palestine. Egyptian and Babylonian documents prove that a West-Semitic (Canaanite) language resembling Hebrew was current in Canaan before the coming of the Hebrews. Egyptian documents from the 16th century B.C. onwards reveal over 1,200 Semitic words, some common to various Semitic languages, others peculiar to the Syro-Canaanite branch; *e.g.*, Eg.-Can. *'nb* (Hebr. *'ĕnābh*), "grape," occurred in Aramaic and Arabic, but Eg.-Can. *brt* (=Hebr. *bĕrîth*), "covenant," was confined to Hebrew. The feminine nouns preserved the primitive ending *-t*, which had already become *-h* in the Old Testament; *e.g.*, Eg.-Can. *spt* (=Hebr. *'ashpāh*), "quiver." In the earlier words the plural and dual took *-n*, as in Aramaic, but later *-m*, as in classical Hebrew; thus the Eg.-Can. *krmyn* (c. 1200 *B.C.)* gave place to *krmym*, which was closer to the Hebrew *kĕrāmîm*, "vineyards" (*c.* 1100 B.C.). The form in *-n* survived in the North-Palestinian dialect of Hebrew, as *ṣîdōnîn* for *ṣîdōnîm*, "Sidonians"; similarly the Eg.-Can. *sh-* corresponded with the dialectical Hebr. *she-* (for the correct *'ăsher*), "who," "which." These texts exhibit many names of places afterwards famous, as well as those of deities like *'shtrt* (=Hebr. *'ashtōreth*), "Astarte," and of persons like *'brm* (=Hebr. *'abrām*), "Abram," especially in composition. Many terms describing common objects, either in composition or independently, appear early in the texts; *e.g.*, Eg.-Can. *rsh* (=Hebr. *rō'sh*), "head," and Eg.-Can. *kmh* (=Hebr. *qemah*), "flour." Others, having changed their meanings or not having survived in Hebrew literature, emphasize the fact that much has disappeared from the Hebrew vocabulary. The cuneiform correspondence found in Egypt, chiefly between the Egyptian kings and their vassals in Syria and Palestine (c. 1400 B C.), also exhibits a language similar to, but older than, biblical Hebrew. These letters were written in a Babylonian exhibiting Western peculiarities closely approximate to Hebrew idiom: the Babylonian permansive tense, expressing properly a state, served also to describe a past action, like the Hebrew perfect with whose form it was identical; the Babylonian preterite, like the Hebrew imperfect with which its form agreed, served to express incomplete action in present time; the first person singular of the permansive (perfect) was closer to Hebrew than to Babylonian; *e.g.*, Bab.-Can. *naṣrâti* (=Hebr. *nāṣartî*, not Bab. *naṣrâku*) "I have kept"; a passive is formed by the internal modification of the vowels; *e.g.*, Bab.-Can. *yudan* (=Hebr. *yuttan)*, "is given." This passive type, though unknown in Babylonian, is found sporadically in Hebrew and regularly in Arabic. But the principal evidence lies in the Canaanite glosses which, more than 100 in number, were added to explain Babylonian terms; for they closely resemble pure Hebrew. Thus the Bab. *ina qātishu* is explained by the Can. *badiu* (=Hebr. *bĕyādhô*), "in his hand," Bab. *elippu*, by Can. *anaya* (=Hebr. *'ŏnîyāh*), "ship," and so on. Again, the language of these glosses is earlier than Hebrew; *e g.*, Bab.-Can. *yakwun*, "is," in which the half-vowel *w* is retained, is older than a form like the Hebr. *yāqûm*, "he arises," in which it has been assimilated to the *u* (cf. Pun. *ichon*, "he is"); it preserved also the old feminine *-t*, as in *abadat* (cf. Hebr. *'ābhĕdhāh*), "is ruined," which rarely appeared in Biblical Hebrew. These texts prove the pronominal suffix *-mô*, which is a Iate poetical variety of the usual *-m*, "their," to be a genuine archaism; for example, Bab.-Can. *panimu* corresponds with the archaistic Hebr. *pānêmô*, not the classical Hebr. *pĕnêhem*, "their face." Most place-names, many of them afterwards found in the Old Testament, and some personal names exhibit purely Canaanite forms; and divine names like the Bab.-Can. *ba'alu* or *dagan*, contained in various proper names, are identical with the Hebr. *ba'al*, "Baal," and *daghdn*, "Dagon." Clearly, Canaanite, as reflected in these ancient Egyptian and Babylonian texts, though not merely a form of Hebrew, certainly

contributed much to it.

The central group (Aramaic) made some contribution to Hebrew. This is illustrated by certain differences in the vowels: where old Aramaic prefers a, Canaanite and Phoenician prefer *u* (o), while the alternations in Hebrew betray its composite origin; for example, *rō'sh,* "head," goes back to the Can. and Phoen. rush, but *rā'shîm,* "heads," to the Aram. *rā'sh.* Again, in certain weak verbs Hebrew prefers the Aramaic a in the active but the Canaanite *u* (*o*) in the reflexive (passive) voice; for example, the active *naḥtî* agrees with the Aram. *nāḥt* against the Can. *nuḥti,* "I rested," while a form like the passive *nākhôn,* ('was established," reflects the Canaanite vocalization. The vocabulary, however, exhibits few words which are undoubtedly old Aramaic.

Another element comes from the Eastern (Accadian or Assyro-Babylonian) branch of the Semitic family. Through this it obtained a few Sumerian loan-words, like *hêkhāl,* "temple," through Acc. *ēkallu,* "palace," from Sum. *E.GAL,* "great house." Those weak verbs, whose last two consonants are identical, show this Accadian (and Aramaic) element; for example, the alternatives *qaṣaṣ* and *qaṣ* represent the Acc. *qasiṣ* and the Aram. *qaṣ* "cut," respectively. Similarly the alternatives *mîshôr* and *mêshār,* "justice," represent the Phoen. *misor* and the Acc. *mîshāru,* "justice," respectively.

A number of alternative words confirms this view. The Hebr. *'ānōkhî* and *'ănî* reflect, the first, the Bab.-Can. *anuki* (cf. Acc. *anâku*) and the second, the Aram. *'ănâ* (cf. vulgar Arab. *'anî*), "I"; the Hebr. *'ēl* and *'ĕlō'ăh* reflect the Bab.-Can. ilu and Phoen. el (cf. Acc. *ilu*) and the Aram. *ĕlāhâ* (cf. Arab. *'ilâh*), "God," respectively.

There are even occasionally three synonyms each from a different source in current use.

Hebrew, therefore, has drawn upon Assyro-Babylonian, old Aramaean (Amorite) and Canaanite. Now the correspondence 'from Tallu-'l-'Amarnâ tells of people called *Ḫabiru* pressing into Syria and Palestine from the north-east and the east. The name can hardly be dissociated from that of the Hebrews (cf. Bab.-Can. *ḫaparu*=Hebr. *'āphār,* "dust," in illustration of the philological equation); but the people are not the biblical Hebrews, if only because of their time and manner of entering Palestine. Cuneiform sources, however, relate that they came from Mesopotamia, through Hittite territory, into Syria and Palestine; so tradition asserts that Abraham came from Babylonia by Haran, through Hittite and Amorite territory, into Palestine. The analysis, too, of the Hebrew language shows that those who spoke it borrowed elements from and therefore in all probability passed through lands whose inhabitants spoke the Babylonian, Amorite (or Aramaean) and Canaanite languages. Thus history and philology confirm the traditional origin of the Hebrew people.

Hebrew retained but few traces of dialect; the reason lies probably in the Masoretic editing of the sacred text, which obliterated all local peculiarities. The Amorites substituted *s* for *sh;* and a trace of this is seen when the Ephraimites said *sibbōleth* for *shibbōleth.* Another mark of dialect was the Gileadite use 'of *shōmēă'* (cf. Ass, *shāmeānu* and Eth, *samā'i*), "hearer," for *'ēdh,* "witness." Again, the North-Palestinian narratives preferred *'attî* to *'att,* "thou" (fem.), *zōh* to *zō'th,* "this" (fem.), and exhibited a few other Aramaizing peculiarities, notably in certain pronominal suffixes. This explanation probably accounts for certain infinitives, like *hălōkh* for lekheth, "to go," used by the Elohist. The use of *mĕlôkhāh* for molkhdh, "rule," *'ālaz* for *'ālaṣ,* '(exulted," and *'al,* "upon," for 'el, "unto," may also be dialectical. But certainty on this point, in view of the lack of sufficient evidence, is unattainable.

Hebrew was written in the common Semitic alphabet, used alike by Moabites, Hebrews, Phoenicians (who transmitted it to the Greeks), and Aramaeans. The earliest Hebrew examples occur on the Calendar from Gezer (c. 8th century B.C.) and on the inscription in the Pool of Siloam (c. 700 B.C.); there are, however, earlier instances in other languages. This character remained longest unaltered in Hebrew and Phoenician. The transition to the "square script" was effected first in Aramaic and later in Hebrew, undoubtedly in consequence of the growing influence of Aramaic immediately before the Christian era. It was called the "Assyrian script" on the assumption that it was the hand of the Eastern Aramaeans, which the Jews adopted about the 5th century B.C. Tradition ascribed this change to Ezra; but inscriptions, ostraka and papyri, prove that it was a gradual process which was not completed in Hebrew by 400 B.C. Another form of this hand is found in Egyptian Aramaic in the 5th and 4th centuries B.C. From these were developed the "square" characters used in biblical manuscripts, important texts and most printed books; the "Rabbinic" script, used in every kind of treatise, and the "cursive" writing of letters and informal documents, which was not generally printed. Hebrew palaeography is not sufficiently advanced to determine accurately the date of a manuscript, but the country of its origin can be recognized. The clearest distinctions are between Spanish, French, Italian, Maghrebi, Greek, Syrian and Egyptian, Yemenite, Persian and Karaite hands. This alphabet numbered 22 letters, whose order the evidence of certain acrostic poems proves not always to have been precisely that which afterwards prevailed; and there are signs that it was not definitely fixed even when the Greek version of the Old Testament was made. In default of figures the consonants served also as numerals, of which usage the earliest traces are found on Maccabaean coins. On these, too, abbreviations, which are unknown in the Old Testament but are extremely common afterwards, make their first appearance.

This alphabet was purely consonantal, except that w and y could denote *u* and *i,* while ' (*'āleph*) sometimes marked a and more rarely o, and h supported various final vowels; the first two also indicated the diphthongs au (6) and *ai* (*ê*). In inscriptions these helping consonants were rarely written and were inserted in the Scriptures only by later scholars, often wrongly. That this alphabet was imperfect, apart from the absence of vowels, is evident; for, firstly, the versions prove that h and ' (*'ayin*) each represented a harder and a softer sound, which Arabic distinguishes by diacritical points; secondly, the Masoretes inserted a point in b, g, d, k, *p* and *t,* to distinguish their unaspirated from their aspirated sounds. Yet it was over-rich in the possession of five sibilants: *z,* a strongly articulated s, two forms of *s* which were so alike that one of them almost fell into desuetude, and sh.

The writing was from right to left. On the earliest inscriptions the words were divided by a point; but this was not so on gems and coins, and separation of the words was probably irregular in early manuscripts of the Scriptures; for the versions not infrequently imply a different division. It seems, however, to have been completed, like the introduction of special final forms of k, *m, n, ṗ* and *ṣ,* before the time of the Masoretes, As Hebrew became ever more the language solely of the learned, the need of preserving the original pronunciation in the reading of the Scriptures was increasingly felt; for this the vowel-less text was a very imperfect instrument. The insertion of *w* and *y'* (*'āleph*) and h to mark long vowels and diphthongs was the first step; that of ' (*'āleph*) and h was very early; but, since the Greek version often implies a reading without such a w or y, they had probably not been generally introduced even after the 2nd century B.C. The system of vowels found in modern Bibles was a much later invention, having been gradually developed by Jewish grammarians in the 6th and 7th centuries A.D., imitating the Syriac vocalization. Two main systems were invented: the Babylonian with mostly supra-linear signs, and the Palestinian, in which they were chiefly put under the line. The Palestinian, as elaborated by the scholars of Tiberias, is that found in modern Bibles. It was so exact as to show all the vowel-changes occasioned by lengthening, by tone, by gutturals, and so on, which other languages seldom indicate in writing. This vocalization, which was little used except in Bibles, represented the traditional pronunciation observed in reading the Scriptures in synagogues and schools; but doubts have, on good grounds, been raised whether it represents the true pronunciation of ancient Hebrew. This can be shown by the Assyrian writing of Hebrew names and by the Greek and Latin transcription of Hebrew names and words. Thus "Dibon" (Hebr. *Dibhôn*) should probably be pronounced "Daibon" (Hebr. *Daibhôn*) if the Greek Δαιβων is to be trusted. (See GREEK

LANGUAGE.) It is also noteworthy that the punctuation often exhibits a later i or e where the Septuagint preserves an a which comparative philology proves to be original. Yet caution is necessary; for the alphabet into which a word is being transcribed may not possess any means of representing the necessary sound; for example, the Assyrian transcription *Ausi'* and *Usi'* for "Hoshea" (Hebr. *Hôshēă'*) does not imply any different pronunciation, since Assyrian had no signs for *h,* o and e; the Greek Ωσηε, as far as it can, here confirms tradition. In fact, although the Masoretic vocalization might sometimes be wrong, internal reasons as well as the analogy of the cognate languages testify to the general faithfulness of the tradition. At the same recension, or soon afterwards, other signs, such as a complicated system of accents, different in the prose-works and the poetical books were added. There are now two pronunciations of Hebrew current, viz., the Polish and German, which partly resembles that of Syriac, and the Spanish and Portuguese, which approaches that of Arabic; Christians, after Reuchlin, generally prefer the latter to the former.

In development Hebrew was later in many respects even than classical Arabic, which hardly began till several centuries after Hebrew had ceased to be spoken. Classical Arabic, like early Babylonian, had case-endings (sing. nom. *-u,* acc. -a, gen. *-i*). Of these there are traces of a nom. -9 (or *-ô*), found only with a following genitive case, in the Calendar found at Gezer in which *yarhû* stands besides *yeraḥ,* "month," and sporadically in the Old Testament in names like "Methushael" (Hebr. *Mĕthûshā'ēl,* cf. Bab. *mutu shâ ili,* "man of God") and in certain phrases like *ḥayĕthô* (for *ḥayyath*) *'ereṣ,* "beasts of the earth." The acc. *-āh* survived as an adverbial ending, chiefly denoting place and time; otherwise it had no force, as in *laylāh* (for layil), "night" (cf. ἡ νύκτα for ἡ νύξ in Romaic). No genitive ending is found in Hebrew; for the termination -i, sometimes attached to nouns governing the genitive case, was probably a binding vowel, like the *-i* of early Babylonian. The plur. *-îm* and du. -aim were properly acc. endings, as Babylonian (plur., nom. *-û* and acc.-gen. *-î;* du. nom. *-ân* and acc.-gen. *-ên*) and Arabic (plur., nom. *-ûna* and acc.-gen. *-îna;* du. nom. *-âna* and acc.-gen. *-aina*) show. The Canaanite glosses *shamuma* and *shamema* (cf. Hebr. *shāmaim*), "heaven," show two plural cases; of these the alternative forms of the name "Penuel" (Hebr. *Pĕnû'ēl*) and "Peniel" (Hebr. *Pĕnî'ēl*), "face of God," of which the plur. *pānîm* (cf. Bab. Ass. *pânû*), "face," is an element, were the sole surviving trace in Hebrew. The earliest Hebrew, then, was on a level with modern Arabic or Greek; for the accusative had become the only case.

Classical Hebrew construction was almost exclusively paratactic, subordinate conjunctions being extremely rare. In pre-exilic writings many verses and even whole chapters can be found, exhibiting no conjunction other than 9- or *wĕ-,* "and." Yet there is no monotony; for extraordinary skill is displayed in varying the tenses and the order of the words, often with good effect; *e.g.,* Hebrew says graphically "this do and live" for the ordinary English "if you do this, you will live." Further relief was provided by "*wāw*-consecutive," a construction almost confined to biblical Hebrew; elsewhere it is found only in one Moabite and one Aramaic inscription, and died out before Mishnaic Hebrew arose. This construction was the normal method of connecting each fresh verb in the narration of a series of events with the preceding clause. Hebrew tenses involved no relations to actions as past or future but only as complete or incomplete: by it, therefore, in past time only the first verb stood in the perfect and the narration was continued in the imperfect; in present or future time, the first verb stood in the imperfect and the subsequent verbs in the perfect. This progress in the sequence of time was indicated by a variety of the ordinary conjunction we- or *û-* "and," which either had a heavier vocalization or altered the accent of the verb; for example, *hāla'khtā wat-tiqṭōl* meant "thou hast gone and killed"; similarly, *tēlēkh wĕ-qāṭaltā'* meant "thou wilt go and kill." In the first the imperfect represented the action as emergent; accordingly, when combined with a conjunction connecting the event introduced by it with a point already reached by the narrative, it represented it as the development of the part which preceded it; thus, *wat-tiqṭōl* meant "and thou wentest on to kill," while *wĕ-tiqṭōl* is simply "and thou wilt kill." In the second the perfect *wĕ-qāṭaltā'* meant "so thou hast killed," the possible occurrence of the event being confined to a particular area previously implied or defined, whereas the simple perfect *wĕ-qāṭa'ltā* would mean unconditionally "and thou hast killed." The various uses of this construction afford a relief to the monotony of a long string of clauses co-ordinated rather than subordinated to one another. But this idiom began, under Aramaic influence after the exile, to die out, and the simpler constructions, like *hālakhtā wĕ-qāta'ltā,* "thou hast gone and killed," and *tēlēkh wĕ-tiqṭōl,* "thou shalt go and kill," become a mark of later Hebrew. The participle also in all periods was freely used to eke out the inadequacy of these two tenses. Another device was the "circumstantial clause," whereby a clause introduced by "and" served as a secondary predicate; *e.g.,* the Hebrew said "he found him (and) he ploughing" instead of "he found him ploughing," using the participle and not a finite verb in a parallel, in place of a subordinate, clause.

The material for forming a judgment on Hebrew is itself scanty and inadequate. Even so, the smallness of the vocabulary and the paucity of adverbs, adjectives and abstract nouns are noticeable. The first difficulty was obviated by prepositional phrases, auxiliary verbs and similar devices, the second by apposition or a descriptive genitive case. The lack of abstract nouns, which only became frequent after the exile, was circumvented by the feminine singular or plural adjective; thus *rā'āh* (fem. sing.) stands for "wickedness" and *qāshôth* (fem. plur.), "harsh things," for "harshness." Another feature was the expression of the abstract under a concrete form; thus *kābhēdh,* "was heavy," meant also "was honourable," and from it both *kābhēdh,* "liver" (as the "heavy" organ), and *kābhôdh,* "abundance" and "honour," were both derived. It is, on the contrary, a sign of lateness when an abstract noun like *môdha'* "acquaintance," designated a concrete person.

Hebrew was less suited for the definite expression of studied thought and the treatment of abstract subjects than for poetry. There was a great lack of particles to express the more subtle connection of ideas; there were few words or inflexions to indicate slight modifications of meaning, although possibly Hebrew, like other Semitic languages, formerly distinguished verbal moods in a way now obscured by the Masoretes. The use of the tenses was largely determined, especially in poetry, by the imagination, which regarded things unaccomplished as accomplished, the past as present and the future as fulfilled. It must, however, be remembered that living Hebrew never had to express abstract ideas; Ecclesiastes, which alone grappled with an abstract subject in plain prose, was composed when Hebrew was already dying out.

In prose, especially of the pre-exilic period, considerable differences of form and style can be detected, due partly to the time and place of composition, partly to the individuality and talent of the authors. Through them especially the various documents woven into the text can be disentangled. Yet the structure and, except in isolated cases, the vocabulary and phraseology, were much the same. The post-exilic literature shows a constantly closer approximation of the language to the cognate Western Aramaic idiom. The process was very gradual; for literary Hebrew was still understood, if not spoken, by the people at least in the 2nd century B.C.; and its extensive use in popular religious literature, partly preserved in the liturgy and elsewhere, proves that it was not entirely forgotten even in the 3rd century A.D. The poetical language employed peculiar words and meanings, forms especially of prepositions and pronominal suffixes, inflexions and constructions; but these distinctions were not so marked as in Greek. Many of them, being found in ordinary use in the cognate languages, notably in Aramaic, were often probably archaisms from the common Semitic vocabulary, surviving in Hebrew only in poetry; for example, the late and poetical kethem, "gold," has now been found in Canaanite. In other cases, possibly, Hebrew poets deliberately embellished their language with Aramaisms; for there is evidence that Aramaic was known to educated Hebrews in the latter part of the 8th century B.C. Apart from Arama-

isms, there was a definite poetical vocabulary; for example, *'ōraḥ* for derekh, "way." There was, particularly, a tendency to substitute adjectives for nouns; for example, *lĕbhānāh,* "the white one," for *yārēăḥ,* "moon." The article and *'ēth,* the sign of the accusative, were frequently omitted; the relative particle was freely dropped; the shortened imperfect was more widely employed; the governing power of prepositions was extended; the greater scope allowed to the imagination in the use of the tenses frequently obscures the sequence of events to a Western reader; and a forceful brevity of expression was affected. Poetry was accentual and was distinguished from prose by rhythm and parallelism. The poetical instinct was seemingly satisfied by lines of approximately the same length, combined normally into groups of two, three or four lines and constituting verses which marked more distinct pauses in the thought than the separate lines. The line normally consisted of seven or eight syllables, but there was apparently no rule on the subject; when it was longer than seven or eight syllables, a caesura commonly divided it into halves, each of so many beats. The fundamental form of the verse was the two-lined couplet, of which the second either repeated or re-enforced or completed the thought of the first. These couplets exemplified the main principle of Hebrew poetry, the parallelism of two roughly equal clauses, of which the second answered or completed the first. This might be synonymous, in which the second repeated the thought of the first line; antithetic, in which the thought of the one was contrasted with that of the other line; constructive, in which the second supplemented the thought of the first line; or climactic, in which the second line took up words from and completed the first line, which was incomplete. The poets sometimes grouped their verses into stanzas, marking the close by a refrain; but the number of verses in a stanza was never, according to the Masoretic text, more than approximately uniform in any poem. The *qînāh,* "elegiac rhythm," in which the line consisted of two members, the first containing one beat more than the second, exhibited the clearest scheme. Rhyme was as accidental as in classical Greek or Latin poetry; but both rhyme and quantitative metre were introduced, after the Arabic model, by mediaeval poets, who combined them with the vocabulary and idiom, as far as possible, of the earlier language.

At first foreign words were rare. There are occasional Egyptian words like *'āḥû* (Eg. *'hw*), "reeds," and qeseth (Eg. gsty), "inkhorn," and Assyrian words like *sĕ'ôn* (Ass. *shênu*), "boot," learnt probably from invading soldiers. The Babylonian *pûru,* "lot," was introduced in the plural *pûrîm,* "lots," to designate a post-exilic feast. Persian words also, like *dāth* (Pers. ddta), "law," came in. But late Aramaic, as closely resembling Hebrew, exerted, especially after the exile, an ever-increasing influence. Aramaic words and forms appeared: the Hebr. -6h began to be displaced by the Aram. *-â* in feminine nouns, and the Hebr. *dābhār* to yield to the Aram. *millĕthā'* in the Hebraized form *millāh,* "word," which even has two plur. forms (Hebr. *millîm* and Aram. *millîn*) in the same book. Hebrew words were sometimes Aramaized in form, as when the Hebr. *nāṣar* became *nāṭar* like the Aram. *nĕṭar,* "kept," or in meaning, as when the Hebr. *ṭa'am,* "taste," came to mean "decree" like the Aram. *ṭe'êm* (cf. Ass. *ṭêmu*), "command." Abstract nouns in *-ûth,* like *malkhûth,* "kingdom," became common and are even formed from infinitives, like hashma'zith, "proclaiming," on the Aramaic model. The pronominal suffixes were weakened, so that such an Aramaism as *karmî shellî,* "my vineyard which is to me," tended to oust the simple Hebrew *karmî,* "my vineyard." The classical *'ăsher,* "who, which," lingered chiefly in combinations based on the old literary language, while the dialectical she- on the analogy of the Aramaic *dĕ-* displaced it in those derived from the popular Aramaic.

This post-exilic Hebrew showed also great simplicity and uniformity of style, again largely due to Aramaic influence. For some centuries the Jews must have been bilingual, still understanding Hebrew but speaking Aramaic, the official language of the western provinces of the Persian empire; by the time of Christ, however, Aramaic versions of the Scriptures, called *targûmîm,* were becoming necessary. Meanwhile Hebrew, without dying out, became gradually a *lĕshôn ḥăkhāmîm,* "language of scholars," as indeed it had begun to be in the later Scriptures. Roughly from 100 B.C. to A.D. 100 little is known of it; but, after that it was greatly developed in the *Mishnāh* (c. A.D. 200). It was still a living language, though mainly confined to the schools and clearly distinct from Biblical Hebrew. In the Scriptures the range of subjects was limited; in the *Mishnāh* it was much extended. Matters of daily life were minutely discussed and words and phrases were adopted from the earlier and presumably popular speech; further, since the language was no longer in the same sense familiar, greater definiteness of expression was required in the written style.

The first alteration noticeable was the confusion of consonants, especially of the gutturals, which classical Hebrew had kept distinct. This change shows that the writers were accustomed to the daily use of Aramaic. Greek and Latin words, relating to the affairs of ordinary life, for whose writing the rules of classical orthography were violated, crept in. For example, biblical Hebrew almost universally required that initial *w* should become y, as in *yeledh* for the very rare *wālādh* (cf. Arab. waladu), "boy"; but barbarisms like *wĕthas* (Gr. εὐθύς), "at once," and *wîlôn* (Lat. velum), "curtain," were admitted, and henceforward the objection to forms like wa'ad (B. Hebr. *mô'ēḏ*), "meeting," was less strongly felt.

Biblical Hebrew, having lost the case-endings, used *'ēth* to mark the definite accusative case; but Mishnaic Hebrew employed *'ēth* not only to introduce the direct object, but also to serve alone as a definite article or, with a pronominal suffix, as a pronoun meaning "that" or "the same." Fresh pronouns, too, were coined by combining those already existing into compound forms or by adopting or adapting many from Aramaic. New adverbs, prepositions and conjunctions, especially subordinating conjunctions, were freely invented or imported from Aramaic.

The vocabulary was greatly enriched. Many biblical words remained, although some nouns changed their meaning; thus B. Hebr. *gōlem,* "embryo," became the M. Hebr. *gôlem,* "lump," "mass." New nouns were coined from biblical roots; so beside the B. Hebr. hemedh, "desire," there arose the M. Hebr. himmzidh, "desire," from *ḥāmadh,* "desired." Especially noticeable are the numerous quadriliteral and quinqueliteral formations, which were rare in biblical Hebrew. Lastly, good Hebrew words appear which, though unknown in the Scriptures, must have belonged to the old spoken language. Beside the numerous Greek and Latin words, a few Persian (or Arabic) words crept in. These generally retained their original appearance, while one Greek word passed over in the genitive case (M. Hebr. *'andrî'antôs* = Gr. *ἀνδριάντος,* from *ἀνδριάς,* "statue"); only rarely were they furnished with Hebrew terminations. The inflection of nouns remained unchanged; but many masculine nouns acquired feminine endings, and the Aramaic masculine plural ending -in was much commoner than the Hebrew *-îm,* although the Hebrew feminine ending -6th was regularly retained. Finally, the "construct state," whereby a noun governing a genitive case undergoes phonetic modification, survived sporadically; but a periphrasis with shel- ("which is to"), "of," the preposition ל, "to," or the Aram. *dĕ-,* "of," tended to displace it. This relative particle she-, which belonged to dialect in biblical Hebrew, completely ousted the classical *'ăsher,* "who," "which," from Mishnaic Hebrew.

The supply of verbs also was much enlarged. Foreign verbs, being ill suited to the Hebrew conjugations, were rarely adopted, but a few were formed from nouns; *e.g., sāphagh,* "absorbed," from *sĕphôgh* (Gr. σπόγγος), "sponge." The imperatives *kîrî* (written חיי = Gr. χαῖρε) "hail!" and *wîwî* (written חיי = Lat. vive), "live," are exceptions. But Aramaic verbs, which closely resembled Hebrew verbs, were readily assimilated, while some classical verbs received new meanings; *e.g., zākhāh,* "was innocent," acquired the sense of "succeeded." Others, used originally in the simple theme, afterwards affected a derived theme. Many roots known only from derived nouns or quite unknown in biblical Hebrew, became general. Additional verbs were coined from derivative nouns; *e.g., tāram,* "exacted the heave-offering" (B. Hebr. *tĕrûmāh*) and *mishkēn,* "took a pledge" (M. Hebr. *mishkôn*), "pledge." Quadriliteral and quinqueliteral verbs, rare in biblical

Hebrew, became common. The conjugations remained substantially unchanged; but the third person feminine singular took *-eth (-ath)* in place of *-āh* in the reflexive theme. Certain weak verbs also deviated slightly from the classical norm.

The themes underwent some slight changes. Canaanite had marked the active and passive voices by modifying the vowel *(cf. laqaḥu,* "they took," but *laqiḥu,* "they were taken"), and biblical Hebrew sporadically preserved this difference between transitive and intransitive verbs *(cf.* between *zākhar,* "remembered," and *shākhēn,* "dwelt"). Of an internally formed passive the only certain survival is the participle; *e.g., zākhûr,* "remembered." Other traces are probably concealed under certain forms which the Masoretes obscured. In its place, biblical Hebrew used the passives of the derived themes. These (according to the paradigm of *pa'al,* "did") were the reflexive *niph'al,* the intensive and causative *pi'ēl,* the causative *hiph'îl* and the reflexive *hithpa'ēl.* The *niph'al* easily acquired a passive force; the *pu'al,* less often the *hoph'al* (the passives of the *pi'ēl* and *hiph'îl* respectively), were often also so used. But in later Hebrew the *niph'al* and even more the *hoph'āl* tended, because of ambiguity in their meanings, to become less frequent, whereas the *hithpa'dl* became extremely common, both with a reflexive and less often with a passive force. Simultaneously a new form, the *nithpa'ēl,* of which biblical Hebrew offers but three examples, became extremely common with a purely passive sense. Of the active themes the *pi'el* served extensively in forming new verbs from nouns and replacing the simple theme customary with many classical verbs and the *hiph'îl* extended its usage. An Aramaic causative theme, formed by prefixing *sha-* or *sa-,* instead of *hi-,* was not unknown.

The old tense system was inadequate, and the loss of "*wāw*-consecutive" made it even more inadequate. The perfect expressed only completed action in past time; and more than the old imperfect was required for incomplete action in the past, present and future. Various periphrases were therefore devised. Past incomplete action was denoted by the verb *hāyāh,* "was," with the participle; *e.g., hāyāh 'ômēr,* "he was saying," was distinguished from *'āmar,* "he said," while the imperfect *yômēr* was left with a jussive force, meaning "he should say." The present participle alone connoted present time; but a pronominal subject, being no longer implicit or explicit in inflection, had to be expressed; *e.g., 'ănî 'ômēr* or *'ômēr 'ănî,* "I say." This gave rise to a completely new Aramaizing tense, formed by combining the participle with the following pronouns; for example, *'ômĕranî,* "I say." The future was expressed by the adjective *'athidh,* "ready," or the noun *sôph,* "end," with a pronominal suffix referring to the subject, followed by the infinitive introduced by *lĕ-,* "to"; *e.g., 'ănî 'āthîdh lômar,* "I am ready to say," or *sôphî lômar,* "my end (is) to say"; viz., "I will say"; or by *lĕ-* and the infinitive alone, as sometimes in biblical Hebrew, denoting rather what ought than what will happen; *e.g., 'anî lômar,* "I am to say." To express obligation, for which biblical Hebrew had no regular phrases, mishnaic Hebrew used the adjective *ṣārîkh,* "needed," with the infinitive; *e.g., 'ănî ṣārîkh lômar," I* must say." Thus Hebrew, with its archaic stiffness, lost also the austere beauty and stately dignity of its prime. In exchange it acquired simplicity and flexibility and adapted itself better to the needs of every day, though the disappearance of much that is characteristically Hebrew before the invasion of Aramaic cannot but be regretted. Hebrew still lives as the language of Jewish scholars, though coloured in varying degrees with the writer's own speech, whether Persian, Arabic, French, German or whatever it may be. The structure is Hebrew; the vocabulary is often very foreign. This must be increasingly so, for ancient Hebrew is ill adapted to modern needs. As mediaeval grammar and philosophy demanded Arabic terms, so modern science requires European terms, often borrowed through Arabic. *(See.* YIDDISH LANGUAGE *AND* LITERATURE.) (G. R. D.)

HEBREW **LITERATURE.** Works in Hebrew were written by Rabbanite and Karaite Jews, by Samaritans, and some also, in the 16th and 17th centuries, by Christians. Rabbanite Jewish literature, with which this article deals, includes for practical purposes Jewish writings in Aramaic and certain Arabic works current in Hebrew translations. Other Jewish literatures exist in Yiddish, in Judaeo-Spanish and in other languages.

Biblical Literature.—All works preserved from the biblical period *(c.* 1200–586 B.C.) are included in the Bible *(q.v.),* but the titles of several other books are mentioned, especially in the Books of Chronicles. The oldest literary remains are some fragments of epic poems (Gen. iv, 23; Num. xxi, 17–18 and xxiii-xxiv; Judg. v). According to M. Cassuto large parts of the Pentateuch and of the books of Joshua and Judges still betray their original epic form. Biblical poetry closely resembles in form and phraseology the Canaanite epics from Ugarit (Ras Shamra) of the 14th century B.C. or earlier. It differs from prose in vocabulary and in syntax and is distinguished by parallelism: each verse consists of two parts of roughly equal length expressing identical or complementary ideas. Other metrical features were still under debate at mid-20th century. *See* G. B. Gray, *The Forms of Hebrew Poetry* (London, 1915); W. H. Cobb, *A Criticism of Systems of Hebrew Metre* (Oxford, 1905). The style of the historical books of the Bible was based on that of the royal chancelleries, whose official chronicles they used *(cf.* the style of the Lachish letters, ed. by N. H. Torczyner, Oxford, 1938). Deuteronomy is in a rhetorical prose style of its own. Dialogue often exhibits marked colloquial features—evidence of observation and stylistic maturity.

The Period of the Second Temple, 539 **B.C.–A.D.** 70.—The literary output of the period of the Second Temple was large *(cf.* Eccles. xii, 12): some of it was included in the biblical canon, while other works, excluded because they were written or used by sectarians (*i.e.,* non-Pharisees), remained in translations in Christian hands *(see* APOCALYPTIC LITERATURE; APOCRYPHAL LITERATURE); of some only the titles are known; and new works come to light with the discoveries in the caves near the Dead sea (1947 *et seq.).* The language of this literature—as far as it is possessed in Hebrew—is a somewhat degenerated Biblical Hebrew. The formal conventions of biblical prose and poetry are adhered to. The only new genre is *midrash,* the interpretation of biblical texts so as to bring out their relevance for the commentator's time or their practical legal application.

The use of Biblical Hebrew was artificial. The spoken language in Judaea until the 1st century A.D. mas Mishnaic Hebrew *(see* M. H. Segal, "Mišnaic Hebrew and its Relation to Biblical Hebrew and to Aramaic," *Jewish Quarterly Review,* xx, pp. 647–737 (London, 1908); H. Birkeland, *Språk og Religion hos Jøder og Arabere* (Oslo, 1949). The Pharisees used the Mishnaic colloquial for their oral teaching, as handed down in tannaitic works. For prayer, they used the same dialect but enriched it with extensive borrowings from Biblical Hebrew, especially from its poetry. They did away with parallelism: instead, they used short lines, mostly of four words, often in sets of three. Simple rhymes occur; this may be the earliest use of this device in poetry *(see* K. G. Kuhn, *Das Achtzehngebet, der Vaterunser und der Reim,* Tiibingen, 1950). These old prayers now make up only a small part of the Jewish liturgy and differ in wording according to the rites. See *The Authorized Daily Prayer Book,* annotated ed. by I. Abrahams (London, 1914); N. Glatzer (ed.), *Language of Faith* (New York, 1947), an anthology; G. Elbogen, *Der jüdische Gottesdienst in seiner geschichtlichen Entwicklung* (Berlin, 1913); W. O. E. Oesterley and G. H. Box, *A Short Survey of the Literature of Rabbinical and Medieval Judaism* (New York and London, 1920).

In the synagogues weekly portions of the Bible were read and then interpreted in the vernacular with a limited use of *midrash* technique. Hence all ancient versions, whether Greek, Aramaic *(see* TARGUM), the Syriac Peshitta or Jerome's Vulgate, include midrashic elements.

The last work of this type is the Arabic version by Seadiah (d. 941/942). Some of the late Targums (*e.g.,* those on Canticles, Ecclesiastes and Esther) incorporate so much *midrash* as to be independent writings rather than translations. *See* P. Kahle, *The Cairo Geniza* (Toronto and Oxford, 1947); B. J. Roberts, *The Old Testament Text and Versions* (Cardiff, 1951); I. L. Seeligmann, *The Septuagint Version of Isaiah* (Leyden, 1948); L. Prijs, *Jüdische Tradition in der Septuaginta* (Leyden, 1948).

The Tannaitic and Amoraic Periods, 70–200 **and** 200–500. —The oral teaching of the Pharisees and, after A.D. 70, of the rab-

bis concerned either legal and ritual matters (halakhah, "walking," viz., in the way of God) or theological and ethical questions (aggadah or haggadah, *q.v.*, "telling"). Even when such teachings were purely traditional (the Oral Law) or avowedly of recent innovation, it was sought, especially since Rabbi 'Akiba (d. between 130 and 140), to attach them to Scripture. This was done by means of hermeneutic rules (middoth), which were most probably derived from Hellenistic rhetoric (cf. D. Daube, "Rabbinic Methods of Interpretation and Hellenistic Rhetoric," Hebrew Union College Annual, xxii, Cincinnati, 1949; S. Lieberman, Hellenism in Jewish Palestine, New York, 1950).

In Halakhah these rules were few and strict, while in Aggadah, where nothing was binding and reciprocally exclusive views could coexist, much more liberal methods were used. The influence of rhetoric is also discernible in the style of the aggadah, the nearest thing in this period to literature in our sense. Aggadah freely reshapes biblical history; a composite view of the resulting picture is given by L. Ginzberg, Legends of the Jews, 7 vol. (Philadelphia, 1909–38). For an analysis of its thought see M. Kadushin, The Rabbinic Mind (New York, 1952); also I. Heinemann, *Darkhe ha-Aggadah* (Jerusalem, 1940).

For the books of the period, see TALMUD and MIDRASH. In Mishnah and Tosefta the tannaitic teachings are arranged by subjects (often disturbed by older, mnemonic, arrangements); in the tannaitic midrashim they are arranged in the order of the biblical laws to which they refer. All these works include aggadah. The Babylonian and Palestinian Talmuds summarize in Aramaic the discussions of the Amoraim on the Mishnah, point by point, but in doing so often stray far from the subject and for whole pages give only aggadah. Much tannaitic material is preserved only in these discussions (Baraita).

While as books these works are shapeless and unsystematic, the individual paragraphs are often constructed with consummate art. In Rabbi 'Akiba ben Joseph, by E. Ben-Yehudah (Jerusalem, 1945), an attempt is made to evaluate the style of an individual tanna.

The halakhic method of the Babylonian Talmud is highly developed, while its aggadah is crude and affected by Mesopotamian demonology. In the Palestinian Talmud the halakhic discussions are simple and there is much less careful editing; the aggadah is of a national and messianic character and more artistic in style. The aggadah of the Babylonian Talmud is extracted in 'En Ya'akov by Jacob ibn Habib (1460–1515) (tr. by S. H. Glick, New York, 1922), that of the Palestinian Talmud in Yefeh Mar'eh by Samuel Yaffe (16th century).

The Literary Revival and the Gaonic Period, 500–1000.—In Justinian's Novella CXLVI "De rebus iudaicis," of A.D. 553, note is taken of the attempt of some Jewish groups to enforce the exclusive use of Hebrew in the ritual of the synagogue. This tendency was part of a Hebrew revival that began in Palestine and spread westward but reached Babylonia (*i.e.*, southern Iraq) only in the 10th century.

Midrash.—The aggadic thought of the Amoraic age was now built into skilfully constructed sermons. Sayings originally Aramaic are mostly translated into a Hebrew strongly influenced by the style of the liturgy. The earlier works, foremost among them Genesis Rabba (translated in The *Midrash* Rabba by M. Simon and H. Freedman, 10 vol., London, 1948), are largely concerned with theological controversy against gnostics. In the later collections, represented mainly by the Tanhuma cycle, the sermons are given in greater detail and are purely ethical. For the first time real books with a sustained theme appear. Besides a large number of minor midrashim, two deserve special note: *Tanna* de-be Eliyahu, a lofty ethical work, and Pirke Rabbi Eliezer (tr. by G. Friedlander, London, 1916), mystical in tone. A whole literature, the Hekhaloth writings, describes the mystic's ascent to heaven and vision of God. Their symbolism influenced the numerous additions which were during this period made to the liturgy, as well as the piyyut (cf. G. Scholem, Major Trends in Jewish Mysticism, pp. 57–63, rev. ed., Ne York, 1946). Mystical cosmology is the theme of Sefer Yezirah or "Book of Formation" (tr. by K. Stenning, 1923). See further L. Zunz, Die *gottesdienstlichen* Vortriige der Juden (Berlin, 1832).

Piyyut.—Synagogues began in this period to appoint official precentors (hazzanim), part of whose duty it was to compose poetical additions to various parts of the liturgy on special Sabbaths and festivals. The authors of such compositions were called *poytan* = ποιητής (the more usual form, *paytan*, is Babylonian usage), their poems piyyutim. There are numerous similarities between these and the Byzantine and Syriac hymns of the time.

The keynote is messianic fervour and religious exuberance. Besides employing the entire Biblical, Mishnaic and Aramaic vocabularies, the *paytanim* coined thousands of new words, sometimes for new ideas, but more often simply recherche' and full-sounding synonyms. The poems presuppose a highly educated audience. They abound in recondite allusions to halakhic and aggadic literature and contain exhaustive lists of rites and laws, so much so that it was at one time believed that their purpose was to teach the law during periods when the rabbinic schools were suppressed. Persons are rarely mentioned by name but nearly always introduced by ingenious allusions. There are often elaborate strophic arrangements, with rhymes or refrains. Already the Bible knows acrophonic poems (*e.g.*, Ps. ix, x, xxv, xxxiv); in *piyyut* there are all kinds of ingenious arrangements involving the beginnings of lines, words in the middle, or even all words. Frequently the initial letters of lines spell out the name of the author. These "signatures" help to establish the history of this literature, which is still largely unknown. It is known that the most outstanding poets—Phineas the Priest, Yose ben Yose, Yannai (poems ed. by M. Zulay, Berlin, 1938) and Eleazar ha-Kalir or ben Kalir—lived in that order, but of none of them is it known when or where in Palestine he lived.

Many piyyutim are still used in the synagogue. The Service of the Synagogue, ed. by I. Davies and H. Adler (London, 1906 et seq.), contains many famous ones with translations and has lists of poets at the end of each volume. All known *piyyutim* are listed by I. Davidson, Ozar ha-shirah ha-'ivrith (New York, 1924–33). For history see L. Zunz, Die synagogale Poesie (Berlin, 1855) and Literaturgeschichte der *synagogalen* Poesie (1865); also I. Elbogen, *op. cit.*

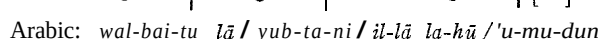
Halakhah.—Babylonian Jewry took no part in the literary renaissance. During the 6th and 7th centuries the Saboraim edited the Babylonian Talmud. After this the Geonim—the heads of the academies (Yeshiboth) of Sura and Pumbeditha—worked to spread the influence of the Talmud by encouraging communities everywhere to submit legal problems to them. They answered these in responsa (she'eloth u-teshuvoth). Such responsa remained a characteristic form of Hebrew literature. B. Cohen, Kuntres *ha*-teshuvoth (Budapest, 1930), lists 1,795 collections of them, some containing thousands of items; works of this kind were still being published at mid-20th century. They are an invaluable source for social history. See Z. Frankel, Entwurf zu einer Geschichte der Literatur der nachtalmudischen *Responsen* (Breslau, 1865); S. B. Freehof, The Responsa Literature (Philadelphia, 1954).

The responsa often deal with controversial points left unsolved in the Talmud; their authors thus act as decisors (*posekim*). Such problems were discussed in formal set lectures (she'iltoth) at the semiannual Kalla conferences. There is a collection of such speeches by Rabbi Ahai (d. 762). Yehudai Gaon (680–761) was the first one to arrange compendiums of practical rulings, which were important as a weapon in the struggle against Palestinian halakhah. This activity culminated in complete epitomes of the halakhic material in the Talmud. The earliest is by Simon Kayyara (9th century), the latest and most authoritative by Isaac al-Fasi of Lucena in Spain (1013–1103).

The Classicist Revival.—The rise of the Karaites (or Qaraites, *q.v.*) with their insistence on return to the Bible may have been a contributory factor in bringing about the intensification of Bible study among the Rabbanites in the 9th century. It is no longer held that these studies originated with the Karaites. Fragments from the Cairo Genizah, however, prove that some atheistic sceptics actually used Biblical Hebrew in writing against the Bible. One fragment was edited by S. Schechter (Jewish Quarterly Re*vim*, xiii, 1901); the work of Hiwi of Balkh is known through

Seadiah's retort (ed. by I. Davidson, New York, 1915). Seadiah Gaon (*q.v.*; d. 941/942), who wrote several works in biblical style, points out the names of other works in this genre in his autobiography. The reason for the choice of Biblical Hebrew appears to be the desire to emulate the Arabs' zeal for keeping their language pure, by cultivating the Hebrew equivalent to pre-Islamic Arabic. This was all the easier as Mishnaic Hebrew never had been a living idiom among Babylonian Jews, and they were at this time exchanging their Aramaic speech for Arabic. Seadiah had to translate the Bible into Arabic and to add Arabic translations to his compositions in biblical style. At the same time Seadiah introduced piyyut to Babylonia. His *piyyutim* are much more difficult and artificial than those of the Palestinians.

Metrical Poetry.—Soon after Seadiah, probably by his pupil Dunash ben Labrat (c. 920–80; poems ed. by N. Allony, Jerusalem, 1947), the Arabic system of quantitative metre was adapted for Hebrew by equating the Hebrew reduced vowels (shewa and *hathefs*) with the Arabic short vowels (since the former long and short vowels of Hebrew were no longer distinguished), as in the following example of the metre *basit*,



Arabic: *wal-bai-tu lā / yub-ta-ni / il-lā la-hū / 'u-mu-dun*
wa-lā 'i-mā- / da i-dhi / lam tur-sa au- / tā-dū
Hebrew: *zi-yon hi-lo / tish-'ă-li / lish-lom i-si- / ra-yikh*
dor-she shĕ-lo- / mekh wĕ-hem / ye-ther 'ă-da- / ra-yikh

At first the piyyut form was retained for religious poems, and the new metres were used only for secular poetry, which closely imitated Arabic models and was, like the latter, chiefly employed for laudatory addresses to prominent people. For poems see J. Mann, The Jews in Egypt and *in* Palestine under the *Fatimid* Caliphs, vol. 2 (New York and London, 1922).

Spheres of *Influence*.—During the Roman empire, Jewish communities settled throughout western Europe and North Africa. They spoke Greek and, in the west later on, Latin and possessed writings in those languages (cf. D. S. Blondheim, *Les* Parlers *judéo-romains* et la *Vetus* Latzna, Paris, 1925). They came first under the influence of the Palestinian renaissance; soon after they were affected by the missionary activities of the Babylonian schools. The results differ in each country. On the whole, Italy, southern France and the Carolingian empire remained within the Palestinian orbit but accepted the Babylonian Talmud and some of Seadiah's work, particularly the Beliefs and Opinions in a Hebrew translation couched in piyyut phraseology. Spain and North Africa continued for a while to cultivate piyyut but otherwise completely adopted the outlook of the Babylonian centre, including the revived biblical style and the Arabic metres. In the 10th and 11th centuries northern France and Germany (but not Italy or Provence and Languedoc) adopted the Palestinian ("Ashkenazi") pronunciation.

The Jews of South Arabia adopted the Babylonian Talmud and the Babylonian method of vowel-notation (though their pronunciation is Palestinian), but retained the Palestinian devotion to midrash (an important collection, *Midrash* Hagadol, exists only among them) and produced piyyut until modern times.

With the political and economic decline of the Abbasid empire after 932, oriental Jewry rapidly lost its prosperity and cultural hegemony. The last Geonim were among the greatest. Sherira (fl. 968–998) outlined in a *responsum* for the first time the history of halakhic studies (French tr. by L. Landau, Antwerp, 1904). His son Hai (939–1038) was a philosopher, a commentator of Bible and Talmud along scientific lines, and a poet (Moral Instruction, tr. by H. Gollancz, London, 1922). With him the Babylonian gaonate ceased; a much reduced activity continued for a while in Palestine and Syria, but the focus of Hebrew literature shifted to the west. The opposition between Babylonian and Palestinian thought and writing was from then on replaced by that of their spiritual heirs: Spain on the one hand and northwestern Europe on the other.

The Palestinian Tradition in Europe, 800–1300.—From Palestine, the Hebrew renaissance soon spread into the Byzantine empire. A remnant of literary work in the Balkans is the *Midrash* Lekah Tov by Tobias ben Eliezer of Castoria (Bulgaria, c. 1100). Learned Jews from Byzantium or from Byzantine refugee communities on the Black Sea coast converted in the 9th and 10th centuries the Khazar princes on the lower Volga. Russian heroic ballads contain references to Hebrew singing (cf. J. Yasser in Jewish Social Studies, xi, 21–48, New York, 1949).

In Sicily and southern Italy (which belonged to Byzantium) a number of important *paytanim* were at work. Their poems are often extremely artificial. Midrash was extensively cultivated. Midrashic commentaries to biblical books outside the Pentateuch and the Five Scrolls were produced there by extracting from the older midrashim (including some now lost) and the Talmuds incidental comments on verses from those books (*e.g.*, Samuel, Proverbs, Psalms and Job). Compilations of this kind for the whole Old Testament are called yalkut, "haversack": Yalkut *Shim'oni* (Germany, 13th century); Yalkut Mekhiri (southern France, 14th century); Yalkut Talmud Torah (Sicily, 1331).

Before 1000 there began in Italy a secular literature: the phantastic travelogue of Eldad the Danite; the historical romance Sefer ha-Yashur, which deals with the Pentateuchal period; and *Josippon,* which is Josephus' Antiquities translated from Hegesippus' abridgment and filled up with legendary incident (English abridgment by Peter Morvyn, 1558). This last-named book was popular until modern times and translated, inter alia, into Arabic and Ethiopic. Mainly for entertainment too, was the family chronicle of the *paytan* Ahima'az, in rhymed prose and piyyut style (The Chronicle *of* Ahimaaz, ed. and tr. by M. Salzman, New York, 1924). Jews took part in the work of the medical academy at Salerno. The philosopher and mystic Sabbethai Donnolo (913–983) wrote a book of *materia medica* in Hebrew (ed. by Z. Muntner, Jerusalem, 1949); this makes it probable that it was possible for a doctor to train himself through Hebrew works. Some contact with the philological scholarship of the Latins is also probable in the case of Nathan ben Jehiel, who in 1101 completed at Rome a dictionary of Talmudic Aramaic and Hebrew, the 'Arukh, "one of the greatest monuments of medieval scholarship" (G. Sarton). It is still used, especially in the modernized form (Aruch *Completum*) given to it by the New York rabbi A. Kohut (Vienna, 1878–92).

Of the literary activity of Provence and Languedoc, which laid the foundations for the high scientific culture which evolved there after 1100, little has been preserved. Raimundus Martin, in his Pugio Fidei, quotes extensively from a *Midrash* Bereshith Rabbathi by Moses ha-Darshan of Narbonne (11th century), presumably because it would be acknowledged as the best authority by Jews; yet only extracts have been preserved (ed. by H. Albeck, Jerusalem, 1940). The Bible commentaries of this scholar and of Menahem ben Helbo are known only through quotations in Rashi.

Members of the North Italian family Kalonymos brought Talmudic studies and piyyut to Mainz in the middle of the 10th century. The academy there became a centre of studies under the direction of Gershom ben Judah, "the Luminary of the Diaspora" (960–1028 or 1040). As a poet, he established the distinctive style of European *piyyut*—simple language, uncomplicated strophic arrangements and personalized emotion—in poems that read very much like early European popular poetry (Selihoth *u-Pizmonim,* ed. by A. M. Habermann, Jerusalem, 1944). The greatest alumnus of the Mainz academy was, of course, Rashi (*q.v.*), himself a poet of note. The characteristic contribution of the later Franco-German school to halakhic thought was the Tosafoth, brief but extremely profound glosses on the Babylonian Talmud. Also, following a practice begun by the last Geonim, they produced works of comprehensive practical guidance on specific legal matters.

The slaughter during the crusades drove large masses of Jews to seek refuge in a new home in eastern Europe, whither they carried their German speech (see YIDDISH LANGUAGE AND LITERATURE), but hardly any literary culture, so that their descendants had to start from a new basis. In Germany accounts of the disaster were written in a new prose style, permeated with poetry (see A. Neubauer and M. Stern, Hebraische Berichte, Berlin, 1892); liturgical poetry became henceforth mainly a chronicle of persecutions. These sufferings inspired an important mystical movement, which was influenced by Seadiah (in the old translation) and by contemporary Christian asceticism. Its teachings were largely transmitted through stories; the chief collections are the *Ma'aseh*

Book (tr. by M. Gaster, Philadelphia, 1934) and the Sefer *Hasidim* of Judah the Pious of Regensburg (d. 1217), who also wrote the Songs *of* Unity, mystical prayer-poems of great force (tr. in The Service *of* the Synagogue). Another mystic, Eleazar of Worms (1176–1238), composed the legal compendium Sefer *Mizwoth Gadol* (*"Semag"*) with a preface on asceticism.

The Jews of Angevin England belong entirely to French Jewry. They produced some works on halakhah and a grammatical treatise which betrays acquaintance with work done in Spain. Berakhyah ha-Nakdan, a French Jew who made a summary of Seadiah's philosophy (tr. by H. Gollancz, *Ethical* Treatises, London, 1902) and wrote a collection of "Fox Fables," may have lived for a time in England: he translated Adelard of Bath's *Quaestiones naturales* (ed. by H. Gollancz, London, 1920). See C. Roth, Intellectual Activities *of* Medieval English Jewry (British Academy Supplemental papers, viii).

Pethahiah of Regensburg, of the circle of Judah the Pious, described his travels to Russia and to the orient (German trans. by J. Griinhut, Frankfurt, 1905). Benjamin of Tudela (in Christian Spain) travelled in the years 1160–73 as far as India; his account gained lasting popularity (tr. by M. N. Adler, London, 1907). Though living in Toledo, Abraham ibn Da'ud (1110–80) adhered to northwestern European tradition in his histories of Rome, of the Second Temple (tr. by Peter Morvyn, 1561) and of the Oral Law.

"The Golden Age" in Spain, 900–1200.—Spanish Jewry began to flourish under the caliphate of Cordova (912–1002); the vizier Hasdai ibn Shaprut (c. 915–970/90) was the first Maecenas of Hebrew letters. His secretary Menahem ben Saruk wrote a biblical lexicon, which was trenchantly criticized by Dunash ben Labrat when the latter arrived from Baghdad and introduced in Spain the arabicized poetry that he had invented. The dispute was continued by their pupils. Already Samuel ha-Nagid, vizier of Granada (990–1jj), himself a poet (ed. by M. Habermann and M. Abramson, Jerusalem, 1947) and philologist, gathered around him a group of poets, most outstanding among whom was Ibn Gabirol (*q.v.*). Moses ibn Ezra of Granada (1060–1139) was the centre of the most brilliant circle of poets. He wrote in Arabic a history of Hebrew poetry and ars *poetica* (available only in a Hebrew tr. by B. Halper, Shirath *Yisra'el*, Leipzig, 1924). He wrote in his youth poems full of the joy of life (Selected Poems, trans. by S. Solis-Cohen, Philadelphia, 1934), later mainly penitential prayers. Like all earlier poets, he employed the Arabic metres and biblical idiom only for his secular poems, while his religious poetry followed patterns of *piyyut,* though its language, too, had by now become almost purely biblical. Moses' kinsman, Abraham, the poet, philosopher, grammarian and Bible-commentator, attacked the language and style of the early *paytanim* (comm. on Eccles. v, 1): he and Judah ben Samuel Halevi (*q.v.*) were the first to use the metres in religious poems.

This poetry was entirely dominated by Arab standards of taste. It dealt with the themes of Arabic poetry—friendship, love, drinking and self-praise—and often reproduced Arabic phrases. It was court-art, written to be appreciated by a small circle of connoisseurs. Except for the Odes to Zion of Halevi, they are mainly elegant expression of conventional sentiments. With the collapse of Jewish prosperity in Moslem Spain, this art lost its *raison d'être.* The last major poet in Spain was Judah al-Harizi (1165–123j), an important translator of philosophical works. He achieved the feat of translating al-Hariri's Maqamat into Hebrew (Mahberoth *Ithi'el,* ed. by T. Chenery, London, 1872; *cf.* J. Schirmann, Die hebraische *Uebersetzung* der *Maqamen,* Frankfurt, 1930). He then composed an original set of equally scintillating jeux *d'esprit, Tahkemoni* (partial German tr. by S. Kaempf, Prague, 1858). See F. Delitzsch, Zur Geschichte der judischen Poesie (Leipzig, 1836); J. M. Millás Vallicrosa, La Poesia *sagrada hebraicoespañola,* 2nd ed. (Madrid, Barcelona, 1940); H. Brody and M. Wiener, *Anthologia* hebraica (Leipzig, 1922), with a partial translation by C. de Mouilleron, *Poèmes hébreux* anczens (Limoges, 1947).

The use of Biblical Hebrew was made possible by the work of the philologists. The science of grammar began with the Massoretes (see BIBLE) whose system was followed by Seadiah and Rashi. Of great importance was the creation of comparative linguistics by Judah ibn Kuraish (ed. by D. B. Goldberg and J. J. L. Barges, Paris, 1857) and Isaac ibn Barun. Following the advances made by Arab grammarians, Judah Hayyuj, a disciple of Menahem ben Saruk, recast the system. In the form given to it by David Kimhi of Narbonne (1160–1235), the new system was taken over by the Christian humanists and through them by modern scholarship. The first complete Hebrew grammar, Kitab al-luma', was written by Ibn Janah of Cordova (990–1050). Like most of the Spanish grammarians, he wrote Arabic. All of them concentrated exclusively on Biblical Hebrew. The philological method was the principal feature of the Spanish Bible-commentaries, among which those of Abraham ibn Ezra and David Kimhi are the most important. See W. Bacher, Die hebraische *Sprachwissenschaft* (Trier, 1892); H. Hirschfeld, Literary History *of* Hebrew Crammarians and Lexicographers (London, 1926); L. Prijs, Die grammatikalische Terminologie des Abraham *ibn* Ezra (Basle, 1950).

While hardly any Jews wrote poetry in Arabic, the philosophers (often the same men as the poets) wrote only in Arabic. On the whole the Jewish writers were not so much concerned with creating general systems of philosophy—the only exception is Ibn Gabirol in his Fons Vitae—as with demonstrating the harmony between the Jewish faith and the system of philosophy accepted by their readers. Neoplatonists, like Ibn Gabirol, were Judah Halevi (*q.v.*) and Bahya ibn Paquda (fl. 1080), whose Duties of the Heart (French tr. by A. Chouraqui, Paris, 1950) is the Jewish counterpart to the Imitatio Christi and was equally influential. With the historian Abraham ibn Da'ud (see above), Aristotelianism came upon the scene (*Emunnah Ramah,* German tr. by S. Weil, Frankfurt-am-Main, 1852). The Guide (1190) of Maimonides (*q.v.*) already constitutes a new philosophy in some ways independent of Aristotle. It should be noted that all Arab and Jewish Aristotelians introduce some Neoplatonist elements into the master's system. See I. Husik, A History of Mediaeval Jewish Philosophy (New York, 1916); J. Guttmann, Die Philosophie des Judentums (Munich, 1933); J. Klatzkin, Anthologiah *shel* ha-philosophiah ha-'Ivrith (Berlin, 1926); Thesaurus philosophicus linguae hebraicae (Berlin, 1928–33).

Though, apart from Isaac Israeli (North Africa, *c.* 845–*c.* 940) and Maimonides, few Jews made original contributions to science, the Spanish Jews shared the best scientific education. Thus, when in the 11th century European scholars flocked to Toledo in order to translate Arabic scientific literature, they found learned Jews able to serve as interpreters. Among these, Abraham bar Hiyya Savasorda (*i.e.,* "chief of police"; d. *c.* 1136) of Barcelona was an original mathematician (he solved $x^2 + b = ax$) who wrote in Hebrew works on mathematics, astronomy and philosophy. including a scientific encyclopaedia (ed. by J. M. Millás Vallicrosa, Madrid, 1952) and the Liber Embadorum, a geometry textbook which in the Latin translation by Plato of Tivoli (1145) became "one of the fountainheads of European mathematics" (G. Sarton). There is little doubt that he wrote for the Jewish public of Provence and Languedoc; hence he also employed the late Mishnaic Hebrew current among them, not the biblical style of the Spanish writers of belles-lettres. The same style was also used by Abenezra.

When the Almohades expelled the Jews from Moslem Spain in 1148, many learned refugees came to Languedoc and Provence and were there invited by local groups to translate scientific and philosophical works. The most ,important translators were Judah ibn Tibbon (1120–90) and his son Samuel (1150–1230) at Lunel. By 1400 more than 100 translators had made available works by more than 150 authors, some in several renderings. This was much more than was at the disposal of Christian students. Often the Hebrew version was preserved when the Arabic original had disappeared. The translators coined hundreds of new technical terms, but also, at any rate to present taste, followed Arabic syntax and idiom too slavishly. See M. Steinschneider, Die hebraischen *Uebersetzungen* des Mittelalters (Berlin, 1893).

The Period of Retrenchment, 1200–1750.—This is the era of the ghetto, during which the area of western European Hebrew culture shrank to a remnant in Italy, while a new and entirely different culture arose in eastern Europe.

The Decline of Philosophy.—The appearance of the Hebrew ver-

sion of Maimonides' Guide (1204) provoked orthodox circles into opposition to all secular studies (cf. J. Sarachek, Faith and Reason; the *Conflict* over the Rationalism of Maimonides, i, Williamsport, Pa., 1932). Philosophy was defended by Shemtob Palquiera (d. c. 1290), author of an interesting propaganda pamphlet, The Searcher, and by the mathematician Levi ben Gerson (Gersonides, *q.v.*; 1288–1344), who wrote philosophical commentaries on the Bible. Hasdai Crescas (1340–1410) attacked philosophy by its own methods, using talmudic devices of argumentation (see H. A. Wolfson, Crescas' Critique of Aristotle, Cambridge, Mass., 1929). Dogmatic theology was popularized by the 'Zkkarim of Joseph Albo (1380–1444; tr. by I. Husik, Philadelphia, 1929–30).

Already Savasorda had delivered philosophical sermons in his Meditation of the Soul. Jacob Anatoli (fl. 1231) was the first to write such sermons to the whole Pentateuch (see I. Bettan, "The Sermons of Jacob Anatoli," Hebrew Union College Annual, xi, pp. 391–424, 1936). The most popular work of this genre is 'Akedath Yizhak by Isaac Arama (1440–1505).

Philosophy, midrash and mysticism are mixed in the ethical collectanea, generally ascetic in outlook, which soon became the "learning" of the semieducated. The oldest is Israel an-Nakawah's *Menorath* ha-Ma'or (ed. by H. G. Enelow, New York, 1929–35), elaborately classified according to virtues. It was, however, overshadowed by an imitation of the same title by one Isaac Aboab (German tr. by S. Bamberger, Hamburg, 1923). Equally popular remained Prince and *Hermit,* an adaptation by Abraham ibn Hasdai (d. 1240) of the Buddha story *Barlaam* and Josaphat (*q.v.*). The vanity of all earthly things was preached in elegant Biblical Hebrew by Jedaiah of Béziers (Yedaiah Bedaresi, 1270–1340) in his *Examination of the World* (tr. by T. Goodman, London, 1806).

The real reaction to Maimonidism, however, was the return of Neoplatonist mysticism, with an admixture of gnostic elements, in the form known as kabbalah. Beginning with the Pentateuch commentary of Moses Nahmanides (1194–1270), it culminated in the theosophy of the Zohar (c. 1290), which during the remainder of this period exercised an influence comparable only with that of the Bible and Talmud. See CABALA; also A. Neubauer and E. Renan, Les *Écrivains juifs français* du *14e siècle* (Paris, 1893).

The Final Codification of *Halakhah.*—Maimonides' code still remains the most systematic digest of Jewish law and ritual ever written. Though some Talmud students condemned the very idea of a code, another compendium, closer to Franco-German practice, was compiled by Jacob ben Asher (1269–1343), called *Arba' Turim* or simply Tur. Joseph Karo (or Qaro; 1488–1575), rabbi in Adrianople and later at Safed, digested in a commentary on the *Tur* all previous halakhic writings and decided all controversial matters; he then (1555) summed up his results in the *Shulhan* 'Arukh ("Well-laid Table"), which is always printed with glosses by Moses Isserles of Cracow (c. 1525–72) and is still, in this form, the authoritative guide to orthodox Jewish practice, though for present-day usage in everyday matters the *Kizzur* ("Abridgment") made in 1864 by S. Ganzfried (tr. by A. Goldin, 1928) should be consulted. Karo also left a diary recording mystical revelations granted to him by the personified Mishnah (cf. H. L. Gordon, The Maggid of Caro, New York, 1949).

Artistic Writing.—In Provence and Languedoc much poetry and rhymed prose was written, mostly nugatory displays of linguistic skill. The tradition remained alive until modern times among the Spanish exiles in North Africa and Turkey. Kabbalistic sexual symbolism brought back emotional poetry, a fine example of which is the Sabbath hymn Lekhah Dodi by Solomon Alkabez (Safed, 16th century; tr., Authorized Daily Prayer Book, p. 111). Israel Najara (1542–1619) used sensuous erotic images to describe Israel's relation to God in rhythms borrowed from popular airs (cf. M. Wiener, Die Lyrik der Kabbalah, Leipzig, 1920).

Though reduced to miniature scale in keeping with the size of the ghettos, western Hebrew culture was kept alive in Italy after the expulsion of the Jews from England (1290), from France (1326) and from Spain (1492) and remained in contact with contemporary Christian thought. Immanuel of Rome (c. 1270–c. 1330) exhibits in his picaresque *Mahbaroth* (ed. by M. Habermann, Tel Aviv, 1946) the influence of Dante (cf. Tophet and Eden, tr. by H. Gollancz, London, 1921). Isaac Abrabanel (*q.v.*) was fully conversant with European thought. Others, for example, Jacob Mantinus (d. 1549), acquainted the Latin reader with Jewish philosophy and Kabbalah. Azariah de' Rossi (1513–78) applied historical criticism to Jewish sources. Leon of Modena (1571–1648) rejected Kabbalah and perhaps more (cf. Simon Stern, Der Kampf des Rabbiners gegen den Talmud, Breslau, 1902). Poetry followed the developments of Italian taste. Judah Sommo (1527–92), author of an Italian handbook of drama, wrote the first Hebrew play (ed. by H. Schirmann, Jerusalem, 1946). The most gifted representative of this tradition was M. H. Luzzatto (*q.v.*), whose play La-Yesharim Tehillah was taken as a model by so many Haskalah authors. See C. Roth, History of the *Jews* of Italy (Philadelphia, 1946); J. Schirmann, Mivhar ha-shirah *ha-'ivrith be-Italiah* (Berlin, 1934).

The Marranos who after 1600 returned to Judaism and settled in Amsterdam were often highly educated and, though narrowly orthodox in religious matters, remained in close contact with happenings in general literature. Their own culture is typified by Menasseh ben Israel (*q.v.*). Their artistic writing followed Italian models: for example the allegorical drama Prisoners *of* Hope by Joseph Penço (1650–92). D. F. Mendes (1713–92) combined Racine's *Athalie* and Metastasio's *Gióas* into one Hebrew play. See J. Melkman, David *Franco* Mendes (Amsterdam, 1951), for a general survey of Dutch-Jewish culture at this time.

Eastern Europe and the Religious *Crisis.*—In the kingdom of Poland (which then extended from Lithuania to the Black sea) refugees from German persecution mingled with earlier Byzantine emigrés to create, by the 15th century, a prosperous Jewry with extensive autonomy.. Their culture was not a continuation of western European Hebrew civilization, but a new creation. The Bible (except for the Pentateuch) was neglected, while the Babylonian Talmud—hitherto studied only by specialists—became the basis of all intellectual life, particularly since the *pilpul* method of Jacob Pollak (1460–1541) had turned its study into an exciting form of mental gymnastics. The typical literature consisted of novellae (*hiddushim*), ingenious discussions of talmudic minutiae written in an ungrammatical mixture of Hebrew and Aramaic. Imaginative literature existed only in Yiddish, for women and the uneducated.

The expulsion from Spain in 1492 produced a wave of messianic emotion. Kabbalah flourished in the new Palestinian centre, the meeting place of Spanish, European and oriental Jews. There, in 1570–72, Isaac Luria (*q.v.*) created a cosmic messianism. Though its formulation, in the writings of Hayyim Vital (1543–1620), was abstruse and esoteric, its phraseology penetrated the widest masses, as a result of the introduction of Kabbalistic prayers, and coloured all later Hebrew writing. Luria's teachings were developed by the false messiah Sabbatai Sebi (see SABBATAI ZEBI) in the next century, for and against whom a vast literature was written.

The sufferings of Polish Jewry in the Cossack massacres of 1648—described in a long poem by the talmudist Yomtob Lippmann Heller (1579–1654)—opened their country to Lurianic mysticism. Out of popular Kabbalistic elements, Israel Ba'al Shem Tov in Podolia (1700–60) produced Chasidism (Hasidism). His teaching, like that of his successors, was oral and, of course, in Yiddish; but it was noted by disciples in a simple, colloquially flavoured Hebrew. Since they taught mainly through parables, there is here a beginning of the Hebrew short story. Indeed these narratives exercised, and still exercise, a profound influence on Modern Hebrew writers. See L. I. Newman and Samuel Spitz, The Hasidic Anthology (New York, London, 1934); and M. Buber, *Hundert* Chassidische Geschichten (Berlin, 1935), Geschichten des Rabbi Nachman (Frankfurt, 1906) and other works.

The **Haskalah Period,** 1750–1880.—Chasidism rapidly spread over all eastern Europe except Lithuania. There the Gaon Elijah of Wilna (1720–97), a writer of unusually wide scope, advocated a better-graded course of talmudic training and a modicum of secular studies; he himself wrote a handbook of mathematics. Shne'ur Zalman of Ladi (1747–1812) created the highly systematized and elaborate *Habad* Chasidism which was widely accepted in Lithuania. The Mussar movement of Israel Salant (1810–83) encouraged the study of the mediaeval ethical writers.

In the Berlin of Frederick the Great, young intellectuals from Poland and elsewhere, brought in as teachers by the families of wealthy "privileged" Jews, met the representatives of European enlightenment. They came under the influence of Moses Mendelssohn (*q.v.*), but they also met some representatives of Italian-Dutch Hebrew culture. One was the Dane N. H. Wessely (1725–1805), a friend of D. F. Mendes, who wrote several works on the Hebrew language and an epos on the life of Moses. The other. the Italian S. A. Romanelli (1757–1814), a much more modern personality then Wessely, wrote and translated plays; he is notable for an amusing account of his stay in Morocco. Out of these contacts grew Haskalah (perhaps best translated as "cultivation of the mind"), a moderate tendency toward westernization that retained a somewhat rationalist Jewish orthodoxy and contained as an essential element the veneration of Hebrew and of mediaeval western Jewish literature. Its ideals were expressed by the periodical *Ha*-Me'assef (1784–1811, with long interruptions). Wessely's program for the paper banned love poems, mention of classical deities and criticism of the Jewish religion. In fact, it contained principally translations of German poems and book reviews. Among German Jews, then already in a rapid process of germanization, this Hebrew movement had no place. Only in Breslau — which until recently had been part of eastern Europe — it continued for another generation. There a young Hungarian student, M. Kunizer, wrote in 1796 a historical character play (Beth Rabbi, published in Vienna, 1805), and David Samosz (1789–1864) published in 1821 and 1829 two short plays about contemporary Jewish life.

To Galicia, a centre of Chasidism, the Enlightenment was somewhat brusquely introduced by the Toleranzedikt (1782) of the emperor Joseph II. By supporting some of its aims, the Hebrew writers incurred hatred and persecution. Their chief weapon was satire. The imitation by J. Perl (1773–1839) of the Epistolae obscurorum *virorum* and the essays of I. Erter (1791–1851) are classics of the genre. There was only one poet, M. Letteris (1800–71), and one dramatist, N. I. Fischman (1800–75), who wrote two interesting biblical plays. Galicia's chief contribution was to the Judische Wissenschaft, a school of historical research with romanticist leanings. Its centre was in Germany (see ZUNZ, LEOPOLD), but the Galicians N. Krochmal (*q.v.*) and the biographer S. J. Rappoport (1790–1867) employed Hebrew, thereby gaining a much wider popular audience for their writings. Several excellent semi-learned periodicals appeared in Vienna. See M. Weissberg, Die neuhebraische Aufklarungsliteratur in *Galizien* (Leipzig, Vienna, 1898); B. Wachstein et al., Die hebruische Publizistik in Wien, 3 pt. (Vienna, 1930).

The impact of Haskalah ideas upon the humanistic Italo-Hebrew tradition produced a short literary renaissance. Its main connections were with the Jiidische Wissenschaft, to which I. S. Reggio (1784–185j) materially contributed. S. D. Luzzatto (1800–65), a prolific essayist, philologist, poet and letter writer, became prominent by his philosophy of Judaism, which he opposed as a superior form of human life to an amoral and rationalist "Atticism"; this led him to reject also all rationalist forms of Judaism. The poetess Rachel Morpurgo (1790–1871) strikes some remarkably modern chords. See Luzzatto's Discorsi storico-religiosi (Padua, 1870) and *Autobiografia* (Padua, 1882).

For the Jews of the Russian empire the Enlightenment may be said to have begun with I. B. Levinsohn (1788–1860) in the Ukraine and with M. A. Ginzberg (1795–1846) in Lithuania, who spread general knowledge and discussed religious questions in Hebrew. In the 1820s an orthodox reaction against such activities set in; it coincided with the rise of a romanticist Hebrew school of writers. A. D. Lebensohn (Adam ha-Cohen, 1794–1878) wrote fervent love songs to the Hebrew language. His son Micah Joseph (Mikhal, 1828–52), the most gifted pdet of the Haskalah period, wrote biblical romances and pantheistic nature lyrics. The first Hebrew novel, The Love of Zion by A. Mapu (1808–67), was a romantic idyll, which however had a powerful effect just because of the difference between the conditions that it depicted and the squalor of Jewish life (tr. by F. Jaffe, 1887). Mapu's second novel, The Guilt of Samaria, is in the grandiose manner. Like all Haskalah writers, he employed the melizah style; *i.e.,* phrases culled from the Bible and more or less ingeniously adapted to the thought that the writer wished to express.

The Realist *Movement.*—Mapu's third novel, The Hypocrite (1857–69) marks a new departure: it deals with contemporary life and attacks its social evils; and it portrays a new type, the *maskil* (possessor of Haskalah) in his fight against orthodox obscurantism. His last novel, The Visionary, which intended to expose Chasidism, was banned. The new, aggressive Haskalah soon came under the influence of Russian left-wing writers such as N. G. Chernyshevsky and Dmitry Pisarev. Literary criticism began. In 1867 A. D. Lebensohn published his 20-year-old allegorical drama Truth and Faith, but times had changed, and A. J. Paperno (1840–1919) rejected it as out-of-date, not least on account of its *melizah* style. Like Mapu. J. L. Gordon (1830–92) had started as a romantic writer on biblical subjects. From 1871 onward he produced a series of ballads exposing the injustices of traditional Jewish life. M. L. Lilienblum (1843–1910) began as a moderate religious reformer — his struggle with orthodoxy is the theme of the novel Religion and Life by R. A. Braudes (1851–1902) — but later became absorbed by social problems: in the Mishnah of *Elisha* ben Abuyah (1878) be used the figure of the heretic friend of Rabbi 'Akiba to preach a Jewish socialism. Later Lilienblum became a Zionist. P. Smolenskin (1840–85) created in six novels a kaleidoscope of Jewish life in which he rejects the westernized Jew as much as the orthodox reactionaries.

Modern Hebrew Literature. — If thus the realists had become impatient with Haskalah ideals, the Russian pogroms seemed to demonstrate the futility of its aims. That part of eastern European Jewry which read Hebrew books (*i.e.,* the middle classes) turned to Jewish nationalism. Zionist activity, coupled with the movement for speaking Hebrew which was started *c.* 1880 by Eliezer Ben-Jehudah (E. Perelman, 1857–1922), widened the circle of Hebrew readers. Hebrew daily papers began to appear in 1886. Writers abandoned *melizah* for a blend of Biblical and Mishnaic Hebrew with extensive borrowings from the mediaeval translators, as well as from European languages. The new character of Hebrew was symbolized by Ben-Jehudah's lexicon Thesaurus *totius* hebraitatis, which includes words from all periods.

S. J. Abramovich (1835/6–1917), who wrote under the pseudonym Mendele Mokher Sefarim ("Mendele the Itinerant Bookseller"), holds a key position in the transition to modern writing. His first novel (1868) was inspired by Ivan Turgenev. He soon became convinced that the Biblical Hebrew of the Haskalah was unsuitable for modern subjects and turned to writing in Yiddish. From 1886 onward he went back to Hebrew, into which he also translated his Yiddish stories. By extensive use of Hebrew and Aramaic phrases from the Talmud (without abandoning the Biblical vocabulary) he matched the homeliness of Yiddish and conveyed the atmosphere of Jewish life to perfection. In his stories life was, for the first time, depicted as it really was, with a warm humour that made the basically critical attitude of the author acceptable. Since the study of the Talmud was the chief education in traditional circles, Mendele's talmudic style and more positive attitude to traditional values attracted a much wider circle of readers than Haskalah literature had ever possessed. The fact that the life that Mendele described was rapidly disappearing added a nostalgic appeal. Stories of ghetto life remained the most characteristic and fertile genre of Hebrew literature until the middle of the 20th century. His *Fishke* the Lame is translated by A. S. Rappoport (London, 1928).

The *National* Revival. — "Grandfather Mendele" became the spiritual mentor of a galaxy of exceptionally gifted writers at Odessa. This group holds a position similar to that of J. W. von Goethe and J. C. F. von Schiller in German literature. Asher Ginzberg (1856–1927) wrote from 1889 onward, under the pen name of Ahad Haam ("One of the People"), a series of articles in which he brought modern sociological thought to bear upon Jewish affairs and evolved a philosophy of secular Jewish nationalism and of a "cultural centre in Palestine. His style, based largely upon the mediaeval translators, was European in spirit. In his monthly *Hashiloah* (founded 1896) he applied editorial standards hitherto unknown in Hebrew. During his stay in London (1907–21) he

inspired a minor Hebrew renaissance in England. In Tel Aviv from 1921, he devoted his last years to the edition of his correspondence, a valuable documentary of a vital period (1,700 letters, 6 vol., Jerusalem, 1923–25). See his complete works, Am Scheidewege, tr. by I. Friedlander and H. Torczyner (Berlin, 1923 et seq.); for Eng. tr., by L. Simon, see Selected Essays (Philadelphia, 1912), Ten Essays (London, 1922) and Essays, Letters, Memoirs (New York and London, 1947); see also N. Bentwich, *Ahad* Ha-am and his Philosophy (London, 1927).

Much influenced by Ahad Haam (he was for a time literary editor of Hashiloah) was H. N. Bialik (*q.v.*). Bialik was an important essayist, editor and anthologist of mediaeval literature and, during his stay in Palestine (1924–34), an arbiter on linguistic matters. His main role, however, was that of the "national poet," whose poems gave expression to the inner struggles of a generation much concerned about its attitude to Jewish tradition and who, in some of his utterances, reached an almost prophetic intensity. See his Complete Poetic Works, tr. and ed. by I. Efros (New York, 1948); also the autobiographical Aftergrowth, and Other Stories, tr. by I. M. Lask (Philadelphia, 1940).

In sharp contrast with Bialik, Saul Chernikhovsky (1875–1943) was unconcerned with the burden of tradition. Born in the Crimea, he studied in Germany and, from 1931, lived in Palestine. His poems, in strongly Biblical language, deal with the nature of these three countries, with love and with beauty. He was attracted by Greek culture and inspired by the gods of ancient Canaan. Where he touches upon Judaism, his approach is secular and militant, yet he lovingly depicted Russian-Jewish village life in a series of idylls. He translated the Iliad, the Odyssey, Hiawatha and many other works of world literature into Hebrew and did important work to establish the medical and scientific vocabulary of Hebrew. See his complete works, 10 vol. (Berlin, 1930); his poems (Jerusalem, 1948); and L. V. Snowman, Tchernichovski and His Poetry, With Renderings From the Hebrew (London, 1929).

The short stories of J. L. Peretz (1851–1915), who wrote both in Hebrew and Yiddish, introduced the Chasidic milieu into literature. The emotionalism and simple joy-of-life of that milieu henceforth exercised a powerful influence upon Hebrew artistic writing, and the language absorbed many Chasidic terms. His works include: *Jüdische* Geschichten, German tr. by A. Eliasberg (Leipzig, n.d.); Bontshe the Silent, tr. by A. S. Rappoport (London, 1927); The Three *Gifts,* tr. by M. Fine (London, 1946); and Stories and Pictures, tr. by H. Frank (Philadelphia, 1906).

The "New Trend." — Already Bialik sensed the conflict between the demands of Judaism and the natural instincts and needs of the Jew. This psychological interest dominates the work of a group of short-story writers, outstanding among whom is the literary critic D. Frischman (1860–1922) who did more than anyone to impose European standards on Hebrew literature. In In the Desert he projects the conflict back into Moses' time. M. J. Berdichevsky (1865–1921), in a neoromantic vein, idealized in his stories the uneducated manual worker, the pariah of traditional society. It was the literary historian R. Brainin (1862–1939) who discerned the presence of a "new trend" (ha-mahalakh he-hadash) and postulated *l'art* pour *l'art* and concentration on generally human problems.

The Emigre' Writers. — With this, Hebrew literature became fully co-ordinated with European tendencies. However, the next generation of writers were uprooted by the two Russian revolutions, emigrated to western Europe and gradually drifted to Palestine. The U.S.S.R. at first favoured Hebrew culture but then banned it (*cf.* W. Blattberg, The Story of the Hebrew and Yiddish *Writers* in the Soviet Union, New York, 1953); in other eastern European countries the culture decayed with the deterioration of the Jewish position; and many writers were killed by the Germans after the rise of Adolf Hitler. The writing of the emigre' generation is profoundly pessimistic. A hopeless rootlessness is the keynote of the stories of U. N. Gnessin (1880–1913) and J. H. Brenner (1881–1921); the delicate thumbnail sketches of G. Schofmann (1880–) are pervaded by perplexity; Z. Shne'ur (1887–1959) sings of revolt and desperate passion.

Palestinian Literature. — Almost all writers active in Palestine before 1939 were born in the Diaspora. An exception was J. Burla (1888–), an oriental whose novels deal with oriental Jewry. The Palestinian milieu with its colourful types attracted the attention of other writers. too: notably D. Shim'oni (1886–1956), whose idylls describe the agricultural chalutz immigrants; and A. Smilansky (1874–1953), whose stories are inspired of Arab life. The majority of Palestinian writers, however, were more concerned with nostalgic descriptions of life in eastern Europe or with the past — as for instance was A. A. Kabak (1881–1945), author of an especially interesting novel on the life of Jesus, In the Narrow Path.

The transition from the ghetto to Palestine was achieved only by few, among them being A. Barash (1889–1952), who after many stories and novels on life in Galicia wrote descriptions of the early struggles of Palestinian Jewry. This preoccupation with the early stages of the new life is also marked in the later work of S. J. Agnon (1888–), the outstanding Hebrew prose writer of his generation. Agnon developed an original Hebrew narrative style by going back to the midrash and the popular stories and ethical writings of earlier centuries. While his earlier stories were set in Galicia, he began in the 1940s to write about Palestine. At a still later stage the Kafkaësque atmosphere, found already in some of his early stories, became predominant in short sketches set in contemporary Israel. See his Buch von den *polnischen Juden* (Berlin, 1916); In der Gemeinschaft der Frommen, tr. by N. N. Glatzer and G. Scholem (Berlin, 1933); and the English translations by I. M. Lask, The Bridal Canopy (New York, 1937), Land of Israel Earth (Jerusalem, 1942), In the Heart of the Seas (New York, 1948).

Although the writers were hesitant to grapple with contemporary life, the Hebrew-speaking surroundings exercised an influence upon their style, which became more natural and expressive. The translation of world literature became a pressing need, occupying many first-class writers, and did much to increase the suppleness of the language. Poetry, especially, was profoundly changed by the transition from the Ashkenazi pronunciation with its penultimate stress to the Palestinian pronunciation with its alternation of stress positions.

In contrast with prose, poetry immediately concerned itself with Palestinian life. Among a large number of good writers, mention should be made of Rachel (R. Blovstein, 1890–1931) whose intensely personal poems, many of which have been set to music, are universally beloved; U. Z. Greenberg (1894–), a political poet whose *vers libre* reaches almost prophetic grandeur; and the symbolist school led by A. Shlonsky (1900–). See D. Vardy, The New Hebrew Poetry (Tel Aviv, 1947).

World War II and the Arab-Israeli war of 1948–49 brought to the fore numerous "Sabra" (Palestinian-born) writers who deal, in a racy and ever more difficult Hebrew, almost exclusively with the problems of their own milieu. Among the published diaries of youngsters who fell in the war are some of considerable literary merit. See J. Melkman, En een geslacht Komt (Amsterdam, 1952); Judd L. Teller, "Modern Hebrew Literature of Israel," Middle East Journal, vii (Washington. D.C., 1953).

Hebrew Literature in the United States. — After World War I, U.S. Jewry began to develop a school of Hebrew writers of its own, including novelists, poets and essayists. At first a scion of the emigre' school, it drew closer to Israeli style, while at the same time undergoing U.S. influence. There is also a number of important scholarly works in Hebrew. Various literary periodicals and even a Hebrew medical journal exist. See M. Ribalow, Anthology of Hebrew Poetry in America (New York, 1938); A. Epstein, *Soferim* 'ivrim be-Amerikah (Jerusalem, 1953).

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1937). Anthologies: J. Winter and A. Wiinsche, *Die jüdische Literatur*, 3 vol. (Trier, 1891–96); B. Halper, *Post-Biblical Hebrew Literature* (Philadelphia, 1921); L. I. Feuer and A. Eisenberg, *Jewish Literature since the Bible* (Cincinnati, 1937–41).

Haskalah and Modern Literature.—The standard work is J. Klausner, *Historiah shel ha-Sifruth ha-'Ivrith ha-Hadashah*, 6 vol. (Jerusalem, 1930–50). Other major Hebrew works are P. Lachover, *Toledoth ha-Sifruth ha-'Ivrith ha-Hadashah*, 3 vol. (Tel Aviv, 1929–48), and A. Orinowski, *Toledoth ha-Sifruth ha-'Ivrith ha-Hadashah* (Tel Aviv, 1946–). Volumes iii and iv of Waxman's *History* deal with this period. For introduction: J. Klausner, *A History of Modern Hebrew Literature* (London, 1932); S. Spiegel, *Hebrew Reborn* (New York and London, 1930); S. Halkin, *Modern Hebrew Literature, Trends and Values* (New York, 1950); J. S. Raisin, *The Haskalah Movement in Russia* (Philadelphia, 1913). Anthologies: A. Barash, *Mivhar ha-shirah* (Jerusalem, 1938); P. M. Raskin, *Anthology of Modern Jewish Poetry* (New York, 1927). The semiannual *Israel Argosy* (Jerusalem) contains translations of contemporary prose. (C. RN.)

HEBREW RELIGION. The Hebrews were western Semites, and from the Semites sprang Judaism, Christianity and Islam (or Mohammedanism) (*qq.v.*).

By Judaism is meant the religion of the Jews (*i.e.*, properly "Judaeans") based upon the Old Testament. There are, however, striking differences within the Old Testament; *e.g.*, between the piety of the Psalms, the pessimism of Ecclesiastes and the eroticism of Canticles, or between the popular stories in Genesis and the priestly ritual in Leviticus. Moreover, it is instructive to compare and contrast the treatment of the history of the monarchy in Samuel–Kings with the parallel portions in Chronicles.

Further, the prophets condemn the polytheistic and degrading cults of the Israelite religion of their day, although the Israelites felt that they stood apart from their neighbours, whether Canaanites within the land or other peoples without: Edom, Ammon, etc. In fact, "Israel" is a much more restricted term than "Hebrew" (see JEWS). Israel, which strictly includes both Judah and the northern tribes (Joseph, Ephraim, etc.), was closely related to Edom (its "brother"), Moab and Ammon, the Aramaeans of north Syria and the Arabs of the desert. Hence, while the Old Testament (with the religion of Israel) led to both Judaism and Christianity, one must not ignore the religious beliefs and practices over the larger world of which Israel formed part. The ideas which made the monotheistic religion of Israel unique are best appreciated when it is seen how they developed, now in touch with and now in reaction against, the contemporary religions.

By Hebrew religion, therefore, we mean the religion of the Hebraic background upon which Israel grew up and developed its monotheism, and which extends outside the chronological limits of the Old Testament. (See BIBLE: *Old* Testament; JUDAISM.)

HEBREWS, EPISTLE TO THE, a book of the New Testament.

In the oldest manuscripts it bears no other title than "To Hebrews." This brief heading embraces all that on which Christian tradition from the end of the and century was unanimous; and it says no more than that the readers addressed were Christians of Jewish extraction. This would be no sufficient address for an epistolary writing (xiii, 22) directed to a definite circle of readers, to whose history repeated reference is made and with whom the author had personal relations (xiii, 19, 23). Probably, therefore, the original and limited address, or rather salutation, was never copied when this treatise in letter form, like the epistle to the Romans, passed into the wider circulation which its contents merited.

Authorship.— In the earlier manuscripts it is anonymous; and the Roman church, where the first traces of the epistle occur, about A.D. 96 (1 Clement), and which was in constant connection with provincial churches, was at a later date sure only that it was not by Paul (Euseb., *Eccl.* Hzst., iii, 3). The Alexandrine tradition, on the other hand, dwells on its affinities to Paul's thought. Origen implies that "the men of old" regarded it as Paul's. But he feels that the language is un-Pauline, though the "admirable" thoughts are not second even to Paul's. Thus he is led to the view that the ideas were orally set forth by Paul, but that the written form was attributable to some one's giving free interpretation of his mind. According to some this was Clement of Rome; others named Luke; but the truth, says Origen, is known to God alone. (Euseb., vi, 25; cf. iii, 38).

From the time of Origen the theory of Paul's own authorship became prevalent in the east. The earliest North African tradition, preserved by Tertullian (*De pudicitia*, c, 20) but hardly invented by him, ascribed the epistle to Barnabas. Yet it was probably only an inference, as if this "word of exhortation" (xiii, 22) must needs be by the Son of Exhortation (Acts iv, 36; *see* BARNABAS). On the whole, then, the earliest traditions in east and west alike agree that it was not by Paul but by one of his associates.

This is also the result reached by modern scholarship. Following the lead of Erasmus, Luther (who suggests Apollos) and Calvin added the decisive argument that Paul, who lays such stress on the fact that his gospel was not taught him by man (Gal. i), could not have written Heb. ii, 3. And since the revival of the historical sense, more than a century ago, opinion has set irrevocably against Pauline authorship. Its type of thought is really different. The Jewish law is viewed not as a code of "works of righteousness," as by Paul, but as a system of religious rites (vii, 11) shadowing forth the way of access to God in worship, of which the Gospel reveals the archetypal realities (ix, 1, 11, 15, 23 *et seq.*; x, 1 *et seq.*, 19 *et seq.*). The old and the new Covenants are related to one another as imperfect (earthly) and perfect (heavenly) forms and methods of salvation—differing in point of spiritual reality—each with its own type of sacrifice and priesthood. Thus the conception of Christ as high priest emerges, for the first time, as a central point in Christianity. The Old Testament is cited after the Alexandrian version more exclusively than by Paul, even when the Hebrew differs. Nor is this accidental. The author was, in fact, a Hellenist who lacked knowledge of the Hebrew text and derived his metaphysic and his allegorical method from the Alexandrian rather than the Palestinian schools.

Yet the epistle has Pauline affinities and can hardly have originated beyond the Pauline circle, to which it is related not only by the author's friendship with Timothy (xiii, 23) but by many echoes of the Pauline theology and even, it seems, of passages in Paul's epistles (*see* Holtzmann, *Einleitung in das N.T.*, p. 298 [1892]). Everything turns, then, on internal criticism of the epistle, together with such personal allusions as it affords.

Readers.—As to its first readers, with whom the author stood in close relations (xiii, 19, 23; *cf.* vi, 10; x, 32–34), it used to be agreed that they were "Hebrews" or Christians of Jewish birth. But this cannot be inferred simply from the fact that the epistle approaches Christian truth through Old Testament forms. That was the common method since the Jewish scriptures were the word of God to all Christians alike.

Still the exclusive use of the argument from Mosaism, as itself implying the Gospel of Jesus the Christ as final cause (τέλος), does favour the view that the readers were of Jewish origin. Further, there is no allusion to the incorporation of "strangers and foreigners" (Eph. ii, 19) with the people of God. Yet the readers are not to be sought in Jerusalem (see, *e.g.*, ii, 3), nor anywhere in Judaea. The whole Hellenistic culture of the epistle (let alone its language) and the personal references, notably that to Timothy in xiii, 23, are against any such view. Caesarea, as a city of mixed population and lying just outside Judaea proper, would satisfy many conditions of the problem. Yet these might exist among other members of the Dispersion, like "the Jews of Asia" whose zeal for the Temple and the Mosaic ritual customs led to Paul's arrest in Jerusalem (Acts xix, 27 et seq.; cf. 20 et seq.). The dispersed Christian Jews, who kept in touch with the Temple by annual contribution to its services, would tend to continue their reliance on those services for the forgiveness of their recurring "sins of ignorance" even after the great initial messianic forgiveness coming with faith in Jesus. Accordingly many of them, while placing their hope for the future upon Messiah and His return in power, might seek continuous cleansing of conscience in the old mediatorial system.

In particular the annual Day of Atonement might be relied on, and that in proportion as the expected Parousia tarried and the first enthusiasm of a faith that was largely eschatological died away, while ever-present temptations pressed the harder as disappointment and perplexity increased.

Its Argument.— Such was the general situation of the readers, men who rested partly on the Gospel and partly on Judaism. For lack of a true theory as to the relation between the two, they were now drifting away (ii, 1) from effective faith in the Gospel, as being mainly future in its application, while Judaism was a very present, concrete and impressive system of religious aids—to which also their sacred scriptures gave constant witness. The points at which it chiefly touched them may be inferred from the author's counterargument, with its emphasis on the spiritual ineffectiveness of the whole Temple system, its high priesthood and its supreme sacrifice on the Day of Atonement. With passionate earnestness he sets over against these his constructive theory as to the efficacy, the heavenly yet unseen reality, of the definitive "purification of sins" (i, 3) and perfected access to God's inmost presence, secured for Christians as such by Jesus the Son of God (x, 9–22); and traces their moral feebleness and slackened zeal to want of progressive insight into the essential nature of the Gospel as a "new Covenant," moving on a totally different plane of religious reality from the now antiquated Covenant given by Moses (viii, 13).

The following plan of the epistle may help to make apparent the writer's theory of Christianity as distinct from Judaism, which is related to it as "shadow" to reality:

Thesis: The finality of the form of religion mediated in God's Son, i, 1–4.

i. The supreme excellence of the Son's Person (i, 5–iii, 6), as compared with (a) angels, (b) Moses.
Practical exhortation, iii, 7–iv, 13, leading up to:

ii. The corresponding efficacy of the Son's high priesthood (iv, 14–ix).
1. The Son has the qualifications of all priesthood, especially sympathy.
Exhortation, raising the reader's thought to the height of the topic reached (v, 11–vi, 20).
2. The Son as absolute high priest, in an order transcending the Aaronic (vii) and relative to a Tabernacle of ministry and a Covenant higher than the Mosaic in point of reality and finality (viii, ix).
3. His sacrifice, then, is definitive in its effects (τετελείωκε) and supersedes all others (x, 1–18).

iii. Appropriation of the benefits of the Son's high priesthood, by steadfast faith, the paramount duty (x, 19–xii). More personal epilogue (xiii).

As lack of insight lay at the root of their troubles, it was not enough simply to enjoin the moral fidelity to conviction which is three parts of Faith to the writer, who has but little sense of the mystical side of faith so marked in Paul. There was need of a positive theory based on real insight, to inspire faith for more strenuous conflict with the influences tending to the apostasy from Christ, and so from "the living God," which already threatened some of them (iii, 12). Such "apostasy" was not a formal abjuring of Jesus as Messiah, but the subtler lapse involved in ceasing to rely on relation to Him for daily moral and religious needs, summed up in purity of conscience and peace before God (x, 19–23; xiii, 20 et seq.).

This "falling aside" (vi, 5; cf. xii, 12 et seq.), rather than conscious "turning back," is what is implied in the repeated exhortations which show the intensely practical spirit of the whole argument, These exhortations are directed chiefly against the dullness of spirit which hinders progressive moral insight into the genius of the new Covenant (v, 11–vi, 8). The antidote to such "profane" negligence (ii, 1, 3; xii, 12 et seq., 15–17) is an earnestness animated by a fully assured hope and sustained by a "faith" marked by patient waiting (μακροθυμία) for the inheritance guaranteed by Divine promise (x, 11 et seq.). The outward expression of such a spirit is "bold confession" and mutual encouragement therein (iii, 6, 12 et seq.); while the sign of its decay is neglect to assemble together for mutual stimulus, as if it were not worth the odium and opposition from fellow Jews called forth by a marked Christian confession (x, 23–25; xii, 3)—a very different estimate of the new bond from that shown by readiness in days gone by to suffer for it (x, 32 et seq.).

Their special danger, then, the sin which deceived (iii, 13) the more easily that it represented the line of least resistance (perhaps the best paraphrase of "the besetting sin" in xii, 1), was the exact opposite of "faith" as the author uses it, especially in the chapter of Old Testament illustrations, and of which Jesus Himself was at once the example and the inspiration (xii, 2 *et* seq.). To quicken this by awakening deeper insight into the real objects of "faith," as these bore on their actual life, he develops his high argument on the lines already indicated.

The Special Situation.— Their situation was so dangerous just because it combined inward debility and outward pressure, both tending to the same result; viz., practical disuse of the distinctively Christian means of grace, as compared with those recognized by Judaism, and such conformity to the latter as would make the reproach of the Cross to cease (xiii, 13; *cf.* xi, 26). But the practical surrender of what was distinctive in their new faith meant a theoretic surrender of the value once placed on that element, when it was a living religious experience far in advance of what Judaism had given them (vi, 4 et *seq.;* x, 26–29). This twofold infidelity, in thought and deed, God, the "living" God of progress from the "shadow" to the substance, would yet visit (x, 30 et seq.; xii. 22–29). For it meant turning away from an appeal that had been known as "heavenly," for something inferior and earthly (xii, 25); from a call sanctioned by the incomparable authority of a greater than Moses and all media of the old Covenant, even the Son of God.

Thus the key of the whole exhortation is struck in the opening words, which contrast the piecemeal revelation. "to the fathers," in the past, with the complete and final revelation to themselves in the last stage of the existing order, in a Son of transcendent dignity (i, 1 et seq.; cf. ii, 1 et seq.; x, 28 et seq.; xii, 18 et *seq.*). This goes to the root of their difficulty, ambiguity as to the relations of the old and the new elements in Judaeo-Christian piety, so that there was danger of the old overshadowing the new, since national Judaism remained hostile. At a stroke the author separates the two. There is no use, religiously, in falling back upon the old forms, in order to avoid the social penalties of a sectarian position within Judaism, when the secret of religious "perfection" or maturity (vi, 1; cf. the frequent use of the kindred verb) lies elsewhere.

Hence the moral of his whole argument as to the two Covenants, though it is formulated only incidentally amid final detailed counsels (xiii, 13 et seq.) is to leave Judaism and adopt a purely Christian standing on the same footing with their non-Jewish brethren in the local church. For this the time was now ripe; and in it lay the true path of safety—eternal safety as before God, whatever man might say or do (xiii, 5 et seq.). The obscure section xiii, g et *seq.,* is to be taken as "only a symptom of the general retrogression of religious energy" (Jiilicher) and not as bearing directly on the main danger of these "Hebrews." The "foods" in question probably refer neither to temple sacrifices nor to the Levitical laws of clean and unclean foods, nor yet to ascetic principles, but rather to some form of the idea, found also among the Essenes, that food might be so partaken of as to have the value of a sacrifice and thus ensure divine favour.

Over against this view, which might well grow up among the Jews of the Dispersion as a sort of substitute for the possibility of offering sacrifices in the Temple—but which would be a lame addition to the Christianity of their own former leaders—the author first points his readers to its refutation from experience and then to the fact that the Christian's "altar" or sacrifice (*i.e.,* the supreme sin-offering) is of the kind which the law itself forbids to be associated with "eating." If Christians wish to offer any special sacrifice to God, let it be that of grateful praise or deeds of beneficence.

External Occasion.— In trying further to define the readers addressed one must note the stress laid on suffering as part of the divinely appointed discipline of sonship (ii, 10; v, 8; xii, 7 et seq.), and the way in which the analogy in this respect between Jesus, as messianic Son, and those united to Him by faith, is set in relief. He is both the inspiring example for heroic faith in the face of unbelievers (xii, 3 et seq.) and the mediator qualified

by experience of suffering to sympathize with His tried followers, and so to afford them moral aid (ii. 17 seq., v. 8 seq., cf. iv. 15). This means that suffering for Christianity, at least in respect of possessions (xii. 5 seq, cf. x. 34), was imminent for those addressed; and it seems as if they were mostly men of wealth and position (xiii. 1–6, vi. 10 seq., x. 34). Such would also possess a mental culture (cf. v. 11 seq.) capable of appreciating the form of an epistle "far too learned for the average Christian" (Jiilicher), yet for which its author apologizes as inadequate (xiii. 22). It was now long since they themselves had suffered seriously for their own faith (x. 32 seq.) and the writer's impatience to hurry to their side implies that the crisis was both sudden and urgent.

Place and Author.— Many attempts have been made to identify the home of the Hellenistic Christians addressed in this epistle. For Alexandria little can be urged. "Alexandrine" idealism and allegorism was a mode of thought diffused throughout the Eastern Mediterranean, and the divergencies from Philo's spirit are as notable as the affinities (cj. Milligan, ut *infra* 203 sqq.). For Rome there is more to be said, in view of the reference to "them of Italy" (xiii. 23 seq.); and the theory has found many supporters. It usually contemplates a special Jewish-Christian house-church, like that meeting in the house of Prisca and Aquila (Rom. xvi. 5)—a chapter which some hold to have been part of a recension sent to Ephesus (see ROMANS, EPISTLE TO). Little, however, really points to Rome and a good deal points away from it. The words in xii. 4 "Not yet unto blood have ye resisted," would ill suit Rome after the Neronian "bath of blood" in A.D. 64 (as is usually held), save at a date too late to suit the reference to Timothy. Nor does early currency in Rome count for much, any more than do the words "they of Italy salute you." Read in the light of the reference to Timothy they rather suggest that he had been in prison in Rome and was about to return, possibly in the writer's company, to the region which was apparently the headquarters of both. Now this in Timothy's case, as far as we can judge, was Ephesus; and it is natural to ask whether it will not suit all the conditions of the problem. It suits those of the readers, as analysed above, a house-church which the gospel had reached as it had also the writer himself through certain hearers of the Lord (ii. 3), not necessarily apostles (cf. the Ephesian group of Acts xix. 1 sqq.). And it has the merit of suggesting to us as author the very person of all those described in the New Testament who seems most capable of the task, Apollos, the learned Alexandrian (Acts xviii. 24 sqq), connected with Ephesus and with Paul and his circle (cf. 1 Cor. xvi. 12), yet having his own distinctive manner of presenting the Gospel (1 Cor. iv. 6). That Apollos visited Italy during Paul's imprisonment in Rome is a reasonable inference from Titus iii. 13 (see PAUL); and if so, it is quite natural that he should be there again about the time of Paul's martyrdom. With that event it is again natural to connect Timothy's imprisonment, his release from which our author records in closing; while the news of Jewish success in Paul's case would enhance any tendency among Asian Jewish Christians to shirk "boldness" of confession in fear of further aggression from their compatriots. On the chronology adopted in the article PAUL, this would yield as date for the epistle A.D. 61–62. The place of writing would be some spot in Italy ("they of Italy salute you") outside Rome, probably a port of embarkation for Asia, such as Brundisium.

Historical Significance.— Be this as it may, the epistle is of great importance, as reflecting a crisis inevitable in the development of the Jewish-Christian consciousness, when a definite choice between the old and the new form of Israel's religion had to be made, both for internal and external reasons. It seems to follow directly on the situation implied by the appeal of James to Israel in dispersion, in view of Messiah's winnowing-fan in their midst (James i. 1–4, ii. 1–7, v. 1–6 and especially v. 7–11). It may well be the immediate antecedent of that revealed in 1 Peter, an epistle which perhaps shows traces of its influence (*e.g.*, in i. 2, "sprinkling of the blood of Jesus Christ"). It is also of high interest theologically, as exhibiting, along with affinities to several types of New Testament teaching (see STEPHEN), a type all its own, and one which has had much influence on later Christian thought (*cf.* Milligan. ch. ix). Indeed, it shares with Romans the right to be styled "the first treatise of Christian theology."

BIBLIOGRAPHY.—The older literature may be seen in F. Rleek, *Der Briej an die Hebraer* (1828–40); the more recent in G. Milligan, *The Theology of the Epistle of the Hebrews* (1899), a useful summary of all bearing on the epistle, and in the large New Testament Introductions (*e.g.*, Jiilicher or Moffatt). *See* also Hastings, *Dict. of the Bible*, the *Encycl. Biblica*, *A. S.* Peake in *The Century Bible* and J. Moffatt in the *Internat. Crit. Comm.* (J. V. B.)

HEBRIDES, THE, a group of islands off the west coast of Scotland, between 55° 35′ and 58° 30′ N. and 5° 26′ and 8° 40′ W., also known as the Western Isles. They have been broadly classified into Outer and Inner Hebrides, the hlinch and Little Minch dividing them. The chief islands of the crescentic chain of the Outer Hebrides are Lewis-with-Harris (or Long Island), North Uist, Benbecula, South Uist. Barra. the Shiants. St. Kilda and the Flannan Isles, or Seven Hunters, about 20 mi. N.W. of Gallan head in Lewis. Of these the Lewis portion of Long Island, the Shiants and the Flannan belong to the county of Ross and Cromarty. and the remainder to Inverness-shire. The total length of this group, from Barra head to the Butt of Lewis, is 130 mi.. the breadth varying from less than 1 mi. to 30 mi. The Inner Hebrides include Skye, Small Isles (Canna, Sanday. Rum. Eigg and Muck), Coll, Tiree, Lismore. Mull. Clva, Staffa, Iona. Kerrera, the Slate Islands (Seil. Easdale, Luing, Shuna, Torsay), Colonsay, Oronsay, Scarba, Jura, Islay and Gigha. Of these Skye and Small Isles belong to Inverness-shire, and the rest to Argyllshire. The Hebridean islands exceed 500 in number, of which less than one-fifth are inhabited. The population of the Hebrides is unevenly distributed and depopulation has been variable in onset and progress. The 1951 census gave the following figures: Lewis-with-Harris 26,465; Skye 8,267; Mull 2,420; Small Isles 215; Coll 210; Tiree 1.216.; Colonsay and Oronsay 233; Jura 258; Islay 4,267. The population of Lewis-with-Harris in 1951 was 79% of its maximum reached in 1911; of Mull, 25% of maximum (1821); Islay, 28% of maximum (1831); Skye, 37% of maximum (1841). Several small islands have been evacuated.

The Hebrides are extremely interesting geologically. The stupendous cliff scenery of St. Kilda, 40 mi. W. of the main chain of the Outer Hebrides, is formed of igneous gabbro. which also forms the Cuillin hills of Skye (3.309 ft.), the most spectacular and awe-inspiring massif in Britain. The Outer Hebridean chain is of Lewisian gneiss. the oldest rock in the world; Skye, Mull, Canna and Eigg are largely of volcanic basalt. a formation which gives the columnar scenery of Staffa and the Shiant Isles. Jura is almost wholly metamorphic quartzite.

The islands are hilly or mountainous and only the basalt islands are intrinsically and potentially fertile; the middle area of Lewis is covered by deep peat and a tundralike herbage of limited pastoral value; but the Atlantic side of the southern Outer Hebrides. North Uist, Benbecula. South Uist and Barra is a low platform of gneiss overlaid by shell sand from the Atlantic ocean. The whole of Tiree and the western sides of Coll and Colonsay are similarly affected. These sand-covered grassy plains (the *machair*) with their high soil content of calcium carbonate are fertile cattle-raising areas and support a predominantly agricultural population. The rocky, peaty. much-indented eastern side of the Hebrides is infertile and the inhabitants of this more sheltered coast are mainly fishermen and weavers.

The shell-sand *machair* greatly increases the cultivable area of the Outer Hebrides and Tiree and differentiates them from the Inner Isles. Nevertheless. it must not be plowed for many years in succession or the organic matter is lost and the sand blows disastrously. The *machair* is particularly interesting in Highland economy because of the adaptation of husbandry to the special conditions. The primitive four-rowed barley or bere was the bread corn until recently, a cereal fitted to such highly calcareous soil. The common oat does not grow in such soil, and its place is taken by the bristle-pointed oat. *Avena strigosa*, which would be considered a weed anywhere else. This crop is used entirely for cattle feed, garnered as hay. Potatoes are an important arable crop on both *machair* and peaty land. Cultivation of turnips has almost completely declined because of the high incidence of finger-

and-toe disease. Great quantities of seaweed or tangle (*Laminaria*) are used on the *machair* land. while on the east side of the Outer Isles, wrack (*Fucus*) is cut from the rocky shores and carried to the lazy beds or terracelike. peaty cultivated ground.

The manufacture of the so-called Harris tweed of the Outer Hebrides provides part-time occupation for the crofters, *i.e.*, the small landholders. The tweed is of ancient origin. the wool being vegetable-dyed. hand-spun and hand-woven in the crofters' own homes. The earl and countess of Dunmore, who had a sporting estate in Harris, developed the crofters' marketing of the tweed during the 1860s to 1880s. Thus the name "Harris" tweed. The old type of tweed is now mostly produced in the Uists. but a much greater quantity of aniline-dyed, machine-spun, hand-woven tweed is produced in Lewis.

Stornoway in Lewis is still a herring-fishing centre, but most of the local fleets of herring boats have sadly declined. Many men from the Outer Hebrides join the merchant marine.

Steamer services leave Glasgow daily for Islay and thrice weekly for Jura; Oban daily for Lismore and Mull and thrice weekly for Coll, Tiree. Barra and South Uist; Kyle of Lochalsh daily for Skye and thrice weekly for Harris and the Uists. There are also services, augmented in summer, from Kyle of Lochalsh and Mallaig to the smaller isles. Air services from Glasgow and Inverness serve the Outer Hebrides and Tiree.

The wildlife of the Hebrides is particularly rich. There are red deer in Lewis, Harris. North Uist. Skye. Mull. Jura and Islay; the Atlantic gray seal is numerous. with considerable nurseries on North Rona, the Treshnish Isles. Haskeir (North Uist). Sound of Harris and Oronsay. There are several pairs of golden eagles. and many spectacular sea-bird cliffs. On the island of Soay there is a race of primitive sheep of moufflon type.

The fine Megalithic stone circle at Callanish (Lewis) is the Hebrides' largest prehistoric monument and is well preserved. There is a long barrow as far afield as Hirta (St. Kilda) and chambered cairns, duns and standing stones are of frequent occurrence. Early Christian cells are found on many small and remote islands, and Iona. Oronsay, Rodil (Harris). Inchkenneth (Mull) and Islay are rich in early mediaeval Christian carved stones and architectural remains.

History. — The Goidelic inhabitants of the 1st millennium A.D., Christianized from Iona after Columba's voyage there in j63 A.D., suffered increasingly from Norse raids from the 8th century. Harald Fairhair eventually placed the-Hebrides under Norse sovereignty and it was not until the treaty of 1266 that the Norwegians renounced their claim. The present Gaelic language is surprisingly little affected by Norse, though place names are often pure Norse and may predominate over Gaelic place names in some districts. *e.g.*, Skye. The fusion of Norsemen and Goidel produced a period of relatively high culture and material well-being in the 11th and 12th centuries, and the dynasty of the lordship of the isles was founded hy Somerled. The clan system was strong throughout the region until the Jacobite risings of 1715 and 1745. The hereditary jurisdictions of the chiefs were abolished in 1748 and forfeited estates were not restored until 1784. The clan system with its notion of *jus sanguinis* was at bottom egalitarian but disruption brought about the feudal notion that the land belonged to the chief. With the merging of the chiefs into the life of the Cnited Kingdom, the culture moved much more onto a money basis. At the same time, through cultivation of the potato, vaccination and cessation of internecine warfare, the population increased rapidly and came against the ceiling of subsistence.

There began in the later 18th century a period of social unrest. The central government did or could do little. The chiefs were put into awkward positions in which some of them acted highhandedly, while others were impoverished trying to order a bursting economy. Emigration to Canada and later to Australia became common. The infiltration of southern upland sheep farmers paying high rents for large acreages of ground caused many evictions of small tenants and resettlement in townships on the coasts where, with small plots of land, the people were expected to supplement their living from fishing. The potato famines of 1846 and 1847 were responsible for much destitution.

Gradually, the central government took more part, ponderously, in that urban administrative ideas were unsuitably applied. A royal commission (1883) under Lord Napier reported in 1884. The result was the Crofters' Holdings (Scotland) act of 1886, which gave the crofter security of tenure and heritability of tenure, fair rents being established by a crofters' commission. From this point. the government of the United Kingdom took an increasing part in administration and became the largest landowner of crofting estates in the islands. Economically, the Hebrides continued in parlous state. and in 1944 the Development commission made possible the establishment of the West Highland survey. a research body which investigated the problem sociobiologically in considerable detail.

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HEBRON, a city of Jordan about 20 mi. S.W. of Jerusalem and about 3.000 ft. above sea level (pop. 1952, 35,983), almost all Moslems. The town, no longer walled, with its stone houses, boasting curious vaulted cupolas, and narrow. winding streets, stands on the eastern slope of a shallow valley. It has many wells and two large reservoirs, one of which is generally identified with the Pool of Hebron (2 Sam. iv. 12).

History. — Reputed one of the oldest cities (Num. xiii. 22), it was closely connected with Abraham in Bible tradition and was destroyed by Joshua (x. 26). From Hebron Joseph set out to seek his brethren at Shechem. David made it his home for a period. Absalom was born there and Abner was treacherously murdered at its gates by Joab. Absalom made the town the headquarters of his revolt. It was fortified by Rehoboam, captured from the Edoniites by Judas Maccabaeus and destroyed by the Romans. It revived under the Moslems and was a substantial town when captured by the crusaders.

Haram.—Hebron's chief interest is its haram, an enclosure (198 ft. by 112 ft.) built over the traditional side of the cave of Machpelah. The ancient wall which encloses it rises to a height of 40 ft. (above that rise modern walls) and in construction and masonry closely resembles that of the haram in Jerusalem. Within the enclosure is a mosque formerly a crusaders' church (12th century). which in its turn was built on the site of a basilica of Justinian's time. Within the mosque are the cenotaphs of Abraham, Isaac. Jacob. Sarah. Rebecca and Leah, erected above the places where their tombs are presumed to he in the cavern beneath. The mosque is approached by two flights of steps, but Jews are not permitted to go beyond the seventh step. At the fifth is an aperture believed to lead to the tomb of the patriarchs.

See C. R. Conder, *Pal. Expl. Fund Memoirs,* iii, 333, *seq.* (1881); C. Warren, "Hebron," *Hustings' Bible Dictionary; L. H.* Vincent, E. J. H. Mackay and F. M. Abel, *Hébron, Le Haram el-Khalīl: Sépulture des Patriarches* (1923); *B.* Meistcrmann, *Guide to the Holy Land* (1923); W. M. Flinders Petrie, *The Cave of Machpelah: Ancient Egypt,* 105, *seq.* (1923); P. J. Baldensperger, *Pal. Expl. Fund Quart. Statement* (1915 *seq.*) (on characteristics of people of Hebron). (E. Ro.; X.)

HECATAEUS OF ABDERA (or OF TEOS) (*fl.* 4th century B.C.). Greek historian and Sceptic philosopher, accompanied Ptolemy I Soter to Syria and sailed up the Nile to Thebes with him. His travels were described in Αἰγυπτιακά and Περὶ Ὑπερβορέων, which mere used by Diodorus Siculus.

Fragments in C. W. Müller, *Frag. Hist. Graec.;* Diels, *Fragmente dev Vorsokratiker,* vol. 2, 4th ed. (1922).

HECATAEUS OF MILETUS (6th–5th century B.C.), Greek historian and traveller, son of Hegesander. flourished during the time of the Persian invasion. He tried to dissuade the Ionians from revolt against Persia, and (Herodotus, v. 36, 125) in 494, when they were obliged to sue for terms, he was one of the ambassadors to the Persian satrap. whom he persuaded to restore the constitution of the Ionic cities (Diod. Sic.. x, 25). He is by some credited with a geographical work entitled Τῆς περίοδος ("Travels Round the Earth"). in two books, one on Europe, the other on Asia, the account of Egypt being especially comprehensive; the book was accompanied by a map. based upon that of Anaximander. The authenticity of the work is, however, strongly

attacked by J. Wells in the *Journal* of *Hellenic Studies* (1909), xxix, pt. i. The only certainly genuine work of Hecataeus was the Γενεηλογίαι or Ἱστορίαι, a systematic account of the traditions and mythology of the Greeks. He was probably the first to write a serious prose history and employ critical method to distinguish myth from fact, though he accepts Homer and the other poets as trustworthy authority. Herodotus, though he once at least (vi, 137) controverts his statements, is indebted to Hecataeus not only for facts, but also in regard to method and general scheme, but the extent of the debt depends on the genuineness of the Γῆς περίοδος.

See fragments in C. W. Müller, *Fragmenta historicorum Graecorum,* i; or F. Jacobp, *Fragmente der griechischen Historiker* (1923), i, where references in ancient authors are quoted. H. Berger, *Geschichte der wissenschaftlichen Erdkunde der Griechen* (1903); E. H. Bunbury, *History of Ancient Geography,* i; W. Mure, *History of Greek Literature,* iv; *H* Diels, *Herodot und Hekataios* in *Hermes,* 1887; especially J. V. Prašek, *Hekataios als Herodots Quelle zur Geschichte Vorderasiens Beiträge zur alten Geschichte* (Klio) (1904), iv, 193 *seq.,* and J. Wells in *Journ. Hell. Stud.,* as above, and in reply, Max Carey in *J.H.S.* xxx.

HECATE (Gr. Ἑκάτη, "she who works from afar"), a goddess in Greek mythology. According to the generally accepted view, she was of Hellenic origin, but Farnell regards her as a foreign importation from Thrace, the home of Bendis, with whom Hecate had many points in common. She is not mentioned in the *Iliad* or the *Odyssey,* but in Hesiod *(Theogony,* 409) she is the daughter of the Titan Perses and Asterie. She is there represented as a mighty goddess, having power over heaven, earth and sea; hence she is the bestower of wealth and all the blessings of daily life. Hecate is frequently identified with Artemis, and both occasionally with the moon.

Later, Hecate is the chief goddess who presides over magic arts and spells; hence occasionally she is referred to as the mother of Circe, and her name is very common in charms. She is said to have been worshipped at Samothrace, and is closely connected with Demeter. Alone of the gods besides Helios, she witnessed the abduction of Persephone, and, torch in hand, assisted Demeter in her search for her daughter. On moonlight nights she was seen at the crossroads (hence her name τριοδῖτις, Lat. *Trivia),* accompanied by ghosts and hell-hounds. There, on the last day of the month, eggs and fish were offered to her. Black puppies and she-lambs (black victims being offered to chthonian deities) were also sacrificed (Schol. on Theocritus, ii, 12), the former unusual but not quite unparalleled victims in Greece. Pillars like the Hermae, called Hecataea, stood, especially in Athens, at crossroads and doorways, perhaps to keep away the spirits of evil. It is to be noted that Hecate plays little or no part in mythological legend.

In older times Hecate is represented as single-formed, clad in a long robe, holding burning torches; later she becomes *triformis,* "triple-formed," with three bodies standing back to back—probably in order to look all ways at once from the crossroad. In her six hands are various emblems.

See L. R. Farnell, *Cults of the Greek States,* ii, ch. xvi, xix; Preller-Robert i, p. 321 et seq.; O. Gruppe, *Griechische Mythologie,* ii, p. 1,288 (1906); and the classical dictionaries.

HECATOMB, originally, perhaps, the sacrifice of a hundred victims, then of any large number. Hence in modern languages, the destruction of a multitude of living, or even of inanimate, things. (Gr. ἑκατόμβη from ἑκατόν, "a hundred.")

HECK, BARBARA RUCKLE (1734–1805), the "mother of Methodism" in the United States and Canada, was born in the county of Limerick, Ireland, in 1734. Her grandparents had been among the Palatines who fled from Germany before the invasion of Louis XIV. But she was reared in the Wesleyan faith and early welcomed among her associates as a religious counselor. In 1760 she married Paul Heck whose background was similar to that of her own. With him and a company of neighbours. including her cousin Philip Embury, a local Methodist preacher, she sailed for New York, arriving on August 10.

Philip Embury is often called the founder of American Methodism but Barbara Heck takes precedence in that role by several years Embury grew disheartened in the new world and for nearly five years lost his zeal in the cause for the promotion of which he had come to America.

Barbara Heck maintained her evangelizing fervour but was unable to stimulate him to pursue his mission during this period. In 1765 a second band of former neighbours, some of them Methodists, joined this earlier company. Barbara Heck, when visiting one of the newly arrived families, found some of its members engaged in a card game of chance. Her wrath aroused, she seized the cards, threw them into a fire, and rebuked the players Seeking out Philip Embury, she then persuaded him that his ohlipation to preach was imperative. She collected his first small congregation, organized and attended the first Methodist society in America, and started the movement that resulted in the erection of the first Methodist church in any of the colonies.

At the outbreak of the revolution, being British sympathizers, Barbara and Paul Heck, accompanied by their three sons, and several other devout members of their faith, crossed the border into lower Canada, near Montreal, and from there went to Augusta, in upper Canada in 1775. They formed the earliest Methodist society in Canada about 1778.

Barbara Heck died in 1805, sı viving her husband 12 years. They were buried in Augusta, Canada.

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HECKER, FRIEDRICH KARL FRANZ (1811–1881), German revolutionary, was born at Eichtersheim in the Palatinate on Sept. 28, 1811, the son of a revenue official. On entering the second chamber of Baden in 1842, he at once began to oppose the government. A speech, denouncing the projected incorporation of Schleswig and Holstein with Denmark, delivered in the chamber of Baden on Feb. 6, 1845, spread his fame beyond the limits of his own state, and his popularity was increased by his expulsion from Prussia on the occasion of a journey to Stettin. In 1847 he became president of the *Volksverein,* where, with Struve, he drew up the Radical program carried at the Liberal meeting held at Offenburg on Sept. 12, 1847 (entitled "thirteen claims put forward by the people of Baden"). In addition to the Offenburg program, the *Sturmpetition* of March 1, 1848 demanded further far-reaching concessions. New demands were made at Offenburg on March 19, and Hecker moved a resolution in the preliminary parliament of Frankfort that Germany should be declared a republic.

On April 12, Hecker and Struve sent a proclamation to the inhabitants of the *Seekreis* and of the Black Forest "to summon the people who can bear arms to Donaueschingen at mid-day on the 14th, with arms, ammunition and provisions for six days." They expected 70,000 men, but only a few thousand appeared. The troops of Baden and Hesse marched against them, under the command of General Friedrich von Gagern, and Hecker was defeated at Kandern (April 20). Hecker escaped to Switzerland, and in Sept. 1848 retired to the United States, where he had a fnrrn at Summerfield, Ill. During the second rising in Baden in the spring of 1849 he returned, and had got as far as Strasbourg when he had to retreat before the victories of the Prussian troops over the Baden insurgents.

After his return to the United States he fought in the Civil War as colonel of a regiment which he had himself got together on the Union side in 1861 and 1864. In a famous festival speech at St. Louis in 1871 he expressed the enthusiasm of the German Americans for their newly-united fatherland. He received a less favourable impression during a journey he made in Germany in 1873. He died at Summerfield on March 24, 1881.

Hecker was very much beloved of all the German democrats. The song and the hat named after him (the latter a broad slouch hat with a feather) became famous as the symbols of the middle-classes in revolt. In America, too, he won great esteem, not only on political grounds but also for his personal qualities.

Hecker's works are: *Die Erhebung des Volkes in Baden für die deutsche Republik* (Baden, 1848); and *Reden und Vorlesungen* (Neerstadt, a. d. H.. 1872). *See* F. v. Weech, *Badische Biographien,* iv

(1891); L. Mathy, ***Aus dem Nachlasse von K. Matty, Briefe aus den Jahren** 1846–1848* (1898).

HECKER, ISAAC THOMAS (1819–1888), U.S. Roman Catholic priest, founder of the Paulist Fathers, was born of Protestant German immigrant parents in New York city, Dec. 18, 1819. His early education came chiefly from private reading and activity in local politics. Later, at Brook Farm, he made contact with Brownson, Emerson, Dana. Alcott, Ripley and Thoreau. Baptized a Catholic in 1844, he became a Redemptorist priest in 1849 and with four other convert priests gave the first organized missions in English by the Redemptorists, who were chiefly Germans. The enthusiastic response of the people in New York and in many other places along the eastern coast suggested the need of an English-speaking house, and Hecker was delegated to urge this upon the rector major in Rome. He was expelled from the order for having come to Rome without permission; but on appeal, Pope Pius IX dispensed him and his four associates from their vows, encouraging them to work under local bishops. Four of them, with Hecker as superior, founded the Paulist Fathers, a diocesan organization for missionary work in New York.

Hecker wrote three books—*Questions of the Soul* (1855), *Aspirations of Nature* (1857) and The Church and the Age (1887)—and established the Catholic Publication society and two magazines, the Catholic World and the Young Catholic. He addressed the bishops at the Second Plenary Council of Baltimore, and accompanied Archbishop Spalding to the Vatican council as theologian. After his death on Dec. 22, 1888. Cardinal Newman declared, "We had begun a work of the same kind, he in America and I in England." The French translation of Hecker's biography occasioned a controversy on "Americanism" which Leo XIII settled in 1899 by the encyclical *Testem* Benevolentiae.

The Paulist Fathers became a papal institute in 1940, and by that time they had houses in the United States, Canada, Rome and South Africa.

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HECTOGRAPH: see OFFICE MACHINES AND APPLIANCES.

HECTOR, son of Priam and Hecuba and husband'of Andromache. In Homer he is the chief Trojan warrior. He is an especial favourite of Apollo. and later poets even describe him as son of that god. After Achilles (*q.v.*) had killed him. Aphrodite and Apollo preserved his body from corruption and mutilation. Priam. guarded by Hermes. went to Achilles and prevailed on him to give back the body. which was buried with great honour. Hector was afterward worshipped in the Troad and also at Tanagra.

HECUBA, in Greek Hekabe, principal wife of Priam, daughter of the Phrygian king. Dymas (or of Cisseus, or of the river-god Sangarius). When Troy was captured and Priam slain, she was made prisoner by the Greeks. Her fate is told in various ways, most of which connect her with the promontory Cynossema ("dog's monument") on the Hellespont. According to Euripides (in the *Hecuba*), her youngest son Polydorus had been placed during the siege of Troy under the care of Polymestor. king of Thrace. When the Greeks reached the Thracian Chersonese on their way home she discovered that her son had been murdered, and in revenge put out the eyes of Polymestor and murdered his two sons. Later. she was turned into a dog, a legend variously rationalized by later writers, and her grave became a mark for ships (Ovid, *Metam.*, xiii, 399–573: Juvenal. x. 271, and Mayor's note).

HEDA, WILLEM CLAESZ (1594–1680/82), one of the earlier Dutch 17th-century still-life painters. was born probably in Haarlem. where he worked and died. Early in his career he produced some figure subjects. but nearly all of his known works are still lifes, of which the earliest dated example is a "Vanitas" of 1621. His most characteristic compositions are of glass and metal vessels delicately arranged on a table with oysters, a half-peeled lemon or other motifs that display his precise draftsmanship and his skill in imitating the varied qualities of different light-reflecting surfaces. His colour range is a subdued one of silvery grays and browns, the naturalistic effects being achieved by accurate tone values. Heda's pictures are not uncommon in public and private collections. (R. E. W. J.)

HEDGE BINDWEED (*Convolvulus sepium*), a perennial vine of the morning glory family, Convolvulaceae (*q.v.*), called also great bindweed, bracted bindweed and Rutland beauty. It is cosmopolitan in temperate regions, found in North America from Newfoundland to British Columbia and southward to Mexico, and occurring in hedges and thickets in the British Isles. It is an extensively trailing or high-climbing vine, 3 ft. to 10 ft. high, with slender-stalked, spear-shaped leaves and handsome solitary flowers, pink with white stripes or entirely white, about 2 in. long. The species varies greatly and several races have been described, some of which are cultivated for ornament. See BINDWEED.

HEDGEBOT or HAYBOTE, an ancient legal term signifying the right of a tenant or copyholder to take or cut wood for specific purposes such as the repairs of fences and hedges for the upkeep of the premises as distinguished from the cutting of timber for building purposes, which constituted an infringement of the law.

HEDGEHOG, a mammal of the order Insectivora (*q.v.*), remarkable for its armature of spines and short tail. The common hedgehog (Erinaceus *europaeus*), the type of the family Erinaceidae, extends over nearly the whole of Europe but is found nowhere in the new world.

JOHN MARKHAM
COMMON HEDGEHOG (ERINACEUS EUROPAEUS), NATIVE TO EUROPE

The upper jaw is longer than the lower, the eyes small, the snout long and flexible and the claws long but weak. The animal is about 10 in. long, the lower surface covered with coarse hair. The brain is remarkable for its low development.

When startled during its nightly foragings the hedgehog rolls itself up into a ball, from which the spines stand out in every direction; these are sharp, hard and elastic and form an efficient defense. The moment it is touched, or even hears the report of a gun, it rolls itself up by the action of four muscles beneath the skin, while the same contraction effects the erection of the spines. Though insectivorous, the hedgehog will devour mice, frogs, snakes, birds' eggs and young, and toads, as well as plants and fruits.

The hedgehog does not emerge from its retreat, a hollow stump or rocky crevice. during the daylight unless urged by hunger or by the necessities of its young. During the winter it passes into a state of hibernation (*q.v.*), rolled up in a nest of dry leaves.

In July or August the female brings forth four to eight young; at birth the spines—which ip adult are brownish-black with yellowish tips—are white and soft, but soon harden, attaining their full size in the succeeding spring. The spines of the hedgehog are not barbed like those of the porcupine (*q.v.*), but they are still sharp enough to dissuade attackers. The fox, however, often rolls the prickly ball into water, where it immediately opens up to swim thus exposing its vulnerable parts to the predator.

The family is represented by about a score of species among which are the moonrats and gymnures ranging over Europe, Asia except the Malay countries, and Africa.

HEDGE NETTLE (*Stachys palustris*), a plant of the mint family (Labiatae). called also marsh woundwort, marsh betony and clownheal. widely distributed in Europe, Asia and North America.

The plant is an erect, slender, sometimes slightly branched, rather stiffly hairy perennial, 1 ft to 4 ft. high. with lance-shaped, more or less sharply toothed leaves and purplish flowers. about ¾ in. long borne usually in elongated clusters at the end of the stem but sometimes also in the upper axils of the leaves. This plant is typically representative of the botanical genus Stachys, embracing about 200 species, found (except in Australia) throughout the world; about 20 are native to the United States and Canada and 4 others, including the woundwort (*S. officinalis*), occur in Great Britain.

HEDGE SPARROW, small old-world birds belonging to the

family Prunellidae, related to the thrushes, old-world warblers and finches, also called accentors from their sweet accented songs. The most common is the European hedge sparrow *(Prunella modularis)*, also called dunnock or shufflewing, common about hedges. It has a reddish-brown back, iron-gray head and under parts, and the wing coverts are tipped white. The sexes are similar in appearance.

In England it is one of the earliest breeders in spring. The warmly built nest, in which the hedge sparrow lays its greenish-blue eggs, is often chosen by the European cuckoo as a place to leave its egg for the hedge sparrow to incubate, as noted by Shakespeare in *King Lear*.

Other species occur in Europe and northern Asia to China and Japan. A few of these are similar to the European hedge sparrow in habitat, but most species occupy rocky regions and higher mountain ranges. A Siberian species (P. *montanella*) is known as the mountain accentor. The Alpine accentor (P. *collaris)* is plumper and more brightly coloured than the dunnock. (G. F. Ss.; X.)

HEDGING: *see* FUTURES.

HEDIN, SVEN ANDERS (1865–1952), Swedish explorer, was born in Stockholm, Feb. 19, 186j He was educated at Uppsala university and later studied in Berlin and Halle. In 1885–86 he travelled through Persia and Mesopotamia, and in 1890 was attached to King Oscar's embassy to the shah of Persia. In the same year he visited Khurasan and Turkestan and reached Kashgar in 1891. His travels in Tibet placed him in the first rank of modern Asiatic explorers. Between 1893 and 1897 he travelled across the Asiatic continent from Orenburg by the Urals over the Pamirs and the plateau of Tibet to Peking During two other expeditions he made valuable additions to the scientific knowledge of these tracts and explored especially the sources of the Sutlej, the Indus and the Brahmaputra. In 1902 he became a Swedish noble. and in 1909 the Indian government invested him with the K.C I E. In 1927 he directed the Sino-Swedish expedition to China and spent many of the last years of his life preparing the results of this expedition for publication.

Sven Hedin's writings include: *Journey Through Persia and Mesopotamia and the Caucasus* (1887); *Journey Through Khorasan and Turkestan* (1892–93); *Through Asia* (1898); *Central Asta and Tibet* (1903); *Adventures in Tibet* (1904), *Scientific Results of a Journey in Central Asia 1899–1902*, 8 vol (1904–07); *Transhimalaya*, 3 vol (1909–12); *Overland to India*, 2 vol (1910); *To Jerusalem* (1917); *Southern Tibet*, 12 vol (1917–22); *My Life as an Explorer* (1926); *The Gobi Desert* (1928; Eng ed 1931); *Scientific Results of the Sino-Swedish Expedition 1927–35*, 30 vol (1937–42).

HEDJAZ: see HEJAZ.

HEDON, a municipal borough in the Bridlington parliamentary division of the East Riding of Yorkshire, Eng, 6 mi. E of Hull and 2 mi from the Humber river. Pop (1951) 1,994. Area 0.7 sq mi. Standing on Hedon haven, it was formerly a considerable port, but it lost its importance with the growth of Hull at the end of the 13th century; it is now largely agricultural The manor formed part of the lordship of Holderness which William the Conqueror granted to Eudes, count of Aumale. An undated charter of Henry II contains the first certain evidence of settlement By it. the king granted to William. count of Aumale, free borough rights in Hedon. In 1200 King John granted a confirmation of these liberties, and for this second charter the burgesses themselves paid 70 marks. In 1272 Henry III granted to Edmund, earl of Lancaster, and Avelina his wife, then lord and lady of the manor, the right of holding an eight-day fair at Hedon. After the countess' death the manor came to Edward I. In 1280 it was found by an inquisition that the men of Hedon "were few and poor" and that if the town were demised at a fee-farm rent, the town might improve. Apparently the grant was not made until 1346. Hedon was incorporated by Charles II in 1661, and James II gave the burgesses the charter. granting, among other privileges, that of holding two extra fairs. The church of St. Augustine is of Early English. Decorated and Perpendicular styles. with a 15th-century central tower 130 ft. high. The west front is particularly fine, and there is a lofty clerestory. The corporation possesses a remarkable mace of 15th-century workmanship The borough sent two members to parliament from 1295 to 1832. Hedon is said to mean "the rise covered with heather."

HEDONISM, in ethics, a general term for all theories of conduct in which the criterion is pleasure of one kind or another (Greek *hedone,* "pleasure," from *hedys,* "sweet," "pleasant"). Hedonistic theories of conduct have been held from the earliest times. They have been regularly misrepresented by their critics because of a simple misconception, namely, the assumption that the pleasure upheld by the hedonist is necessarily purely physical in its origins. This assumption is in most cases a complete perversion of the truth. Practically all hedonists recognize the existence of pleasures derived from fame and reputation, from friendship and sympathy, from knowledge and art. Most of them have urged that physical (or "lower") pleasures are not only ephemeral in themselves but also involve, either as prior conditions or as consequences, such pains as to discount any greater intensity that they may have while they last. *(See* ETHICS; ETHICS, HISTORY OF.)

The earliest and most extreme form of hedonism is that of the Cyrenaics (*q.v.*) as stated by hristippus, who argued that the only good for man is the sentient pleasure of the moment. Since, as Protagoras maintained, knowledge is solely of momentary sensations, it is useless to try to calculate future pleasures and to balance pains against them. The true art of life is to crowd as much enjoyment as possible into each moment.

No school has been more subject to the misconception noted above than the Epicurean. Epicureanism is completely different from Cyrenaicism. For Epicurus (*q.v.*) pleasure is indeed the supreme good, but his interpretation of this maxim is profoundly influenced by the Socratic doctrine of prudence and Aristotle's conception of the best life. The true hedonist will aim at a life of enduring pleasure, but this is obtainable only under the guidance of reason. Self-control in the choice and limitation of pleasures with a view to reducing pain to a minimum is indispensable. "Of all this, the beginning, and the greatest good, is prudence." This negative side of Epicureanism developed to such an extent that some members of the school found the ideal life rather in indifference to pain than in positive enjoyment.

In modern times Jeremy Bentham (*q.v.*) revived hedonism both as a psychological and as a moral theory. Each man has no other end than his own greatest pleasure. Each man ought to pursue the greatest pleasure. It would seem to follow that each man inevitably always does what he ought. Bentham sought the solution of this paradox on different occasions in two incompatible directions. Sometimes he says that the act which I do is the act which I *think* will give me most pleasure, whereas the act which I ought to do is the act which *really will* give me most pleasure: calculation is salvation, sin is shortsightedness. Alternatively he suggests that the act which I do is that which will give me most pleasure, whereas the act I ought to do is that which will give all *those affected by it* most pleasure. *(See* UTILITARIANISM for further developments of this second solution.)

The psychological doctrine that a man's only aim is pleasure was effectivelyattacked by Bishop Joseph Butler. He pointed out that each desire has its own specific object and that pleasure comes as a welcome addition or bonus when the desire achieves its object; hence the paradox that the best way to get pleasure is to forget it and to pursue wholeheartedly other objects. Butler went too far in maintaining that pleasure cannot be pursued as an end. Normally, indeed, when I am hungry or curious or lonely, I desire to eat, to know or to have company; and these are not desires for pleasure. But I can also eat sweets when I am not hungry, for the sake of the pleasure that they give.

Moral hedonism has been attacked by most moralists since Socrates. though they too have tended to go to the extreme of holding that I never have a duty to bring about pleasure. It does seem odd to say that I have a duty to give myself pleasure, but the pleasures of others certainly seem to count among the factors relevant in making a moral decision. One particular criticism which may be added to those usually urged against hedonists is that whereas they claim to simplify ethical problems by introducing a single standard, namely pleasure, in fact they have a double standard: "Nature has placed mankind under the governance of

two sovereign masters, pain and pleasure" (Bentham). Hedonists make the mistake of thinking of pleasure and pain as if they were, like heat and cold, degrees on a single scale, when they are really different in kind.

See further *G. E.* Moore, *Principia Ethica* (1903). (J. D. M.)

HEDRICK, ULYSSES PRENTISS (1870–1951), U.S. horticulturist, was born at Independence, Ia., on Jan. 15, 1870. He graduated in 1893 from Michigan Agricultural college, in which he was assistant horticulturist, 1893–95. He was professor of horticulture in Oregon Agricultural college in 1895–97, in Utah Agricultural college in 1897–99 and in Michigan Agricultural college in 1899–1905. In 1905 he became horticulturist at the New York agricultural experiment station, Geneva, conducting extensive researches in fruit growing, especially in pomology. He was director of the station from 1928 until his retirement in 1937. He died on Nov. 14. 1951, in Clifton Springs, N.Y.

His works include *Grapes of New York* (1908); *Plums of New York* (1910); *Cherries of New York* (1915); *Peaches of New York* (1917); *Sturtevant's Notes on Edible Plants* (1919); *Cyclopedia of Hardy Fruits* (1921); *The Pears of New York* (1922); *Systematic Pomology* (1923); *A History of Agriculture in the State of New York* (1933); *Grapes and Wines From Home Vineyards* (1945).

HEDWIG, JOHANN (1730–1799), German botanist, was the first scientist to interpret correctly the microscopically small sex structures of mosses and to exploit the spore-distributing mechanism of the capsule to classify those plants. Born at Kronstadt. Rumania (Transylvania), on Dec. 8, 1730, he studied in Leipzig and practiced medicine there and in Chemnitz. At the University of Leipzig he became professor of pharmacology in 1786 and professor of botany in 1789. Six volumes, published in Latin between 1782 and 1798, are highly regarded because of their hand-coloured plates of mosses and other plants. Hedwig followed the binomial system of naming plants instituted by his contemporary Linnaeus, and recognized more mosses than any man of his day owing to his skill with the microscope.

Hedwig died on Feb. 18, 1799, while working on his greatest contribution to the knowledge of mosses—Species Muscorum Frondosorum . . . Published in 1801, and later followed by four supplements, this posthumous treatise has been designated by international botanical congresses as the beginning point in the naming of mosses. (P. D. V.)

HEEL, in anatomy, is that part of the foot in man which is situated below and behind the ankle; by analogy, the calcaneal part of the tarsus in other vertebrates. The heel proper in digitigrades and ungulates is raised off the ground and is commonly known as the "knee" or "hock," while the term "heel" is applied to the hind hoofs.

HEEM, JAN DAVIDSZ DE (1606–1683/84), Dutch painter, was born at Utrecht. He was, if not the first, perhaps the greatest painter of still life in Holland. Sometimes De Heem painted alone or in company with men of his school, Madonnas or portraits surrounded by festoons of fruit or flowers, but his most numerous and characteristic works are still-life subjects. These are sometimes arrangements of fruits, metal dishes, wine-glasses, etc., in the manner of the Haarlem school, but they include also compositions of books and of musical instruments and some examples of the popular "Vanitas" theme, with a skull, hourglass and other suitably symbolic articles.

At one time Jan de Heem signed with initials, at others with Johannes, at others again with the name of his father (DAVID I DE HEEM, *c.* 1570–*c.* 1632) joined to his own. He entered the Antwerp guild in 1635–36 and became a burgher of that city in 1637, maintaining his residence there until 1667, when he moved to Utrecht. His death is recorded in the guild books of Antwerp.

CORNELIS DE HEEM (1631–95), the son of Jan Davidsz, was in practice as a flower painter at Utrecht in 1658, and was still active in 1671 at The Hague. His pictures are not equal to those of his father, but they are all well authenticated, and most of them are in the galleries of The Hague, Dresden, Cassel, Vienna and Berlin. In the Staedel at Frankfurt is a fruit piece, with potherbs and a porcelain jug, dated 1658; another, dated 1671, is in the museum of Brussels.

DAVID II DAVIDSZ DE HEEM, David I's second son, entered the guild of Utrecht in 1668 and that of Antwerp in 1693. The best piece assigned to him is a table with a lobster, fruit and glasses in the Rijksmuseum, Amsterdam; others bearing his signature are in the museums of Florence, Leningrad and Brunswick. (R. E. W. J.)

HEEMSKERCK, MAARTEN VAN (MAARTEN VAN VEEN) (1498–1574), Dutch Mannerist painter, was born at Heemskerck in Holland. He spent a period (c. 1528) in the Haarlem studio of Jan van Scorel, then lately returned from Italy. Heemskerck's earliest works—a portrait of his father (New York), "Ecce Homo" (Ghent), "Judah and Thamar" (formerly Potsdam) and "St. Luke Painting the Portrait of the Virgin" (Haarlem), all dated 1532—while adhering closely to the Romanist style of Scorel, seek to outdo it by dramatic lighting and illusionistic effects of plasticity which do, indeed, achieve an effect of surprise, but fail to conceal a certain spiritual vacuity which was to remain characteristic of Heemskerck's painting.

From 1532 to 1535 he was in Rome recording in innumerable sketches, some of which are preserved in Berlin, the architecture and sculpture of classical antiquity and the painting of the High Renaissance. Of the latter he directed his attention particularly to the frescoes of Michelangelo in the Sistine chapel and those of Raphael in the Villa Farnesina.

Throughout the rest of his long career, which was spent almost exclusively in Haarlem (where he died), he drew liberally on this garnered store of Roman motifs. Among the more notable of the religious paintings of his maturity are a great "Crucifixion" altar (1538–43, Linkoping cathedral. Sweden), a "Crucifixion" (1543, Ghent), an "Annunciation" and "Adorations of the Kings and Shepherds" (1546, Haarlem), two triptychs with Passion subjects (1559–60, Haarlem and Brussels), the "Story of Momus" (1561, Berlin) and the "Baptism of Christ" (1566, Brunswick). He also painted portraits, among them a self-portrait with the Colosseum (1553, Fitzwilliam museum, Cambridge), and from 1548 onward he produced many designs for engravings.

Heemskerck was one of the leading Dutch artists of his day and a painter of undoubted ability, yet it is hard to avoid the conclusion that his native force was stifled by his Mannerist practice of imitating and reproducing the most admired models. Relying on these, and neglecting nature, he evolved a style which, though not without originality, remains inexpressive and second-hand. The tendency to reduce the forms, textures and colours of nature to arid, abstract formulas extends even to his portraits, though these are perhaps his most attractive work. (D. KG.)

HEEMSKERK, JOHAN VAN (1597–1656), Dutch poet, born at The Hague on Feb. 27, 1597. He was educated at Bayonne, and at the University of Leyden in 1617. In 1621 he went abroad. He settled in 1640 in Amsterdam where he died on Feb. 27, 1656. For the last 12 years of his life he sat in the upper house of the states-general.

Heemskerk published volumes of poems—Minnekunst (1622), *Minnepligt* (1625) and Minnekunde (1628); but he is famous as the author of Batavische Arcadia (1647), which introduced the Italian pastoral romance into Holland.

HEEMSKERK, THEODORE (1852–1932), Dutch statesman, son of Jan Heemskerk, entered the second chamber in 1888. He made a great reputation as a jurisconsult, and as prime minister (1908–13) reserved for himself the portfolio of the interior. He was minister of justice (1918–25) and minister of state (1926). He was the leader in the second chamber of the Anti-Revolutionary party.

HEER, JAKOB CHRISTOPH (1859–1925), a prolific Swiss novelist, was born at Toss (Canton Zürich) on July 17, 1859, and died on Aug. 20, 1925. After some experience as a teacher and editor, he devoted himself to writing romantic novels, chiefly dealing with Swiss life and marked by a certain old-fashioned air that enhances rather than detracts from their charm.

Heer's best work is An Heiligen *Wassern* (1898), but the most popular is Der Konig der Bernina (1900), describing an interesting phase in the history of the Grisons. His Tobias Heider (1923) is autobiographical in character.

See G. H. Heer, ***Jakob Christoph Heer*** (1927).

HEER, OSWALD (1809–1883), Swiss geologist and naturalist, was born at Nieder-Utzwyl in Canton St. Gallen on Aug. 31, 1809. He was a pioneer in paleobotany, distinguished for his researches on the Miocene flora. In 1851 he became professor of botany in the University of Zurich, and he directed his attention to the Tertiary plants and insects of Switzerland. For some time he was director of the botanic garden at Zurich. He died at Lausanne on Sept. 27, 1883.

He published *Flora Tertiaria Helvetiae,* 3 vol. (1855–59); *Die Urwelt der Schweiz* (1865), and *Flora fossilis Arctica* (1868–83).

HEEREN, ARNOLD HERMANN LUDWIG (1760–1842). German historian, was born on Oct. 25, 1760 at Arbergen, near Bremen. He studied history at Gottingen, and was appointed (1787) one of the professors of philosophy, and then of history in his university. He died at Gottingen on March 6, 1842. Heeren regarded the states of antiquity from an altogether fresh point of view; he examined their economic relations! their constitutions, their financial systems, and thus threw a new light on the development of the ancient world. He was a pioneer in the movement for the economic interpretation of history.

Heeren's chief works are: *Ideen über Politik, den Verkehr, und den Handel der vornehmsten Völker der alten Welt* (2 vol., Göttingen, 1793–96; 4th ed., 6 vol., 1824–26; Eng. trans. 1833); *Geschichte des Studiums der klassischen Litteratur seit dem Wiederaufleben der Wissenschaften* (2 vol., Gottingen, 1797–1802; new ed., 1822); *Geschichte der Staaten des Altertums* (Gottingen, 1799; Eng. trans., Oxford, 1840); *Geschichte des europäischen Staatensystems* (Gottingen, 1800; 5th ed., 1830; Eng. trans., 1834); *Versuch einer Entwickelung der Polgen der Kreuzzüge* (Gottingen, 1808; French trans. 1808), a prize essay of the Institute of France. With Friedrich August Ukert (1780–1851) he founded the famous historical collection, *Geschichte der europäischen Staaten* (Gotha, 1819 *seq.),* and contributed many papers to learned periodicals.

HEERENVEEN, a town of the Netherlands on the railway Leeuwarden-Zwolle; pop. (1947) 7,621. The nearby castle Oranjewoud was established in the 17th century by the Frisian stadtholders.

HEERLEN, a town of the Netherlands in the south of the province of Limburg, on the railway about 3 mi, from the German frontier at Alsdorf. Pop. (1947) 35,001. The town is one of the centres of the coal field. The most important mines are the Orange-Nassau I, II and IV and the state mine, Emma.

HEFELE, KARL JOSEF VON (1809–1893), German Catholic theologian, was born at Unterkochen, Württemberg, on March 15, 1809. and was educated at Tubingen, where, after minor appointments elsewhere, in 1840 he became professor of church history and patristics. From 1842 to 1845 he sat in the national assembly of Wurttemberg, and in 1869 was enthroned bishop of Rottenburg. Previous to this appointment. Hefele had won a reputation for scholarship by his early publications: *Patrum Apostolicorum Opera* (1839, 4th ed. 1855), *Der Kardinal Ximenes* (1844, 2nd ed. 1851), *Chrysostomuspostille* (1845, 3rd ed. 1857) and particularly the *Conciliengeschichte* (1855–74, 2nd ed. 1873–90, Eng. trans. 1871). He opposed the decrees of papal infallibility at the Vatican council of 1870, and did not submit until 1871.

Hefele died at Rottenburg on June 6, 1893.

HEGEL, GEORG WILHELM FRIEDRICH (1770–1831), German philosopher, was born at Stuttgart on Aug. 27, 1770. His father was a revenue officer. He learned the elements of Latin from his mother before he went to the Stuttgart grammar school, where he remained until he was 18. As a schoolboy he made a collection of extracts, alphabetically arranged, comprising annotations on classical authors, passages from newspapers, treatises on morals and mathematics from the standard works of the period.

In 1788 he went to Tiibingen as a student with a view to taking orders, as his parents wished. He studied philosophy and classics for two years and took his Ph.D. in 1790. Thereafter he took the theological course; but he was impatient with the orthodoxy of his teachers, and the certificate given to him when he left in 1793 states that while he had devoted himself vigorously to philosophy, his industry in theology was intermittent. He was also said to be a poor orator, and this deficiency in oral exposition was to dog him throughout his life. His fellow students called him "the old man" but he liked cheerful company and a "sacrifice to Bacchus" and he enjoyed kisses too. His chief friends were J. C. F. Holderlin, the poet, his contemporary, and F. W. J. Schelling, the philosopher, five years his junior. Together they read the Greek tragedians and celebrated the glories of the French Revolution.

On leaving college, he did not enter the ministry. He wished to have leisure for the study of philosophy and Greek literature and became a private tutor. For the next three years he lived in Berne, with time on his hands and the run of a good library where he read Edward Gibbon and Montesquieu, as well as the Greek and Roman classics. He also studied Rant and was stimulated by his essay on religion to write certain papers which remained unpublished until 1907 *(see* below). Kant had maintained that, while orthodoxy requires a faith in historical facts and in doctrines which reason alone cannot justify and while it imposes on the faithful a moral system containing many arbitrary commands alleged to be revealed, Jesus had originally taught a rational morality, reconcilable with the teaching of Kant's ethical works, and a religion which, unlike Judaism. was adapted to the reason of all men. Hegel accepted this teaching but, being more of a historian than Kant was, brought it to the test of history by writing two essays: first, a life of Jesus in which he attempted to reinterpret the Gospel on Kantian lines; and secondly an answer to the question of how Christianity had ever become the authoritarian religion that it was if in fact the teaching of Jesus was not authoritarian at all but essentially rationalistic.

Hegel was lonely in Berne and was glad to move, at the end of 1796, to Frankfurt-on-Main, where Holderlin had been able to get another tutorship for him. His hopes of more companionship were unfulfilled: Holderlin was engrossed in a love affair with his employer's wife and shortly afterward lost his reason. Hegel began to suffer from melancholia and. to cure himself. worked harder than ever, especially at Greek philosophy and modern history and politics. He read and made cuttings from English newspapers, wrote about the internal affairs of his native Württemberg and studied economics. This immersion in studies which had had little effect on Kant enabled Hegel to free himself from the domination of his master's influence and to look with a fresh eye on the problem of Christian origins.

It is impossible to exaggerate the importance which this problem had for Hegel. His early theological writings contain plenty of hard sayings about Christianity and the churches, but the object of his attack is orthodoxy, not theology itself. All that he wrote at this period throbs with a religious conviction which is totally absent from Kant and his other 18th-century teachers. Above all. he is inspired by a doctrine of the Holy Spirit. The spirit of man, his reason. is the candle of the Lord and therefore cannot be subject to the limitations which Kant had imposed on it in the *Critique of Pure Reason.* This faith in reason, with its religious basis, animates the whole of Hegel's work henceforward.

His outlook has also become that of a historian, and this again distinguishes him from Kant. who was much more influenced by the conceptions of physical science. Every one of Hegel's major works is a history, and indeed it was among historians and classical scholars rather than among philosophers that his work mainly fructified in the 19th century.

When in 1798 he turned back to look over the essays he had written two or three years earlier in Berne, he saw with his historian's eye that under Kant's influence he had misrepresented the life and teachings of Jesus and the history of the Christian church. His new-won insight found expression then in his essay on *The Spirit of Christianity,* likewise unpublished until 1907. This is one of Hegel's most remarkable works. Its style is often difficult and the connection of thought not always plain, but it is written with passion, insight and conviction.

He begins by sketching the essence of Judaism, which he paints in the darkest colours. The Jews were slaves to the

Mosaic law, leading a life unlovely in comparison with that of the ancient Greeks and content with the material satisfaction of a land flowing with milk and honey. Jesus taught something entirely different. Men are not to be the slaves of objective commands: the law is made for man. They are even to rise above the tension in moral experience between inclination and reason's law of duty, for the law is to be "fulfilled" in the love of God wherein all tension ceases and the believer does God's will wholeheartedly and single-mindedly. A community of such believers is the Kingdom of God.

This was the kingdom which Jesus came to teach. It is founded on a belief in the unity of the divine and the human. It is one life which flows in them both, and it is only because man is spirit that he can grasp and comprehend the Spirit of God. Hegel works out this conception in an exegesis of passages in St. John. The kingdom, however, can never be realized in this world: man is not spirit alone but flesh also. "Church and state, worship and life, piety and virtue, spiritual and worldly action can never dissolve into one."

In this essay the leading ideas of Hegel's system of philosophy are rooted. Kant had argued that we could have knowledge only of a finite world of appearances; if reason attempted to go beyond this sphere and grapple with the infinite or with ultimate reality, it became entangled in insoluble contradictions. Hegel, however, found in love as a union of opposites a prefigurement of spirit as the unity in which contradictions, such as infinite and finite, were embraced and synthesized. His choice of the word *Geist* to express this his leading conception was deliberate: the word means "mind" as well as "spirit" and is commonly so translated; but the English word "mind" has no religious overtones and therefore does not convey Hegel's meaning adequately. Contradictions in thinking at the scientific level of Kant's "understanding" are indeed inevitable, but thinking as an activity of spirit or "reason" can rise above them to a synthesis in which the contradictions are resolved. All this, expressed in religious phraseology, is contained in the manuscripts written toward the end of Hegel's stay in Frankfurt. "In religion," he says in the paper which his editor unfortunately called *Fragment of a System,* "finite life rises to infinite life." Kant's philosophy has to stop short of religion because it rests on an opposition between thought and its object and must place the true infinite beyond its confines. But there is room for another philosophy, based on the conception of spirit, which will distill into conceptual form the insights of religion. This was the philosophy now within Hegel's grasp, and he felt himself ready to expound it.

Fortunately his circumstances had changed for him at this moment, and he was at last able to embark on the academic career that had long been his ambition. His father's death in 1799 had put him in possession of an inheritance, slender indeed, but sufficient to enable him to surrender a regular income and to take the risk of becoming a *Privatdocent.* By the end of 1800 he was ready to burn his boats, and in Jan. 1801 he arrived in Jena, where Schelling had been a professor since 1798. The golden age of Jena was over. J. L. Tieck, Novalis and the Schlegels, who had made it the headquarters of their fantastic mysticism, and Fichte, who had developed certain aspects of Kant's ethics rather one-sidedly in the direction of revolutionary idealism, had all left the place. The precocious Schelling, who was but 26 on Hegel's arrival, had several books behind him already, for he was apt to "philosophize in public" and was fighting a lone battle in the university against rather dull followers of Kant. It was suggested that Hegel had been summoned as a new champion to aid his friend, and this impression received some confirmation from the Latin dissertation by which Hegel qualified as a university teacher and which betrays the influence of Schelling's philosophy of nature, as well as from Hegel's first publication, an essay on the difference between Fichte and Schelling (*Differenz des Fichte'schen und Schelling'schen Systems der Philosophie,* Jena, 1801), in which preference is given to the latter. Nevertheless, even in this essay, and still more in its successors, Hegel's difference from Schelling is clearly marked; they had a common interest in the Greeks, they both wished to carry forward Kant's work, they were both iconoclasts, but Schelling had too many romantic enthusiasms for Hegel's liking, and all that Hegel took from him, and then only for a very short period, was a terminology.

Hegel's lectures, in the winter of 1801–02, on logic and metaphysics, were attended by about 11 students. Later, in 1804, we find him with a class of about 30, lecturing on his whole system; but his average attendance was rather less. Besides philosophy, he once at least lectured on mathematics. As he taught, he was gradually able to work out his system, and notice after notice of his lectures promised a textbook of philosophy — which, however, failed to appear.

After the departure of Schelling from Jena (1803), Hegel was left to work out his own views untrammeled. Besides philosophical and political studies, he made extracts from books, attended lectures on physiology and dabbled in other sciences. As a result of representations made by himself at Weimar, he was in Feb. 1805 appointed extraordinary professor at Jena; and in July 1806, on Goethe's intervention, he drew his first stipend—100 thalers. Though some of his hearers became attached to him, Hegel was not yet a popular lecturer.

Hegel, like Goethe, felt no patriotic shudder when Napoleon won his victory at Jena (Oct. 14, 1806): in Prussia he saw only a corrupt and conceited bureaucracy. Writing to his friend F. I. Niethammer (1766–1848) on the day before the battle, he speaks with admiration of the "world-soul," the emperor, and with satisfaction of the probable overthrow of the Prussians. Hegel's fortunes were now at the lowest ebb. Yet at this time he finished and published his first great work, the *Phenomenology of Mind (Phanomenologie des Geistes,* Bamberg and Würzburg, 1807). He was, therefore, glad to become editor of the *Bamberger Zeitung* (1807–08). This, however, was not a suitable vocation, and he gladly accepted the rectorship of the Aegidiengymnasium in Nuremberg, a post which he held from Dec. 1808 to Aug. 1816. There Hegel inspired confidence in his pupils and maintained discipline without pedantic interference in their associations and sports.

In 1811 Hegel married Marie von Tucher (22 years his junior), of Nuremberg. The marriage was entirely happy. His income at Nuremberg amounted to 1,500 gulden and a house (in Heidelberg, as professor, he was to receive about the same sum; in Berlin, about 3,000 thalers, more than twice as much). His wife bore him two sons: Karl (1813–1901), who became eminent as a historian; and Immanuel (1814–91), whose interests were theological. The family circle was joined by Ludwig, a natural son of Hegel's from Jena.

At Nuremberg in 1812 appeared *Die objektive Logik,* being the first part, in two sections, of his *Science of Logic (Wissenschaft der Logik),* which in 1816 was completed by the second part, *Die subjektive Logik.* This work. in which his system was first presented in what, with minor alterations, was its ultimate shape, earned him the offer of professorships at Erlangen, at Berlin and at Heidelberg. He accepted the chair at Heidelberg, in succession to J. H. Fries (1816). For use at his lectures there he published his *Encyclopaedia of the Philosophical Sciences* (*Encyklopädie der philosophischen Wissenschaften im Grundrisse,* Heidelberg, 1817), an exposition of his system as a whole.

In 1818 Hegel accepted the renewed offer of the chair of philosophy at Berlin, which had been vacant since Fichte's death. There his influence over his pupils was immense, though his expectation of other government employment was not fulfilled. After the publication of his *Philosophy of Right (Naturrecht und Staatswissenschaft im Grundrisse,* alternatively entitled *Grundlinien der Philosophie des Rechts,* Berlin, 1821), he seems to have devoted himself almost entirely to his lectures. Between 1823 and 1827 his activity reached its maximum. His notes were subjected to perpetual revisions and additions. We can form an idea of them from the shape in which they appear in his published writings. Those on *Aesthetics,* on the *Philosophy of Religion,* on the *Philosophy of History* and on the *History of Philosophy* have been published by his editors, mainly from the notes of his students, under their separate heads; while those on logic, psychology

and the philosophy of nature are appended in the form of illustrative and explanatory notes to the sections of his *Encyclopaedia*. During these years hundreds of hearers from all parts of Germany and beyond came under his influence. His fame was carried abroad by eager or intelligent disciples.

Three courses of lectures are especially the product of his Berlin period: those on aesthetics, on the philosophy of religion and on the philosophy of history. In the years preceding the revolution of 1830, public interest, excluded from political life, turned to theatres, concert rooms and picture galleries. At these Hegel became a frequent and appreciative visitor and made extracts from the art notes in the newspapers. In his holiday excursions, his interest in the fine arts more than once took him out of his way to see some old painting. This familiarity with the facts of art, though neither deep nor historical, gave a freshness to his lectures on aesthetics, which, as put together from the notes of 1820, 1823, 1826, are among his most successful efforts.

The lectures on the philosophy of religion are another application of his method. Shortly before his death he had prepared for the press a course of lectures on the proofs for the existence of God. In his lectures on religion he dealt with Christianity, as in his philosophy of morals he had regarded the state. On the one hand he turned his weapons against the rationalistic school, who reduced religion to the modicum compatible with an ordinary worldly mind. On the other hand he criticized the school of Schleiermacher, who elevated feeling to a place in religion above systematic theology. His middle way attempts to show that the dogmatic creed is the rational development of what was implicit in religious feeling. To do so, of course, philosophy becomes the interpreter and the superior.

The lectures on the history of philosophy are especially remarkable for their treatment of Greek philosophy. Hegel worked mainly with the Renaissance editions of Plato and Aristotle and without the indexes and annotated editions which are at the disposal of modern scholars. In these circumstances his grasp and understanding' of these authors is astounding, and it is only just to recognize that it was from Hegel that the scholarship lavished on Greek philosophy in the century after his death received its original impetus.

A Hegelian school began to gather. The flock included intelligent pupils, empty-headed imitators and romantics who turned philosophy into lyric measures. Opposition and criticism only served to define more precisely the adherents of the new doctrine. Though he had soon resigned all direct official connection with the schools of Brandenburg, Hegel's real influence in Prussia was considerable—even if largely exaggerated in popular estimate. In the narrower circle of his friends his birthdays were the signal for congratulatory verses. In 1831 he received a decoration from Frederick William III. In 1830 he was rector of the university.

One of the last literary undertakings in which he took part was the establishment of the Berlin *Jahrbiicher fur wissenschaftliche Kritik*.

The revolution of 1830 was a great blow to him, and the prospect of mob rule almost made him ill. His last literary work, the first part of which appeared in the *Preussische Staatszeitung* while the rest was censored, was an essay on the English Reform bill of 1831, considering its probable effects on the character of the new members of parliament and the measures which they might introduce. In the latter connection he enlarged on several points in which England had done less than many continental states for the abolition of monopolies and abuses.

In 1831 cholera entered Germany. Hegel and his family retired for the summer to the suburbs, and there he finished the revision of the first part of his *Science of Logic*. At the beginning of the winter session he returned to his house in the Kupfergraben. On Nov. 14, after one day's illness, he died of cholera and was buried, as he had wished, between Fichte and Karl Solger.

Hegel in his classroom was more impressive than fascinating. You saw a plain, old-fashioned face, without life or lustre—a figure which had never looked young and was now prematurely aged; the furrowed face bore witness to concentrated thought. Sitting with his snuffbox before him and his head bent down, he looked ill at ease and kept turning the folios of his notes. His utterance was interrupted by frequent coughing; every sentence came out with a struggle. The style was no less irregular: sometimes in plain narrative the lecturer would be specially amkward, while in abstruse passages he seemed specially at home, rose into a natural eloquence and carried away the hearer by the grandeur of his diction.

PHILOSOPHY

Hegel took seriously Plato's saying that the philosopher is "the spectator of all time and all existence." His philosophy is a systematic whole, an attempt to comprehend the entire universe; he tried to do for the modern world what Aristotle had done for the ancient.

The system is grounded in faith. In the Christian religion God has been revealed as truth and as spirit. Since spirit alone can comprehend spirit, it is only because man is spirit that he can receive this revelation. In receiving it, he knows God; *i.e.*, he knows absolute truth. In religiop this truth is veiled in imagery; but in philosophy the veil is torn aside.

The task of philosophy is thus to know the infinite and to see all things in God. Hegel's system is a spiritual monism, but it is a monism in which differentiation is essential; *i.e.*, it accords with the Christian faith in God as triune, not with Islam.

Hegel accepts from Aristotle the conception of God as pure thought thinking itself and from his predecessors in modern philosophy the central importance of mind's knowledge of itself as mind. In these instances thought and the object of thought are identical, and in that identity alone does thinking attain the through-and-through intelligibility which is the goal of all its endeavour as thinking. The identity is reached, however, only through an experience of difference. Truth is the absence of error, but it is known to be true only because error has been experienced and truth has triumphed. God, in Hegel's view, is infinite only because he has assumed the limitations of finitude and triumphed over them. Adam and Eve were innocent in the Garden of Eden, but their fall was necessary if man was to attain moral goodness. Only if the universal particularizes itself can it come to know itself as universal. Spirit knows itself as spirit only by contrast with nature. Spirit must always give itself forms through which it can work; it must objectify itself in a creed or in an institution if it is not to wither away. The letter killeth, yet the letter is spirit's indispensable expression and self-manifestation.

The infinite spirit's eternal enjoyment of himself as spirit thus necessitates the existence of the finite in the form of nature, finite spirits and all the imperfection and evil of the world. But Hegel's system finds room for all these and yet remains monistic because it seeks to show that the truth, the essential substance, of the finite is the infinite whose manifestation, in varying degrees, the finite is: there is a heart of goodness in evil, and this heart is all the reality that it has; the rest perishes and passes away into nothingness.

The system is monistic too in having a single theme. What makes the universe intelligible is to see it as the eternal cyclical process whereby absolute spirit comes to knowledge of itself as spirit (1) through its own thinking; (2) through nature; (3) through finite spirits and their self-expression in history and their self-discovery, in art, in religion and in philosophy, as one with absolute spirit itself.

Hegel's terminology presents difficulties to those who approach his works for the first time, even if German be their native language. He prided himself in having taught philosophy to speak German instead of Greek or Latin, but on some of the German words that he uses he imposes his own technical meaning. But he uses them consistently and it is not difficult to learn them, especially if their ancestry in Proclus and in Martin Luther is borne in mind. Hegel was a master of language, whichever of his differing styles he chose.

The early theological writings and the *Phenomenology* of *Mind* are packed with brilliant metaphors. In his later works, which were produced as textbooks for his lectures, the *Encyclopaedia*

of the Philosophical Sciences and the Philosophy *of* Right, he compresses his material into relatively short, numbered paragraphs. It is only necessary to translate them to appreciate their conciseness and precision. The common idea that Hegel's is a philosophy of exceptional difficulty is quite mistaken. Once his terminology is understood and his main principles grasped, he presents far less difficulty than Kant, for example. One reason for this is a certain air of dogmatism. Kant's statements are often hedged around with qualifications; Hegel had, as it were, seen a vision of absolute truth and he expounds it with confidence.

The **Phenomenology** of Mind. — This, perhaps the most brilliant and the most difficult of Hegel's books, describes how the human mind has risen from mere consciousness, through self-consciousness, reason, spirit and religion, to absolute knowledge. The native attitude of consciousness toward existence is reliance on the evidence of the senses; but a little reflection is sufficient to show that the reality attributed to the external world is as much due to intellectual conceptions as to the senses and that these conceptions elude us when we try to fix them. If consciousness cannot detect a permanent object outside itself, so self-consciousness cannot find a permanent subject in itself. It may, as in Stoicism, assert freedom by holding aloof from the entanglements of real life; or it may sceptically regard the world as a delusion; or finally, as the "unhappy consciousness" (*unglückliches Bewusstsein*), it may be a recurrent falling short of a perfection which it has placed above itself in the heavens. But in this isolation from the world, self-consciousness has closed its gates against the stream of life. The perception of this is reason. Reason, convinced that the world and the soul are alike rational, observes the external world, mental phenomena and specially the nervous organism as the meeting ground of body and mind. But reason, finding much in the world that recognizes no affinity with her, turns to practical activity and seeks in the world the realization of her own aims. Reason abandons her efforts to mold the world and is content to let the aims of individuals work out their results independently, intervening only to lay down precepts by the rules of formal logic.

So far we have seen consciousness on one hand and the real world on the other. The stage of Geist reveals the consciousness no longer as critical and antagonistic but as the indwelling spirit of a community, as no longer isolated from its surroundings but the union of the single and real consciousness with the vital feeling that animates the community. This is the lowest stage of concrete consciousness — life, and not knowledge; the spirit inspires, but does not reflect. It is the age of unconscious morality, when the individual's life is lost in the society of which he is an organic member. But increasing culture presents new ideals, and the mind, absorbing the ethical spirit of its environment, gradually emancipates itself from conventions and superstitions. This emancipation prepares the way for the rule of conscience, for the moral view of the world as subject of a moral law. From the moral world the next step is religion: the moral law gives place to God. But the idea of Godhead, too, as it first appears, is imperfect, and has to pass through the forms of nature worship and of art before it reaches a full utterance in Christianity. Religion in this shape is the nearest step to the stage of absolute knowledge; and this absolute knowledge — "the spirit knowing itself as spirit" — is not something which leaves these other forms behind but the full comprehension of them as the organic constituents of its empire; "they are the memory and the sepulchre of its history and at the same time the actuality, truth and certainty of its throne." Here, according to Hegel, is the field of philosophy.

The Hegelian System and Dialectic. — The compendium of Hegel's system, the Encyclopaedia of the Philosophical Sciences, is in three parts: "Logic," "Nature" and "Mind" (or "Spirit"). The relation between these is dialectical and the method of exposition within each of them is dialectical again. The notion of dialectic Hegel took both from the Greek philosophers and from Kant; it means, originally, "discussion." In a discussion between two people who are both seeking the truth of the topic which is being discussed, diametrically opposed points of view may be advanced in the first instance. Each party, however, may gradually come to understand the other's position, and ultimately both of them may come to agree to reject their own partial views and to accept a new and broader view which does justice to the substance of what each of them had begun by maintaining; the original opposition has been reconciled in a higher synthesis.

Hegel believed that thinking always proceeded according to this pattern: it begins by laying down a positive thesis which is at once negatived by its antithesis; then further thought produces the synthesis. But this in turn generates an antithesis and the same process continues once more, but not indefinitely, for it is circular. Ultimately thinking reaches a synthesis which is identical with its starting point, except that all that was implicit there has now been made explicit.

What is it that drives thinking on in this way? Hegel answers: the power of the negative. Any process of development has two inseparable aspects: (1) the positive aspect of growth, the emergence of something new; and (2) the negative aspect of rejection, the discarding of the old. We become men by putting away childish things, but not by that alone; there must be growth as well. Hegel's point is that thinking itself, as a process, has negativity as one of its constituent moments. In a discussion, the positive thesis advanced by one party is negatived by the other party, so that negation comes from the outside. But thinking, as the discourse of the soul with itself, is dialectical because it carries the negation within itself. Or, to give Hegel's doctrine its theological background, the infinite and the finite are not set over against one another, for if the finite were outside the infinite, the infinite itself would not be all-embracing and would only be another finite; on the contrary, the finite is part and parcel of the infinite itself — its implicit negative moment, to which explicit reality must be given, as God's self-manifestation, in order that spirit's knowledge of itself as a unity of opposites may be complete.

The presence of this element of negativity within thinking itself is, in Hegel's view, the clue to development of all kinds. Suppose a man to be capable of intellectual advance; there is then a clash between his achievement and his potentialities; but the potentialities are actually his and there thus arises for him. as self-conscious mind, a tension between them and his achievement; if they are to be realized the achievement must be rejected, and yet the achievement and a series of achievements are necessary to the realization of the potentialities. The power of mind is infinite, but mind in thinking must think something definite and so something finite; but the finite thing thought is in contradiction to the infinity of thinking and must therefore be rejected in favour of some thought less inadequate to that infinity. This is the sort of dialectical process of which Hegel's system provides an account in three phases.

"Logic". — The system begins with an account of God's thinking "before the creation of nature and finite spirit"; *i.e.,* with the categories or pure forms of thought, which are the structure of all physical and intellectual life. The Phenomenology of Mind has already described the process by which the philosopher has come to occupy the vantage ground from which such an account can be given. Throughout we are dealing with pure essentialities, with spirit thinking its own essence; and these are linked together in a dialectical process which advances from abstract to concrete.

If we try to think the notion of pure being (the most abstract category of all), we find that it is simply emptiness; *i.e.,* nothing. Yet nothing is. The notion of pure being and the notion of nothing are opposites; and yet each, as we try to think it, passes over into the other. But the way out of the contradiction is at once to reject both notions separately and to affirm them both together; *i.e.,* to assert the notion of becoming, since what becomes both is and is not at once. The dialectical process advances through categories of increasing complexity and culminates with the absolute idea, or with the spirit as objective to itself.

"Nature".—Nature is the opposite of spirit. The categories studied in "Logic" are all internally related to one another; they grow out of one another. Nature, on the other hand, is a sphere of external relations. Parts of space and moments of time exclude one another; and everything in nature is in space and time and thds finite. But nature is created by spirit and bears the

mark of its creator. Categories appear in it as its essential structure, and it is the task of the philosophy of nature to detect that structure and its dialectic; but nature, as the realm of externality, cannot be rational through and through, though the rationality prefigured in it becomes gradually explicit when man appears. In man nature rises to self-consciousness. It is clear that the theory of the evolution of species fits in admirably with Hegel's conception of nature, but he rejected it because it had no justification in the science of his day.

"Mind".—Here Hegel follows the development of the human mind through the subconscious, consciousness and the rational will; then through human institutions and human history as the embodiment or objectification of that will; and finally to art, religion and philosophy, in which finally man knows himself as spirit, as one with God and possessed of absolute truth. It is thus then open to him to think his oan essence; *i.e.*, the thoughts expounded in "Logic." We have returned to the starting point of the system but en route have made explicit all that was therein implicit and discovered that "nothing but spirit is, and spirit is pure activity."

Hegel had an eye for detail; his system is not developed a *priori* or in *vacuo* but depends throughout on the results of scientific, historical, theological and philosophical inquiry. No reader of his lectures can fail to be impressed by the penetration and breadth of his mind or by the immense range of knowledge which in his view had to precede the work of philosophizing. "The owl of Minerva spreads her wings only with the falling of the dusk"; *i.e.*, a civilization must be mature and indeed in its death throes before, in the philosophic thinking which has implicitly been its substance, it becomes conscious of itself and its significance. When philosophy comes on the scene, some form of the world has grown old; and it rises into self-consciousness in the philosophy which it produces. The business of philosophy is to comprehend, not to construct.

Philosophy of Right.—Although Hegel's works on politics and history merely elaborate part of his system—that part in which human mind objectifies itself in its endeavour to find an object identical with itself—and are unintelligible in isolation, they deserve separate treatment because they have become so famous, if not notorious. The Philosophy of Right (or of Law) falls into three main divisions. In the first, Hegel is concerned with law and rights as such: persons. not individuals, are the subject of rights, and what is required of them by law is mere obedience, no matter what the motives of obedience may be. The law or a right is thus an abstract universal and therefore, though it is an embodiment of the human will, does justice only to the universal element in that will; all persons are equal before the law. My will, however. though universal as will and rational, is also mine, and this element of individuality demands recognition. The individual cannot be satisfied unless the act which he does accords, not merely with law or custom, but with his own conscientious convictions. Hegel points out that the claims of conscience are what distinguishes the modern world from, for instance, Plato's *Republic*. This distinction has its origin in Christianity. Thus the problem in the modern world is to construct a social and political order which satisfies the claims both of the universal law and of the individual conscience. This is a hard task. because conscience is intimately linked with freedom, the freedom of the rational will as vindicated by Kant. No political order in the modern world can satisfy the demands of reason unless it is organized so as to avoid on the one hand a centralization which would make men slaves or ignore the individual conscience and on the other hand an antinomianism which nould allow freedom of conviction to any individual, no matter what the conviction was. and so produce a licentiousness that would make social and political order impossible.

Hegel proceeds to describe a state in which this synthesis of universal and individual claims is achieved. It rests on the family and on the guild, tno institutions in which, in personal and in communal life. the individual is taught to find in co-operation with others the full satisfaction of his individual needs. Thus schooled, the individual can recognize the state not as something alien and oppressive but as something which, in so far as he participates in it, does satisfy him as an individual while at the same time it maintains peace and order.

The state so described is unlike any existing state in Hegel's day. It is a form of limited monarchy, with parliamentary government, trial by jury and toleration for Jews and dissenters. In all these respects it differed from the contemporary Prussia. It has often been said by Hegel's detractors that his book was nritten on the "dunghill of servility" and that his ideal state is identical with the monarchy of Frederick William. Little historical knowledge and little study of Hegel is required to see that this is nonsense.

Philosophy of History.—Hegel presupposes that the whole of human history is a process through which mankind has been making spiritual and moral progress; it is what human mind has done in the course of its advance to self-knowledge. In other words, history has a plot, and the philosopher's task is to discern it. Many eminent historians have been unable to discern any plot and have contented themselves with recording what has happened; others have found the key to history in the operation of natural laws of various kinds. Hegel's attitude rests on the faith that history is the carrying out of God's purpose and that by the beginning of the 19th century man had advanced far enough to descry what that purpose is. The purpose in question is the gradual realization of human freedom.

The first step was to make the transition from a natural life of savagery to a state of order and law. States had to be founded, and the heroes who founded them had to use force and violence. There is no other way to make men law-abiding before they have advanced far enough mentally to apprehend and to accept the rationality of an ordered life. This process cannot succeed all at once: there will be a stage at which some men have accepted the law and become free, while others must perforce be slaves. In the modern world we have come to appreciate that all men, as minds. are free in essence, and our task is to frame institutions under which they will be free in fact.

Hegel is careful to leave room for developments in the future. He did not believe, despite some critics, that history had ended in his lifetime. In particular, he maintained against Kant that to eliminate war was impossible. Each nation state was an individual, sovereign in its own sphere; and, so long as this remained true, disputes between sovereigns could be settled by violence alone. As Hobbes had said of relations between individuals in the state of nature, pacts without the sword were but words. Students of the history of Europe since Hegel's day may be the last to think him wrong. His reverence for fact prevented him from accepting Kant's idealism.

The Fate of Hegelianism.—Hegel's system is avowedly an attempt to unify opposites—spirit and nature, universal and particular, ideal and real—and to be a synthesis in which all the partial and contradictory philosophies of his predecessors are alike contained and transcended. It is thus both idealism and realism at once, and hence it is not surprising that his successors, emphasizing now one and now another strain in his thought, have interpreted him variously. Conservatives and revolutionaries, believers and atheists have professed alike to draw inspiration from him. In one form or another his teaching dominated German universities for some years after his death and spread to France and to Italy; but its very success produced, as he would himself have foretold, a reaction. Its influence, indeed, was almost dead when in the later part of the 19th century it blossomed anew in England and Scotland in the work of such writers as Benjamin Jowett, T. H. Green, John and Edward Caird. J. M. E. McTaggart and Bernard Bosanquet (see NEO-HEGELIANISM). This success led to a reaction in its turn; but when Hegelianism was dying in Great Britain, interest in Hegel suddenly revived in Germany under the influence of Georg Lasson, a clergyman, and of Wilhelm Dilthey (*q.v.*). These two studied Hegel's manuscripts in the University of Berlin; and on the basis of this study Lasson began a new critical edition of Hegel's works while Dilthey wrote Die *Jugendgeschichte Hegels* (Berlin, 1905) on the development of Hegel's thought prior to the date of his first publications. The

manuscripts on which Dilthey's work is based were then published as *Hegels theologische Jugendschriften,* ed. by H. Nohl (Tübingen, 1907).

Hitherto Hegel's philosophy had won either enthusiastic disciples or bitter opponents; in the 75 years since his death, however, passions had had time to cool, and, thanks to Dilthey and to Lasson and also to Benedetto Croce (*Ciò che è vivo e ciò che è morto della filosofia di Hegel,* Bari, 1907), the critical study of Hegel began. The early theological writings gave rise to an immense body of literature in Germany, in Italy and in France between 1925 and 1950, and an English translation of the more important of them appeared in Chicago in 1948. Interest in these writings and in the *Phenomenology* was increased by the rise of existentialism during the same period. At the same time the growing importance of Communism encouraged political thinkers to study Hegel's political works, as well as his "Logic," because of their influence on Karl Marx.

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HEGEMON OF THASOS, Greek writer of the old comedy, flourished during the Peloponnesian War. According to Aristotle (*Poetics,* ii, 5) he was the inventor of a kind of parody; by slightly altering the wording in well-known poems he transformed the sublime into the ridiculous.

Fragments in T. Kock, *Comicorum Atticorum fragmenta,* i (1880); B. J. Peltzer, *De parodica Graecorum poesi* (1855).

HEGEMONY, leadership, predominance and preponderance —originally the leadership of one particular state in a group of federated or loosely united states. The term was first applied in Greek history to describe the predominance, at different times, of individual Greek city-states; *e.g.,* Athens, Sparta and Thebes, over other city-states. Philip of Macedon claimed for Macedonia the "hegemony" of Greece. In the 19th century, hegemony, as leadership within a confederation, was similarly applied to the position of Prussia vis-à-vis the other German states. The term has come to assume a more general meaning as the predominance of a nation or group of nations within a given area. Thus, Great Britain is said to have enjoyed a position of over-all hegemony from the end of the Napoleonic wars (1815) to the advent of World War I.

With 20th-century advances in communications, making the remotest areas of the globe accessible to conquest, the "drive for hegemony" denotes the attempt by any nation to dominate. Hitler, for example, with the support of Italy and Japan, made a bid for global hegemony. (R. S.-HE.)

HEGESIAS OF MAGNESIA (in Lydia), Greek rhetorician and historian, flourished about 300 B.C. Strabo (xiv, 648) speaks of him as the founder of the florid "Asiatic" style (*see* TIMAEUS). Agatharchides, Dionysius of Halicarnassus and Cicero all speak of him in disparaging terms, although Varro seems to have approved of his work. He professed to imitate the simple style of Lysias, avoiding long periods and expressing himself in short, jerky sentences, but his vulgar affectation and bombast made his writings a mere caricature of the old Attic.

See C. W. Müller, *Scriptores rerum Alexandri Magni,* p. 138 (appendix to Didot ed. of Arrian, 1846); Norden, *Die antike Kunstprosa* (1898); J. B. Bury, *Ancient Greek Historians,* pp. 169–172 (1909), on origin and development of "Asiatic" style, with example from Hegesias. Fragments and references in ancient authorities in F. Jacoby, *Fragmente der griechischen Historiker,* vol. ii (1927).

HEGESIPPUS (*fl.* 4th century B.C.), Athenian orator and statesman, who may have been the author of an oration ascribed to Demosthenes, his contemporary, was the son of Hegesias of Sunium. In 343 B.C. he was sent on an embassy to Philip of Macedon, who subsequently wrote a letter to which the 7th oration (*Peri Halonnesou*) in the Demosthenes corpus is a reply. Libanius and some other early critics ascribed this oration to Hegesippus on grounds of style, but Photius suggested that it was one of Demosthenes' less typical pieces. No other works of Hegesippus are extant.

See G. Dindorf's ed. of Demosthenes in the "Teubner Series," vol. 1, pp. 114–126 (1885) and Pauly-Wissowa, *Real-Encyclopädie,* suppl. 4, col. 713–714 (1924).

HEGESIPPUS (*fl.* A.D. 150–180), early Christian writer, was of Palestinian origin, and lived under the emperors Antoninius Pius, Marcus Aurelius and Commodus. He belonged to that group of Judaistic Christians which, while keeping the law themselves, did not attempt to impose on others the requirements of circumcision and Sabbath observance. He was the author of a treatise in five books dealing with various aspects of the Christian religion, fragments of which are found in Eusebius. Hegesippus was also a great traveler, and like many other leaders of his time came to Rome about the middle of the 2nd century. His journeyings impressed him with the idea that the continuity of the church in the cities he visited was a guarantee of its fidelity to apostolic orthodoxy: "in each succession and in every city, the doctrine is in accordance with that which the Law and the Prophets and the Lord (*i.e.,* the Old Testament and the evangelical tradition) proclaim." To illustrate this opinion he drew up a list of the Roman bishops.

HEGESIPPUS, the supposed author of a free Latin adaptation of the *Jewish War* of Josephus under the title *De bello Judaico et excidio urbis Hierosolymitanae.* The seven books of Josephus are compressed into five, but much has been added from

the *Antiquities* and from the works of Roman historians, while several entirely new speeches are introduced to suit the occasion. Internal evidence shows that the work could not have been written before the 4th century A.D. The author, who is undoubtedly a Christian, describes it in his preface as a kind of revised edition of Josephus. Some authorities attribute it to Ambrose, bishop of Milan (340–397), but there is nothing to settle the authorship definitely. The name Hegesippus itself appears to be a corruption of Josephus, through the stages Ἰώσηπος, Iosippus, Egesippus, Hegesippus, unless it was purposely adopted as reminiscent of Hegesippus, the father of ecclesiastical history (2nd century).

See edition by C. F. Weber and J. Caesar (1864); E. Schurer, *History of the Jewish People* (Eng. trans.), i, 99 *seq.*

HEGIUS, ALEXANDER (c. 1433–1498), German humanist schoolmaster, was born at Heek (from which his name, in Latin form, is derived) in Westphalia. He was associated with the Brethren of the Common Life in the revival of learning in northern Europe. His long teaching career included the headship of schools in Wessel, Emmerich and Deventer, where Erasmus, Butzbach and the future Pope Adrian VI were among his pupils. At Deventer, Hegius put into practice the humanistic ideas of his youthful friend and teacher. Rudolph Agricola, who brought from Italy the new learning, stressing the liberal arts and the art of conduct. To this end Hegius reformed instructional methods to make Latin and Greek grammar subordinate to the appreciation of classical literature. New textbooks were introduced and the school was divided into eight classes. Hegius died at Deventer on Dec. 7, 1498. His writings were published in 1503 by his pupil Jacob Faber.

See William H. Woodward, *Studies in Education During the Age of the Renaissance, 1400–1600* (1906); D. Reichling, "Beitrage zur Charakteristik des Alex. Hegius," in the *Monatsschrift fur Westdeutschland* (1877). (*J. M.* Bk.)

HEHE, a Bantu tribe inhabiting the Tanganyika plateau, combining agriculture with animal husbandry. Sheep, goats and fowls are kept in addition to cattle, the care of which is almost exclusively man's province, while women are responsible for agricultural economics, raising millet, yams, maize and a variety of leguminous and other vegetable crops. While their characteristics are chiefly eastern they display certain lacustrian contacts and southern influences can be traced in their internal organization.

The most characteristic feature is the tembe, a long building partitioned into separate chambers for families. Each chamber is subdivided into two rooms, the outer one for boys, the inner for women and the head of the family. A tembe varies in size from one sufficient for a few families to the length of a kilometre, and a village may consist of anything from one small tembe to a number of large ones adjoining. The houses are made of palings neatly plastered with clay, with a slightly curved roof also constructed with palings covered with rushes and caulked with clay.

Kinship is mainly reckoned in the paternal line and the maternal kinship imposes obligations for one generation only, whereas any paternal relationship that can be proved in the remotest degree is important and is a bar to marriage. Marriage is arranged between a man and the bride's father and involves the payment of a dowry by the former. Polygyny is practised, but the first wife must be the mother's brother's daughter, and only after this statutory marriage may a man exercise his own choice. On marriage a boy or girl leaves the family chamber and builds anew. A peculiar system of totemism prevails, as every one possesses one or two totems inherited paternally. The totem may be an animal or part of an animal or a part of all animals, for instance a sheep's head or the heart of all animals. But though there is no prohibition against killing the totem, a dispensatory ceremony is required before it may be eaten. The possession of the same totem is no bar to marriage unless a common paternal ancestor can also be determined.

The weapons employed are the heavy-bladed thrusting spear, light throwing spears with barbed blades and a battle axe, showing an influence which is probably traceable to the Angoni. A large oval shield of oxhide is carried.

The Hehe believe in a vague deity *Nguruhe,* who controls things in general but to whom neither prayers nor sacrifices are offered. Their religion consists mainly of the worship of ancestor-spirits *(masoka),* to whom prayers are made for success and prosperity and the avoidance of evils. Offerings of grain, milk or flesh are made at the grave of an ancestor by the head of the family.

See E. Nigmann, *Die Wahehe* (1908). (J. H. D.)

HEIBERG, JOHAN LUDVIG (1791–1860), Danish dramatist and man of letters, originator of the Danish vaudeville, or ballad opera, was born in Copenhagen, Dec. 14, 1791, son of the playwright and political writer, P. A. Heiberg (1758–1841) and his wife Thomasine, later Baroness Gyllembourg-Ehrensvard (1773–1856), the novelist. He matriculated at Copenhagen university in 1809, and his first publication, *Marionettheater* (1813; dated 1814), comprising two romantic dramas, showed independence of outlook, elegance and clarity of thought. In 1817 he took his doctorate with a thesis on Calderón, to whose work he was attracted, though not himself a mystic, by its blend of sublime and "folk" elements. In 1819 he went to Paris with a government grant, and in 1822 was appointed lecturer in Danish at Kiel university. There he wrote the treatise *Om den menneskelige Frihed* ("On Human Freedom," 1824) which introduced Hegelian philosophy to Denmark.

He returned to Copenhagen in 1825 and his *Kong Salomon og Jprgen Hattemager* was produced there, with great acclamation, on Nov. 28. It was the first Danish vaudeville, with songs set to well-known melodies, and although derived from Parisian and Viennese models, the subject and the humour were national and topical. Heiberg exploited the new genre with verve and versatility in *Aprilsnarrene* (1826). *De Uadskillelige* (182;) and many others, and defended it on sound Hegelian principles in the treatise *Om Vaudevillen som dramatisk Digtart* ("On the Vaudeville as a Dramatic Form," 1826). More serious and poetical in intention and execution were the romantic dramas *Elverhøi* (performed 1828), *Alferne* (1834). *Fata Morgana* (1838) and *Syvsoverdag* (1840), which blend fantasy and realism and contain much of Heiberg's best lyrical poetry.

From 1827 to 1830 Heiberg edited the *Kjøbenhavns flyvende Post,* which, with its successors, exerted considerable influence by introducing new authors and criticizing Ohlenschlager and other romantics for deficiencies in taste. form and intellectual content. His polemics and his gift for pointed satire. of which the apocalyptic poem "En Sjæl efter Døden" (included in *Nye Digte,* 1841) and the satyr play *Nøddeknækkerne* (1845) are supreme examples, made Heiberg many enemies and he never fully recovered his popularity. From 1849 to 1856 he had some success as the director of the Royal theatre, but the last 20 years of his life were mainly spent in studying physical science. He died at Bonderup near Ringsted. Aug. 25, 1860. His prose works appeared in 11 vol. (1861–62), and his poetical writings in 11 vol. (1862).

In 1831 Heiberg married Johanne Luise Patges (1812–1890), the foremost Danish actress of her day and herself author of some good vaudevilles and of interesting memoirs *(Et Liv,* 4 vol.. 1891–92).

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HEIDE, a town in the *Land* of Schleswig-Holstein, Germany, on a small plateau between the marshes and moors bordering the North sea, 35 mi. N.N.W. of Gluckstadt. Pop. (1950) 22,169. In 1447 it became the capital of the Ditmarsh peasant republic, but on June 13, 1559, it was the scene of the complete defeat of the peasant forces by the Danes.

HEIDEGGER, JOHANN HEINRICH (1633–1698), Swiss Reformed theologian, was born at Bärentschweil, in the canton of Zürich, Switz., on July 1, 1633. After studying in Germany he settled in 1665 in Zurich, where he was successively professor of moral philosophy and of theology. He died there on Jan. 18, 1698.

Heidegger was the principal author of the *Formula Consensus Helvetica* in 1675, which was designed to unite the Swiss Reformed

churches, but had an opposite effect.

Heidegger's autobiography appeared in 1698, under the title *Historia vitae J. H. Heideggeri.*

HEIDEGGER, MARTIN (1889–), German philosopher who exercised a major influence on 20th-century existentialism, was born at Messkirch in the Black Forest on Sept. 26, 1889. He studied philosophy at Freiburg, coming under the influence of Edmund Husserl, the founder of phenomenology. He was appointed professor of philosophy at Marburg in 1923. In 1927 he published *Sein und Zeit,* part i, the work on which his reputation chiefly rests. I-laving succeeded Husserl as professor at Freiburg in 1928, he was made rector of that university in 1933; in his rectorial address he expressed his hope for "a complete revolution of German existence." In 1934 he resigned this post and resumed his teaching.

While the second part of *Sein und Zeit* was not forthcoming, Heidegger published numerous essays and lectures, of which the following are particularly noteworthy: *Was ist Metaphysik?* (Bonn, 1929); *Vom Wesen des Grundes* (Halle, 1929); *Hölderlin und das Wesen der Dichtung* (Munich, 1937, previously printed in *Das Innere Reich,* 1936); *Vom Wesen der Wahrheit* (Frankfurt-am-Main, 1943); *Brief über den Humanismus* (Frankfurt-am-Main, 1947); *Holzwege* (Frankfurt-am-Main, 1949); *Einführung in die Metaphysik* (Tiibingen, 1953); and *Vorträge und Aufsätze* (Pfullingen, 1954).

In *Sein und Zeit* Heidegger sets out to discover "the meaning of being" *(Sein).* He holds that a necessary preliminary is an investigation of human being *(Dasein),* carried out. not in terms of sophisticated theoretical conceptions such as "substance" or "cause," but in terms of the tools with which men are practically concerned and of men's basic situation, aims and moods. When considered in this way human existence is seen to be grounded in care and dread and to consist in projects brought to nothingness in death. Although Heidegger acknowledges the influence of Soren Kierkegaard, he denies that he himself is an existentialist, but nevertheless *Sein und Zeit* mas important in the development of the atheistic forrn of existentialism. Heidegger continued to employ the method, prominent in *Sein und Zeit,* of basing metaphysical assertions on the literal meanings of the roots of German words and amplified it with parallel discussions based on the etymology of Greek philosophical terms. He holds that the basic metaphysical question is "Why is there something rather than nothing at all?", emphasizes fate and destiny and asserts that although Christian faith exists "here and there." in the 20th-century world "God is no longer a living God" ("Nietzsche's Wort 'Gott ist tot' " in *Holzwege,* pp. 234–235). Nevertheless he also says that in poetry the holy beings or the gods are "named" and communicated to the people.

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HEIDELBERG, the name of two towns in the Union of South Africa:

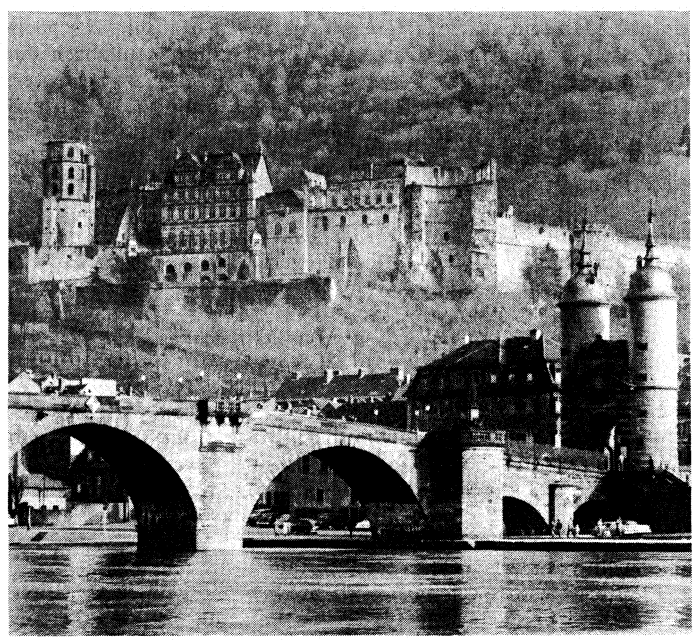
1. Situated in the Transvaal, 31 mi. S.E. of Johannesburg, and 390 mi. from Durban. Altitude, 5.026 ft. Pop. (1951) 7,677, including 2,896 Europeans. The town is built on the Blesbokspruit, just on the southeastern side of the Witwatersrand gold fields. The district of Heidelberg extends southward to the Vaal river and is part of the great maize triangle of South Africa.

2. Situated on the Duivenhoeks river in Cape Province, 230 mi. east of Cape Town by rail. Altitude, 250 ft. Pop. (1951) 2,898, including 1,259 Europeans. The principal productions of the region are wool, grain, aloes and tobacco.

HEIDELBERG, a town of Baden-Württemberg, Germany, on the south bank of the Neckar, 12 mi. above its confluence with the Rhine, 13 mi. S.E. from Mannheim and 54 mi. from Frankfurt-on-Main by rail. The town lies between hills covered with vineyards and forests, at the spot where the rapid Neckar leaves the gorge and enters the plains of the Rhine. The town itself consists practically of one long, narrow street—the Hauptstrasse—running parallel to the river. A number of smaller streets intersect the Hauptstrasse at right angles and run down to the river. Heidelberg is an important railway centre, and is connected by trunk lines with Frankfort, Mannheim, Karlsruhe. Spires and Wiirzburg.

Of the churches the chief are the Protestant Peterskirche dating from the 15th century and restored in 1873, to the door of which Jerome of Prague in 1406 nailed his theses; the Heilige Geist Kirche (Church of the Holy Ghost), an imposing Gothic edifice of the 15th century; and the Jesuitenkirche (Roman Catholic), nith a decorated interior.

Heidelberg castle. overhanging the east of the town, stands on the Jettenbuhl, a spur of the Konigsstuhl (1,857 ft.), 330 ft. above the Neckar. It is one of the chief monuments of Germany, begun in the 13th century and extended by addition of a wing, Ruprechtsbau, under the elector palatine and the German king



BY COURTESY OF THE GERMAN TOURIST INFORMATION OFFICE

THE TOWN OF HEIDELBERG FROM THE NECKAR RIVER IN THE FOREGROUND IS THE KARL-THEODORE BRIDGE (ERECTED IN 1786) WITH ITS TWO-TOWERED GATE: IN THE BACKGROUND IS THE CASTLE (CONSTRUCTION BEGUN IN THE 13TH CENTURY)

Rupert III (d. 1410). Otto Henry "the Magnanimous" (d. 1559), built the beautiful early Renaissance wing (1556–59); the fine late Renaissance wing called the Friedrichsbau was added (1601–07) under Frederick IV; and, on the west side, the Elisabethenbau or Englischebau (1618), named after his wife, the daughter of James I of Great Britain, built under Frederick V. At the peace of Westphalia, Heidelberg was given back to Frederick V's son, Charles Louis, who restored the castle. At the end of the 17th century it was despoiled by the French and finally, in 1764, it was struck by lightning and reduced to ruin. Apart from outworks, the castle is an irregular square with round towers at the angles, the principal buildings being grouped round a central courtyard containing the Alte Bau and the Bandhaus with the entrance from the south through a series of gateways. In this courtyard, besides the buildings already mentioned. are the oldest parts of the castle, the so-called Alte Bau (old building) and the Bandhaus. The Friedrichsbau was elaborately restored and rendered habitable between 1897 and 1903. The fountain in the courtyard is decorated with four granite columns from Charlemagne's palace at Ingelheim; the Elisabethentor is a beautiful gateway named after the English princess, there is a beautiful octagonal bell tower at the northeast angle; and the castle chapel and the museum of antiquities are in the Friedrichsbau. In a cellar entered from the courtyard is the famous vat built in 1751, which has been used only occasionally. Its capacity is 49,000 gal., and it is 20 ft.

high and 31 ft. long. Behind the Friedrichsbau is the Altan (1610), or castle balcony with a magnificent view.

The university of Heidelberg was founded by the elector Rupert I., the bull of foundation being issued by Pope Urban VI. in 1385. It was constructed after the type of Paris, and had four faculties; Otto Henry gave it a new organization, further endowed it and founded the library, first kept in the choir of the Heilige Geist Kirche, and consisting of 3500 mss. In 1623 it was sent to Rome by Maximilian I. of Bavaria, and stored as the Bibliotheca Palatina in the Vatican. It was afterwards taken to Paris, and in 1815 was restored to Heidelberg.

At the Reformation the university became a stronghold of Protestant learning. Damaged by the Thirty Years' War, it led a struggling existence for a century and a half and many of its endowments uere cut off by the peace of Lunéville (1801).

Heidelberg makes metalware, pianos, cigars, leather. cement, surgical instruments and beer, but is ordinarily concerned with catering for tourists and students. Pop. (1950) 116,488. In World War II the city suffered little damage.

HEIDELBERG CATECHISM, THE, the most attractive of all the catechisms of the Reformation, was drawn up at the bidding of Frederick III., elector of the Palatinate, and published on Tuesday the 19th of January 1563. The task was entrusted to two young men who have won deserved remembrance alike by their learning and their character: Zacharias Ursinus (1536–1583), a man of modest and gentle spirit, unwearied in study and well fitted to impart his learning to others; and Caspar Olevianus (1536–1587), whose ardour and enthusiasm made him the happy complement of Ursinus. The elector could have chosen no better men, young as they were, for the task in hand. As a first step each drew up a catechism of his own composition, that of Ursinus being naturally of a more grave and academic turn than the freer production of Olevianus, while each made full use of the earlier catechisms already in use. But when the union was effected it was found that the spirits of the two authors were most happily and harmoniously wedded, the exactness and erudition of the one being blended with the fervency and grace of the other. Thus the Heidelberg Catechism, which was completed within a year of its inception, has an individuality that marks it out from all its predecessors and successors. The Heidelberg synod unanimously approved of it; it was published in January 1563, and in the same year officially turned into Latin. The Heidelberg book, in spite of violent attacks on it by the extreme Lutherans, rapidly passed beyond the bounds of the Palatinate and gained an abundant success not only in Germany but also in the Netherlands and in the Reformed churches of Hungary, Transylvania and Poland. It was officially recognized by the synod of Dort in 1619, passed into France, Britain and America, and probably shares with the De *imitatione Christi* and *The Pilgrim's Progress* the honour of coming next to the Bible in the number of tongues into which it has been translated.

This wide acceptance and high esteem are due largely to an avoidance of polemical and controversial subjects, and even more to an absence of the controversial spirit. There is no mistake about its Protestantism, even when we omit the unhappy addition made to answer 80 by Frederick himself (in indignant reply to the ban pronounced by the Council of Trent), in which the Mass is described as "nothing else than a denial of the one sacrifice and passion of Jesus Christ, and an accursed idolatry"—an addition which is the one blot on the ἐπιείκεια of the catechism. The work is the product of the best qualities of head and heart, and its prose is frequently marked by all the beauty of a lyric. It follows the plan of the epistle to the Romans (excepting chapters ix.–xi.) and falls into three parts: Sin, Redemption and the New Life. This arrangement alone would mark it out from the normal Reformation catechism, which runs along the stereotyped lines of Decalogue, Creed, Lord's Prayer, Church and Sacraments. These themes are included, but are shown as organically related.

BIBLIOGRAPHY.—See *The Heidelberg Catechism,* the *German Text, with a Revised Translation and Introduction,* edited *by A* Smellie (London, 1900), and *The Hezdelberg Catechism* (New York, 1863), with introduction and German, Latin and English text; also Schaff, **Creeds** of *Christendom,* **vols.** i. 529 ff.and iii. 307 ff., and Müller, *Die Bekenntniss Schriften der Reformierten Kirche* **(Leipzig,** 1903).

HEIDENHEIM, a town of Germany, in the *Land* of Baden-Württemberg, 31 mi by rail N. by E. of Ulm. Pop. (1950) 40,142. The town, which received municipal privileges in 1356, is overlooked by the ruins of the castle of Hellenstein, standing on a hill 1,985 ft. high. Its industrial establishments include cotton, tobacco, machinery, metal and rubber factories, bleach-works, dyeworks and breueries. Heidenheim is also the name of a small place in Bavaria famous on account of the Benedictine abbey, founded in 748 by the bishop of Eichstatt, which formerly stood therein. It was plundered by the peasantry in 1525 and was closed in 1537.

HEIDENSTAM, (KARL GUSTAF) VERNER VON (1859–1940), Swedish poet and prose writer, who won the Nobel prize for literature in 1916 and whose reputation rests on his lyrical poetry. uas born. July 6. 1859, at the manor house of Olshammar, in the province of Närke, which inspired much of his poetry. A delicate boy, in 1876 he was sent to the middle east and after his first (of three) marriages, in 1880, lived in Italy, France and for several years in Switzerland, where he had an important meeting nith Strindberg. On return to Sweden, he published *Vallfart och Vandringsår* (1888), richly coloured poems based mainly on impressions of the east. early study of painting gave all his literary work a strong sense of colour. Original and imaginative, it formed a protest against naturalism and marked the beginning of the literary renaissance of the 1890s. Similar in effect were *Endymion* (1889), a novel set in Damascus. and *Hans Alienus* (1892), a fanciful epic describing a pilgrimage in search of beauty through various ages and countries, partly suggested by *Childe Harold.* Travel sketches, full of wit and psychological observation, were collected in *Från Col dt Tenda till Blocksberg* (1888).

Heidenstam's second collection of poems (1895), expressing personal feelings with great richness of texture, marks a transition to love of home and nationalism, which culminated in the famous *Karolinerna,* 2 vol. (1897–98; Eng. trans. *The Charles Men,* 1920). impressionistic stories of Charles XII and his followers. His historical writings were continued nith *Heliga Birgittas pilgrimsfard* (1901): *Folkungaträdet,* 2 vol. (1905–07) a powerful story of ancient and medieval Sweden, and a book for schools, *Svenskarna och deras hövdingar,* 2 vol. (1908–10; Eng trans. *The Swedes and thezr Chieftains,* 1925). His third and greatest collection of poetry, *Nya Dikter* (1915), contains lyrics comparable with those of Goethe. For the rest of his life he did not publish anything; after his death, at Övralid. May 20. 1940, some of his literary remains nere edited, the most notable being *Nar kastanjerna blommade* (1941), charming evocations of the Olshammar of his childhood. His collected works were edited by F. Book and K. Bang, 23 vol. (1943–44).

BIBLIOGRAPHY.—H. Kamras, *Den unge Heidenstam* (1942); F Böök, *V von Heidenstam* (2 vol., 1945–46; 2nd ed., 1 vol. 1959); K Bang, *Vagen till Ovralid* (1945) and *Övralid* **(1946)**; S. Björck, *Heidenstam och sekelskzjtets Sverige* **(1946)**; *G* Axberger, *Diktaren och elden* (1959) (H Ks.)

HEIJERMANS, HERMANN (1864–1924), Dutch writer, of Jewish origin, was born on Dec. 3, 1864, at Rotterdam. In the Amsterdam *Handelsblad* he published a series of realistic sketches of Jewish family life under the pseudonym of "Samuel Falkland," which were collected in volume form. His novels and tales include *Trinette* (1892), *Fles* (1893), *Kamertjeszonde* (2 vols., 1896), *Intérieurs* (1897), *Diamantstadt* (2 vols.. 1903). He created great interest by his play *Op Hoop van Zegen* (1900), represented at the Théâtre Antoine in Paris, and in English by the Stage Society as *The Good Hope.* His other plays include. *Dora Kremer* (1893), *Ghetto* (1898), *Ora et labora* (1901), *De Groote Vlucht* (1908), *Eva Bonheur* (1919). *A Case of Arson,* an English version of the one-act play *Brand in de Jonge Jan,* was notable for the impersonation (1904 and 1905) by Henri de Vries of all seven witnesses who appear as characters Heijermans lived for a few years in Berlin, but returned to the Netherlands in 1912 to manage a society of players. He died at Zandvoort on Nov. 22, 1924

HEILBRONN, a town of Germany, in the *Land* of Baden-Wurttemberg, on the Keckar, 33 mi. by rail N. of Stuttgart. and

at the junction of lines to Crailsheim and Eppingen. Pop. (1950) 139,332, administrative district; 64.643, town. It occupies the site of an old Roman settlement; it is first mentioned in 741, and the Carolingian princes had a palace there. It owes its name–+riginally Heiligbronn, or holy spring—to a spring of water which issued from under the high altar of the church of St. Kilian.

The older streets are narrow, and contain a number of high turreted houses with quaint gables. The principal public buildings are the church of St Kilian (restored 1886–1895) in the Gothic and Renaissance styles, begun about 1019 and completed in 1529, with a tower 210 ft. high, a beautiful choir. and a finely carved altar; the town hall (Rathaus), founded in 1540, and possessing a curious clock made in 1580; the house of the Teutonic knights (Deutsches Haus); the Roman Catholic church of St. Joseph, formerly the church of the Teutonic Order; and the tower (Diebsturm or Götzens Turm) on the Neckar. The town is commercially the most important in Württemberg, and possesses an immense variety of manufactures, of which the principal are gold, silver, steel and iron wares, machines, motor cars, sugar of lead, white lead, vinegar, beer, sugar, tobacco, soap, oil, chemicals, artificial manure, glue, soda, paper and leather.

HEILSBERG (after World War II, LIDZBARK WARMINSKI), a town in Olsztyn province, Poland, at the junction of the Simser and Alle, 38 mi. S. of Kaliningrad (Konigsberg). Pop. (1950) 7,200. It has a castle, founded by the Teutonic order in 1240, which was the seat of the bishops of Ermeland (1306–*c* 1800). In 1807 the French fought the Russians and Prussians nearby. Industries are tanning, dyeing and brewing, and there is trade in grain.

HEILSBRONN or KLOSTER-HEILSBRONN, a village of Germany, in the Land of Bavaria, on the railway between Nürnberg and Ansbach. Pop. (1950) 3,464. In the middle ages it possessed one of the great monasteries of Germany, which belonged to the Cistercian order and owed its origin to Bishop Otto of Bamberg in 1132, existing till 1555. Its sepulchral monuments are of exceptionally high artistic interest. It was the hereditary burial-place of the Hohenzollern family. The buildings of the monastery have mostly disappeared, with the exception of the fine church, a Romanesque basilica, restored between 1851 and 1866, and possessing paintings by Albert Durer.

HEILUNGKIANG (HEI-LUNG-CHIANG SHENG), northernmost of the three Manchurian provinces of China. It is named for the Amur river, which is known as Heilungkiang (Black Dragon river) in Chinese, and forms the northern border of the province. Heilungkiang has an area of 99,522 sq.mi. and a population of 11,897,309 (1953). Its capital is Harbin.

The black chernozem soils of Heilungkiang favour the growing of wheat, which is planted to a large extent in large mechanized state farms established by new settlers in the ndrthern virgin lands of the province. Other important crops are sugar beets, soybeans and flax. Timber is felled in the Little Khingan mountains around the lumber town of Ichun. The principal mineral resources are coal, which is mined at Hokang. Shwangyashan and Kisi, and gold, which occurs in placers along tributaries of the Amur river.

Most of the province's large cities are situated along the Chinese Eastern railroad, which crosses Heilungkiang from northwest to southeast, and along the Sungari river, a navigable tributary of the Amur. Harbin, with a population of 1,163,000 (1953 census), is the principal manufacturing and transportation centre, with machine building and agricultural processing industries. Other cities and their 1953 population are Tsitsihar (200,000), Mutankiang (250,000) and Kiamusze (146,000). (T. SD.)

HEIM, ALBERT VON ST. GALLEN (1849–1937), Swiss geologist, was born at Ziirich on April 12, 1849. He was educated at Zurich and Berlin universities, and became professor of geology at Zurich, and director of the geological survey of Switzerland. With E. Schmidt he prepared the geological map of Switzerland (2nd ed. 1912). His researches on the structure of the Alps threw light on the structure of mountain masses in general. He traced the plications from minor to major stages, and illustrated the remarkable foldings and overthrust faultings in numerous sections with the aid of pictorial drawings. His *Mechanismus* der Gebirgsbildung (1878) is a classic.

HEIMDAL (HEIMDALL), in Scandinavian mythology. keeper of the gates of Heaven, guardian of the rainbow bridge Bifrost, used by the gods between heaven and earth, son of Odin by nine virgins. He lives in the fort of Himinsbiorg at the end of Bifrost. Nothing can escape his vigilance, for he sleeps less than a bird, sees at night and in his sleep, can hear grass and the wool on a lamb's back grow. With Gjallarhorn he will summon the gods on the day of judgment.

HEINE, HEINRICH (originally HARRY) (1797–1856), one of the greatest German lyric poets and an outstanding satirist and publicist, was born at Dusseldorf on Dec. 13, 1797, the eldest of the four children of Jewish parents, Samson Heine and Betty (Peierche) van Geldern. He took the name Heinrich at his baptism in 1825. Owing to the French occupation of the Grand Duchy of Berg (1806–13), his education inspired in him an ardent love of liberty and hero worship for Napoleon (Die Grenadiere, Das Buch Le Grand and passim). Destined for a commercial career, he made a bad start at Frankfurt-on-Main and was sent to his millionaire uncle, the banker Solomon Heine, at Hamburg (1816–19), for his father's health had declined and his business had failed. Heine was set up on his own, but the firm Harry Heine & Co. went bankrupt within a year and thereafter relations between the millionaire and the poet were often strained. The latter's sufferings at Ottensen, his uncle's country seat, are described in the poem "Affrontenburg," written 30 years later; they were intensified by his unrequited passion for "Molly," presumably his cousin Xmalie Heine. Being unfit for commerce, Harry was sent to Bonn to read law; but he preferred to study literature under A. W. Schlegel, moving on to Gottingen in 1820. Rusticated for six months because he had challenged a fellow student to a duel, he went to Berlin where he sat at the feet of Hegel and the classical scholar Friedrich Wolf. He frequented the salon of Varnhagen and Rahel von Ense and other literary and intellectual circles, and belonged to the Society for the Culture and Learning of the Jews. In 1821 he published a volume of Gedichte and in 1823 *Tragödien nebst* einem lyrischen Intermezzo. The tragedies, Almansor and *Ratcliff*, showed no great promise; but the lyrical sequence contained a number of those songs made famous by the settings of Schubert, Schumann, Mendelssohn, Liszt, Brahms, Wagner, Hugo Wolf and others. Yet already in this collection the pure melodies of the love lyrics were mingled with ironical, flippant and even cynical strains in a deliberate effort at emotional truth.

In 1823 the civil disabilities against the Jews were again enforced; rather than accept baptism Heine decided to become a journalist in Paris. He went to Hamburg to obtain his uncle's consent, and found passion overwhelming him again, "grafting a new folly on to the old," as he put it. This has been plausibly interpreted by E. Elster to mean that he had fallen in love for the second time with a daughter of Solomon Heine, Amalie's younger sister Therese. He fled from Hamburg to Cuxhaven, where his first sight of the sea and his first experience of a storm aroused that feeling of kinship to which we owe his magnificent Nordsee cycles. An incensed letter from his uncle, threatening to cut off his meagre allowance because it had been anticipated, added to his emotional turmoil. The Paris scheme was dropped and Heine returned to Gottingen in January to prepare for his final examination. His excursion to the Harz mountains that autumn was to bring him fame, but his visit to Goethe in Weimar on Oct. 2 resulted in a snub and he was in very low spirits when, having passed the written examination, he was baptized privately on June 28, 1825, in order to proceed to the public disputation on July 20, at which he obtained the degree of doctor of laws. He felt this "apostasy" keenly, although he was neither a practising nor-a professing Jew, and it never procured him any practical advantage; but the striking success of Reisebilder I (Heimkehr, Harzreise, Nordsee I) in 1826, followed by *Reisebilder* 11 (Nordsee *II*, Nordsee III, Ideen oder das Buch Le Grand, Briefe aus Berlin) in 1827 and Buch der Lieder in the same year opened up literary prospects.

Buch der Lieder, which ran through 13 large editions in Heine's lifetime, placed him in the first rank of contemporary poets. As a ballad poet he is unrivaled; and the best of his love lyrics crystallize in a few short, exquisite verses his poignant personal emo-

tions, combining the charm and simplicity of the folksong with informal modern speech. Musical and magical, they are, as Benedetto Croce was to say, "pure and transparent as a dew-drop." The *Nordsee* cycles in free rhythms echo the stormy splendour, the ceaseless ebb and flow, the gentle murmuring and the breathless calm of the sea which harbours Heinesque Homeric divinities. A new note too mas struck in the prose sketches in the *Reisebilder,* written in a flexible, vivid and racy style. They are intensely subjective and multiple in mood, witty, captivating, exasperating, challenging, daring and provocative. Heine, who needed a courageous publisher for such works, had found one in Julius Campe; but this best-selling author was never remunerated adequately; so that, between his uncle and his publisher, the poet was perpetually on the rocks.

Things were rather easier in 1827, however, and Heine, attracted by the fame of George Canning, was in London from April to August. "Never send a poet to England," he moaned, aghast at English materialism. He saw all the sights and assiduously frequented the house of commons, admiring English liberal institutions and continuing to revere Canning. But what with England's treatment of Napoleon and Byron, its stiffness and coldness, its cooking and its climate, he returned to Germany a full-blown Anglophobe. Worse still, he returned in very bad odour with Solomon, having cashed a letter of credit on the London house of Rothschild which had been entrusted to him merely to serve as an introduction. Fortunately Baron J. F. Cotta, the well-known liberal publisher, offered him the joint editorship of *Neue politische Annalen,* and Heine went to Munich in the autumn of 1827 to take up this work. He found it uncongenial, and the news of Therese's marriage increased his depression. It was somewhat lightened when the minister for the interior, Eduard von Schenk, proposed him for the chair of German literature in Munich university. He left for a holiday in Italy in July, fully expecting to hear in Florence that Louis I of Bavaria had approved the appointment. But it did not go through owing to the machinations of the Catholic party in Munich and also, or so Heine believed, to the poet August von Platen, who brought out a vicious lampoon in 1829, *Der romantische Oedipus,* reviling Heine as a "baptised Jew." Heine retaliated in "Die Bader von Lucca" *(Reisebilder* 111, 1829) holding Platen up to ridicule as a pitiable poetaster and a sexual pervert. By this witty but scurrilous retort he incurred widespread odium; and his next publication, *Reisebilder IV* (1831) was banned in Prussia as pernicious, blasphemous, indecent and obscene, stock epithets at the time for anything liberal and unorthodox. *Persona non grata* in Germany, Heine now turned his eyes once more toward France. He had been profoundly stirred by the July Revolution in 1830 and believed that Saint-Simonism, which was daily gaining converts in the French capital, was the religion of the future. He took farewell of Germany in *Kahldorf über den Adel* (1831), in which he voiced his rage against the suppression of the Polish insurrection and against the reactionary governments of Germany, Austria and Russia, and saluted revolutionary France. Having shot this bolt, he left his native land and arrived in Paris on May 19, 1831, for what was to be a lifelong exile.

A curious state of affairs awaited him: the implacable enmity of the German refugees, with Ludwig Borne at their head. The latter, like Heine a baptized Jew, and a witty, singleminded and powerful publicist, was an out-and-out revolutionary, rigid and puritanical. He regarded his more moderate young compatriot as a traitor to the cause, took the darkest view of his private life and pursued him with unrelenting malice, whereas Heine was welcomed with open arms by the French literary and intellectual circles and was on intimate terms with many of the romantic poets. The historian Thiers, then the all-powerful president of the council, tried to persuade him to accept French nationality and place his brilliant gifts at the service of France. This would have assured his future; but he declined the offer, although in 1835 he accepted a *pension de secours* of 4,800 francs annually from the secret funds. This did not influence his political opinions, and he criticized the July monarchy sharply sometimes in his articles for Cotta's *Augsburg Allgemeine Zeitung* (1831–32 and 1840–43). These were collected and published under the titles *Franzosische Zustande* (1832) and *Lutezia* (1854), appearing almost simultaneously in German and French. His account of contemporary German literature *(Zur Geschichte der neueren schönen Literatur in Deutschland,* 1833; expanded into *Die romantische Schule,* 1835) also appeared in French in *L'Europe littéraire* in 1833; and his history of German religion and philosophy, published in *Salon* **11** (1835) was given in French in *La Revue des deux mondes* in 1834.

The two books about Germany are impregnated with Saint-Simonian ideals and expound the gospel of the new religion which aimed at establishing a perfect harmony between the spirit and the flesh. Heine preached it with a poetical fervour and an infectious enthusiasm which won him disciples in Germany and helped to precipitate the catastrophe which overtook him and his Young German followers in Dec. 1835, when both federal and Prussian edicts placed the works of the whole school under a perpetual ban. In 1836 this took the somewhat milder form of a special Prussian censorship; but for many years Heine and his fellow victims, Ludolf Wienbarg, Heinrich Laube, Karl Gutzkow and Theodor Mundt, were effectively muzzled by it.

This disaster coincided with Heine's devastating passion for Crescentia Eugénie Mirat, a young assistant in a little glove-and-shoe shop, whom he called Mathilde, and took to live with him. He married her in 1841 on the eve of a duel with Solomon Strauss, the result of a slanderous passage inserted at the eleventh hour into his self-justificatory book on Borne, who had died in 1837. Bitter polemics of one sort or another darkened the years 1836–41, during which Heine was mentally and physically at a low ebb. Mathilde had anything but a soothing influence, and the censorship inhibited free production, although two beguiling prose works, "Florentinische Nachte" and "Elementargeister" *(Salon III,* 1837), managed to slip through. His health, and especially his eyes, gave cause for alarm; he was in dire financial straits and once more estranged from his uncle. Happily a reconciliation was effected in 1838, and an allowance of 4,800 francs annually granted him for life. This, with his government pension, eased the situation, and a visit to Cauterets in the Pyrenees brought about a poetical resurgence which produced in 1843 the enchanting, half-romantic, half-satirical epic poem, *Atta Troll,* published in book form in 1847.

Heine was a devoted son and brother; and in 1843, risking arrest, he traveled to Hamburg after a 12 years' absence to see his mother and his sister Charlotte, returning for another visit in 1844. The renewed contact with his native land inspired *Deutschland, ein Wintermarchen* (1844), a scintillating, hard-hitting, topical and yet visionary satire, applauded by the liberal-minded and banned throughout Germany.

In Dec. 1844 Solomon Heine died. His will contained no mention of the pension he had promised his nephew; and the ensuing conflict with his son and heir, Carl Heine, aggravated the spinal disease which was already incapacitating the poet and which for the last eight years of his life (1848–56) confined him, half-blind and paralytic, to his "mattress-grave."

His mental and physical anguish resulted in an extraordinary flow of poetical inspiration, producing *Rornanzero* (1851), *Gedichte 1853 und 1854* (1854) and some remarkable posthumous poems. The prose works of the period also witness to unimpaired intellectual and imaginative powers: *Doktor Faust, ein Tanzpoem* (1851), *Nachwort zum Romanzero* (1851), "Gestandnisse" and "Gotter im Exil" (both in *Vermischte Schriften,* 1854). But his fiercest energies were bent on the revision and completion of his *Memoiren* which had occupied him at intervals most of his life. Only a mutilated but charming fragment has survived, and it is generally believed that the Solomon Heines destroyed what had been for many years a *casus belli* between the poet and his rich relations. The last months of Heine's life were lightened by Camille Selden (Elise Krinitz) whom he called "La Mouche." They were passionately attached to each other, and she inspired some wonderful poems, the last and one of the loveliest he ever wrote being based on a dream. She called it *The Passion Flower;* Alfred Meissner, who first published it, called it *Fur die Mouche.*

Heine's life was torn by conflicts, and his personal satire often

overstepped the bounds of decency; but he fought tyranny both in verse and in prose with such kindling wrath and such annihilating laughter as to justify his proud claim to have been a good soldier in the war of liberation. A passionate sense of justice and a deep prophetic instinct inform his political works; and in his mature prose his brilliant wit and poetical imagination counteract the innate tendency toward self-pity and self-display also apparent in his poetry. Religiously disorientated, he depicted in many striking mythological poems, prose monographs and sudden flights of fancy the conflict between paganism and Christianity in his own breast; these passages greatly influenced the English Neo-Hellenists, in particular Swinburne and Pater, while his more satanic moods were echoed in Baudelaire's *Les Fleurs du Mal.* His unfinished novel, *Der Rabbi von Bacherach,* as well as "Jehudah ben Halevy," in *Romanzero,* and several other poems, not to mention his short-lived mattress-grave "conversion," show him groping vainly after a shattered faith.

Heine's later poems are greater than those in *Buch der Lieder,* although they are more diffuse on the whole and suffer from lack of inner harmony to an even greater extent. The themes are often macabre; the satire is more searing, the tone is more tragic, the laments are more piercing, the compassion is profounder, the hatred more demonic, the love deeper and more intense. As for the humour, it is, said Havelock Ellis, "a modern development of the humour of the mad king and the fool in *Lear*—that humour which is the last concentrated word of the human organism under the lash of fate."

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HEINECKEN, CHRISTIAN HEINRICH (1721–1725), a child prodigy, was born on Feb. 6, 1721, at Liibeck, Ger. Able to speak at the age of ten months, he knew by heart the principal incidents in the Pentateuch by the time he was one year old. At two years of age he is said to have mastered sacred history; at three he was intimately acquainted with history and geography, besides being able to speak French and Latin; and in his fourth year he began the study of religion and church history. Crowds of people flocked to Liibeck to see the wonderful child, who mas able to discuss what he had learned. He began to learn writing, but died on June 27, 1725, at the age of four.

See C. von Schoneich, *Ehren-Bedachtnis von . . . Christian Henrich Heineken* (1726).

HEINEMANN, WILLIAM (1863–1920), British publisher who introduced an international outlook into British publishing, mas born in Surbiton, Surrey, on May 18, 1863. In 1890 he set up in London without any previous experience and immediately made available for the first time direct English translations of Dostoevski, Turgenev and, in part, Tolstoy. Thus were the Russian masterpieces first adequately presented to the English reading public.

Heinemann also introduced to the English theatre the plays of Ibsen, translated by William Archer. and launched such series as the Ars Una and the surviving Loeb Classical Library. His literary activities did not only concern translations; at one time or another he published works by R. L. Stevenson, Henry James, H. G. Wells, Joseph Conrad, George Moore and many others and he "discovered" John Galsmorthy, Sir Max Beerbohm and Somerset Maugham. Heinemann died in London on Oct. 5, 1920.

HEINRICH VON MORUNGEN (d. 1222) was one of the few notable courtly poets from east central Germany. A native of Thuringia, he spent much of his later life in the service of Duke Dietrich of Meissen. He died in the monastery of St. Thomas, near Leipzig, in 1222. His poems, of which some 33 are to be found in the Heidelberg manuscript, are all devoted to the fashionable cult of love. While his outlook was influenced both by the classical schooling, consistent with his upbringing near the court of Hermann of Thuringia, and by courtly manners from Provence, his poems show more originality and spontaneity than those of his contemporaries, through his vivid imagination and the intensity of his emotion. As a result his poems appeal to the modern reader more than those of any other *Minnesänger* with the exception of Walther von der Vogelaeide.

See C. von Kraus (ed.), *Des Minnesangs Frühling,* 31st ed. (1954). (W. W. Cs.)

HEINRICH VON VELDEKE (*fl.* 1185) Middle High German poet, whose *Eneide* was the first German court epic to attain an artistic form worthy of the elevated subject matter, was born near Maastricht, Holland, of a noble family, and served at the court of Cleves. He attended Frederick I's famous *Hof-fest* at Mainz in 1184 and subsequently joined the court of the landgrave of Thuringia, in whose service he completed his greatest work *Eneide,* modeled on the French *Roman d'Énéas. Eneide* was written not in Veldeke's native Flemish but in the Franconian literary language of such works as Eilhart von Oberge's *Tristan.* Both Gottfried von Strassburg and Wolfram von Eschenbach testify to the value of the *Eneide* as an example. The language of the poem is simple and direct. if somewhat cramped and conventional, and the verse flows smoothly.

Veldeke also wrote a religious epic, *Servatius,* and a number of lyric poems. In these, as in his epics, he appears as the ideal transmitter to Germany of the new literary fashions of Romance courtly civilization.

See G. Ehrismann, *Geschichte der deutschen Literatur bis zum Ausgang des Mittelalters* II, 2, 1, pp. 79–95 (1954); and many articles by T. Frings and G. Schieb in *Beiträge zur Geschichte der deutschen Sprache und Literatur* (1945 ff.). (RD. J. T.)

HEINSE, JOHANN JAKOB WILHELM (1746–1803), German novelist and art critic who had a considerable influence on the romantic school. He was born near Ilmenau, Thuringia, Feb. 15, 1746. As a law student at Erfurt he met C. M. Wieland and through him J. W. L. Gleim (called "Father" Gleim because of his patronage of young poets), who in 1772 procured him the post of tutor in a family at Quedlinburg. In 1774 he went to Düsseldorf, where he helped J. G. Jacobi in editing the periodical *Iris.* He traveled in Italy between 1780 and 1783, and after returning to Germany became librarian to the archbishop of Mainz at Aschaffenburg. He died there on June 22, 1803.

Heinse's *Über einige Gemälde der Düsseldorfer Galerie* (1776–77) stressed the dependence of artistic production upon historical and national circumstances and appreciated Rubens. His famous novel *Ardinghello oder die Glückseeligen Inseln,* 2 vol. (1787) glorified eroticism in a kind of Utopia; *Hildegard von Hohentltal* (2 vol.; 1795–96) contained stimulating musical criticism. He also translated Tasso (1781). His *Sämtliche Schriften* were ed. by H. Laube, 10 vol. (1838) and by C. Schiiddekopf, 10 vol. (1902–25), and a selection by R. Benz (1944).

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(1938). (A. Gs)

HEINSIUS (HEINS), **DANIEL** (1580–1655), one of the most famous scholars of the Dutch Renaissance, was born at Ghent on June 9, 1580, and died at The Hague on Feb. 25, 1655. The troubles of the Spanish war drove his parents to settle first at Veere in Zeeland, then in England, next at Ryswick and lastly at Flushing. In 1594 he was sent to the University of Franeker; six months later he went to Leyden, where he remained for the rest of his life, becoming professor and then librarian. There he studied under Joseph Scaliger, and there he found Marnix de St. Aldegonde, Janus Douza, Paulus Merula and others, and was soon taken into the society of these celebrated men as their equal. His proficiency in the classic languages won the praise of all the best scholars of Europe, and offers were made to him, but in vain, to accept honourable positions outside Holland The remainder of his life is recorded in a list of his productions. He published his original Latin poems in three volumes—Iambi (1602), *Elegiae* (1603) and Poemata (1605); his Emblemata amatoria, poems in Dutch and Latin, were first printed in 1604. In the same year he edited Theocritus, Bion and Moschus, having edited Hesiod in 1603. In 1609 he printed his Latin Orations. In 1610 he edited Horace, and in 1611 Aristotle and Seneca. In 1613 appeared in Dutch his tragedy of The Massacre of the Innocents; and in 1614 his treatise De *politica sapientia.* In 1616 he collected his original Dutch poems into a volume. He edited Terence in 1618, Livy in 1620, published his oration De *contemptu mortis* in 1621, and brought out the *Epistles* of Joseph Scaliger in 1627.

HEINSIUS, NIKOLAES (1620–1681), Dutch scholar, son of Daniel Heinsius, was born at Leyden on July 20, 1620. His boyish Latin poem of Breda *expugnata* was printed in 1637, and attracted much attention. In 1642 he began his wanderings with a visit to England in search of mss. of the classics. From 1644 to 1653 he travelled without cessation between the principal libraries of Europe, everywhere collating mss and taking philological and textual notes He collected his Latin poems into a volume in 1653. His latest labours were the editing of Velleius Paterculus in 1678, and of Valerius Flaccus in 1680. He died at The Hague on Oct. 7, 1681. Nikolaes Heinsius was one of the purest and most elegant of Latinists, and if his scholarship was not quite so perfect as that of his father, he displayed higher gifts as an original writer.

HEIR, in modern usage, tends to be synonymous with the'term "next of kin," that is, he who succeeds to property of a person who dies without a will. In Scotland and other countries whose law derives from Roman law, heir has always had this meaning. Technically, in Anglo-American law, heir refers to the person who succeeds by descent to an estate of inheritance in land (see ESTATES, ADMINISTRATION OF) in contradistinction to the person to whom personal property is distributed by the executor to the next of kin. A few **U.S.** jurisdictions retain some vestiges of this distinction which has been abolished in England and elsewhere in the United States. (See INHERITANCE; INTESTACY.) An heir apparent is he whose right of inheritance is indefeasible provided he outlives the ancestor; *e.g.,* the eldest son in such matters as titled (see PEERAGE). An expectant heir or heir presumptive is he whose right of inheritance is defeasible by the birth of a nearer heir or by the owner executing a will or by his death before that of the owner; *e.g.,* the brother of an owner childless but capable of having children. (A. DM.)

HEIRLOOM, strictly so called in English laa a chattel which by immemorial usage is regarded as annexed by inheritance to a family estate Any owner of such heirloom may dispose of it during his lifetime, but he cannot bequeath it by will away from the estate If he dies intestate it goes to his heir-at-lax and if he devises the estate it goes to the devisee At the present time such heirlooms are almost unknown and the word has acquired a secondary and popular meaning and is applied to furniture pictures etr . vested in trustees to hold on trust foi the person for the time being entitled to the possession of a settled house Such things are more properly called settled chattels An heirloom in the strict sense is mdde by family custom not settlement Under the Settled Land act 1882 a settled chattel might be sold under the direction of the court, the money arising under such sale being capital money. By the Lam- of Property act, 1925, pt. iv, settlements of realty and personal property were assimilated.

HEISENBERG, WERNER KARL (1901–), German physicist, who was awarded the 1932 Nobel prize for physics "for the creation of quantum mechanics," is best known as the formulator of the Uncertainty Principle (*q.v*). He was born on Dec. j, 1901, at Wurzburg, where his father was a professor. He studied theoretical physics at the University of Munich under Arnold Sommerfeld and obtained his doctor's degree in 1923. In the same year he became assistant to Max Born at Gottingen and was appointed lecturer there in 1924. He then worked for three years with Niels Bohr (*q.v.*) at Copenhagen, and from 1927 to 1941 he was professor of theoretical physics at Leipzig. From 1942 to 1945 he was director of the Max Planck Institute for Physics at Berlin and from 1946 was director of the Max Planck Institute for Physics at Gottingen. Heisenberg's work on the quantum theory profoundly influenced the development of atomic and nuclear physics. He wrote *Die physikalischen Prinzipien* der Quantentheorie (1930) and many other books and papers on quantum mechanics, atomic physics and cosmic rays. (W. J. BP.)

HEJAZ (AL-HIJAZ), a province of the independent kingdom of Saudi Arabia, formerly under King Husain and prior to 1916 a vilayet of the old Ottoman empire. It then extended from Ma'an and 'Aqaba in the north to Hali point on the Red sea coast on the south, and had its headquarters under a wali at Mecca. The northern part of this territory is now included in Jordan, the northern boundary running east from the Gulf of 'Aqaba in approximately 29° 35' N. as far as 38" E. The Hejaz is about 800 mi. long and forms a narrow strip varying in depth from about 100 to 200 mi. broad. An indeterminate frontier with the province of 'Asir forms the southern boundary, and the area is about 134,600 sq.mi. The population is probably about 2,000,000. The majority of the inhabitants are Bedouin, but the Moslem holy cities of Mecca (1956 est., 200,000), the birthplace of the Prophet, Medina (19jj est., 80,000), the tomb of the Prophet, and Jidda (1955 est., 160,000), the port of Mecca, form considerable urban areas, swollen by the annual influx of pilgrims, whose presence, much interrupted by the troublous events of two world wars, formed one of the most important parts of the commercial activities of the Hejaz. Medina produces dates, and Taif and the mountain oases fruit and honey; otherwise the products of the Hejaz are limited to camels, horses, sheep and donkeys, hides, wool and charcoal; also ore products from the one operating mine.

Geography. — The Hejaz is divided into two zones, a coastal and an inland, by a range of mountains whose highest peaks probably reach 8,600 ft. Along the coastal strip there are a few settlements where the wadis (stony valleys) run from the hills on to the coastal plains, the most important of these wadis being the Wadi Hamdh. which has three main sources. a northern, a central. on which Khaibar stands, and a southern. which supplies Medina. The valley of Medina can also be approached from the coast, either from Yenbo (Yanbu') or Jidda by the Wadi al-Safra. The wadis, though liable to heavy floods, are not permanent water supplies, but in places permanent springs are to be found, accompanied by the luxuriant vegetation of palm groves. Along the desolate coast of the Red sea there is a series of ports. of which Jidda the port for Mecca, and Yenbo (for Medina) are the most important. The others include Muwailih. Wajh. Rabigh, Laith and Qunfidha. Wajh was formerly of importance as a port for Egyptian pilgrims. while in Roman times it was a post and the port of the Nabataean town of al-Hijr.

The inland region consists of a series of basins. mostly aith internal drainage. but in one or tno cases, through the wadis mentioned above, the valleys communicate nith the coastal region. Over this barren mountain country runs the old pilgrim nay and the track of the Hejaz railway North of Tebuk there is a large arid sandstone plateau, much eroded and carved into fantastic forms whence it has been suggested the sands of the interior are derived. while along the western boundary of the Nejd plateau stretches the desolate volcanic lava bed of the Harrat ar Raha. There are few settlements apart from the oasis of Tebuk and el-

'Ala (Egra of Ptolemy). The southern Hejaz is more fortunate in its water supplies. The city of Medina lies in the broad plain between the coastal range and the Nejd plateau. There at an altitude of 2,500 ft. there is an abundance of water, and dates, wheat and barley flourish. There is also a string of small settlements down to the port of Yenbo along the Wadi al-Safra. Mecca (*q.v.*), the chief town of the Hejaz, lies to the south, about 48 mi. from Jidda. From the hot lowland in which Mecca is situated the country rises up steeply to the Taif plateau, which because of its altitude. about 5,200 ft., possesses a climate closely resembling the southern part of Arabia. On the northern edge of the plateau lies Jabal al-Kura, a fertile well-watered region. producing grain, fruit and dates. Taif itself lies in a gravel plain, surrounded by numerous granite and gneiss hills.

History.— The Hejaz, together with the other provinces of Arabia, which on the overthrow of the Baghdad caliphate in 12 j8 by the Mongol invaders had fallen under Egyptian domination, became, after the conquest of Egypt by the Turks in 1517, a dependency of the Ottoman empire. Although the title caliph passed to Constantinople, the government remained for the most part in the hands of the sherifs of Mecca, until, in the religious upheavals at the beginning of the 19th century, the holy cities were pillaged by Wahhabis. The sultan accordingly entrusted to Mohammed Ali, viceroy of Egypt, the task of restoring peace. Eventually, in 1818, the Wahhabis were defeated but not destroyed and their capital Deraiyeh, in Nejd, was taken by Ibrahim Pasha. Egypt continued to administer the Hejaz until 1845 when the administration, under a wali, was taken over by Constantinople directly. Because of bad communications, however, it was difficult to control these distant and unruly parts and in 1900 Abdul Hamid began the construction of a railway, financed by Moslems throughout the world. which avoided the Suez canal and improved communications. The first part of the line from Damascus to Ma'an was opened in 1904 and four years later the last section, terminating at Medina. was finished, and the Turkish control of the whole region considerably strengthened. In that year (1908), however, Husain ibn Ali was appointed amir of Mecca, and this ambitious man at once began to oppose the Turkish plans, particularly in regard to the further extension of the railway to Mecca itself. The outbreak of World War I gave him further opportunities to satisfy his aspirations. So long as the railway was in the hands of the Turks. who had proclaimed a *jihad*, the sea route to the east was exposed to attack: Great Britain therefore negotiated with Husain, Jidda was bombarded hy British ships and that town and Mecca, and later Taif. were taken from the Turks. Medina, however, held out and was defended by Fakhri Pasha till Jan. 1919, when he surrendered on receiving explicit orders from Constantinople. Meanwhile Col. T. E. Lawrence and Husain's third son, Amir Faisal, organized a brilliant guerrilla warfare against the railway and the northern positions of the Turks. Tenbo, Wajh and 'Aqaba (1917) fell and after the capture of Ma'an, Shaubak and Hejaz they reached a northern frontier which was kept until 1925. Husain assumed the title of king in 1916. He was represented by the Amir Faisal at the peace conference in Paris in 1919, and the Hejaz was admitted as an original member of the League of Nations. but eventually he refused to ratify the peace treaties. In the summer of 1921 Lawrence visited Jidda on behalf of the British government to negotiate a treaty with Husain, but as the latter would not accept the de *facto* position in Palestine negotiations broke down. Meanwhile other factors were clouding the horizon. During the war Husain's reign had been mild. but he became more and more autocratic and alienated the sympathies both of his neighbours and of his own people. He had undertaken, by the terms of the peace treaties, to maintain the annual pilgrimage but his administration of the arrangements for the reception of the pilgrims was very unsatisfactory. Government departments were corrupt, even the army was not properly cared for and the air force which had been organized lapsed more than once until revived once more by his successor. On the other hand his transport fleet and system of wireless communication were satisfactory and proved of value. It was under such conditions that the Hashimite dynasty faced its new perils. Early in 1919 King Husain's relations with Ibn-Sa'ud became strained as a result of a dispute over Khurma oasis. His forces were defeated by the Wahhabis at Taraba and in 1922 Ibn-Sa'ud occupied Khaibar and Taima. Meanwhile negotiations with the British government were kept alive by Kaji al-Asil, the Hashimite representative in London, and were not finally abandoned till the outbreak of war between Nejd and Hejaz in 1924. King Husain. however, refused until it was too late to send a representative to the conference summoned by the British government at Kuwait. Early in 1924 he visited Transjordan. where he assumed the title of caliph (*khalifah*) and returned to Mecca to attempt to obtain recognition of his new position by the Moslem world. This brought matters to a head and Ibn-Sa'ud declared war on the Hejaz. Taif fell without any resistance and Husain abdicated in favour of his son Ali. The latter evacuated Mecca and attempted to raise an army. Jidda was organized for defense. Ibn-Sa'ud entered Mecca in Dec. 1924 and immediately attacked Jidda without any success. The siege was temporarily raised in June 192 j. In the meantime, however, considerable success attended his arms. the ports fell one by one, and at the beginning of December Medina. and shortly afterward Wajh, surrendered. The end was not far off. King Ali abdicated a fortnight later. Jidda and Yenbo surrendered and Ibn-Sa'ud was master of the Hejaz. He was crowned king at Mecca in Jan. 1926. Certain changes later took place in the actual political boundaries. 'Asir, the coastal strip to the south, was in a difficult position between its two powerful neighbours, Ibn-Sa'ud and the imam of the Yemen. In Oct. 1926 the former was definitely recognized as paramount sovereign. The annexation on the other hand by the British government, in July 1925, of the 'Aqaba-Xla'an region to the Transjordan mandated area deprived the Hejaz of territory won during the war. In this region alone was the Hejaz railway, which made this land so important during World War I, in working order. The southern section was put out of order during the Wahhabi siege of Medina and was not repaired. In May 1927 a treaty was signed between Great Britain and Ibn-Sa'ud at Jidda. Great Britain agreed to recognize Ibn-Sa'ud's independence. He therefore secured a dominant position in Arabia from his headquarters at Riyadh and became absolute ruler of the country which in Sept. 1932 became known as Saudi Arabia, comprising the three former divisions of Nejd, Hejaz and Hasa. and, after 1934, 'Asir. In Jan. 1928 the old currency was superseded by a silver currency of rials (about 10 rials = £1). (See also ARABIA; 'ASIR; IBN SA'UD, 'ABD UL-'AZĪZ IBN 'ABD UR-RAHMAN IBN FAISAL.)

HEJIRA or HEGIRA, the name of the Mohammedan era (Arab, *hijra*, flight). It dates from 622, the year in which Mohammed "fled" from Mecca to Medina to escape the persecution of his kinsmen of the Koreish tribe. The years of this era are distinguished by the initials A.H. (*anno hegirae*). The Mohammedan year is a lunar one. about 11 days shorter than the Christian. Although Mohammed himself appears to have dated events by his flight, it was not till later that the actual era was systematized by Omar, the second caliph, as beginning from the first day of Muharram (the first lunar month of the year) which in that year (639) corresponded to July 16. The term hejira is also applied in its more general sense to other "emigrations" of the faithful; *e.g.*, to that to Abyssinia (see MOHAMMED), and to that of Mohammed's followers to Medina before the capture of Mecca. These latter are known as *Muhajirun*.

HEL, in Korse mythology, was originally the name of the world of the dead; it came to be personified as the goddess of death. Hel was one of the children of Loki, and her kingdom was said to lie downward and northward. It was called Niflheimr, or "the world of darkness," and appears to have been divided into several sections, one of which was Nastrond, the shore of corpses. There stood a castle facing north and filled with the venom of serpents, in which murderers, adulterers and perjurers suffered torment, while the dragon Nidhoggr sucked their bodies. Mention is made in an early poem of the nine worlds of Niflheimr. It was said that those who fell in battle did not go to Hel, but to the god Ódin, in Valhalla, the hall of the slain. The name Hel is probably related to the verb *hylja*, "to cover, to hide." (G. T.-P.)

HELDENBUCH, DAS, the title under which a large body of German epic poetry of the 13th century has come down. The main subjects of the individual poems were drawn from sagas based on the struggles and conquests of the Germanic tribes during the epoch of the migrations (*Völkerwanderung*), although many other themes, doubtless based on the traditional allegorical interpretations of natural forces and phenomena, became, in the course of time, associated with the historical events. The poems of the *Heldenbuch* belong to two cycles: the Ostrogothic saga of Ermanrich, Dietrich von Bern (*q.v.*) (*i.e.*, Theodoric the Great) and Etzel (*i.e.*, Attila); and the cycle of Hugdietrich, Wolfdietrich (*q.v.*) and Ortnit (*q.v.*), which was probably of Franconian origin. Dietrich of Berne, the central figure of the more important group, was the ideal type, of German medieval hero. Of the romances of this group, the chief are *Biterolf und* Dietlirb, Der *Rosengarten* and *Laurin und* der kleine *Rosengarten.* Other episodes of the Dietrich saga are recounted in *Alpharts* Tod, *Dietrichs Flucht*, and Die *Rabenschlacht.* Of these, the first is the finest poem of the cycle. The other two, by an Austrian. Heinrich der Vogler, date from the end of the 13th century and show the decay that had by this time set in in Middle High German poetry. The second cycle of sagas is represented by several long "popular" romances, notably Ortnit, Hugdietrich and Wolfdietrich, but their literary value is not very high.

. BIBLIOGRAPHY.—This collection of romances was one of the first German books printed. The date of the first edition is unknown, but the second appeared in 1491. A reprint of 1590 forms the basis of the edition by A. von Keller for the Stuttgart *Literarische Verein* in 1867. In 1472 the Heldenbuch was remodeled in rough *Knittelvers* and this version was printed by F. von der Hagen and S. Primisser in their *Heldenbuch* (1820–25). A critical edition was published in 5 vol. by O. Janicke et al. (1866–73). 4 selection, ed. by E. Henriei, appeared in J. Kiirschner's Deutsche rational-literatur, vol. 7 (188;). All the poems have been translated into modern German by K. Simrock and others. The literature of the Heldensage is very extensive. See especiallv O. L. Jiriczek, *Deutsche Heldensage,* vol. i. (1898); and H. Schneider, *Germanische Heldensage,* 2 vol. (1928). (W. W. Cs.)

HELDER or DEN HELDER, seaport in North Holland province, Netherlands. 51 mi. by rail N.N.W. of Amsterdam. Pop. (1957 est.) 46,102 (mun.). It is on the Marsdiep, the channel separating the island of Texel from the mainland and the main entrance to the Zuider Zee. It is the terminus of the North Holland canal from Amsterdam. On the east side of the town is the harbour with naval wharves and magazines, wet and dry docks. The great sea dike stretches from Nieuwe Diep to Fort Erfprins, a distance of about ¡ mi. It descends at an angle of 40° for 200 ft. into the sea. The town is fortified and the province can be flooded from this point. The defenses were insufficient to prevent German capture of the town early in May 1940. Helder has a meteorological observatory, a zoological station and a lighthouse.

HELEN, in Greek mythology, daughter of Zeus by Leda (wife of Tyndareus, king of Sparta) or by Nemesis; sister of Polydeuces and Clytemnestra, and wife of Menelaus. She was the most beautiful woman in Greece, and indirectly the cause of the Trojan War. When a child she was carried off from Sparta by Theseus to Attica, but was recovered and taken back by her brothers. When she grew up, the most famous of the princes of Greece sought her hand in marriage and her father's choice fell upon Menelaus. During her husband's absence she was induced by Paris, son of Priam, with the connivance of Aphrodite, to flee with him to Troy. After the death of Paris she married his brother Deiphobus, whom she is said to have betrayed into the hands of Menelaus at the capture of the city (Aeneid, vi, 517 ff). Menelaus thereupon took her back, and they returned to Sparta. where they lived happily till their deaths and were buried at Therapnae in Laconia. According to another story, Helen survived her husband and was driven out by her stepsons. She fled to Rhodes, where she was hanged on a tree by her former friend Polyxo, to avenge the loss of her husband Tlepolemus in the Trojan War (Pausanias, iii. 19). After death, Helen was said to have married Achilles in his home in the island of Leuke. According to Stesichorus. Paris, on his voyage to Troy with Helen. was driven ashore on the coast of Egypt. where King Proteus detained the real Helen in Egypt, while a phantom Helen was carried off to Troy; the real one was recovered by her husband after the war (Herodotus. ii, 112–120; Euripides. *Helena*). Helen was worshiped as the goddess of beauty at Therapnae in Laconia, where a festival was held in her honour. At Rhodes she was worshiped under the name of Dendritis (the tree goddess), where the inhabitants built a temple in her honour. There are thus an epic heroine Helen and a goddess Helen; the relations between the two are a problem as yet unsolved. Like her brothers, the Dioscuri, she was a patron deity of sailors.

HELENA, SAINT (c. 248–*c.* 328), mother of the emperor Constantine I the Great, was the reputed discoverer of Christ's cross. She served in an inn at Drepanum in Bithynia before marrying Constantius I Chlorus, who in 293 divorced her so that he might on becoming Caesar marry Theodora. stepdaughter of the emperor Maximian. When Constantine became emperor at York in 306, he made his mother empress-dowager. She later became a Christian. Her devotion to her eldest grandson. Crispus, and grief at his execution in 326, perhaps impelled Constantine to execute Fausta, his empress, and the accuser of Crispus. This double tragedy in the imperial family was immediately followed by the aged empress' pilgrimage to the Holy Land. She caused churches to be erected on the sites of the Nativity and of the Ascension. Coins bearing her name or effigy cease from 330. She was buried in Constantinople.

Before 337 it was claimed in Jerusalem that. during the building of Constantine's church on Golgotha, Christ's cross had been found. Later in the century, Helena began to be credited with the discovery. There grew up a crop of legends, of which Ambrose's panegyric on Theodosius the Great in 395 is the earliest witness. The story of the "Invention of the Holy Cross." enhanced by subsidiary romances and confusions with other Helens, became a favourite throughout Christendom (*see* CROSS).

Eastern churches commemorate Constantine and Helena together, on May 21, as "equal to the Apostles." In the west, only St. Helena. popularized by the cross legend, is commemorated. on Aug. 18. Geoffrey of Monmouth (1147) spread the idea, already extant. that Helena was a British princess. The consequent popularity of her legend in the British Isles is attested by the many medieval church dedications there to St. Helen and to Holy Cross.

See H. Chadwick in Journal of Theological Studies, vol. xlix, pp. 32–33 (1948); H. Thurston and D. Attwater (eds.), Butler's Lives of the *Saints,* vol. iii, pp. 346–348 (1956). (W. TR.)

HELENA, a city in Arkansas, U.S., and seat of Phillips county, is on the Mississippi river about 55 mi. (airline) S.W. of Memphis, Tenn.

Hernando de Soto (in 1541) and other early explorers along the Mississippi visited the area: which became a part of the Louisiana Purchase. Settlers began to arrive in 1800 and built a warehouse for barge shipping. In 1811, the steamboat "New Orleans" called at Helena, opening a prosperous era of river traffic. The county was named after an early settler, Sylvanus Phillips (1766–1830) and Helena, which was named for his daughter, was incorporated as a town in 1833 and as a city in 1856. Streets and many homes were laid out in mid-19th century. Helena was the site of a Civil War battle July 4, 1863, and the county sent seven generals to the Confederate army. Long important as an agricultural and river shipping centre for cotton, cottonseed products and lumber, the area became increasingly industrialized after World War II, especially at West Helena (founded 1909, incorporated 1917). Manufactures include tires, sporting goods, luggage, ladies' clothing, wood products and fertilizer. For comparative population figures see table in ARKANSAS: *Population.* (K. W. P.)

HELENA, the capital city of Montana, U.S., the seat of Lewis and Clark county, is near the Missouri river and the centre of the western third or the mountainous portion of the state, about 50 mi. N.N.E. of Butte. It is picturesquely situated at the eastern foot of the continental divide, at an altitude of 3,955 ft., in Prickly Pear valley, a rich agricultural region surrounded by rolling hills and lofty mountains. Mt. Helena and Mt. Ascension form a background for the city.

The area was first visited by the expedition of Meriwether Lewis and William Clark (*qq.v.*) in 1805, and in 1862 a wagon train of

immigrants wintered in Prickly Pear valley. Gold was discovered in Last Chance gulch, now the official name of former Main street, in July 1864. On Oct. 30, 1864, the town was founded, and named Helena at the instigation of John Somerville for his home town in Minnesota, and within two years had a population of 7,500. Gold to the value of $16,000,000 was taken from the gravels of Last Chance gulch, much of it before 1868. Rich gold and silver deposits were found within a 20-mi. radius, which stimulated Helena's growth. In the 1880s and early 1890s, Helena's prosperity was reflected by a display of ornate mansions, built by the nouveaux riches, onetime prospectors. By 1893 when the price of silver dropped, the boom passed. Business waned, and prosperity came in cycles with the building of the Canyon ferry, Hauser and Holter dams on the Missouri river (1900–10), with the renewal of mining activities following the demand for metals in World War I, and with the piping of natural gas from surrounding fields. The damage caused by the series of earthquakes in 1935, 1936 and 1937 was rapidly repaired.

The town continued to be a regional centre for trade, finance and transportation with about 65% of Montana's population and most of the state's mining, agricultural and livestock enterprises located within a radius of 125 mi. Industries include concrete, ceramics, paints, brick and tile, and machine parts. At nearby East Helena there are quartz crushers and smelters and a large zinc reduction works. Helena was made the capital of the territory in 1875, was chartered as a city in 1881, and became state capital in 1894.

The capitol building and the state office buildings lie in the southeast section of the city. The Pioneers and Veterans Memorial building houses the Historical Society of Montana with an excellent library and museum, and a Charles M. Russell art collection valued at $500,000. The Veterans Administration centre and hospital is located at Fort Harrison, 3 mi. from the city. The State Vocational School for Girls is located in Helena, as is the Montana Children's home for crippled children and the Florence Crittenden home. The Deaconess home and St. Joseph's orphanage, both for children, and old people's homes operated by the Masons and the Independent Order of Odd Fellows are nearby. There are state offices of the Montana Education association, the Montana Physicians service, the Montana Stockgrowers association and many other state organizations and institutions.

Carroll college (Roman Catholic) established in 1909, has about 800 students. The Archie Bray foundation provides a nationally known centre for artists interested in ceramics. Helena has a number of buildings which are distinctive for their architectural design, including the Roman Catholic St. Helena cathedral (Gothic, modeled after the Cologne cathedral in Germany), the Episcopal procathedral (English Tudor) and the civic centre, formerly the Algeria Shrine temple (of Moorish design).

For comparative population figures see table in MONTANA: *Population.* (M. G. Bu.)

HELENIUM, a genus of the Compositae (*q.v.*) family comprising more than 30 species of North American hardy annual or perennial herbs, commonly known as sneezeweeds. Their stems are erect, usually branched above, with alternate leaves extending downward and flowers in yellow or brownish heads. either solitary or in flat clusters, opening from early summer to late autumn. All the species may be grown in gardens, but perhaps the common sneezeweed. H. *autumnale,* is used most frequently, while the orange sneezeweed, H. hoopeszi, is the most valuable species for general planting.

The bitter sneezeweed, H. *tenuifolium,* is a troublesome weed in pastures in many sections of the southern states because when eaten by dairy cows it imparts a bitter flavour to the milk and butterfat. (J. M. BL.)

HELENSBURGH, a small burgh in Dunbartonshire, Scot., on the north shore of the Firth of Clyde, opposite Greenock. 22 mi. N.W. of Glasgoa by road. Pop. (1951) 8.760. There is steamer communication from Craigendoran pier with Gourock, Dunoon, the Isle of Bute. Wemyss Bay and other Clyde resorts.

In 1776 the site began to be built upon, and in 1802 the town, named after Helen, sister of the earl of Sutherland and wife of Sir James Colquhoun of Luss, the ground landiord, was erected into a burgh of barony.

John Logie Baird (*q.v.*), the inventor and television pioneer, was born at the manse in Helensburgh.

HELENUS, in Greek legend, son of Priam and Hecuba and twin brother of Cassandra. In Homer, he appears as a seer and warrior. In later writers it is related that he and his sister fell asleep in the temple of Apollo Thymbraeus and that snakes came and cleansed their ears, whereby they obtained the gift of prophecy and were able to understand the language of birds. After the death of Paris, because Helen rejected him for Deiphobus, Helenus withdrew in indignation to Mt. Ida, where he was captured by the Greeks; in other accounts he was captured by a stratagem of Odysseus, or surrendered voluntarily in disgust at the treacherous murder of Achilles (q v.). He informed the Greeks of the "fates" of Troy (Palladium, arrows of Hercules, arrival of Neoptolemus) and advised the building of the wooden horse. (See TROY AND TROAD)

After the capture of Troy he and his sister-in-law Andromache accompanied Neoptolemus (Pyrrhus) as captives to Epirus, where Helenus persuaded him to settle. After the death of Neoptolemus, Helenus married Andromache and became ruler of the country. He was the reputed founder of Buthrotum and Chaonia, named after a brother or a companion whom he had accidentally slain while hunting. He was said to have been buried at Argos, where his tomb was shown.

See Homer, Iliad, vi, 76, vii, 44, xii, 94, xiii, 576; Sophocles, Philoctetes, 604, who probably follows the Little Iliad of Lesches; Pausanias. i, 11, ii, 23; Conon, *Narrationes,* 34; Dictys Cretensis, iv, 18; Virgil, Aeneid, iii, 294–490; Servius on Aeneid, ii, 166, iii, 334.

HELFFERICH, KARL (1872–1924), German financier and politician. was born in Neustadt-an-der-Haardt on July 22, 1872. In 1901 he became a professor of political science in Berlin. and in 1906 went to Constantinople as manager of the Anatolian railway. He returned to Berlin in 1908 to take up the chairmanship of the Deutsche bank. In 1913 he was the chief German delegate at the Paris conference for the settlement of Balkan financial affairs. In 1915 Helfferich was appointed secretary of state for the imperial treasury. where he followed the principle of defraying the cost of the war by borrowing rather than by fresh taxation, relying on a final German victory. In June 1916 he left the treasury for the home office. In June 1918 he was appointed to succeed Count Mirbach, who had been assassinated, as Germany's representative in Moscow. He remained in Moscow for three months, returning to Berlin in August to conduct the economic and industrial demobilization of Germany after the Armistice. He devoted himself thenceforward principally to financial questions. In 1923 he secured the currency of the Rentenmark, and then fought against the Government policy of fulfilment of treaty obligations. He was fatally injured April 23, 1924.

HELGAUD or **HELGALDUS** (d. *c.* 1048), French chronicler, was a monk of the Benedictine abbey of Fleury. Little else is known about him save that he was chaplain to the French king, Robert II. the Pious, whose life he wrote. The only extant ms. of this Epitoma vitae Roberti *regis* is in the Vatican. Editions have been printed by J. P. Migne in the Patrologia *Latina,* tome cxli. (Paris, 1844); and by M. Bouquet in the *Recueil* des *historiens* des Gaules, tome x. (Paris, 1760).

See *Histoire littéraire* de la France, tome vii. (1865–1869); and A. Molinier, Les Sources de l'histoire de France, tome ii. (1902).

HELIAND, a 9th-century alliterative epic poem in Old Saxon, relating the life and teaching of Christ; the name Heliand ("Saviour") was given to it in 1830 by J. A. Schmeller, its first editor. The poem totals almost 6.000 lines and has come down in one complete, one virtually complete and two fragmentary manuscripts. The Heliand, together with the Genesis fragments (see below), is all that remains of Old Saxon poetry. The only documentary evidence that bears on the composition of the poem consists of two Latin passages—a prose Praefatio in *librum* Antiquum lingua *Saxonica conscriptum,* and a *Versus* de poeta et *interprete huius* codicis in hexameters—included in a collection of documents published in 1562 by the Lutheran reformer Flacius Illyricus, who

gave no indication of their origin. Scholars are generally satisfied. however, both that these documents are in all essentials authentic 9th-century records and that they relate to the *Heliand*. The *Praefatio* states that the work was undertaken by an eminent Saxon poet (unnamed) at the instance of Louis the Pious. Since the emperor is referred to in the present tense, the poem must at least have been started during his reign, *i.e.*, between the years 814 and 840. Its precise origin remains uncertain.

The substance of the poem is drawn, not directly from the Vulgate, but from the pseudo-Tatian harmony of the Gospels. with additional matter apparently derived from the Gospel commentaries of Rabanus Maurus. Alcuin and Bede. The particular interest of the work lies in the way in which the religious narrative is assimilated to the form of the Germanic heroic epic. Biblical scenes and characters are portrayed against a Germanic background. cardinal elements in the Germanic code of ethics, such as the bond of service between lord and vassal: are drawn into the motivation, while the poetic language and form are those of Germanic alliterative verse. On the other hand the ideals which sustain the work as a whole are entirely Christian, and the poet's evangelical purpose requires that particular emphasis be laid on the didactic parts of the poem, above all, on the words of the Saviour himself. The most powerful literary influence bearing upon the poet is that of the Anglo-Saxon religious epic. in which certain specific and characteristic techniques used in the *Heliand* are already found.

The fragmentary Old Saxon *Genesis* was once thought to be the work of the poet of the *Heliand,* but it displays different attitudes of mind and different techniques, and is generally of an inferior quality. The relationship between the Old Saxon *Genesis* and the Junian Anglo-Saxon *Genesis* is an interesting and very early example of literary intercourse between Germany and England, for it has been shown that what had long appeared to be a somewhat incongruous passage of some 600 lines in the latter work is in fact a translation from the Old Saxon poem.

The hybrid poetic literature represented by the *Heliand* and the *Genesis* was forced to yield before the pressure of a severe and formal Christianity which denied all concessions to the pagan Germanic forces of history. Yet, for reasons still not properly understood, the High German literature which accompanied this stricter line of thought made no headway in Low German territory. and except for a few insignificant remnants of prose, the *Helinnd* and the *Genesis* remain the only literary documents in a Saxon dialect until the end of the 12th century.

BIBLIOGRAPHY.—The most convenient combined edition of *Heliand* and *Genesis* is that of O. Behaghel. 7th ed. (1958). For textual analysis E. Sievers' edition (1878) prints the tests of the complete Munich and Cotton manuscripts side by side. Bibliographies on specific problems are given in G. Ehrismann's *Geschichte der deutschen Literatur bis zum Ausgang des Mittelalters*, vol. i, pp. 150–171 (1918). (RD. J. T.)

HELICON, a mountain range in Greece, celebrated in classical literature as an abode of the Muses, is situated between Lake Copais and the Gulf of Corinth.

The highest summit, the present Palaeovouni (old hill), rises to the height of 5,735 ft. On the fertile eastern slopes stood a temple and grove sacred to the Muses and adorned with statues, which, taken by Constantine the Great to beautify his new city, were consumed there by a fire in A.D. 404. Near by were the fountains Aganippe and Hippocrene, the latter created by the tread of the winged horse Pegasus. At the neighbouring Ascra dwelt the poet Hesiod, a fact which probably enhanced the poetic fame of the region.

Pausanias describes Helicon as the most fertile mountain in Greece; neither poisonous plant nor serpent was to be found on it, while many of its herbs possessed miraculous virtue. His description makes it possible to reconstruct the classical topography and French excavators have discovered the temple of the Muses and a theatre.

See W. M. Leake, *Travels in Northern Greece,* vol. ii (1835); J. G. Frazer, *Pausanias,* rcl. v, p. 1jo.

HELICON, the circular form of the B-flat contrabass tuba used in military bands. worn round the body. with the enormous bell resting on the left shoulder and towering above the head of the performer. (Fr. *hélicon, bombardon circulaire;* Ger. *Helikon).*

The pitch of the helicon is an octave below that of the euphonium.

HELICONIA, a genus of large tropical American, banana-like herbs of the Musaceae family. but only one species, H. *bihai,* knonn as mild-plantain or baliser. is commonly cultivated. It requires the same cultural methods that are used for the banana.

HELICOPTER, a heavier-than-air aircraft with one or more power-driven horizontal propellers or rotors that enable it to take off and land vertically, to move in any direction or to remain stationary in the air. It is often described as a rotary-wing aircraft in contrast to conventional fixed-wing airplanes. A helicopter does not require a long runway but can land on, and take off from, small areas inaccessible to fixed-wing aircraft. It can land in a small clearing in the jungle. on the deck of a ship, or atop a large building. Its ability to hover motionless over a given area enables it to deliver or take on personnel or cargo without actually landing. In the event of power failure during flight, the rotor, if disengaged from the engine. will continue to turn freely (autorotate) and provide lift as the helicopter descends, thereby permitting safe landing in an emergency.

Because of its versatility the helicopter is used extensively by the military services for transportation of troops into inaccessible areas, for rescue and medical evacuation, and for communication, surveillance and search at sea and on land. It proved its military value during the Korean war (1950–53) when it was used to evacuate thousands of wounded men from the front lines. Commercial uses include short-haul transportation between city centres and outlying airports, transportation into undeveloped areas. crop dusting. surveying and exploration.

The helicopter gained widespread publicity as a result of its lifesaving activities in civil emergencies. particularly those resulting from floods and earthquakes. and from its use by President Eisenhower for commuting from the White House to his farm at Gettysburg. Pa.. and to Camp David. Md. With the increasing congestion of ground transportation. there may be a promising future for the helicopter in the field of commuter travel.

HISTORICAL DEVELOPMENT

To the early inventors vertical take-off appeared to be the logical approach to the problem of flying. Apart from the Chinese top, nhose origin is lost in antiquity, and Leonardo da Vinci's models. which are not knonn to have flown. the first successful flying models utilizing rotating wings appear to have been built by Launoy and Bienvenu in France in 1784 and George Cayley in England in 1796. In the 1840s, Cayley built a steam-powered model. But the helicopter as well as fixed-wing aircraft had to await the development of lightweight gasoline engines before full-scale flights became possible.

The year 1907 saw the first man-carrying flights in France with two gasoline-engine helicopters, one designed by Louis Charles Bréguet and one by Paul Cornu. These pioneers never successfully solved the problem of control and were not sufficiently encouraged to continue their efforts. The simpler flight techniques demonstrated by the Wright brothers utilizing fixed wings discouraged further attempts at direct lift although, in the interests of safety, many further attempts were made to develop aircraft whose lift would be independent of forward speed. Among these early developments was the Petroczy-von Kármán tethered coaxial helicopter intended for surveillance on the front lines by the Germans during World War I; it never progressed beyond the development stage, although flights as long as one hour were recorded. Emile and Henry Berliner in the United States developed, first a coaxial. and then a side-by-side version with large fixed wings for control which achieved limited flight success during 1923. George de Bothezat developed for the U.S. army signal corps a side-by-side helicopter with four large rotors; it flew in 1923 with three people on board lor short distances at moderate heights. However, controlled vertical and forward flight was not officially acknowledged to have been achieved until 1930 when d'Ascanio (Italian) flew a coaxial helicopter, whose rotors were controlled by means of small tabs on the trailing edges of the blades. In 1936 the Bréguet-

Dorand (French) and in 1937 the Focke-Achgelis (German) successively held the record for sustained flight. In 1939 Igor Sikorsky (United States) flew the VS-300, which had only one main rotor; in 1941 he broke all previous records by remaining in flight for 92 minutes. The helicopter from then on developed rapidly.

Autogiro. — During this period another type of rotary wing aircraft, the Autogiro or gyroplane, was developed by Juan de la Cierva of Spain. His first successful flight was made in Spain in 1923. Development of the Autogiro provided much of the technical background that made the evolution of the helicopter possible. "Autogiro" is a trade-name for a type of aircraft that is readily distinguished from the helicopter. Unlike the helicopter rotor, the Autogiro rotor is not powered; the forward movement of the aircraft, through the air causes the rotor to turn like a windmill and hence to produce rotor lift. A conventional propeller provides propulsion for forward motions of the machine. The Autogiro cannot hover or land vertically, as the helicopter can, although a technique was developed known as the jump take-off, in which the rotor was brought up to speed on the ground by mechanical means and the energy stored thereby in the rotor utilized to lift the aircraft off the ground to an altitude sufficiently high to permit a short dive and glide into forward speed. The greater utility of the helicopter has favoured its development over that of the Autogiro, although the principle is still used on certain compound aircraft concepts such as the McDonnell XV-I and the Fairey Rotodyne in which the rotor is powered by jets at the blade tips for vertical take-off or landing and the aircraft is propelled in forward flight by means of a conventional propeller with the rotor unpowered and autorotating. The autorotating rotor in forward flight has a more favourable angle of attack distribution than the powered rotor and consequently can operate at higher forward speeds. Also, by providing fixed wings, some of the lift can be unloaded from the rotor onto the wings and the forward speed further increased over that of the conventional helicopter up to values of the order of 300 m.p.h.

MODERN HELICOPTERS

Hinged Blade. — Juan de la Cierva was responsible for many major contributions of value to later helicopter development, among them the concept of hinging the blade at the root, first put into practice by him. This concept simplified the control problem and made possible the development of lightweight, flexible and structurally reliable rotor systems in which the rotor blades are maintained in equilibrium by centrifugal force. Highly flexible blades adjust readily by bending to the load distribution and its cyclic changes associated with forward speed. This bending allows the vertical loads to be carried by components of the tension in the blade arising from centrifugal force; it minimizes the high stresses that would otherwise be associated with a more rigid blade and thus averts failures due to structural fatigue.

The hinge is located near the root, where the structural material required to carry the tension load makes it difficult to provide sufficient bending flexibility to ensure low stresses. With a hinge located at the root the blade is restrained by centrifugal force but otherwise free to flap up or down as the applied loads change. "Blade flapping" is the basic means of control of the helicopter. Varying the applied load by means of cyclic pitch change or feathering as described below causes the rotor disk to tilt relative to the shaft. The thrust being substantially perpendicular to the rotor disk, tilting the rotor relative to the helicopter produces forces that move the helicopter in any desired direction. This tilt is achieved by changing the pitch of the blades once per revolution thereby forcing them to seek a new plane of rotation in which no cyclic pitch change occurs since, because of the hinge, no cyclic moments can exist. A swash plate, which tilts in response to pilot's controls, is used to change the pitch of each individually hinged blade through a mechanical linkage system. The tilt of the swash plate therefore establishes the tilt of the plane of no cyclic input of the rotor; hence, the tilt of the rotor follows the tilt of the swash plate. The same swash plate is moved up or down to change blade pitch in order to climb or descend.

In general, tilting the plane of rotation of the blades relative to the shaft, which is turning at constant speed, results in a periodic change in rotational speed of the blades once and twice per revolution. These changes in speed would produce large forces causing bending and consequently large blade stresses in the chordwise direction. Since the blade is relatively stiff in the chordwise direction, it is necessary to relieve these stresses by means of a vertical hinge, called the lag hinge, at the blade root. Motion about this lag hinge thus permits the blade to maintain substantially constant speed regardless of the tilt of the rotor disk and, in addition, provides a means of relieving the periodic forces in the plane of rotation due to cyclic changes in drag forces in forward flight.

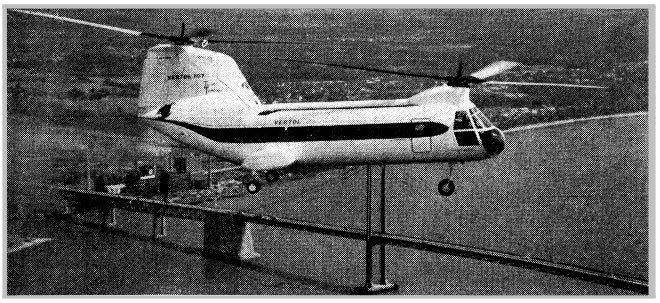
These changes in drag forces and the periodic changes in lift distribution discussed previously exist because of the changes in velocity across the rotor disk as the helicopter moves forward. On one side of the rotor disk, the advancing side, the velocity due to blade rotation and that due to forward speed add and, on the other, retreating side, subtract. The lift at constant pitch setting would therefore vary cyclically around the rotor disk, if the rotor were rigid. However, such a lift variation would result in a tendency to roll, and, by virtue of the hinge at the root, such a tendency can evidently not exist. The blade therefore flaps cyclically, the vertical velocity of flapping combining with the horizontal speed of the blade in such a way as to cyclically change the angle of attack and maintain substantially constant lift and zero moment at the blade root.

Speed Limitation. — This change in angle of attack on the advancing and retreating sides of the rotor disk inherently limits the speed of the helicopter and represents one of the most serious practical limitations to its greater utility. As the forward speed increases, the angle of attack on the retreating side must increase until stalling occurs. The forward speed is thus limited to approximately 0.4 of the rotational speed, or, for typical values of the rotational speed, to approximately 200 m.p.h. Higher speeds may be achieved by increasing the blade area and thereby reducing the mean angle of attack, but there are practical considerations of blade weight and the additional power consumption associated with the increased drag of larger chord blades and the compressibility effects on the advancing side which would appear to set a limit to the high speeds of conventional helicopters.

Other Types. — Other configurations, which operate on the basic principles of the helicopter as described above but overcome the speed limitation have been developed. These include the many machines covered by the generic term VTOL (vertical take-off and landing) of which the helicopter is the best known example. In one such machine the wings and propellers tilt through 90°, with the axis of rotation vertical for take-off and landing and substantially horizontal in forward flight. In others, the wings and propellers remain horizontal, and the slipstream is deflected down by large flaps for vertical flight. In either case, more thrust must be provided in vertical than in forward flight and the final design is therefore a compromise between the hovering and forward-flight regimes. A typical helicopter is designed to lift approximately 12 lb. per installed horsepower but the smaller rotors suitable for use as propellers would produce only 6 lb. or less per horsepower; high forward speeds are therefore achieved at the expense of hovering efficiency. With the advent of lightweight gas turbine power plants, and since most of the additional power is required anyway for the higher forward speeds, this loss of efficiency becomes of lesser importance.

Aerodynamic Theory. — The increase in power required to produce a given thrust as the rotor diameter decreases is fundamental in the rotor aerodynamic theory. Thrust is produced by imparting a downward velocity to the mass of air flowing through the rotor. The lift is proportional to the change in momentum, $m \times v$, where m is the mass flow of air through the rotor and v is its change in velocity. The energy expended, or induced power, is proportional to the change in kinetic energy, $\frac{1}{2}mv^2$. Additional power is consumed in overcoming profile drag of the rotor blades. Considering only the induced power, which represents the major portion of power expended, the ratio of thrust to power is $\frac{mv}{\frac{1}{2}mv^2}$

HELICOPTER

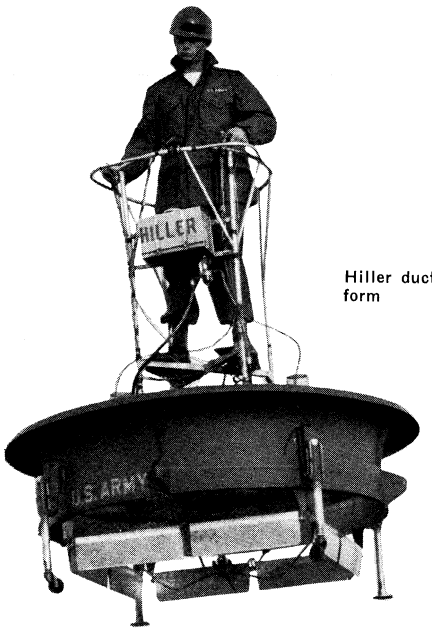


Vertol 107, turbine powered, the commercial version of the U.S. army YHC-1 helicopter

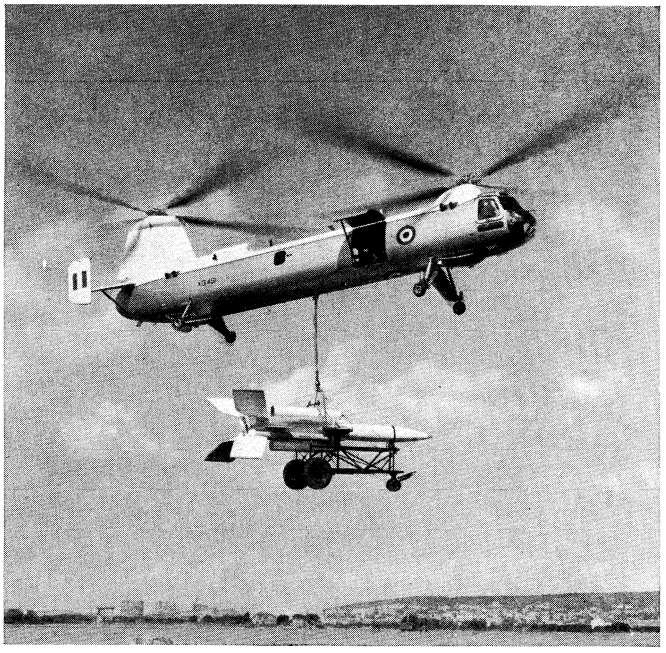
Aiouette II, a French-designed helicopter built by Republic Aviation corporation in the U.S. Powered hy a 400 h.p. gas turbine engine

Bell helicopter equipped with spraying apparatus for agricultural use

Kaman H-43 operating as a fire fighter at a crash scene

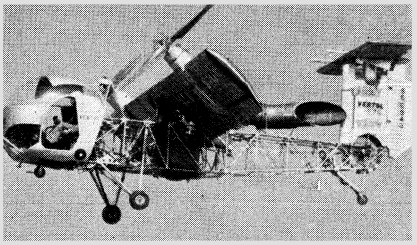


Hiller ducted-propeller flying platform



Bristol 192 (British) helicopter lifting a guided missile and its launcher

Westland Whirlwinds designed for use by Queen Elizabeth II



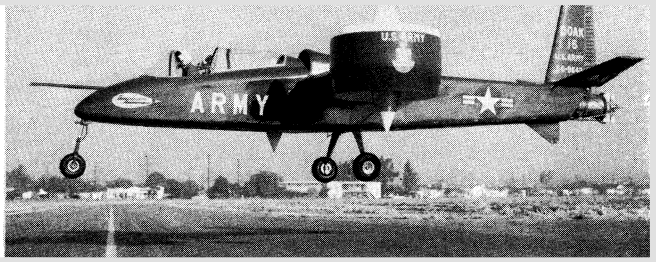
Vertol V-76, a tilt-wing aircraft shown converting from helicopter to airplane configuration

TYPES OF MODERN HELICOPTERS

BY COURTESY OF (TOP LEFT, BOTTOM RIGHT) VERTOL AIRCRAFT CORPORATION, (TOP RIGHT) REPUBLIC AVIATION CORPORATION (SECOND ROW LEFT) BELL HELICOPTER CORPORATION, (SECOND ROW RIGHT KAMAN AIRCRAFT CORPORATION (THIRD ROW LEFT) HILLER AIRCRAFT CORPORATION, (THIRD ROW RIGHT) BRISTOL AIRCRAFT LTD. PHOTOGRAPH (BOTTOM LEFT) CENTRAL PRESS PHOTOS LTD

HELICOPTER

Sikorsky **S-62,** amphibious helicopter with flying-boat hull, landing on water



Doak **16,** a tilt-duct aircraft shown hovering. Ducts tilt forward **900** for conventional airplane flight

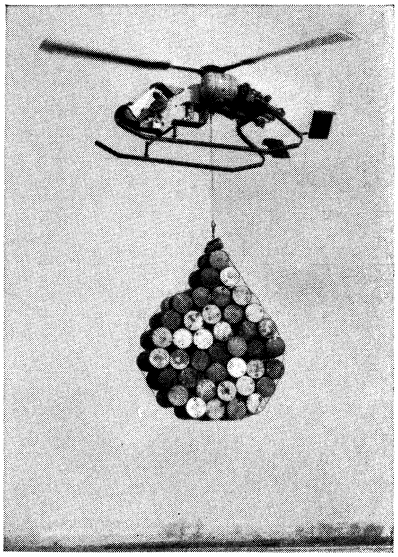
Kaman unmanned drone helicopter which may be operated either by means of a halter as shown, or remotely, by radio control

Vertol **H-21** towing an LST at a forward speed of about 4 knots

Fairey Rotodyne convertiplane, a cross between a fixed-wing airplane and a helicopter, capable of operating at higher forward speeds than the true helicopter

Sikorsky S-58 being used to set electric poles in difficult locations

XROE-1 "Rotorcycle," a collapsible one-man helicopter manufactured by the Hiller Aircraft corporation



McDonnell **120** crane-utility helicopter

THE VERSATILE HELICOPTER IN A VARIETY OF OPERATIONS

BY COURTESY OF (TOP LEFT) SIKORSKY AIRCRAFT CORPORATION. (TOP RIGHT) DOAK AIRCRAFT COMPANY, (SECOND ROW LEFT, THIRD ROW LEFT) KAMAN AIRCRAFT CORPORATION. (CENTRE RIGHT) VERTOL AIRCRAFT CORPORATION. (BOTTOM LEFT) PACIFIC GAS & ELECTRIC COMPANY. (BOTTOM CENTRE) HILLER AIRCRAFT CORPORATION, (BOTTOM RIGHT) MCDONNELL AIRCRAFT CORPORATION

or $\frac{2}{V}$. A large rotor handles a great mass of air, hence requires a lower value of v and therefore less power for a given thrust than a smaller rotor.

Similarly, in forward flight the flow of air passing through a rotor is increased when the rotor is inclined forward to propel the helicopter. The amount of power required therefore drops off as the speed increases. It reaches a minimum value of about half that required for hovering at about 50 m.p.h., then increases with increasing forward speed as the drag of the fuselage increases. This minimum power characteristic is of importance in considering the ability of multiengine helicopters to maintain altitude after failure of an engine during take-off.

Helicopter Types.—Many types of helicopters have been proposed. The single-rotor type, utilizing one main rotor and a small vertical tail rotor, is one of the best known. The tandem type in which two rotors rotate in opposite direction to provide torque balance, is popular for transportation of personnel or cargo because of its long fuselage and insensitivity to load distribution. Another type that is of interest, particularly for small, compact vehicles, is the synchropter in which two rotors are closely intermeshed.

Extensive engineering effort has resulted in the development of helicopters of great reliability and with useful loads of about 30% of the gross weight, which is still somewhat less than the 40% average for fixed-wing aircraft. The additional weight of the helicopter may be attributed to the necessity of providing reliable mechanical transmission systems, operating at low rotational speeds and hence high torques, to power the rotor.

The Sikorsky H-19, developed during 1949, was capable of carrying 10 passengers in addition to the pilot and copilot. It saw extensive service during the Korean war. The Vertol 107, a twin-engine, twin-rotor helicopter is designed to carry 23–30 passengers in airline operation.

The stability and control problem of the helicopter is more serious than that of the airplane because of the necessity for control at zero air speed where the usual stabilizing effects of a horizontal tail and wings are nonexistent. The helicopter in hovering flight is essentially neutrally stable and responds to the controls as would any system with inertia only, and with no damping or static stability. The pilot must therefore develop an anticipatory reaction in order to arrest the motion of the machine when it responds to the controls. However, the development of reliable and lightweight electromechanical control systems utilizing gyro signals for increased damping and static stability have provided a satisfactory solution to this problem.

Finally, the cyclic loads to which the rotor is subjected in forward flight, as discussed above, requires a careful evaluation of the aeroelastic properties of the highly flexible rotor blades in order to avoid vibration levels in the helicopter above the comfort level. Evidently if one of the natural frequencies of the rotor or fuselage is close to a critical harmonic of the rotor speed, an amplification of these forces will occur. Again, careful engineering design effort can avoid resonances and reduce to a negligible amount such vibratory inputs. See also AERODYNAMICS; AERONAUTICS.

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HELIGOLAND (Ger. Helgoland), an island of Germany, in the North sea, lying off the mouths of the Elbe and the Weser, 28 mi, from the nearest point in the mainland. Area .35 sq.mi.

The generally accepted derivation of Heligoland (or Helgoland) is from Heiligeland, *i.e.,* "Holy Land." The original name of the island was Fositesland from a god called Fosite (Forseti). According to northern mythology, Forseti, a son of Balder and Nanna. the god of justice. had on the island a temple subsequently destroyed by St. Ludger. Another suggested etymology, however, is that of Hallaglun, or Halligland, *i.e.,* "land of banks, which cover and uncover."

There Hertha, according to tradition, had her great temple, and the Angles came from the mainland to worship at her shrine, and on this isle St. Willibrord in the 7th century first preached Christianity. For its ownership, before and after that date, many sea rovers fought until it finally became a fief of the dukes of Schleswig-Holstein. The island was a Danish possession in 1807, when the English seized and held it until it was formally ceded to them in 1814. A British possession until 1890, it was ceded in that year to Germany, and after 1892 formed part of the Prussian province of Schleswig-Holstein. It consists of two islets, the main, or Rock island, and the small Dunen-Insel, a quarter of a mile to the east, connected by a neck of land until 1720, when they were severed by a violent irruption of the sea. The former is nearly triangular in shape and is surrounded by steep red cliffs, the only beach being the sandy spit near the southeast point, with the landing stage.

The cliffs are worn into caves, arches and columns. The impression made by the red cliffs, fringed by a white beach and supporting the green Oberland, is commonly believed to have suggested the national colours, red, white and green, or, as the old Frisian rhyme goes:

"Grön is dat Land,
Rood is de Kant,
Witt is de Sand,
Dat is de Flagg vun't hillige Land."

The lower town of Unterland, on the spit, and the upper town, or Oberland, on the cliff above, were connected by a wooden stair and a lift. After cession by Great Britain to Germany, the main island was strongly fortified, but the fortifications were demolished under terms of the treaty of Versailles; they were rebuilt by Hitler before World War II. The island was heavily bombed in World War II. After the war the population (about 2,600) was removed temporarily and the island was razed and used as a target for bombing practice by the British.

Heligoland was returned to Germany in 1952, with plans to repatriate the population gradually. Pop. (1955) 542.

The greatest length of the main island is just a mile, and the greatest breadth less than a third of a mile, its average height 198 ft., and the highest point, crowned by the church. 216 ft. The Dunen-Insel is a sand bank protected by groynes. In 1892 a biological institute, with marine museum and aquarium (1900) attached, was opened.

The winters are stormy. May and the early part of June are wet and foggy, so that few visitors arrive before the middle of the latter month.

HELIGOLAND BIGHT. On Aug. 28, 1914, a sweep by the British light naval forces into the Heligoland bight brought about the first serious contact between the opposing naval forces during World War I. The action began at daylight, developed into a series of confused fights, in misty weather upon a glassy-smooth sea, and lasted until 1:30 P M., when, the sweep having been completed, Vice-Adm. Sir David Beatty withdrew his forces. The day ended to the distinct advantage of the British. who had one cruiser ("Arethusa") and three destroyers damaged with a total casualty list of 35 killed and 40 wounded. The Germans lost 1,242 officers and men, killed, wounded and prisoners; three cruisers ("Mainz," "Coln" and "Ariadne") and one destroyer (V. 187) were sunk; one cruiser ("Frauenlob") was badly crippled, and there was unreported damage to other cruisers and torpedo craft.

THE PLAN OF OPERATIONS

From the first days of the war a watching patrol, maintained by British submarines off the entrance to the German ports, had obtained an accurate kno ledge of the routine movements of the German patrols. Against these patrols the sweep was planned to be carried out by light forces, upon a day when the German heavy ships would be tide-bound until afternoon, inside the Jade river bar.

In the original plan of the operation, Comm. Roger Keyes, commanding the submarine flotilla (eight submarines of the "D"

and "E" class and the destroyers "Lurcher" and "Firedrake") was to place an inner line of three submarines close to Heligoland, with orders to remain submerged until after a certain hour. An outer line of three submarines was stationed 40m. to the westward, instructed to try and draw the enemy destroyers to sea. Two other submarines were to watch the entrance to the Ems river.

The destroyer force, under Comm. Reginald Tyrwhitt, consisted of the "Arethusa" with the 3rd flotilla (16 t.b.d's) and the "Fearless" (Capt. Blunt) with the 1st flotilla (15 t.b.d's). The battle-cruisers "Invincible" (Rear-Admiral Sir Archibald Moore) and "New Zealand" were to act in support and were to meet the destroyer force to the south-east of the Dogger Bank on the evening of the 27th. Whilst the submarines were taking up their positions the cruisers and destroyers were to steer for a point 75m. N.N.W. from Heligoland, so as to arrive there by daylight on the 28th. The flotillas were then to sweep south and west through the Bight to cut off the German destroyers on their return from their nightly patrol. The two battle-cruisers would be in support to seaward and, away to the west, off the Terschilling light, an armoured cruiser force under Rear-Admiral Christian was held in reserve.

Such was the original plan. It was modified at the last moment on account of the diversion at Ostende. A brigade of Royal Marines was landing at that place on the 26th, under cover of the ships of the channel squadron, and a countermove by the German high sea fleet seemed likely. Therefore, support from the grand fleet was arranged and Admiral Jellicoe sent Vice-Admiral Beatty south in command of a force consisting of the battle-cruisers "Lion," "Queen Mary," and "Princess Royal" and Comm. Goodenough's squadron of six light cruisers ("Southampton," "Falmouth," "Birmingham," "Nottingham," "Lowestoft," and "Liverpool"). Beatty joined the "Invincible" off the Dogger Bank on the evening of the 27th and Goodenough's cruisers were sent on towards the destroyers' daylight position. Unfortunately, a wireless message, informing Tyrwhitt and Keyes of the change of plan, miscarried and neither commodore was aware of the presence of the northern forces until after the operation had commenced.

At about 3.30 A.M. Goodenough's cruisers came into contact with Tyrwhitt's destroyers and were at first mistaken for an enemy: recognition signals, however, averted the danger of an attack and at 4.0 A.M. Tyrwhitt, with his destroyers, began his run to the south. Goodenough's six cruisers were eight miles astern of him, and 30m. away on his starboard quarter was Beatty with five battle-cruisers. Keyes, in the "Lurcher," had stationed his submarines, but was still unaware of the presence of the cruisers, a fact which, as will be seen later, complicated the situation during the forenoon, when, owing to the mist, the course of events was by no means clear. Meanwhile, intercepted wireless signals had warned the Germans that a considerable force was approaching the Bight and they altered their normal dispositions. Their patrol force was ordered to retire before the British destroyers and to try and entice them into the Bight, where the light cruisers would be ready to cut them off. Thus, at daylight, the position was an interesting one, the destroyer forces being each intent upon leading its opponent into the arms of its supporting cruisers.

THE FIRST PHASES

The morning broke dull and overcast, with a smooth sea. To seaward the horizon was clear, but inshore it was misty, with the visibility never exceeding three to four miles and sometimes much less. At 4.45 A.M. E.7 fired a torpedo at one of the German outer patrol (G. 194), and this brought the German 5th flotilla out from Heligoland to hunt the submarine. At this time Tyrwhitt, in the "Arethusa," with the 3rd flotilla, was steering S.S.E. into the Bight, followed by "Fearless" with the 1st flotilla. Shortly before 7.0 A.M. a German t.b.d. was sighted on the port bow, about 3½m. off, and "Laurel," with the 4th division, was sent in chase (see fig. 1). The enemy turned S.E. and "Laurel" soon sighted ten more destroyers; shots were exchanged at long range as the Germans made off towards Heligoland. Tyrwhitt turned to the eastward to support his chasing division and, just before 8 A.M., the "Stettin" came in sight to the N.E. Her arrival was opportune, for the German destroyer "V.1" had been hit and was dropping astern. A few minutes later "Frauenlob" was seen to the eastward and "Arethusa" for a short time came under a heavy fire from both German cruisers. "Stettin," which had not yet got steam for full speed, on sighting "Fearless" with her flotilla, turned away and disappeared into the mist. "Frauenlob" turned to the south-west-

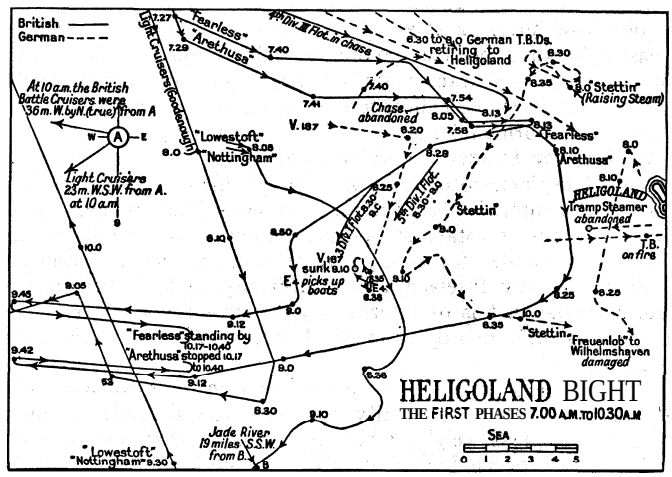


FIG. 1.— INITIAL MOVEMENTS IN BATTLE OF HELIGOLAND BIGHT, DURING WHICH ONE GERMAN CRUISER WAS DAMAGED, ONE DESTROYER SUNK AND H.M.S. "ARETHUSA" RECEIVED DAMAGE TO HER ENGINES

ward, and "Arethusa," turning to a converging course, a sharp fight ensued. "Arethusa," which had been commissioned only the day before, suffered heavily. She came under the fire of the forts of Heligoland and by 8.20 A.M. had only one 6in. gun remaining in action; but she continued her fight with "Frauenlob." At 8.25 A.M. the latter, heavily hit on her forebridge, broke off the action and retired. She reached Wilhelmshaven at noon with 50 killed and wounded on board. A tramp steamer, attempting to cross the bows of "Arethusa," was turned back by the British destroyers, who also chased and smashed up the torpedo boats D.8 and T. 33. After "Frauenlob" had retired S.E. Tyrwhitt turned W. He had, at 8.13 A.M., made the signal "Course W½S" (the course for the sweep), but delayed turning himself until he had finished with "Frauenlob." "Fearless," having lost sight of "Stettin," turned to the new course and recalled the chasing destroyers. The first phase thus closed at 8.30 A.M. with the British flotillas steering to the westward as planned, "Fearless" being about six m. to the north of "Arethusa."

THE SINKING OF "V.187"

The mist had now thickened, and soon after turning, "Fearless" sighted a destroyer coming in from seaward. At first she was mistaken for the "Lurcher," but soon identified as an enemy. "Goshawk" with the 5th and "Ferret" with the 3rd divisions were sent in chase. The enemy was "V.187," the leader of the German flotillas, and she attempted to escape to the southward. At 8.0 A.M. Goodenough had detached "Nottingham" and "Lowestoft" to Tyrwhitt's assistance and "V.187," sighting these two cruisers ahead at 8.38 A.M., was turned back by their 6in. guns into the arms of "Fearless" and eight destroyers. She was soon reduced to a wreck and she sank at 9.10 A.M. ."Fearless," leaving the destroyers to deal with "V.187," rejoined Tyrwhitt and together they resumed the westerly course by 9.0 A.M.

The survivors of the sinking German were rescued by boats from the British destroyers. Whilst the rescue work was in progress "Stettin" appeared from the north and, opening fire upon the destroyers, scattered them, herself receiving a few hits whilst doing so. In the confusion, five boats, full of German wounded and prisoners, were left behind. Submarine "E.4" (Lt.-Com. Leir), made an unsuccessful attack upon "Stettin," which caused that ship to withdraw; then, appearing suddenly on the surface, she went to the rescue of the British boat's crews. One German officer and three men were kept as prisoners; the remainder were left in the British boats, were supplied with bread and water, and given the course to Heligoland. "E.4" then submerged as dramat-

ically as she had appeared.

Goodenough, with four cruisers, turned westward at 8.30 A.M., being at that time ten m. ahead of the flotillas. "Nottingham" and "Lowestoft," after heading off "V.187," tried to rejoin Goodenough, but failing to regain touch, they steered N.W. for the battle-cruiser position. Keyes in "Lurcher," still unaware of the presence of the northern force, sighted and shadowed them, under the impression they were enemy ships. Through the mist, just before 9.0 A.M., Keyes sighted Goodenough's four other ships astern. He informed "Invincible" that he was being chased by four cruisers and was trying to lead them towards her. Goodenough followed "Lurcher" for about ten minutes and then turned back to the westerly course. This took his ships over the outer line of British submarines, who were still unaware of his presence. At 9.30 A.M. "Southampton" sighted "E 6" and promptly attempted to ram; the submarine escaped only by making a rapid dive. Towards 10.0 A.M., the weather to seaward becoming clearer, mutual recognition took place between Keyes and Goodenough and the latter went on to the westward, in order to give the submarines freedom of action.

Tyrwhitt had intercepted Keyes's message to "Invincible," and at 9 45 A.M. he gallantly turned back to his assistance with the crippled "Arethusa." "Fearless" turned back at the same time, and by 10.0 A.M. the 3rd and 5th divisions, having rejoined after sinking "V.187," the re-united flotillas turned once more to the westward. But by this time "Arethusa" could only steam at ten knots, and at 10.17 she was forced to stop to repair her engines. "Fearless" stood by her, and by 10.45 A.M. the two ships were under way again, steaming slowly W., with the destroyers spread out ahead of them.

THE MAIN ACTION

The German command, in the Jade river, had by now realized the situation and was endeavouring to concentrate the light cruisers to attack the British flotillas *(see* fig. 2). "Mainz" left the Ems river at 9.0 A.M. and was coming up from S.W., hoping to cut off the destroyers and to join "Strassburg." That ship left the Jade river at 9.30 A.M., followed at intervals by "Coln," "Ariadne," "Stralsund," and "Kolberg," while the "Stettin" was on her way W. from Heligoland. Thus six light cruisers were endeavouring to encompass the British flotillas, whose position

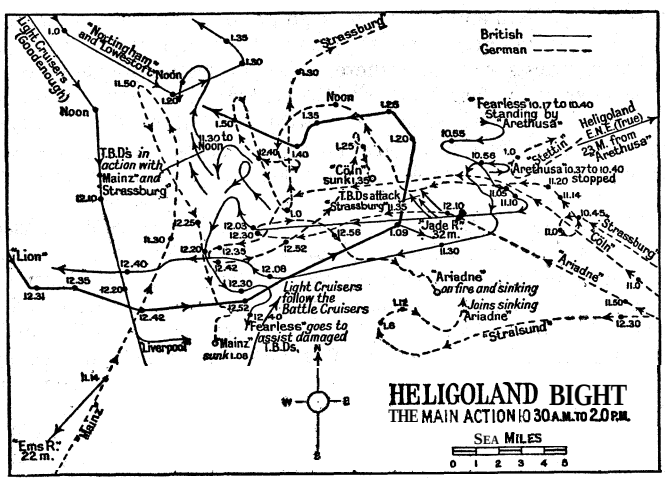


FIG. 2.— CHART SHOWING THE ATTEMPT OF GERMAN CRUISERS TO SURROUND BRITISH FLOTILLAS. THE MOVE WAS UNSUCCESSFUL, BRITISH BATTLE CRUISERS DASHING IN AND SINKING THREE GERMAN CRUISERS

from 11.0 A.M. onwards was precarious. Soon after "Arethusa" resumed her westerly course at 10.45 A.M. "Strassburg" appeared from S.E., and after firing a few salvoes at long range disappeared in the mist to the northward. She was followed at 11.5 A.M. by "Coln," which also passed on after exchanging a few salvoes. When "Coln" appeared Tyrwhitt asked Beatty for support. At 11.16 A.M. "Strassburg" reappeared to the northward and opened a heavy fire upon "Arethusa." A determined attack by the 1st and 2nd divisions of the 3rd and the 1st division of the 1st flotillas drove her off, and the stricken "Arethusa" continued her course to W., supported by "Fearless" and the destroyers. When "Strassburg" reappeared "Fearless" sent out an urgent call for help, and Beatty, at 11.20 A.M., ordered Goodenough to turn back to the assistance of the flotillas.

To Beatty, who had been steaming at high speed around a position about 50m. to the N. and W. of Heligoland, the course of events had by no means been clear. The urgent call from "Fearless," however, made it evident that she and the "Arethusa" were in action with two or more cruisers. The flotillas were still within 30m. of Heligoland, and at any time after noon there was a possibility of heavy enemy ships appearing from the Jade river. Goodenough was turned back, and Beatty, accepting the risk of mines and submarines, determined to take his whole force into the Bight to clear matters up and to extricate "Arethusa" and the flotillas. By 11.30 A M. the battle-cruisers were forming single line ahead on a S.E. course and were working up to full speed.

The Sinking *of the "Mainz."*—At 11.30 A.M. the and, 3rd, and 5th divisions of the 1st flotilla were about six m. to the westward of "Arethusa" when the "Mainz" appeared right ahead and chased them away to the north. At 11.50, after a 20 min. chase, "Mainz" sighted Goodenough's four cruisers coming out of the haze from N.W. and the whole aspect of affairs was at once changed. "Mainz" turned S., followed by the destroyers she had been chasing, and was hit twice by the cruisers before she could draw away in the mist. At 12.08, she met "Fearless" with the remainder of the 3rd flotilla, and in the sharp fight that followed her rudder and port engine were damaged and she was hit by a torpedo from one of the destroyers. Goodenough's cruisers were now closing up and the fate of "Mainz" was sealed. She turned and dealt savagely with the 4th division when they attacked. "Laurel" had her after-funnel blo n away and her captain severely wounded, "Laertes" was stopped dead by four hits from the same salvo, and "Liberty's" mast was shot away and her captain killed. But "Mainz," under the concentrated fire of the cruisers and destroyers, soon became a helpless wreck. She struck at 12.50, and 18 minutes later she rolled over and sank. Keyes, in the "Lurcher," went alongside and rescued 348 of her crew, narrowly escaping damage from her propellers as she sank.

The Battle-Cruisers in Action.—During the half-hour after noon the two British flotilla leaders were in grave danger of being overwhelmed. "Mainz" had appeared ahead, "Coln" and "Ariadne" were fast coming up astern, followed by "Stralsund" and "Stettin," and "Strassburg" was in action with the destroyers about five m. to the N.E. Goodenough's arrival and the sinking of the "Mainz" relieved the pressure and Tyrwhitt continued to limp slowly to the westward. At 12.30 "Arethusa" sighted a large ship in the mist ahead, and after a moment of breathless suspense recognized her as the "Lion," followed by the battle-cruiser squadron. Steaming at high speed, Beatty left the "Arethusa" to port and the sinking "Mainz" to starboard and swept on. Goodenough's cruisers joined in astern and "Fearless" turned away to the assistance of "Laurel" and her damaged consorts. The German cruisers fled. "Strassburg" turned N., disappeared into the mist, and was no more seen. "Coln," sighted on the port bow of the "Lion," made a desperate attempt to escape to N.E. but a few salvoes disabled her engines. "Ariadne" tried to pass ahead of "Lion" on a S E. course, but, hit by the first two salvoes fired at her, she disappeared to the southward, badly on fire and sinking. "Stralsund" and "Stettin" turned eastward and escaped. At 1.09 P.M. Beatty, being only 32m. from the mouth of the Jade river, made the general signal to retire. The battle-cruisers turned in a wide circle to the N. and W. and at 1 25 P.M. the "Coln" was seen again, steaming slowly to the S.E. Three salvoes caused her to list to port and at 1.35 P sr. she sank, taking with her the German cruiser admiral and all her ship's company.

Thus, in a brief hour, Beatty's bold stroke with the battle-cruisers had turned an awkward situation into a brilliant success. The British force withdrew homewards and all ships arrived safely at their ports. Two only, the "Arethusa" and "Laurel," had to be towed home. The German battle-cruisers were slow in getting to sea and did not leave the Jade river until 2.0 P.M. By 4.0 P.M., accompanied by destroyers and the remnants of the light cruiser

squadron, they reached a position close to where the "Cöln" had sunk, and, seeing no enemy, returned to the shelter of their base.

The success achieved in this operation exceeded all expectations and its effects were far-reaching. It came at a time when the British nation needed a success to dispel the dismay caused by the overwhelming advance of the German armies. Upon the British navy the effect was exhilarsting. The command of the North Sea had been asserted right up to the gates of the enemy and the young destroyer commanders had acquired a sense of superiority over their enemy and a trust in their leaders. Serious as was the material loss to the German fleet, it was not comparable to the effect upon its morale. Admiral Tirpitz stated that "August 28 was a day fateful, both in after effects and in incidental results, to the work of the German navy." Certainly, the marked disinclination shown by the German fleet throughout the war to be drawn from the protection of its bases is attributable to this early British success in the Bight of Heligoland.

(S. T. H. W.)

HELIOCENTRIC, *i.e.*, referred to the centre of the sun (ἥλιος) as an origin, a term designating especially co-ordinates of heavenly bodies referred to that origin.

HELIODORUS, of Emesa in Syria, Greek writer of romance. He was the author of the *Aethiopica*, the oldest and best of the Greek romances that have come down to us. It was first brought to light in modern times in a ms. from the library of Matthias Corvinus, found at the sack of Buda (Ofen) in 1526, and printed at Basle in 1534. Other codices have since been discovered. The story is that the daughter of Persine, wife of Hydaspes, king of Aethiopia, was born white. Fearing an accusation of adultery, the mother gives the babe to the care of a gymnosophist. The child is finally taken to Delphi, and made a priestess of Apollo under the name of Charicleia. Theagenes, a noble Thessalian, comes to Delphi and the two fall in love with each other. He carries off the priestess with the help of an Egyptian, employed by Persine to seek for her daughter. After many adventures the chief personages meet at Meroë at the very moment when Charicleia is about to be sacrificed to the gods by her own father. Her birth is made known, and the lovers are married. The rapid succession of events, the variety of the characters, the graphic descriptions of manners and of natural scenery, the simplicity and elegance of the style, give the *Aethiopicn* great charm. As a whole it offends less good taste and moral decency than other romances of its class. Homer and Euripides were the favourite authors of Heliodorus, who in his turn was imitated by French, Italian and Spanish writers. The early life of Clorinda in Tasso's *Jerusalem Delivered* (canto xii. 21 sqq.) is almost identical with that of Charicleia; Racine meditated a drama on the same subject; and it formed the model of the *Persiles* y *Sigismunda* of Cervantes. According to the ecclesiastical historian Socrates (*Hist. eccles.* v. 22), the author of the *Aethiopica* was a certain Heliodorus, bishop of Tricca in Thessaly. But it is now generally agreed that the real author was a sophist of the 3rd century A.D.

The best editions are: A. Coraes (1804), G. A. Hirschig (1856); *see* also *M.* Oeftering, *H. und seine Bedeutung für die Literatur,* with full bibliographies (1901); J. C. Dunlop, *History* of *Prose Fiction* (1888); and especially E. Rohde, *Der griechische Roman* (1900). There are translations in almost all European languages.

HELIOGABALUS: *see* ELAGABALUS.

HELIOMETER, an instrument originally designed for measuring the variation of the sun's diameter at different seasons of the year (named from Gr. ἥλιος, sun, and μέτρον, a measure). By subsequent improvements it became one of the most accurate astronomical instruments for measuring angular distances between stars, but its work is now done by photography and the heliometer is rarely used.

In the standard heliometer the object-glass is cut into two semi-circular segments. In the zero position the two halves form practically a single object-glass; they can be displaced by sliding their straight edges over one another, the amount of displacement being measured by a screw; a double image of each star is thus formed, *i.e.*, one by each half-lens. If the distance between two stars is being measured, the observation consists in turning the screw until the image from one star coincides with that from the other. For greater precision it is found desirable to move both segments an equal amount in opposite directions, so that the centre of the field of view where the observations of coincidence are made remains a centre of symmetry. Distances up to 2° are measured with these instruments.

The first use of a divided object-glass to give a double image is due to Servington Savary in 1743, but his segments were not movable. Pierre Bouguer (1748) invented an instrument used in the manner of a modern heliometer but employing two complete lenses instead of half-lenses to give the double image. In 1754 John Dollond combined Savary's idea of the divided object-glass with Bouguer's method and constructed the first really practical heliometer. The heliometer acquired a great reputation through the work of Bessel at Konigsberg, who used it to measure the parallax of 61 Cygni. Many instruments were made for the transit of Venus expeditions in 1874. The last great heliometer observer was Sir David Gill; his measurements of the parallax of southern stars remained for a long while unsurpassed; he used it also for his important determinations of the solar parallax by observations of Mars and certain minor planets.

See Bessel, *Astronomische Untersuchungen,* vol. i.; Gill, ***Annals*** of *Cape Observatory,* vol. vii., pp. 1–71.

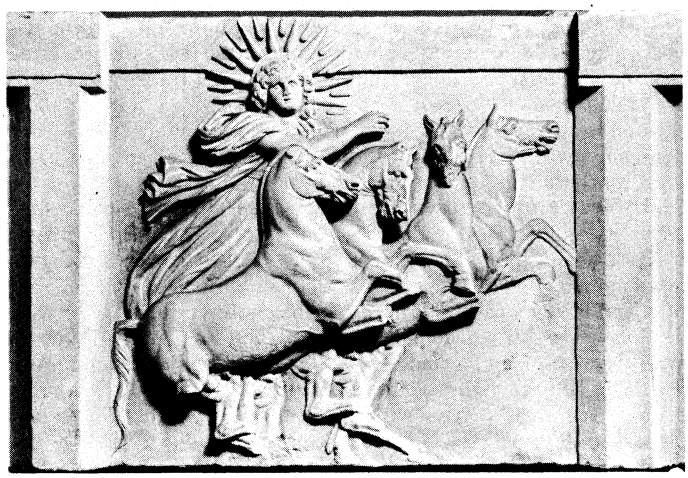
HELIOPOLIS, an ancient city of Egypt (the Biblical On). It stood 5 m. E. of the Nile at the apex of the Delta. It was the principal seat of sun-worship, and in historic times its importance was entirely religious. There appear to have been two forms of the sun-god at Heliopolis in the New Kingdom — namely, Ra-Harakht, or Rē'-Harmakhis, falcon-headed, and Etōm, human-headed; the former was the sun in his mid-day strength, the latter the evening sun. A sacred bull was worshipped here under the name Mnevis (Mreu), and was especially connected with Etōm. The sun-god RE' (*see* EGYPT: *Ancient Religion: Pantheon*) was the royal god, the ancestor of all the Pharaohs, who therefore held the temple of Heliopolis in great honour. Each dynasty might give the first place to the god of its residence — Ptah of Memphis. Ammon of Thebes, Neith of Sais, Bubastis of Bubastis, but all alike honoured Rē'. His temple became in a special degree a depository for royal records, and Herodotus states that the priests of Heliopolis were well informed in matters of history. The schools of philosophy and astronomy are said to have been frequented by Plato and other Greek philosophers; Strabo, however, found them deserted, and the town itself almost uninhabited, although priests were still there. The Ptolemies probably took little interest in their "father" RE', and Alexandria had eclipsed the learning of Heliopolis; thus with the withdrawal of royal favour Heliopolis quickly dwindled. In Roman times obelisks were taken from its temples to adorn Rome and the northern cities of the delta.

Finally, the growth of Fostat and Cairo! only 6 mi. S.W., caused the ruins to be ransacked for building materials. The site was known to the Arabs as *'Ayin esh shems,* "the fountain of the sun," later as Tel Hisn. It has been brought for the most part under cultivation, but the ancient city walls are to be seen in the fields on all sides, and the position of the great temple is marked by an obelisk and a few granite blocks bearing the name of Rameses II.

HELIOSTAT, an instrument containing a mirror driven by clockwork so as to reflect sunlight in a fixed direction; *e.g.*, onto the slit of a fixed spectroscope. It is of more complicated design than the coelostat (*q.v.*).

It has the advantage over the coelostat that the instrument fed by it need not be moved from day to day as the declination of the sun changes; the disadvantage is that only one point of the image remains fixed, the remainder rotating around it, so that unlike the coelostat it cannot be used for photographing an extended region.

HELIOS, the Greek word for the sun, always a god. He was, however, a minor mythological character and had no original Greek cult. He drove a chariot daily from east to west across the sky and sailed round the northerly stream of Ocean each night in a huge cup. In Homer he is invoked. as the all-seeing god, to witness oaths; his wrath when his cattle are killed by Odysseus'



STAATLICHE MUSEEN OF BERLIN

HELIOS IN HIS CHARIOT. RELIEF SCULPTURE, EXCAVATED AT TROY. 1872

companions, who had sworn to spare them, is one of the minor themes in the *Odyssey*. In classical Greece Helios was worshiped almost exclusively in Rhodes, where from at least the early 5th century B.C. he was regarded as the chief god, to whom the island belonged and from whom its first inhabitants sprang. His worship spread as he became increasingly identified aith other deities, often under eastern influence.

From the 5th century B C. Apollo (*q.v*), originally a deity of light, was more and more interpreted by thinkers as a sun-god; during the Roman empire the sun itself came to be worshiped as the Unconquered Sun.

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HELIOTHERAPY: *see* LIGHT AND RADIATION IN RELATION TO HEALTH.

HELIOTROPE or TURNSOLE, a common name applied both to the garden'heliotrope *(see* VALERIAN) and the plants described below, which belong to the genus *Heliotropium.* The name indicates a plant which follows the sun with its flowers or leaves.

Heliotropium is a genus of usually more or less hairy herbs or undershrubs of the family Boraginaceae, having alternate, rarely almost opposite leaves; small white, lilac or blue flowers, in terminal or lateral one-sided simple or once or twice forked spikes, with a calyx of five deeply divided segments, a salver-shaped, five-lobed corolla, and entire four-celled ovary; fruit two- to four-sulcate or lobed, at length separable into four one-seeded nutlets or into two hard two-celled carpels. The genus contains 220 species indigenous in the temperate and warmer parts of both hemispheres, but commonest in the old world. A few species are natives of Europe, as *H. europaeum.* This, as well as four or five other species, is naturalized along the Atlantic seaboard of North America.

The common heliotrope. *H. arborescens,* popularly known as cherry pie, is a great favourite with florists because of the delicious odour of its flowers. It was introduced into Europe by the younger Jussieu, who sent the seed of it from Peru to the royal garden at Paris. About the year 1757 it was grown in England by Philip Miller from seed obtained from St. Germain, near Paris. *H. corymbosum* (probably a native of Peru), which was grown in Hammersmith nurseries as early as 1812. has larger but less fragrant flowers than *H. arborescens.* It is from these two species that most of our garden heliotropes have been derived. Some of them are known as turnsole. The species commonly grown in Russia is *H. suaveolens,* which has fragrant white flowers.

The fragrant butterbur, better known as sweet coltsfoot, *Petasites fmgrans,* a perennial plant of the family Compositae, is sometimes called winter heliotrope because of the perfume of its flowers.

Heliotrope also is a name given to the mineral called bloodstone (*q.v.*) and sometimes girasol—a name applied also to fire opal. The mineral is a green variety of chalcedony, flecked and streaked with spots of red jasper. *See* also SILICA. (X.; N. TR.)

HELIOZOA, an order of single-celled animals (protozoa; *q.v.*) mostly spherical in form, distinguished by numerous, somewhat stiff, protoplasmic processes (axopodia), which serve primarily for capturing food and also are of some use in locomotion.

HELIUM (chemical symbol, He), aside from hydrogen the lightest substance known, is a member of a family of normally gaseous elements, called the noble or inert gases because of their complete lack of chemical activity. Helium was first used in large quantities for lifting airships (see *Uses* below).

History. — Helium was discovered in 1868 in the gaseous atmosphere surrounding the sun. Several scientists, including P. Janssen, a prominent French astronomer, observed in India an eclipse of the sun which occurred on Aug. 18,1868. They noted a number of bright lines in the spectrum of the solar chromosphere and thus recognized the gaseous nature of the prominences, but they were uncertain as to the exact position of the lines in the spectrum. The number of lines seen by several of the scientists differed from the number of lines noted by others in the group. Janssen continued his observations of the unobscured sun for 17 days after the eclipse and reported his findings by telegram to the French Academy of Sciences. If he observed the helium D_3 line. it made no special impression on him. for it was not mentioned in either the telegram or the letter report that followed.

The following October. J. Norman Lockyer, a brilliant English astrophysicist, observed the chromosphere through a special telescope that he had designed in 1866, and he showed conclusively that the prominences of the sun gave a bright-line spectrum and were, therefore, immense volumes of gas, shooting out from a gaseous solar envelope; and, furthermore, that they were composed in part of hydrogen. Lockyer noted also a yellow line in the spectrum that did not correspond to the two already known D lines of sodium. These findings were reported to the Royal society on the day of their discovery, Oct. 20, 1868. They were reported also to the French Academy of Scitnces by Warren de la Rue, who introduced a letter from Lockyer dated Oct. 23. Strangely enough, the announcement by De la Rue of Lockyer's discovery and Janssen's letter report to the academy were received only a few minutes apart.

Thus a problem of proper apportionment of credit for the discovery of the gaseous nature of the prominences was presented. Janssen actually observed the bright lines in the spectrum of the chromosphere two months before Lockyer, but Lockyer conceived the idea of investigating the chromosphere with the spectroscope in 1866 and actually originated the method for doing it. The coincidence of their separate investigations served to cement a close friendship between the two scientists, however, and a medallion bearing the profiles and names of both Janssen and Lockyer was struck by the French Academy of Sciences to commemorate their discovery.

Lockyer continued his investigations and on Nov. 15, 1868, he fixed the yellow line that he had noted previously in the spectrum of the chromosphere at a position which he called D_3. After subsequent exhaustive experiments in co-operation with Edward Frankland, who thought the line might be due to hydrogen at solar temperature and pressure, Lockyer became convinced that the D_3 line was caused by a substance then unknown on earth. He called the substance helium, deriving the word from *helios,* the Greek name for the sun.

Probably the first terrestrial helium mas observed in a laboratory by W. F. Hillebrand, of the U.S. geological survey, in 1891. when he experimented with an inert gas which he obtained by heating uraninite, a uranium oxide. This gas consisted mainly of nitrogen, but its spectrum was unusual because it contained strange lines not identifiable with any elements known to exist on earth. Hillebrand attributed the strange lines to variations of pressure in the spectrum tube and failed to investigate the matter further, rejecting the suggestion by one of his colleagues that a new element might be present.

It remained, therefore, for Sir William Ramsay, a London professor. to discover the existence of helium on earth. When informed of Hillebrand's work. Ramsay obtained a sample of the mineral cleveite (a uranium-bearing mineral). and in March 1895 he duplicated Hillebrand's experiments in an effort to produce

argon, an element which he and Lord Rayleigh had discovered in the air in the summer of 1894. Upon intestigating the resultant gas with the spectroscope, Ramsay found argon as he had hoped; but, to his astonishment, he also found in the spectrum the bright yellow line of helium. At Ramsay's request, Sir William Crookes measured the wave length of the yellow line and confirmed its identity with the line found in the spectrum of the sun. Ramsay's discovery of helium as a constituent of the earth was announced in simultaneous communications to the British Royal society and the French Academy of Sciences on March 26, 1895. In the same year, Ramsay discovered helium in a specimen of meteoric iron from Augusta county, Va., and H. Kayser found helium to be a component of the atmosphere. Later, Ramsay and Frederick Soddy discovered that helium is a product of the spontaneous disintegration of radioactive substances. In 1905 H. P. Cady and D. F. McFarland found that natural gas produced from a shallow well near Dexter, Kan., contained 1.84% helium, and when helium-bearing natural gas was found in other fields large sources of helium became available.

Occurrence. — Although helium occurs in the atmosphere to the extent of 1 part in 186,000, and small amounts occur in radioactive minerals, meteoric iron and mineral springs, by far the greatest volumes of helium are in natural gases produced over widely distributed areas in the Cnited States. In only a few localities, however, is helium present in enough quantity to permit economic extraction.

The best-known sources of supply are in the Texas Panhandle, northwestern New Mexico. Kansas and Utah. The Cliffside gas field near Amarillo, Tex., is perhaps the best-known source because it supplies helium-bearing natural gas to the U.S. bureau of mines Amarillo helium plant where most of the world's supply of helium was produced prior to World War II. The helium content of gas produced from the Cliffside field is about 1.8%. A noncombustible gas containing 7.6% helium was found in 1942 in the Rattlesnake field of northwestern New Mexico. The best natural-gas sources in Kansas contain 1% to 1.5% helium, which is slightly higher than the helium content of gas from the Channing area of the large Panhandle gas field, north of Amarillo, Tex.; however, the volume of helium in the Panhandle field is very great. Helium occurs also in several Canadian provinces, but these occurrences, like all others known to exist outside the United States, are of minor importance.

Production. — The production of helium on a large scale was born of military necessity. The use of lighter-than-air craft filled with hydrogen is exceedingly hazardous in military operations because incendiary bullets easily ignite the gas.

The federal government is the only producer of helium in the United States. There has been a tremendous increase in the amount of helium produced by the U.S. bureau of mines since 1938. In that year the government produced 5,830,750 cu.ft. of helium. Production soared during World War II and reached 137,000,000 cu.ft. in 1944. The output amounted to 81,000,000 cu.ft. in 1950 and then rose rapidly to 235,000,000 cu.ft. in 1955. The increase in production after 1950 is mainly due to the use of helium for welding.

The helium contents of natural gases processed in the bureau of mines plants ranged from 1% to 7½%. Carbon dioxide, other acidic gases and water vapour are removed from the natural gas by washing it with a solution of monoethanolamine and glycol, and it is dried further with activated alumina before it is transmitted to the main separation cycle. The gas then is cooled to approximately −300° F. by a nitrogen refrigeration cycle and counterflow heat exchangers. At that temperature, and under a pressure of more than 600 lb. per square inch, all of the constituents of the gas, except helium and some nitrogen, are liquefied. The liquid is drawn off the bottom of the apparatus, and crude helium composed of about 50% helium and 50% nitrogen is removed from the top of the apparatus for further purification. The crude helium is compressed to 2,500 lb. per square inch pressure and cooled by a cycle similar to that used in the initial separation. Most of the remaining nitrogen is liquefied and the purity of the helium is increased to 98.2%.

This is the grade of helium that was produced until recent developments in welding and other metallurgical processes required that purer helium be made available. The 98.2% pure helium now is purified further by passage through activated coconut charcoal surrounded by a bath of liquid nitrogen. This helium: which contains only a trace of impurity, is conveyed into clean, dry high-pressure containers for shipment.

Physical and Chemical Properties. — Helium is a colourless, odourless and tasteless gas with a density of 0.1785 g. per litre at 0° C. Chemically it is completely inert (zero valence) and forms no compounds. It is a monatomic element with an atomic number of 2, and it exists naturally in two stable isotopic forms, He^3 with an atomic mass of 3.0170 and He4 with an atomic mass of 4.0039. With the exception of a trace (10^{-5}%) of He^3, all of the naturally occurring helium is He^4. The unstable isotope He^6 with atomic mass 6.0208 is radioactive with a half-life of 0.8 sec. The liquid phases of He^4 and He^3 are quite remarkable fluids and have become of considerable scientific interest as macroscopic demonstrations of quantum effects. The detailed understanding of their unusual properties is still a challenge to science. Both He^4 and He^3 do not solidify without the help of an external pressure of at least 25 atmospheres and they stay liquid to the lowest temperatures attained experimentally, and there is no indication that they will form solid crystals at even lower temperatures. This unusual behaviour is a consequence of the zero point energy postulated by quantum mechanics (*q.v.*) which is intimately related to the uncertainty principle (*q.v.*). The momentum and position of a particle cannot be fixed simultaneously with arbitrary accuracy. If the helium atoms have to be localized on the points of a crystal lattice their momentum and therefore their kinetic energy would be so great that they would overcome the forces holding the crystal together. Nature compromises in this dilemma by letting helium stay liquid where the atoms are not so narrowly confined in space. reducing in this way the zero point energy sufficiently so that a condensed phase can be formed. Zero point energy is also responsible for the extremely low liquid density, boiling points and critical points of helium, as shown in the table.

Boiling Points and Critical Points of Helium

	Boiling point				Critical point	
	°C.	°F.	Absolute temperature, °K.	Liquid density, g. per c.c.	Temperature, °K.	Pressure atmosphere
He^4	−268.9	−452.0	4.2	.13	5.2	2.3
He^3	−269.9	−453.8	3.2	.08	3.4	1.2

Other strange properties of helium are due to more subtle features of quantum mechanics. Liquid He^4 undergoes a transition at 2.19° K. called the λ-point. The modification above 2.19° K. is called He I, the modification below this temperature He II. There is no change in density or any latent heat connected with this transition, in contrast to the freezing of a liquid. Specific heat and expansion coefficient change abruptly, and especially striking are the changes in transport phenomena. The heat conductivity of He II is about 100,000,000 times that of He I, and more than 100 times better even than that of copper. The viscosity of He II diminishes rapidly with decreasing temperature to fractions of micropoise (the viscosity of water being about 10,000 micropoise) when measured with a viscometer. The flow through narrow channels of less than 0.001 cm. nidth takes place without any measurable friction at all. A certain amount of liquid He II passes through such a slit in a fraction of a second; the same amount of helium as gas needs several days to pass the slit.

If a temperature difference arises between two chambers filled with liquid He II and connected by such a narrow slit or a diaphragm an appreciable difference in pressure is produced. the warmer side showing the higher pressure. This can be demonstrated by a simple glass tube extending above the level of the liquid, part of which is filled with a fine powder acting as a diaphragm. Heating the ponder by shining a light upon it causes the liquid He II to spout out of the top of the tube up to a height of 10 in. due to the pressure differences created by this strange effect. which earns it the name "fountain effect."

All these extraordinary properties of liquid He II are due to superfluidity. Near the absolute zero of temperature, liquid He^4 can move up to certain critical velocities of several centimeters per second without any friction, a state which is called superfluid. At temperatures between absolute zero and 2.19° K., He II is considered as consisting of a mixture of this superfluid and a normal fluid. the latter behaving more or less like ordinary fluids in showing the usual resistance to mechanical motion or heat flow. At 2.19° K. the whole liquid helium consists only of the normal part of the fluid and becomes He I which has properties similar to those of the other condensed rare gases.

The physical properties of isotopes are usually quite similar, but not in the case of the helium isotopes. The relative difference in mass between He^3 and He^4 is considerable, and as the mass determines the zero point energy it causes also the appreciable differences in boiling points, critical points, etc. of the two isotopes. Moreover, liquid He^3 does not show a A-transition or superfluidity. He" consists of an uneven number of nucleons and obeys therefore the Pauli principle which requires that every quantum state be only singly occupied. He^4 consists of an even number of nucleons and is not subject to this restriction; at very low temperatures all particles can condense into the lowest quantum state, a phenomenon often called Bose-Einstein condensation. It seems rather certain that superfluidity is intimately related with the Bose-Einstein condensation and therefore only possible for He^4. Furthermore a liquid mixture of He^3 and He^4 breaks up into two separate phases containing more or less pure isotopes below $\frac{1}{2}$° K.

uses.—Helium is still used as a lifting gas, the purpose for which it was originally produced in large volumes. It is the ideal gas for this purpose because it will provide 92.64% as much lift as will hydrogen and it is completely safe to handle. Helium-filled U.S. navy blimps played an important part in defeating the axis submarine campaign in the Atlantic ocean in World War II. Smaller, but important, volumes of helium are used by the U.S. weather bureau to carry radiosonde balloons aloft for weather observations.

In addition to this basic use, many medical and industrial applications for helium have been found since the bureau of mines was authorized in 1937 to sell helium for medical, scientific and commercial use. Helium is used to provide inert atmospheres in the welding of light metals and in other metallurgical operations. Because of its low refractive index, helium is used to fill the spaces between multiple optical lenses arranged in series. It is employed as a tracer, especially in the determination of oil and gas migration in underground geologic structures. In 1925 the bureau of mines issued a report by R. R. Sayers, W. P. Yant and J. H. Hildebrand, who recognized that helium is less soluble in body tissues than nitrogen and studied the use of helium-oxygen mixtures in mitigating caisson disease. Resulting developments by the bureau of mines and the navy department proved that divers can go to greater depths and work longer if a breathing mixture of helium and oxygen is supplied to them.

Helium has a low density and can be mixed with oxygen in suitable proportions for medical use. The mixture can be moved through relatively small airways more freely than air. It is useful in partial obstructions and spasms of the air passages. Reports by A. L. Barach. A. R. Benke. P. A. Neal and other physicians state that less effort is required to breathe helium-oxygen mixtures than to breathe air and that such mixtures may be used effectively in the treatment of respiratory diseases. especially acute cases of asthma. G. W. Jones and G. J. Thomas reported also that helium may be used as a diluent with various anaesthetics, especially cyclopropane, to prevent explosions in operating rooms, and in the treatment of certain operative complications with helium-oxygen mixtures.

As a result of the wartime expansion of helium production facilities, and the decline in military requirements which occurred at the end of hostilities in World War II, large volumes of helium became available to private enterprise at moderate cost. This caused the demand to increase so much that at the International Meeting on Low Temperature Physics in Madison, Wis., in Xug. 19j;, an immediate conservation program was unanimously urged.

Sae H. P. Wheeler, Jr., "Helium," U.S. Bureau of Mines *Bulletin* jj6 (Washington, D.C., 1955); W. H. Keesom, *Helium* (New York, 1946); F. London, *Superfluids,* vol. ii (New York, 1954).

(H. P. WR.; L. MR.)

HELIX, a line which rises as it twists, such as the line of a screw thread. In architecture, the term helix is sometimes given to the spirally twisted stalks or volutes under the corners of the abacus of the Corinthian capital (*see* ORDER). The helix form is also found most commonly in architecture in those curving stairways which are popularly known as spiral.

HELL, used in English both of the place of departed spirits and of the place of torment of the wicked after death (O. Eng. *hel,* a Teutonic word from a root meaning "to cover"). In the O.T. it translates the Hebrew *Sheol,* in the N.T. the Greek "Hades," and Hebrew *Gehenna.*

See ESCHATOLOGY; HEAVEN.

HELLANICUS OF LESBOS (fl. late 5th century B.C.), Greek historian, whose work marks an advance in the development of historiography. According to the Suda lexicon, he lived for some time at the court of one of the kings of Macedon and died at Perperene, a town in Asia Minor near the gulf of Adramyttium.

Some 30 works (of which only fragments survive) are attributed to him, including *Hiereiai tes Heras en Argei* ("Priestesses of Hera at Argos"), a chronological compilation; *Karneonikai,* a list of the victors at the Carnean festival with notices of literary events; *Phoronis,* a mainly genealogical work covering the period up to the return of the Heracleidae; and *Atthis* which gives the history of Attica from 683 to the end of the Peloponnesian War (404). Thucydides says that in this work the events of 480 to 431 were treated briefly and superficially, with little regard to chronology.

Hellanicus was not content to repeat the traditions that had gained general acceptance through the poets, but tried to give them as they were locally current. By using the few national or priestly lists that presented something like contemporary registration, he attempted to lay the foundations of a scientific chronology, based primarily on the list of the Argive priestesses of Hera, and secondarily on genealogies, lists of magistrates (*e.g.,* the archons at Athens) and oriental dates, in place of the old reckoning by generations. But as his materials were insufficient he often fell back on the older methods. Because he deviated so much from common tradition he was thought untrustworthy by the ancients themselves.

Hellanicus appears to have made no systematic use of inscriptions, and unlike his contemporary Herodotus, never rose to the conception of a single current of events wider than local and ethnical distinctions. A remark of Dionysius of Halicarnassus that Herodotus was not deterred from a theme already handled by Hellanicus and Charon of Lampsacus refers only to their raw material and not to their historical viewpoint.

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(G. T. GH.)

HELLBENDER, common name for the aquatic salamander *Cryptobranchus alleganiensis* of the eastern United States. The hellbender and the giant salamanders (*Megalobatrachus*) of Japan and China are the only survivors of a primitive family (*Cryptobranchidae*) that was more widely distributed through the northern hemisphere in the Tertiary period, which began about 70,000,000 years ago.

The major part of the range of the thoroughly aquatic hellbender is within the larger, swift-flowing streams of the Ohio river system, but it is also found in other tributaries of the central Mississippi and in the Susquehanna river in New York.

This grotesque salamander has a flat head and body, compressed tail and wrinkled fleshy folds on the sides. Although the adult is lung-breathing, a gill slit persists on each side behind the head. The back colour is gray or brown with darker blotches. Maximum size is 27 in.

The hellbender feeds on small fish, crayfish and other inverte-

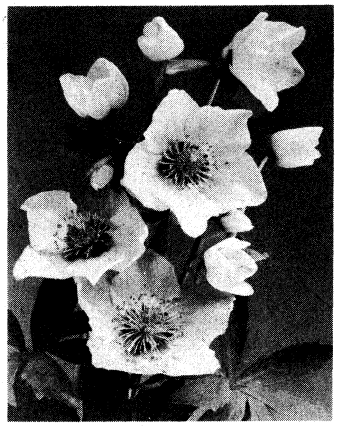
brates and is occasionally caught taking bait off fishing lines.

Mating takes place during August and September. Each female deposits 300–400 eggs in rosarylike strings in a nest scooped out beneath a stone or other shelter in the stream bed. The male fertilizes the eggs as they are laid and guards the nest during incubation, which takes 10 to 12 weeks. Young lose their external gills in a year or two but do not mature until three to four years old.

See AMPHIBIA. (*G.* B, R.)

HELLEBORE, any of a genus *Helleborus,* of plants of the family Ranunculaceae (*q.v.*), natives of Europe and western Asia. They are coarse, perennial, poisonous-juiced herbs with lobed leaves. The flowers have five persistent petaloid sepals, within the circle of which are placed the minute honey-containing tubular petals of the form of a horn with an irregular opening. The stamens are very numerous and are spirally arranged. The carpels are variable in number, sessile or stipitate and slightly united at the base; they dehisce by ventral suture.

Helleborus niger, black hellebore or Christmas rose (so-called because it blooms in midwinter) is found in southern and central Europe, and with other species was cultivated in English gardens as early as the 16th century. Its knotty rootstock is blackish-brown externally and poisonous. The leaves spring from the top of the rootstock, and are smooth, distinctly pedate, dark green above and lighter below, with seven to nine segments and long petioles.



J. HORACE MCFARLAND CO.

BLACK **HELLEBORE** OR **CHRISTMAS ROSE** (HELLEBORUS NIGER)

The scapes, which end the branches of the rhizome, have a loose entire bract at the base and terminate in a single flower with two bracts from the axis of one of which a second flower may be developed. The flowers have 5 broad white or pale rose, eventually greenish sepals; 8 to 13 tubular green petals containing honey; and 5 to 10 free carpels. There are several forms, the best being H. *niger altifolius.*

The Christmas rose is extensively grown in many English and American gardens to provide white flowers about Christmas time for decorations. A related species. H. *orientalis,* blooms in early spring, it is usually called the Lenten rose. H. *niger altifolius* grows to two feet, half a foot taller than the typical form, has red-spotted stalks and a pink-tinged flower nearly four inches wide. Because its roots are brittle, it should be carefully planted, preferably in the shade where the soil is moist and rich. It may be planted either by roots or seeds. The best time for planting is in the months of August and September.

H. orientalis has given rise to several fine hybrids with *H. niger,* some of the best forms being clear in colour and distinctly spotted. H. *foetidus,* stinking hellebore or bear's-foot, is found in England where, like *H. viridis,* it is confined chiefly to limestone districts; it is common in France and the south of Europe. Its leaves have 7- to 11-toothed divisions, and the flowers are in panicles, numerous. cup-shaped and drooping, with many bracts and green sepals tinged with purple alternating with the five petals.

H. viridis is probably indigenous in some of the southern and eastern counties of England and occurs also in central and southern Europe. It has bright yellowish-green flowers, two to four on a stem, with large leaflike bracts.

H. viridis is usually, but unfortunately, called green hellebore, and was thought by some to be the black hellebore. Confusion still exists because green hellebore is properly applied to *Veratrum viride,* an equally poisonous herb. White or false hellebore also belongs to the genus *Veratrum* (*q.v.*), of the family Liliaceae.

The rhizome of H. *niger* occurs in commerce in irregular and nodular pieces, from about one to three inches in length, white and of a horny texture within. Cut transversely, it presents internally a circle of 8 to 12 wedge-shaped ligneous bundles, surrounded by a thick bark. It emits a faint odour when cut or broken and has a bitter and slightly acrid taste. The drug is sometimes adulterated with the rhizome of baneberry, *Actaea rubra,* which however, may be recognized by the distinctly cruciate appearance of the central portion of the attached roots when cut across. *H. niger, viridis,* and *foetidus* contain the glucosides helleborin. helleborem and hellebrin. These compounds are extremely poisonous and in sufficient doses lead to cramps, vomiting, convulsions and sometimes death.

In medical preparations the drug was once employed as a purge in dropsy but is now considered more dangerous than beneficial. It is occasionally used in veterinary medicine. (N. TR.)

HELLENISM. The term Hellenism is ambiguous. It is derived from Gr. ἑλληνίζειν, "to speak the language of the Greeks." who called themselves Ἕλληνες, after Hellen, the son of Deucalion. In late Greek Ἑλληνισμός means "imitation of the Greeks" (Septuagint. II Macc iv, 13). It may be used to denote ancient Greek culture in all its phases. The German historian J. G. Droysen introduced the fashion of using it to describe particularly the latter phases of Greek culture from the conquests of Alexander to the end of the ancient world. when those over whom this culture extended were largely not Greek in blood: *i.e* , Hellenes but peoples who had adopted the Greek speech and nay of life. *Hellenistai.*

While using the term in the larger sense, this article will devote its principal attention to Hellenism as it appeared in the norld after spread of Greek culture which followed the Macedonian conquests

THE EXPANSION OF HELLENISM BEFORE ALEXANDER

In the 5th century B.C. Greek cities dotted the coasts of the Mediterranean and the Black sea from Spain to Egypt and the Caucasus, and already Greek culture was beginning to pass beyond the limits of the Greek race. As early as the 7th century B.C., when Hellenism was still in a rudimentary stage. Greek mercenaries came to be in request throughout the nearer east. But as Hellenism developed, its social and intellectual life began to exercise a power of attraction. The proud old civilizations of the Euphrates and the Nile might ignore it, but the ruder barbarian peoples came in various degrees under its spell. In some cases an outlying colony would coalesce with a native population, and a fusion of Hellenism with barbarian customs take place.

The great developments of the century and a half before Alexander set the Greek people in a very different light before the world. In the sphere of material power the repulse of Xerxes greatly enhanced Greek military prestige. The kings of the east leaned more than ever upon Greek mercenaries. whose superiority to barbarian levies was further brought home to them by the expedition of Cyrus. But the developments within the Hellenic sphere itself were also of great consequence for its expansion outward. The political disunion of the Greeks was to some extent neutralized by the rise of Athens to a leading position in art, literature and philosophy. and by the fact that the Attic dialect attained a classical authority; if Hellenism was to be propagated in the world at large. it was obviously convenient that it should have some one definite form of speech to be its medium.

The Persians. — The ruling race of the east. the Persian, was but little open to the new culture. The military qualities of the Greeks were appreciated. and so, too, was Greek science, where it touched the immediately useful: a Greek architect bridged the Bosporus for King Darius; Greek physicians were retained at the Persian court. Exactly how far Greek influence can be traced in the remains of Persian art. such as the palaces of Persepolis and Susa. may be doubtful, but it is certain that the engraved gems for which there was a demand in the Persian empire were largely the work of Greek artists.

The **Phoenicians**.—As early as the first half of the 4th century communities of Phoenician traders were established in the Peiraceus. In Cyprus, on the frontier between the Greek and

Semitic worlds! a struggle for ascendancy went on. The Phoenician element seems to have been dominant in the island, when Evagoras made himself king of Salamis in 412 and restored Hellenism with a strong hand. Even into the original seats of the Phoenicians Hellenism began to intrude. Abdashtart, king of Sidon (374–362 B.C.), called Straton by the Greeks. entered into close relations with the Greek states and imitated the Hellenic princes of Cyprus.

The Carians and **Lycians.**—The seats of the Greeks in the east touched peoples more or less nearly related to the Hellenic stock. with native traditions not so far remote from those of the Greeks in a more primitive age, the Carians and the Lycians. The Carian princes of the 4th century B.C.. Hecatomnus and especially Mausolus, modelled themselves upon the pattern of the Greek tyrant. The capital of Mausolus was a Greek city, Halicarnassus, and all that can still be traced of his great works of construction shows conformity to the pure Hellenic type. His famous sepulchre, the Rlausoleum (the remains of it are in the British Museum), was a monument upon which eminent Greek sculptors worked in rivalry. In Lycia Greek influence is more limited. There the native language maintains itself against Greek. The proper names are (if not native) mainly Persian. But the Greek language makes an occasional appearance; the coins are Greek in type; above all, the monumental remains of Lycia show strong Greek influence, especially the well-known "Nereid monument" in the British Museum, the date of which is held to go hack to the jth century.

South Russia and the Danube **Lands.**—A brisk trade. which reached its highest point of development in the 4th century B.C., sprang up between the Scythian chieftains and the Greek colonists. The finds of Greek pottery, and still more of gold and silver ware. in the tombs of southern Russia have been very considerable. But in Scythia Greek influence appears to have been limited to the material sphere (see SCYTHIA). A similar trade connection, which also flourished most in the 4th century. sprang up between Greek merchants from the Black sea or the Adriatic and the inhabitants of the Danube lands. But in these regions the Greeks did less than the Celts and the Italians to introduce a higher civilization.

Egypt.—From the time of Psammetichus (d. 610 B.C.) Greek mercenaries had been used to prop Pharaoh's throne, and Greek merchants had begun to find their way up the Nile and even to the oases. A Greek city, Naucratis (*q.v.*), was allowed to arise at the Bolbitinic mouth of the Nile. But the racial repugnance to the Greek probably kept the soul of the people more shut against Hellenic influences than were those of the other orientals.

Macedonia.—In Macedonia the native chiefs had been attracted by Hellenic life. at any rate from the beginning of the 5th century, when Alexander I persuaded the judges at Olympia that his house was of good Argive descent (Herodotus, v, 22). It was probably not until the reorganization of the kingdom by Archelaus (413–399) that Greek culture found any abundant entrance into Macedonia. Archelaus' palace was decorated by Zeuxis; Euripides spent the end of his days there. From that time a certain degree of literary culture was general among the Macedonia nobility; their names in the days of Philip are largely Greek; the Macedonian service was full of men from the Greek cities within Philip's dominions, and Philip chose Aristotle to be the educator of his son. How far the country generally might be regarded as Hellenized is a problem which involves the vexed question whether Macedonian is to be considered a dialect of Greek.

The West.—The process of Hellenization was carried out most completely in Sicily, where the distinction between native Sicels and Greek settlers faded out in the 4th century B.C.

In Italy the peoples of the south, who came into direct contact with the Greek colonists, showed some proficiency in their imitations of Greek ceramic art and coinage, and they derived their alphabets, directly or indirectly, from Greek script. In central Italy the Romans at first remained comparatively impervious to Greek influence. but the Etruscans in the 6th and 5th centuries became partially Hellenized. It is a moot point how far their alphabet was copied from Greek models, but the dependence of their art (architecture, sculpture, pottery, coins) is unmistakable.

In Gaul the native culture was little affected by Greek civilization until the end of the 4th century B.C. But by 300 B.C. the Greek colony of Massilia had become an important focus of Hellenism. The druids of Gaul adopted the Greek alphabet and scraps of Greek philosophic lore. Imitations of Greek coins (especially the pieces of Philip II of Macedon) were struck even in the remote parts of the country. and rude copies of the Gallic pieces were in turn produce'd in southern Britain.

In Spain the native art of the eastern districts came under Greek influence in the jth and 4th centuries B.C.. but the growing political ascendancy of Carthage in the peninsula proved unfavourable to the spread of this influence.

In north Africa the Carthaginians. albeit political enemies of the Greeks. did not remain untouched by Greek culture. By the 4th century they had begun to copy Greek architecture, sculpture and coinage. and to use Greek as a subsidiary tongue.

AFTER ALEXANDER THE GREAT

By 350 B.C. Hellenism had not seriously affected any but the more primitive races which dwelt upon the borders of the Hellenic lands, and there. with the doubtful exception of the Macedonians, was rather for the courts than for the people. Everything was changed when by the conquests of Alexander (334–323) Hellenism rose to material supremacy in all the east as far as India, and when cities of Greek speech and constitution were planted at the cardinal points of intercourse within those lands. The Macedonian chiefs found their pride in being champions of Hellenism. Their courts were Greek in language and atmosphere. All kings liked to win the good word of the Greeks. All of them in some degree patronized Greek art and letters, and some sought fame for themselves as authors. Even the barbarian courts, their neighbours or vassals. were swayed by the dominant fashion. But by the courts alone Hellenism could never have been propagated far. Greek culture had been the product of the city-state, and Hellenism could not be dissevered from the city. It n-as upon the system of Greek and Macedonian cities, planted by Alexander and his successors. that their work rested. Rome. when it stepped into their place, safeguarded its continuance, and acted as a Hellenistic power.

The Character of the New Greek Cities.—The citizen bodies at the outset were really of Greek or Macedonian blood—soldiers who had served in the royal armies, or men attracted from the older Greek cities to the new lands thrown open to commerce. The cities, of course, drew in numbers beside of the people of the land. The cities were Hellenic in their political organs and functions. with boule and demos and popularly elected magistrates. Life was filled with the universal Hellenic interests, which centred in the gymnasium and the religious festivals, these last including, of course, not only athletic contests but performances of the classical dramas or later imitations of them. The wandering sophist and rhetorician would find a hearing no less than the musical artist. The language of the upper classes was Greek; and the material background of building and decoration, of dress and furniture, was of Greek design. A greater regularity in the street plans distinguished the new cities from the older, slowly grown cities of the Greek lands.

Sometimes the Greek city was not an absolutely new foundation. but an old oriental city recolonized and transformed. And in such cases the old name was often replaced by a Greek one. Even where there was no new foundation the older cities of Phoenicia and Syria became transformed by the overwhelming prestige of Hellenic culture. In Tyre and Sidon. no less than in Antioch or Alexandria. Greek literature and philosophy were seriously cultivated, as may be seen by the great names which they contributed.

CHARACTERISTICS OF HELLENISM AFTER ALEXANDER

Hellenism had been the product of the free life of the Greek city-state, and after the Macedonian conquest the great days of the city-state were past. Not that all liberty was everywhere

extinguished. In the history of the next two or three centuries the cities are by no means ciphers. Rhodes takes a great part in Weltpolitik, as a sovereign ally of one or another of the royal courts. In Greece itself the overlordship to which the Macedonian king aspires is imperfect in extent and only maintained'by continual wars. The Greek states on their side show that they are capable even of progressive political development, the needs of the time being met by the federal system. The Achaean and Aetolian leagues are independent powers, which keep a field clear for Hellenic freedom within their borders. As to the cities outside Greece, within or around the royal realms. Seleucid, Ptolemaic or Attalid, their degree of freedom probably differed widely according to circumstances. At one end of the scale, cities of old renown could still make good their independence. At the other end of the scale the cities which were royal capitals, *e.g.*, Alexandria, Antioch and Pergamum, mere normally controlled altogether by royal nominees. Between the two extremes there was variation not only between city and city, but, no doubt, in one and the same city at different times. With the extension of the single strong rule of Rome over this Hellenistic world. the conditions were changed. Just as the Macedonian conquest, while increasing the domain of Greek culture, had straitened Greek liberty, so Rome, while bringing Hellenism finally into secure possession of the nearer east, extinguished Greek freedom altogether. Even now the old forms were long religiously respected. Formally, the most illustrious Greek states. Athens. for instance, or Marseilles or Rhodes, were not subjects of Rome, but free allies. Even in the case of tribute-paying states, municipal autonomy, subject indeed to interference on the part of the Roman governor, was allowed to go on. But during the first centuries of the Christian era, this municipal autonomy decayed. The demos first sank into political annihilation and the council: no longer popularly elected but an aristocratic order. concentrated the whole administration in its hands. After Diocletian and under the eastern empire the Greek world was organized on the principles of a vast bureaucracy.

Social **Changes.**—With this long process of political decline correspond the inner changes in the temper of the Hellenistic peoples. When the vast field of the east was opened to Hellenic enterprise and the bullion of its treasuries flung abroad, fortunes were made on a scale before unparalleled. A new standard of sumptuousness and splendour was set up in the richest stratum of society. This material elaboration of life was furthered by the existence of Hellenistic courts, where the great ministers amassed fabulous riches. and of huge cities like Alexandria. Xntioch and the enlarged Ephesus. With the mingling of Greeks of all sorts in the newly conquered lands, a generalized Greek culture, in which the old local characteristics were merged, overspread the world. The gradual supersession of the old dialects by the koine, the common speech of the Greeks, was one obvious sign of the new order of things. (See GREEK LANGUAGE.)

Art and Literature. — In its artistic. its literary. its spiritual products the age after Alexander gave evidence of change. In no department did activity immediately stop; but the old freshness and creative exuberance was gone. Artistic pleasure, grown less delicate, required the stimulus of a more sensational effect or a more striking realism. Artists and men of letters were now addressing themselves not to their fellow citizens in a free city, but to kings and courtiers or the educated class generally of the Greek world.

In the study of the world of fact, the centuries immediately following Alexander witnessed notable advance. Scientific research might prosper under the patronage of kings, and such research had now a vast amount of new material at its disposal and could profit by the old Babylonian and Egyptian traditions. The medical schools, especially that of Alexandria, really enlarged knowledge of the animal frame. Knowledge of the earth gained immensely by the Macedonian conquests.

The literary schools of Alexandria and Pergamum built up grammatical science. and brought literary and artistic criticism to a fine point. The classical products were registered, studied and commented upon. Libraries became a feature of the age; the one attached to the museum at Alexandria is said to have contained 700,000 rolls.

With the general decay of ancient civilization under the Roman empire, even scientific research ceased, and though there were literary revivals, like that connected with the new Atticism under the Antonine emperors, these were mainly imitative and artificial, and learning became under the Byzantine emperors a formal tradition. (See GREEK LITERATURE.)

Religion and Philosophy.—The mingling of citizens of many cities and the close contact between Greek and barbarian in the conquered lands had made the old sanctions of civic religion and morality of less account. New guides of life mere needed. The Stoic philosophy, with its cosmopolitan note. its fixed dogmas and plain ethical precepts came into the world to meet the needs of the new age. Its ideas became popular among ordinary men as the older philosophies had never been.

Although the cults of the old Greek deities in the new cities might still hold the multitude with their splendid apparatus, men turned in ever larger numbers to alien religions, and the various gods of Egypt and the east began to find larger entrance in the Greek world. Before the end of the 2nd century B.C. there were temples of Serapis in Athens, Rhodes. Delos and elsewhere. Under the Roman empire the cult of Isis became popular in the Hellenistic world. Other religions of oriental origin penetrated far, the worship of the Phrygian Great Mother (see GREAT MOTHER OF THE GODS) and, in the 2nd century A.D.. the religion of Mithras (*q.v.*). The Jews, too, by the time of Christ were discovering in many quarters an open door. Besides those who were ready to accept circumcision, numbers adopted particular Jewish practices, observing the Sabbath, for instance, or turned from polytheism to the doctrine of the One God. The synagogues in the Gentile cities had generally attached to them a multitude of those "who feared God" and frequented the services.

Christianity. — Among the religions which penetrated the Hellenistic world from an eastern source. Christianity ultimately overpowered all the rest and made that world its own. The teaching of Christ Himself contained. as it is given to us, no Hellenic element; so far as He built with older material. that material was exclusively the sacred tradition of Israel. As soon, however, as the Gospel was carried in Greek to Greeks, Hellenic elements began to enter into it; in the writings of St. Paul the appeal to what "nature" teaches would be generally admitted to be a Greek mode of thought. There was, at the same time, in the early church a powerful current of feeling hostile to Greek culture. What the attitude of the New People should be to it, whether it was all bad or whether there were good things in it which Christians should appropriate was a vital question to them. The School of Alexandria represented by Clement and Origen effected a durable alliance between Greek education and Christian doctrine. In proportion as the Christian Church had to go deeper into metaphysics in the formulation of its beliefs, the Greek philosophical terminology. which was the only vehicle then available for precise thought, had to become more and more an essential part of Christianity. At the same time Christian ethics incorporated much of the current popular philosophy, especially Stoical elements. In this way the church itself became a propagator of Hellenism.

EFFECT UPON NON-HELLENIC PEOPLES

India. — In India (including the valleys of the Kabul and its northern tributaries, then inhabited by an Indian, not, as now, by an Iranian. population) Alexander planted a numher of Greek towns. Soon after 321 B.C. Macedonian supremacy beyond the Indus collapsed before the advance of the native Maurya dynasty, and about 303 B.C. large districts west of the Indus were ceded by Seleucus. But the Maurya dynasty broke up about 180 B.C., and at the same time the Greek rulers of Bactria began to lead expeditions across the Hindu Kush. Menander. in the middle of the 2nd century B.C., extended his rule to the Ganges. Then "Scythian" peoples from central Asia gradually squeezed within ever-narrowing limits the Greek power in India. The last Greek prince. Hermaeus. seems to have succumbed about 30 B.C. Under the Roman empire, though Greek rule in India had disappeared,

active commercial intercourse went on between India and the Hellenistic lands. How far, through these changes, did the Greek population settled by Alexander or his successors in India maintain its distinctive character? What influence did Hellenism, during the centuries in which it was in contact with India, exert upon the native mind? Only extremely qualified answers can be given to these questions. Capital data are possibly waiting underground—the Kabul valley, for instance, is almost virgin soil for the archaeologist—and any conclusion arrived at is merely provisional. If certain statements of classical authors were true, Hellenism in India flourished exceedingly. But the philhellenic Brahmins in Philostratus' life of Apollonius had no real existence, and the statement of Dio Chrysostom that the Indians were familiar with Homer in their own tongue is a traveller's tale. India has yielded no Greek inscription except on the coins of the Greek kings and their Scythian successors. If it is argued by probability from what is known of the conditions. it must be considered that the Greek rule in India mas all through fighting for existence, and can have had little time or energy left for such things as art, science and literature. Perhaps the Hellenic colonists should rather be thought of as resembling the Greeks found in modern times dispersed over the nearer east. with interests mainly commercial. easily assimilating themselves to their environment. As to what India derived from Greece there has been a good deal of erudite debate. That the Indian drama took its origin from the Greek is still maintained by some scholars, though hardly proved. There is no doubt that Indian astronomy shows marked Hellenic features, including actual Greek words borrowed. But by far the most signal borrowing is in the sphere of art. The stream of Buddhist art which went out eastward across Asia had its rise in northwest India, and the remains of architecture and sculpture unearthed in this region allow its development to be traced back to pure Greek types. How far to the east the distinctive influence of Greece went is shown by the seal impressions with Athena and Eros types, the stucco reliefs and antefixes and the frescoes found by Sir Aurel Stein in the buried cities of Khotan. These remains belong to the period of the early and middle Roman empire. and were probably the work of Hellenized orientals rather than of Greeks: but their Hellenic character is unmistakable. According to E. B. Havell, there exist "paintings treasured as the most precious relics and rarely shown to Europeans, which closely resemble the Graeco-Buddhist art of India" in some of the oldest temples of Japan (Studio, vol. xxvii, p. 26, 1903).

Iran and Babylonia.—The colonizing activity of Alexander and his successors found a large field in Iran. Cities arose in all its provinces. Media was defended by a chain of Greek cities from barbarian incursion. In eastern Iran the cities which are its chief places today then bore Greek names, and looked upon Alexander or some other Hellenic prince as their founder. Khojend, Herat, Kandahar were Alexandrias, Merv was an Alexandria till it changed that name for Antioch. One document from Antioch in Persis (about 206 B.C.) shows the normal organs of a Greek city in full working. It also throws a remarkable light upon the solidarity of the Hellenic dispersion. The citizen body had been increased several generations before by colonists from Magnesia-on-Meander, and in this decree Antioch determines to take part in the new festival being started in honour of Artemis at Magnesia.

Greek *Kingdoms*.—About 250 B.C. Bactria and Sogdiana broke away from the Seleucid empire; independent Greek kings reigned there till the country was conquered by nomads from central Asia a century later. Alexander had settled large masses of Greeks in these regions. In estimating the amount and quality of Hellenism in Bactria during the 180 years or so of Macedonian and Greek rule. hypotheses must be built upon the scantiest data. W. W. Tarn's careful survey leads to the conclusion that palpable evidences of an active Hellenism have not been found; he inclines to think that the Greek kingdoms mainly took on the native Iranian colour. The coins, of course: are adduced on the other side, being not only Greek in type and legend but (in many cases) of a peculiarly fine execution. (See BACTRIA and works there quoted.)

The west of Iran slipped from the Seleucids in the course of the 2nd century B.C., to be joined to the Parthian kingdom or fall under petty native dynasties. Soon after 130 B.C. Babylonia, too, was conquered by the Parthian. and Mesopotamia before 88. Then the reconquest of the nearer east by oriental dynasties was checked by the advance of Rome. Asia Minor and Syria remained substantial parts of the Roman empire until the Mohammedan conquests of the 7th century A.D. began a new process of recoil on the part of the Hellenistic power. The greatest of all the Hellenic colonies stood there—almost on the site of Bagdad—Seleucia on the Tigris. It superseded Babylon as the industrial focus of Babylonia and counted about 600,000 inhabitants. In Mesopotamia, Pliny especially notes how the character of the country was changed when the old village life was broken in upon by new centres of population in the cities of Macedonian foundation.

Hellenic Iranian *Culture*.—When the Parthians rent away provinces from the Seleucid empire, the Greek cities did not cease to exist by passing under barbarian rule. Gradually, no doubt, the Greek colonies were absorbed, but the process was a long one. Seleucia on the Tigris is spoken of by Tacitus as being, in A.D. 36. "proof against barbarian influences." How important an element the Greek population of their realm seemed to the Parthian kings can be seen by the fact that they claimed to be themselves champions of Hellenism. From the reign of Artabanus I (128/7–123 B.C.) they bear the epithet of "Phil-Hellen" as a regular part of their title upon the coins. That the Parthian court itself was to some extent Hellenized is shown by the story that a Greek company of actors was performing the Bacchae before the king when the head of Crassus was brought in. Artavasdes, king of Armenia (54?–34 B.C.), composed Greek tragedies and histories. The Parthian princes were in many cases the children of Greek mothers who had been taken into the royal harems. Many of the Parthian princes resided temporarily, as hostages or refugees, in the Roman empire; but the nation at large looked with anything but favour upon too liberal an introduction of foreign manners at the court.

Such slight notices in western literature do not give any penetrating view into the operation of Hellenism among the Iranians. As an expression of the Iranian mind there are the Avesta and the Pehlevi theological literature. Unfortunately. in a question of this kind the dating of documents is the first matter of importance; and dates can only be assigned to the different parts of the Avesta by processes of fine-drawn conjecture. And even if the Avesta could be dated securely, borrowing could only be proved by more or less close coincidences of idea. a tempting but uncertain method of inquiry. It is enough here to observe that Iran and Babylonia do, as a matter of fact, continually yield the explorer objects of workmanship either Greek or influenced by Greek models. belonging to the age after Alexander, and that hence. at any rate. such an influence of Hellenism upon the tastes of the richer classes as would create a demand for these things may be inferred.

Sassanian Empire.—If any vestige of Hellenism still survived under the Sassanian kings, the records do not show it. At the court a limited recognition might be given, as fashion veered, to the values prevalent in the Hellenistic world. Chosroes I interested himself in Greek philosophy and received its professors from the west with open arms; according to one account, he had his palace at Ctesiphon built by Greeks. But the account of Chosroes' mode of action makes it plain that the Hellenism once planted in Iran had withered away; representatives of Greek learning and skill had all to be imported from across the frontier.

Asia Minor.—Greek Cities of the *Diadochi*.—Very different were the fortunes of Hellenism in those lands which became annexed to the Roman empire. In Asia Minor it has been seen how, even before Alexander, Hellenism had begun to affect the native races and Persian nobility. During Alexander's own reign progress in the Hellenization of the interior cannot be traced, nor can his activity as a builder of cities be proved here. But under the dynasties of his successors a great work of colonization

went on as each rival dynasty of Greek or Macedonian kings endeavoured to secure its hold on the country by founding fresh Greek settlements.

While new Greek cities were rising in the interior, the older Hellenism oi the western coast grew in material splendour under the munificence of Hellenistic kings. Its centre of gravity to some extent shifted. Ephesus grew in greatness and wealth, and Smyrna rose again after an extinction of four centuries. The great importance of Rhodes belongs to the days after Alexander. when it received the riches of the east from the trade routes which debouched into the Mediterranean at Alexandria and Antioch. In Aeolis the centre of gravity moved to the Attalid capital, Pergamum. But the irruption of the Celts. beginning in 278–277 B.C., checked the Hellenization of the interior. Not only did the Galatian tribes take large tracts of the plateau in possession, but they were an element of perpetual unrest which hampered and distracted the Hellenistic monarchies.

Native Dynasties.—The minor dynasties of non-Greek origin, the native Bithynian and the two Persian dynasties in Pontus and Cappadocia. were Hellenized before the Romans drove the Seleucid out of the country. In Bithynia the upper classes seem to have followed the fashion of the court; the dynasty of Pontus was philhellenic by ancestral tradition; the dynasty of Cappadocia dated its conversion to Hellenism from the 2nd century B.C.

Hellenism Under Rome.—When Rome began to interfere in Asia Minor, its first action was to break the power of the Gauls (189 B.C.). In 133 Rome entered formally upon the heritage of the Attalid kingdom and became the dominant power in the Anatolian peninsula for 1,200 years. Under Rome the process of Hellenization, which the divisions and weakness of the Macedonian kingdoms had checked. went forward. The coast regions of the west and south the Romans found already Hellenized. In Lydia not a trace of the old language was left in Strabo's time; in Lycia, the old language became obsolete in the early days of Macedonian rule. But inland, in Phrygia. Hellenism had as yet made little headway outside the Greek cities. It mas not until the reign of Hadrian that city life on the Phrygian plateau became rich and vigorous. with its material circumstances of temples, theatres and baths. The lower classes at Lystra in St. Paul's time spoke Lycaonian (Acts xiv. 11). In Galatia the larger towns seem to have become Hellenized by the time of the Christian era, while the Celtic speech maintained itself in the country villages until the 4th century A.D. Cappadocia at the beginning of the Christian era was still comparatively townless. a country of large estates with a servile peasantry. Even in the 4th century its Hellenization was still far from complete; but Christianity had assimilated so much of the older Hellenic culture that the church was now a main propagator of Hellenism in the backward regions. The native languages of Asia Minor all ultimately gave way to Greek. The effective Hellenization of Armenia did not take place until the jth century.

Syria.—In Syria the work of planting cities was pursued effectively north of the Lebanon by the house of Seleucus, and, less energetically south of the Lebanon by the house of Ptolemy.

Seleucid *Empire.*—The whole of Syria was brought under the Seleucid sceptre, together with Cilicia, by Antiochus III (223–187 B.C.). Under his son, Antiochus IV (175–164), a fresh impulse was given to Syrian Hellenism. In 1 Maccabees he is represented as writing an order to all his subjects to forsake the ways of their fathers and conform to a single prescribed pattern, and though in this form the account can hardly be exact, it does no doubt represent the spirit of his action. Many cities exchanged their existing name for that of Antioch. With the ever-growing weakness of the Seleucid dynasty, the independence and activity of the cities increased. although they were less protected against military adventures and barbarian chieftains.

Roman *Period.*—When Pompey annexed Syria in 64 B.C. as a Roman province, he found it a chaos of city-states and petty principalities. The Nabataeans and the Jews above all had encroached upon the Hellenistic domain; in the south the Jewish raids had spread desolation and left many cities practically in ruins. Under Roman protection Hellenism was secured from the barbarian peril, and Greek city life, with its political forms, its complement of festivities, amusements and intellectual exercise, went on more largely than before. The great majority of the Hellenistic remains in Syria belong to the Roman period. Such local dynasties as were suffered by the Romans to exist had, of course, a Hellenistic complexion. Especially was this the case with that of the Herods. Not only were such marks of Hellenism as a theatre introduced by Herod the Great (37–4 B.C.) at Jerusalem, but in the work of city building this dynasty showed itself active. Sebaste (the old Samaria). Caesarea, Antipatris were built by Herod the Great. Tiberias by Herod Antipas (4 B.C.–A.D. 39). In Syria: too, Hellenism under the Romans advanced upon new ground. Palmyra, of which nothing is heard before Roman times. is a notable instance.

Greek *Culture in* Syria.—In Syria the same disappearance of native languages and racial characteristics as in Asia Minor are not found. Still less was this the case in Mesopotamia. At Doura-Europus on the middle Euphrates excavations presented the picture of a Seleucid foundation, built and decorated in good Greek style. but unable to resist Semitic encroachments. By A.D. 300 even the people of the wealthier classes usually bore Semitic names. The lower classes at Antioch and no doubt in the cities generally were in speech Aramaic or bilingual. The villages. of course. spoke Aramaic. The richer natives, on the other hand, would become Hellenized in language and manners, and the "Syrian code" of civil laws shows how far the social structure was modified by the Hellenic tradition. Of the Syrians who made their mark in Greek literature; some were of native blood; *e.g.*, Lucian of Samosata, and several later poets and philosophers.

On the other hand there was a Syriac-speaking church as early as the 2nd century, and with the spread of Christianity Syriac asserted itself against Greek. The extant Syriac literature is all Christian. But where Greek gave place to Syriac, Hellenism was not thereby effaced. It was to some extent the passing over of the Hellenic tradition into a new medium. There was an extensive translation of Greek works into Syriac during the next centuries, chiefly handbooks of philosophy and science.

Hellenism and the Jews.—In the first century and a half of Macedonian rule the relation of the Jews to Hellenism is very obscure, since the statements made by later writers. like Josephus, as to the privileges conferred upon the Jews in the new Macedonian realms are justly suspected of being fiction. It has been maintained that Greek influence is to be traced in parts of the Old Testament assigned to this period, as, for instance, the Book of Proverbs; but even in the case of Ecclesiastes, the canonical writing whose affinity with Greek thought is closest. the coincidence of idea need not necessarily prove a Greek source. The one solid fact in this connection is the translation of the Jewish Law into Greek in the 3rd century B.C., implying a Jewish Diaspora at Alexandria, so far Hellenized as to have forgotten the speech of Palestine.

Early in the and century B.C. the priestly aristocracy of Jerusalem had, like the well-to-do classes everywhere in Syria, been carried away by the Hellenistic current. its strength being evidenced no less by thc intensity of the conservative opposition embodied in the party of the "Pious" (Assideans, Hasidim). Under Antiochus IV (176–165) the Hellenistic aristocracy contrived to get Jerusalem converted into a Greek city; the gymnasium appeared, and Greek dress became fashionable with the young men. Rut when Antiochus, for political reasons, interfered violently at Jerusalem, the conservative opposition carried the nation with them. The revolt under the Hasmonaean family (Judas Maccabaeus and his brethren) followed, ending in 143–142 in the establishment of an independent Jewish state. Hut the Hasmonaean state was of the nature of a compromise. The Mosaic Law was respected, but Hellenism still found an entrance in various forms. The first Hasmonaean king, Aristobulus I (104–103), was known to the Greeks as Phil-Hellen. He and all later kings of the dynasty bear Greek names as well as Hebrew ones, and after Iannaeus Alexander (103–76) the Greek legends are' common on the coins beside the Hebrew. Herod, who supplanted the Hasmonaean dynasty (37–4 B.C.), made, outside

Judaea, a display of philhellenism, building new Greek cities and temples. His court, at the same time, welcomed Greek men of letters like Nicolaus of Damascus. Even in the neighbourhood of Jerusalem, he erected a theatre and an amphitheatre. Meanwhile a great part of the Jewish people were living dispersed among the cities of the Greek world. speaking Greek as their mother tongue. These are the Jews who are found contrasted as "Hellenists" with the "Hebrews" in Acts. A large Jewish literature in Greek had grown up since the translation of the Law in the 3rd century. Besides the other canonical books of the Old Testament. it included translations of other Hebrew books (Ecclesiasticus, Judith, etc.); works composed originally in Greek but imitating to some extent the Hebraic style (like Wisdom); works modelled more closely on the Greek literary tradition, either historical, like II Maccabees, or philosophical, like the productions of the Alexandrian school, represented by Aristobulus and Philon; or Greek poems on Jewish subjects, like the epic of the elder Philon and Ezechiel's tragedy, *Exagógé*. It included also a number of forgeries contrived for the heathen public. as a means of propaganda, calculated to inspire them with respect for Jenish antiquity or turn them from idols to God.

Through the Hellenistic Jews, Greek influences reached Jerusalem itself, though their effect upon the Aramaic-speaking rabbinical schools was naturally not so pronounced The large number of Greek words, however, in the language of the Mishnah and the Talmud is a significant phenomenon. The attitude of the rabbinical doctors to a Greek education does not seem to have been hostile until the time of Hadrian. The sect of the Essenes probably shows an intermingling of the Greek with other lines of tradition among the Jews of Palestine.

Egypt and Ethiopia.—In Egypt the Ptolemies were hindered by special considerations from building Greek cities after the manner of the other Macedonian houses. Even at Alexandria Hellenism was not allowed full development. In its population, too. Alexandria was only semi-Hellenic; for besides the proportion of Egyptian natives in its lower strata, its commercial greatness drew in elements from every quarter; the Jews, for instance, formed a majority of the population in two out of the five divisions of the city. At the same time the prevalent tone of the populace mas, no doubt, Hellenistic, as is shown by the fact that the Jews who settled there acquired Greek in place of Aramaic as their mother tongue, and in its upper circles Alexandrian society under the Ptolemies was not only Hellenistic, but notable among the Hellenes for its literary and artistic brilliance. The state university, the "museum," was in close connection with the court, and gave to Alexandria the same pre-eminence in natural science and literary scholarship which Athens had in moral philosophy. Probably in no other country, except Judaea, did Hellenism encounter as stubborn a national antagonism as in Egypt. Yet the papyri show habitual marriage of Greeks and native women, and a frequent adoption by natives of Greek names. In Egypt, too, the triumph of Christianity brought into being a native Christian literature, and if this was in one way the assertion of the native against Hellenistic predominance, it must be remembered that Coptic literature, like Syriac, necessarily incorporated those Greek elements which had become an essential part of Christian theology.

From the Ptolemaic kingdom Hellenism early travelled up the Nile into Ethiopia. Ergamenes, the king of the Ethiopians in the time of the second Ptolemy, who had received a Greek education and cultivated philosophy, broke with the native priesthood, and from that time traces of Greek influence continue to be found in the monuments of the upper Nile. When Ethiopia became a Christian country in the 4th century, its connection with the Hellenistic world became close.

Hellenism in the West.—While in the east Hellenism had been sustained by the political supremacy of the Greeks, in Italy *Graecia capta* had only the inherent power and charm of its culture wherewith to nin its way. Even before Alexander. Hellenism had affected the peoples of Italy. but it was not until the Greeks of south Italy and Sicily mere brought under the supremacy of Rome in the 3rd century B.C. that the stream of Greek influence entered Rome in any volume It was now that the Greek freedman L. Livius Andronicus laid the foundation of a new Latin literature by his translation of the *Odyssey*, and that the Greek dramas were recast in a Latin mould. The first Romans who set about writing history wrote in Greek. At the end of the 3rd century there was a circle of enthusiastic philhellenes among the Roman aristocracy, led by Titus Quinctius Flamininus. who in Rome's name proclaimed the autonomy of the Greeks in 196. In the middle of the 2nd century B C. Roman Hellenism centred in the circle of Scipio Aemilianus, which included men like Polybius and the philosopher Panaetius. The visit of the three great philosophers, Diogenes, Critolaus and Carneades, in 155 was an epoch-making event in the history of Hellenism at Rome. Opposition there could not fail to be, and in 161 a *senatus consultum* ordered all Greek philosophers and rhetoricians to leave the city. The effect of such measures was, of course, transient. Even though the opposition found so doughty a champion as the elder Cato (censor in 184), it was ultimately of no avail. The Italians did not indeed surrender themselves passively to the Greek tradition In different departments of culture the degree of their independence was different. The mere fact that they produced a literature in Latin argues a power of creation as well as receptivity. The great Latin poets were imitators indeed, but mere imitators they were no more than Petrarch or Milton On the other hand. even where the creative originality of Rome was most pronounced. as in the sphere of law, there were elements of Hellenic origin. It has been often pointed out how the Stoic philosophy especially helped to shape Roman jurisprudence.

While the upper classes in Italy absorbed Greek influences by their education, the lower strata of the population of Rome became largely Hellenized by the actual influx on a vast scale of Greeks and Hellenized Asiatics, brought in for the most part as slaves and coalescing as freedmen with the citizen body. The early Christian Church in Rome, to which St. Paul addressed his epistle. was Greek-speaking, and continued to be so until far into the 3rd century. In the western Mediterranean a Greek element was introduced wherever the Romans iosiered town life and thus invited the Greek trader and professional man. This later process of Hellenization is especially noticeable in north Africa. where the native king Juba (under Augustus) actively encouraged it. But in the west the Latin language everywhere ousted the Greek as a spoken tongue, and the prevalent culture was Italian rather than Hellenic.

LATER HISTORY

It remains only to glance at the ultimate destinies of Hellenism in west and east. In the Latin west, knowledge of Greek. firsthand acquaintance with the Greek classics. became rarer and rarer as general culture declined, until in the dark ages (after the jth centuryj it existed practically nowhere but in Ireland. In Latin literature. however, a great mass of Hellenistic tradition was maintained in currency wherever culture of any kind continued to exist. Then the stream began to rise again, first with the influx of the learning of the Spanish Moors, then with the new knowledge of Greek brought from Constantinople in the 14th century. With the Kenaissance and the new learning. Hellenism came in again in flood. to form a chief part of that great river on which the modern world is being carried forward, In the east it is popularly thought that Hellenism, as an exotic. withered altogether away. This view is superficial. Ultimately the Greek east was absorbed by Islam; the popular mistake lies in supposing that the Hellenistic tradition thereby came to an end. The Mohammedan conquerors found a considerable part of it taken over by the Syrian Christians. and Greek philosophical and scientific classics were now translated from Syriac into Arabic. These were the starting points for the Mohammedan schools in these subjects. Accordingly the Arabian philosophy (*q.v.*), mathematics, geography, medicine and philology are all based professedly upon Greek works. Aristotle in the east no less than in the west was the "master of them that know"; the geography and astronomy of Claudius Ptolemaeus had canonical authority in Isiam and in Christendom alike; and Moslem physicians to this day invoke the

names of Hippocrates and Galen. The Hellenistic strain in Mohammedan civilization has. it is true. flagged and failed, but only as that civilization as a whole has declined.

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See also works quoted in articles GREECE: *History;* ROME: *Ancient History;* MACEDONIAN EMPIRE; PTOLEMIES; SELEUCID DYNASTY; etc.

(M. C.)

HELLER, STEPHEN (1814–1888), Austrian pianist and composer. was born at Pest on Slay 1j. For several years he played as a *Wunderkind,* but in 1838 settled in Paris where he became intimate with Liszt. Chopin, Berlioz and their circle.

Heller later visited England. where he performed with Sir Charles Hallé. He composed many elegant short pieces for the piano, and was much esteemed as a teacher in Paris. where he died on Jan. 14. 1885.

HELLESPONT (*i.e.,* "Sea of Helle"; variously named in classical literature Hellespontos. Hellespontum Pelagus and Fretum Hellesponticum). the ancient name of the Dardanelles (*q.v.*). It was so-called from Helle, the daughter of Athamas (*q.v.*), who was drowned there. *See* ARGONAUTS.

HELLMAN, LILLIAN (1905–), U.S. playwright whose dramas bitterly and forcefully attacked injustice, exploitation and selfishness, was born June 20. 1905, in New Orleans, La., attended New York public schools, and received degrees from New York university and Columbia university. Her marriage (1925–32) to playwright Arthur Kober ended in divorce. After working variously as book reviewer, press agent and play reader, she began writing plays.

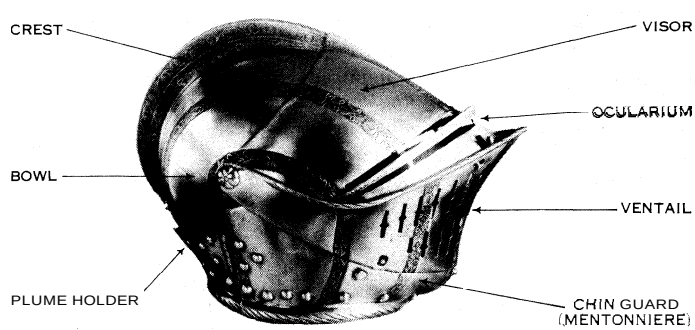
Her dramas exposed various forms in which evil appears—a malicious child's lies about two schoolteachers (The Children's *Hour,* 1934); a ruthless family's exploitation of fellow townspeople and of one another (The Little Foxes, 1939, and Another Part of the Forest, 1946); and the irresponsible selfishness of the Versailles treaty generation (Watch on *the* Rhine, 1941, and The Searching *Wind,* 1944). Criticized at times for her doctrinaire views and characters, she nevertheless kept her characters from becoming merely social points of view by credible dialogue and realistic intensity matched by few of her contemporaries. These plays exhibit the tight structure and occasional overcontrivance of what is known as the "well-made play." In the 1950s she showed her skill in handling the looser structure of Chekhovian drama (The *Autumn* Garden, 1951) and in translating and adapting (Anouilh's *The* Lark, 1955). She returned to the well-made play with *Toys* in the Attic (1960). (Js. T. N.)

HELL'S CANYON, a mile-deep gorge in the central section of the grand canyon of the Snake river, runs along the Idaho-Oregon boundary. Reaching a maximum depth of 7,900 ft. on its Idaho mall, it is the deepest canyon in North America. Two 19th-century steamboats sailed down the canyon with extreme difficulty, but the river is navigable only for small craft.

Excellent hydroelectric power sites. including an incomparable one for a high dam, are numerous in the canyon. When the devastating Columbia river flood of 1948 focused attention upon control of the Snake river, the bureau of reclamation and the U.S. army engineers recommended a high Hell's canyon multiple-purpose dam for flood control (4,400,000 ac.-ft. storage). navigation and power. In 1950 the Idaho Power company applied for private development through three lower dams; after a hearing of four and one-half years, the Federal Power commission granted a licence to the company on Aug. 4. 1955. A national controversy, pitting public against private power advocates, grew out of the hearing, and in 1957 the United States senate approved federal construction of a high dam that would flood the Idaho Power sites. The house did not concur, however, and in 1958 power production commenced at the initial private dam. (M. D. B.)

HELMET, a defensive covering for the head, one of the most universal forms of body armour. Helmets are usually thought of today as items of military equipment for soldiers, sailors or airmen. but modified types are worn by firemen, miners, civil-defense workers. race drivers and others engaged in hazardous occupations or sports.

Although there were earlier protective head coverings, most studies of helmets begin with those worn in ancient Greece and Rome. Made of hard leather or bronze, these helmets ranged from simple caps to highly developed forms with crests projecting before and behind. On some of these types the neck was protected in back; on others there were also hinged plates to guard the ears, and even a rudimentary visor. The most effective of the Greek helmets, and perhaps the best in the ancient world, was the so-called Boeotian or Corinthian form. the helmet usually portrayed on statues of Athena. It covered the entire head with only the narrowest of openings in front for vision and breath. A specialized Roman form different from the rest was the gladiator's helmet with its broad brim and pierced visor 'covering the face.

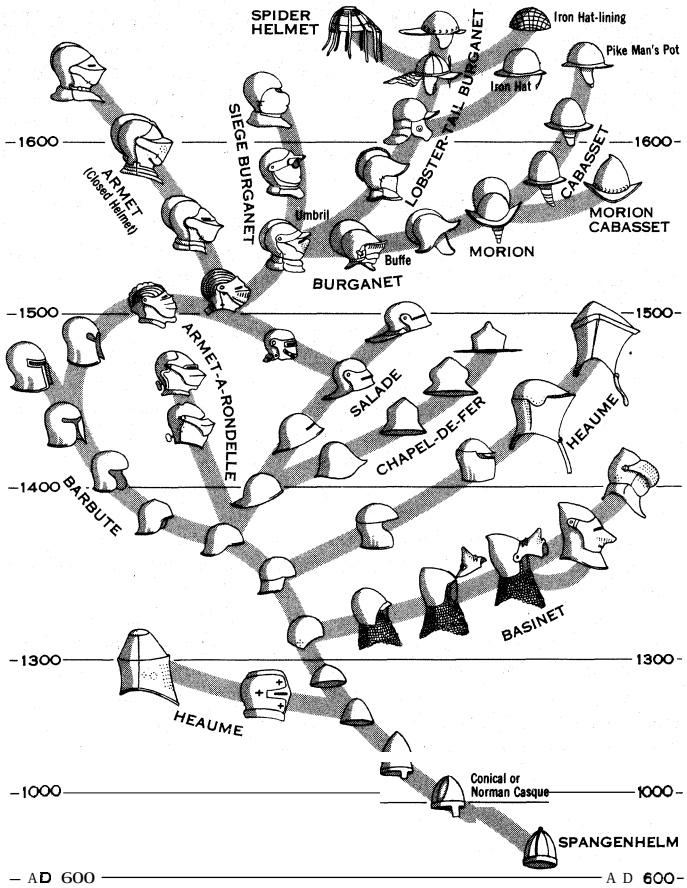


BY COURTESY OF H.M. MINISTRY OF WORKS

FIG. 1.— PARTS OF THE HELMET (CLOSED HELMET OF SIR HENRY LEE. BY JACOB TOPF. 1530–97)

In northern and western Europe the first helmets were made of leather reinforced with bronze or iron straps. Usually they took the form of conical or hemispherical skullcaps. Gradually the amount of metal increased until entire helmets of iron were fashioned, still following the same forms. About the year 1000 a bar projecting below the rim in front, called a nasal, was added to protect the nose. When the owner could afford it, these helmets were worn over a hood of chain mail which protected the cheeks and neck.

The desire for still further protection led to the development of the helm, or heaume, about 1200. At first almost a straight flat-topped cylinder, it was worn over the iron or steel skullcap and hood of mail, usually being put on at the last minute before the beginning of an engagement. Warriors soon discovered that the flat top and perpendicular sides transmitted the full force of any blon to the wearer and that the loose helm could easily be knocked off. Helms then gradually assumed rounded contours that would cause blows to glance off and were extended downward so



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART NEW YORK

FIG 2 —DEVELOPMENT OF THE HELMET FROM AD. 600 TO THE 17TH CENTURY

that they could be attached directly to the breastplate. As such they became for many years the favoured headpiece for tournaments. (See ARMOUR, BODY.)

Meanwhile the skullcap itself was developing. The point grew higher, and the back was extended downward to protect the neck. In this form it became the bascinet (basinet). Shortly after 1300 a movable visor was added to cover the face. Usually these visors were sharply pointed, and the name "dog faced" or "pig faced" has been given to them. A cape of mail, called a camail, was attached to the lower edges of the helmet to guard the neck. About the year 1400 this camail was superseded by additional plates, and the so-called "great bascinet" had appeared.

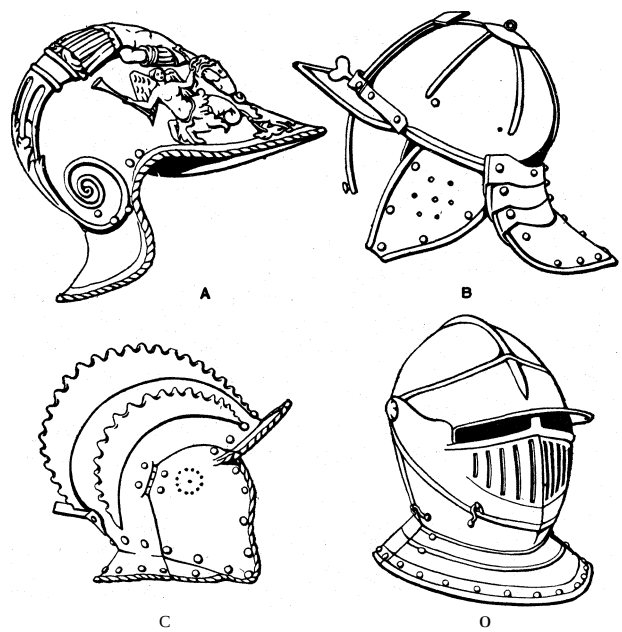
The 11th century, which witnessed the appearance of the great bascinet, also brought forth three other types of helmet, all deriving from the same simple bascinet. These were the salade, the barbute and the armet. In the salade the pointed crown was rounded off. and a long graceful tail protecting the neck was added. As time passed, the rim was lowered in front, covering the upper half of the face with a narrow slot cut through for vision. Still later, the portion below the slot was hinged to provide a movable visor. This helmet protected the upper portion of the head but left the chin and front of the neck bare. If a defense for the chin and neck was desired, it was provided by a separate plate or plates called a beavor, or buffe, that could be strapped around the neck or attached to the breastplate but did not form an integral part of the helmet. The barbute also had a rounded crown, but the tail was missing. Instead, the lower borders were extended almost straight down to protect the neck and cheeks, leaving in some instances only a narrow T-shaped opening in front. In this form it closely resembled the classical Corinthian helmet of Greece.

The real advance in helmet design, however, came with the armet, and later the close helmet. All other helmets had been put on directly over the head, thus requiring that a large opening be provided at the bottom for the head to enter. This made them susceptible to being knocked off and caused many difficulties in protecting the neck. The armet and close helmet changed all that. By hinging the cheek pieces, as on the armet, or pivoting, as on the close helmet, armourers produced a helmet that could fit tightly under the chin and base of the skull. This design fully protected the neck and made it impossible for a blow to dislodge the helmet in battle. The evolution of the armet began shortly after 1400. The close helmet appeared about 1500. Both were truly closed helmets and continued in use as long as full helmets were worn.

While these closed helmets were being brought to perfection, a series of light open helmets also appeared. As early as the 14th century a broad-brimmed helmet with a domed or pointed bowl known as a chapel-de-fer, or "iron hat," had become popular. Aside from the skullcap and small versions of the salade; it was almost the only light open helmet worn throughout the 11th century. About 1110, however, two new types, the morion and the cabasset, became popular. The cabasset had a pointed, keeled bowl or crown and a narrow brim. The morion had a round bowl with a high comb and a crescent-shaped brim rising to points at the front and back. Both helmets sometimes had ear defenses of overlapping plates covering straps that could be fastened under the chin; and sometimes the brim of the morion and the crown of the cabasset were combined to form a morion-cabasset. They were worn by nearly all infantry, by ceremonial guards and by almost everyone who desired a light helmet. Their period of popularity lasted roughly a century, until about 1650, though the Papal Swiss guard continues to wear them in the 20th century.

In England a variant form of helmet for pikemen was developed and worn from about 1600 to 1680. It had a broad straight brim, a hemispherical crown with a low comb, and was generally known as a "pikeman's pot."

During the 16th century there appeared also a very versatile helmet known as a burgonet. This helmet was characterized by a peak over the eyes similar to that found on modern baseball caps and by the fact that it protected the nape of the neck. Usually it also had a comb or combs and ear pieces. Sometimes protection for the face was added in the form of a sliding nasal, a pivoted cage of bars, or even a visor similar to those used on armets. though usually flatter. In the 17th century a particular form of a burgonet with a neck defense of overlapping plates became popular and was called a lobster-tail burgonet because of the supposed resemblance to the plates of a lobster's abdomen or "tail." Light-horsemen were particularly fond of the burgonet, and it became almost standard equipment for them throughout Europe until nearly the end of the 17th century. A very heavy bulletproof bur-



BY COURTESY OF THE ARCHAEOLOGICAL JOURNAL

FIG. 3.— (A) ITALIAN BURGONET, c. 1545: (B) LOBSTER-TAIL BURGONET, 1625–60; (C) GERMAN BURGONET, c. 1535; (D) CLOSED BURGONET, 1600–50

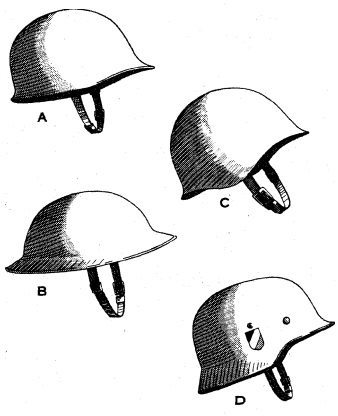


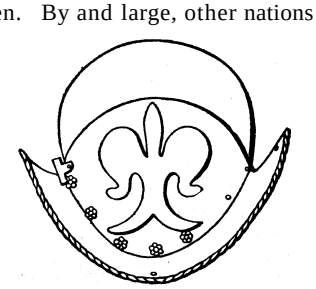
FIG. 4.—WORLD WAR II HELMETS
(A) U.S.; (B) British; (C) Soviet; (D) German

gonet was used by engineers besieging fortresses from at least 1600 until well after 1800.

With the decline of the full helmet late in the 17th century, attention was focused on the light metal skullcap that could be worn under the regular cloth hat. Such caps became standard for dragoons. heavy cavalry and for many officers, and were worn throughout the succeeding century. Some infantry officers wore them as late as World War I. About 1750 it became the custom to equip the newly developed light cavalry with helmets of hard leather in both England and America and with brass helmets in England, France and other European nations. During the 19th century, leather, brass and even steel helmets became fashionable for various types of cavalry. Many of these units retained them for dress use long after they ceased to be worn in the field.

Although some infantry regiments, notably those of Germany, wore leather helmets bound with metal, the steel helmet did not reappear as a regulation item of equipment until the opening years of World War I. The French first adopted the helmet as standard in 1914, the British in 1915, followed quickly by the Germans and then by the rest of Europe and the United States. All were designed to present glancing surfaces so that a bullet or shell fragment would bounce off without imparting its full impact. Many resembled the light helmets of the 15th century, notably the Italian salade and the chapel-de-fer. The performance of these headpieces in action was so successful that they became standard equipment, not only for infantry, but also for other branches and arms of the service. During World War I, Americans used helmets of British design, but in World War II, after continued research by armour specialists, several new models were brought forth and issued for soldiers, sailors and airmen. By and large, other nations retained the helmets they had used in World War I with only slight modifications.

The helmets described above are only a few of the many types developed and used in Europe and the United States during the last 3,000 years. Other cultures in Asia and Africa have also produced and worn them. The ancient Assyrians and Persians had helmets of leather and of iron before the era of the battle of Marathon (490 B.C.).



BY COURTESY OF THE "ARCHAEOLOGICAL JOURNAL"
FIG. 5.—MORION OF THE MUNICH CIVIC GUARD, 17TH CENTURY

In later years, the conical steel helmets of Persia. Turkey and India have been valued as works of art because of their fine forging and delicate damascening. In Tibet and China helmets of bronze, leather and horn have been made and worn for untold centuries, and the highly developed Japanese helmets with detachable face guards. finely forged and lacquered, have also been recognized as fine examples of the armourer's craft.

The primitive cultures of Africa and the South seas also produced distinctive helmets which cannot even be listed in a brief article.

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HELMHOLTZ, HERMANN LUDWIG FERDINAND VON (1821–1894), German philosopher and man of science, made important contributions in a wide range of scientific areas, but is best known for his statement of the law of conservation of energy. He was born on Aug. 31. 1821, at Potsdam, near Berlin. In 1849 he became professor of physiology in Konigsberg. There he remained until 1855. when he removed to the chair of physiology in Bonn. In 1858 he became professor of physiology in Heidelberg, and in 1871 he occupied the chair of physics in Berlin. To this professorship was added in 1887 the post of director of the physico-technical institute at Charlottenburg. near Berlin, and he held the two positions together until his death on Sept. 8, 1894.

His investigations occupied almost the whole field of science, from physiology to mechanics. In 1847 Helmholtz read to the Physical Society of Berlin a famous paper, *Über die Erhaltung der Kraft* ("On the Conservation of Force"), which became one of the epoch-making papers of the century; indeed, along with J. R. Mayer, J. P. Joule and W. Thomson (Lord Kelvin), he may be regarded as one of the founders of the law of the conservation of energy. In 1851, he invented the ophthalmoscope.

Helmholtz' contributions to physiological optics are of great importance. He investigated the optical constants of the eye, measured by his invention, the ophthalmometer, the radii of curvature of the crystalline lens for near and far vision. explained the mechanism of accommodation by which the eye can focus within certain limits. discussed the phenomena of colour vision and gave a clear account of the movements of the eyeballs so as to secure single vision with two eyes. In particular he revived and gave new force to the theory of colour vision associated with the name of Thomas Young, showing the three primary colours to be red, green and violet, and he applied the theory to the explanation of colour blindness. His great work on *Physiological Optics* (1856–66) was by far the most important book to have appeared on the physiology and physics of vision. Equally distinguished was his research in physiological acoustics. He explained accurately the mechanism of the bones of the ear, and he discussed the action of the cochlea on the principles of sympathetic vibration.

Perhaps his greatest contribution in this area, however, was his attempt to account for our perception of quality of tone. He showed. both by analysis and by synthesis, that quality depends on the order, number and intensity of the overtones or harmonics that may, and usually do, enter into the structure of a musical tone. He also developed the theory of differential and of summational tones. His work on *Sensations of Tone* (1862) may well be termed the principia of physiological acoustics. He may also be said to be the founder of the fixed-pitch theory of vowel tones,. according to which it is asserted that the pitch of a vowel depends on the resonance of the mouth, according to the form of the cavity while singing it, and this independently of the pitch of the note on which the vowel is sung.

For the later years of his life his work may be summed up under the following heads: (1) on the conservation of energy; (2) on hydrodynamics; (3) on electrodynamics and theories of electricity; (4) on meteorological physics; (5) on optics; and (6) on the abstract principles of dynamics. In all these fields of labour he made important contributions to science and showed himself equally great in all.

Helmholtz continued his study of the phenomena of electrical oscillations from 1869 to 1871, and in the latter year he announced that the velocity of the propagation of electromagnetic induction was greater than 314,000 m. per second. This work is interesting in view of the fact that Heinrich Hertz was a pupil of Helmholtz at this time and that later he demonstrated the existence of electromagnetic waves while studying a problem suggested to him by Helmholtz. This was followed by a series of papers on electrodynamics which were published from 1870 onward. Helmholtz started with a formula of F. E. Neuman *for* the potential of two current elements. and investigated the terms which must be added to give a general expression which agreed with the phenomena of closed circuits. There followed a controversy on the relative merits of the work of Helmholtz. Weber and J. Clerk Maxwell on this problem. In his paper on the "equations of motion of

electricity in conductors at rest" (1874), Helmholtz applied his generalized formula to the propagation of electric and magnetic disturbances through bodies capable of electric or magnetic polarization. He contributed papers on the theory of the electrical double layer and on electrolysis. Toward the end of his life he wrote on the physical meaning of the principle of least action and applied the principle to electrodynamics; he also wrote and lectured on philosophical and aesthetic problems. His position was that of an empiricist, denying the doctrine of innate ideas and holding that all knowledge is founded on experience, hereditarily transmitted or acquired.

See L. Konigsberger, *Hermann von Helmholtz,* Eng. trans. by F. A. Welby (1906); J. G. McKendrick, H. L. F. *von Helmholtz* (1899).

HELMINTHOLOGY, the study of parasitic worms. *See* NEMATODA; PARASITISM AND PARASITOLOGY; PLATYHELMINTHES; TREMATODES; TAPEWORMS.

HELMOLD, a historian of the 12th century, was a priest at Bosau near Plön. He was a friend of the two bishops of Oldenburg, Vicelin (d. 1154) and Gerold (d. 1163), who did much to Christianize the Slavs. At Bishop Gerold's instigation Helmold wrote his *Chronica Slavorum,* a history of the conquest and conversion of the Slavonic countries from the time of Charlemagne. For the life and times of Henry the Lion, duke of Saxony, Helmold's chronicle: as that of a contemporary who had exceptional means for gaining information. is of first-rate importance. The history was continued down to 1209 by Abbot Arnold of Liibeck.

The *Chronica* were first edited by Siegmund Schorkel (Frankfurt-on-Main, 1556). The best edition is by J. M. Lappenberg in *Mon. Germ. hist. scriptores,* xxi (1869). For critical works on the *Chronica* see A. Potthast, *Bibliotheca hist. med. aevi,* s. "Helmoldus."

HELMOND, town in the province of North Brabant, Netherlands. on the Aa river and the Zuid-Willems Vaart canal between 'sHertogenbosch and Maastricht. 24½ mi. W N.W. of Venlo by rail. It is connected by tramway with 'sHertogenbosch (21 mi. N.W.). Pop. (1957 est.) 40,888 (mun.).

The castle of Helmond. built in 1402, is the seat of the town hall. Helmond is an industrial centre with factories for textiles, iron founding, soap, margarine and tobacco dressing, as well as having an engine works

HELMONT, JAN BAPTISTA VAN (1577–1644), Belgian chemist, physiologist and physician, identifier of carbon dioxide and discoverer of the existence of gases, was born at Brussels in 1577. He was educated at Louvain and, after ranging from one science to another, turned to medicine. in which he took his doctor's degree in 1599. In 1609 he settled at Vilvorde, near Brussels, where he occupied himself with chemical experiments and medical practice until his death on Dec. 30, 1644.

Helmont presents curious contradictions. On the one hand he was a mystic with strong leanings to the supernatural, an alchemist who believed in the philosopher's stone; on the other hand he was touched with the new learning of William Harvey, Galileo and Francis Bacon, and was a careful observer and an exact experimenter. He was the first to understand that there are gases distinct in kind from atmospheric air. The very word "gas" he claims as his oan invention, and he perceived that his "gas sylvestre" (carbon dioxide) given off by burning charcoal is the same as that produced by fermenting must. He believed that water was the chief if not the only ultimate constituent of all matter. He showed that plants could grow though they apparently received nothing but pure water, and so he argued that the wood. bark and roots had been formed from nater alone.

Van Helmont considered that digestion, nutrition and even movement are due to ferments, nhich convert dead food into living flesh in six stages. But having got so far with the application of chemical principles to physiological problems, he introduces a complicated system of supernatural agencies. nhich preside over and direct the affairs of the body. At the same time chemical principles guided him in the choice of medicines—undue acidity of the digestive juices, for example, was to be corrected by alkalies and vice versa; he was thus a forerunner of the iatrochemical school.

His works were collected and published at Amsterdam as *Ortus medicinae, vel opera et opuscula omnia* in 1648 by his son Franz Mercurius (b. 1618 at Vilvorde, d. 1699 at Berlin), in whose own writings, *e.g., Cabbalah denudata* (1677) and *Opuscula philosophica* (1690), mystical theosophy and alchemy appear in still wilder confusion.

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HELMSTEDT, or, more rarely, HELMSTADT, a town of Germany, in the *Land* of Lower Saxony, 30 mi. W.N.W. of Magdeburg on the main railway line to Brunswick. Pop. (1950) 28.041. Helmstedt was probably founded about 900, and obtained civic rights in 1099. In 1457 it joined the Hanseatic league. and in 1490 it came into the possession of Brunswick. In 1576 Julius, duke of Brunswick, founded a university there, and throughout the 17th century it was one of the chief seats of Protestant learning. It nas closed by Jerome, king of 'Cl'estphalia, in 1809. The principal buildings are the Juleum, the former university, in Renaissance style (late 16th century), and the Stephanskirche dating from the 12th century. The principal manufactures are furniture, yarn, soap. tobacco, machinery, glass and earthenware.

HELMUND, a river of Afghanistan, about 600 mi. long, the ancient Etymander, the most important river in Afghanistan next to the Kabul river, which it exceeds both in volume and length. It rises in the recesses of the Koh-i-Baba to the west of Kabul, its infant stream parting the Unai pass from the Irak, the two chief passes on the well-known road from Kabul to Bamian. About the parallel of 33° N. it enters the Zamindawar province which lies to the northwest of Kandahar, and thenceforward it is a well-mapped river to its termination in the lake of Seistan. Until about 40 mi. above Girishk the character of the Helmund is that of a 'mountain river, flowing through valleys which in summer are the resort of pastoral tribes. On leaving the hills it enters a flat country, and extends over a gravelly bed. There also it begins to be used in irrigation. At Girishk it is crossed by the principal route from Herat to Kandahar. Forty-five miles below Girishk the Helmund receives its greatest tributary. the Arghandab, from the high Ghilzai country beyond Kandahar, and becomes a very considerable river, with a width of 300 or 400 yd. and an occasional depth of 9 to 12 ft. Even in the dry season it is never without a plentiful supply of water. The course of the river is more or less southwest from its source until in Seistan it crosses meridian 62°, when it turns nearly north and so flows for 70 or 80 mi. until it falls into the Seistan hamuns, or swamps. by various mouths. In this latter part of its course it forms the boundary between Afghan and Iranian Seistan. and because of constant changes in its bed and the swampy nature of its borders it has been a fertile source of frontier squabbles. Iranian Seistan was once highly cultivated by means of a great system of canal irrigation; but, since the country was devastated by Timur, it has been a barren, treeless waste of flat alluvial plain. In years of exceptional flood the Seistan lakes spread southward into an overflow channel called the Shelag which, running parallel to the northern course of the Helmund in the opposite direction. finally loses its waters in the Gaod-i-Zirreh swamp. Throughout its course from its confluence with the Arghandab to the ford of Chahar Burjak. where it bends northward, the Helmund valley is a narrow green belt of fertility sunk in the midst of a wide alluvial desert, with many thriving villages interspersed among the remains of ancient cities, relics of Kaiani rule.

HELOTS (Gr. Εἵλωτες or Εἵλωται), the serfs of the ancient Spartans. They were probably the aborigines of Laconia who had been enslaved by the Achaeans before the Dorian conquest. After the second Messenian War *(see* SPARTA), the conquered Messenians were reduced to the status of Helots. The Helots were state slaves bound to the soil and assigned to individual Spartiates to till their holdings (Gr. *klēroi*); their masters could neither emancipate them nor sell them off the land, nor raise the rent payable yearly in kind by the Helots. In time of war, they served as light-armed troops or as rowers in the fleet; from the Peloponnesian War onward they were occasionally employed as heavy infantry (Gr. *hoplitai),* distinguished bravery being re-

warded by emancipation. The general attitude of the Spartans toward them was one of distrust and cruelty. The ephors of each year. on entering office, declared war on the Helots so that they might be put to death at any time without violating religious scruple. and there is a well-attested record of 2,000 Helots being freed for service in war and .then secretly assassinated. (Thuc., iv, 80.) (See CRYPTEIA.)

Intermediate between Helots and Spartiates were the neodamodes and mothones. The former were emancipated Helots, or their descendants, and were much used in war; they served especially on foreign campaigns. as that of Agesilaus (396–394 B.C.) in Asia Minor. The mothones, or mothakes, were the sons of Spartiates and Helot mothers; they were free men sharing the Spartan training. but not full citizens.

HELSINGBORG (HÄLSINGBORG), a seaport of Sweden in the *län* of Malmohus, 35 mi. N.E. of Copenhagen by rail and water. Pop. (1960) 76,504. The original site of the town is marked by the tower of the old fortress, first mentioned in 1135, the ruins of which stand on a hill above the town. From 1370, along with other towns in the province of Skane. it was united for 1j years with the Hanseatic league. The fortress was destroyed by fire in 1418, and about 1425 Eric XIII built another near the sea and caused the town to be transported thither. bestowing upon it important privileges. Until 1658 it belonged to Denmark. and in 1684 its fortifications were dismantled. It was retaken by the Danes several times but in 1710 the town came finally into the possession of Sweden. It stands on the narrowest part of Oresund (the Sound), there only 3 mi. wide. opposite Helsingor (Elsinore) in Denmark. On the outskirts are the Oresund park, containing iodide and bromide springs, and sea baths. On the coast to the north is the royal chhteau of Sofiero; to the south, the small spa of Ramlosa. North and east of Helsingborg lies the only coal field in Sweden, extending into the Kullen peninsula. Potter's clay is also found. Helsingborg ranks among the first manufacturing towns of Sweden, having copper works. using ore from Sulitelma in Norway, indin-rubber works. sugar refineries, superphosphate works and breweries. The new harbour has a depth of 32 ft., and there are extensive docks. The chief exports are timber, dairy produce, paper. rubber wares, iron ore.

HELSINKI (Swedish *Helsingfors*), the capita1 and leading seaport of the republic of Finland. on the Gulf of Finland. Pop. (1960) 452,800. Helsinki is well laid out. with wide streets, parks and gardens. The principal square contains the cathedral known as the Great Church designed by C. L. Engel (completed by E. Lohrmann in 1852) who also created other distinguished buildings in classical style such as the old senate house, now the state council building. and the university. In varied styles are the post office building (1938), the National museum (1906–10), the diet building (1931) and Eliel Saarinen's railway station (1916). Many of the buildings have acquired a certain national character through the use of local granite. As the seat of the country's government. Helsinki contains the president's palace, the administrative offices and the supreme courts of justice. The municipality, administered by a city council. spends about 40% of its budget on social services. The fine port, divided into two parts by a promontory and protected at its entrance by a group of small islands. includes five harbours. The port accommodates the largest vessels, but is usually closed by ice from January to May, except for a channel kept open by an icebreaker. Helsinki imports coal. machinery, sugar. grain and clothing. Its main industries are metal goods, foodstuffs. luxury goods and printed matter. Most of Finland's cultural institutions are located in the capital: the university (transferred from Abo (Turku) after the fire of 1827) and technical school, the Athenaeum and its picture gallery, the Swedish theatre and opera house. the Finnish theatre and the archives.

The city was founded by Gustavus Vasa. king of Sweden, in 1550 as a trading centre on the estuary of the Vantaa river. It received its first charter from John III in 1569; but the site proved ill-chosen and in 1640 it was moved to its present position on Vironniemi peninsula. The inhabitants continued to suffer from fire, famine and plague, and in May 1713 were evacuated from the town before its capture by Peter the Great's fleet during the Russian campaign against Sweden. Before retreating. Swedish troops razed the town, and after the treaty of Nystad in 1721 reconstruction was begun only to be destroyed by subsequent Russian invasions. When the fortifications at Suomenlinna were commenced in 1748 however. Helsinki's trade and shipping flourished. Finland having been ceded by Sweden to Russia in 1809, a decree of Alexander I in 1812 appointed Helsinki the capital city instead of Xbo. With the establishment of the republic in 1919 it was at last freed from foreign occupation. It was repeatedly bombed during the Russo-Finnish war of 1939–40 and suffered again in the subsequent world conflict which Finland entered in 1941.

HELST, BARTHOLOMEUS VAN DER (c. 1613–1670), Dutch artist, who enjoyed a successful practice as one of the leading portrait painters of Amsterdam. was born at Haarlem. His first known picture. "Four Regents of the Walenweeshuis" (Amsterdam, Walenweeshuis; signed and dated 1637). is closely related to the work of Nicolas Elias. generally assumed to have been his master. Helst's success was rapid. Influential sitters and important commissions came to him at an early age. In 1642 he painted the Amsterdam burgomaster Andries Bicker and his wife and son. and in the following year he completed a great portrait group, "Captain Roelof Bicker's Company." which formed part of the same scheme of decoration as Rembrandt's "Night Watch." Another of these huge portrait groups. "Captain Cornelis Witsen's Company." followed in 1648. Of the less ambitious portraiture that flowed from his facile brush. many of the official and family groups remain in Holland. Many of these may be seen in the Rijksmuseum in Amsterdam. He died in Amsterdam. Dec. 16. 1 0 . Heist was prone to be too complaisant toward the vanities of his sitters, and the force and insight that in some of his early portraits reflect his study of Rembrandt and Frans Hals tend later to lose themselves in mechanical facture, empty rhetoric or spurious elegance. Yet by his direct approach and solid mastery some achieve genuine distinction. (D. KG.; X.)

HELSTON, a market town and municipal borough in the Falmouth and Camborne parliamentary division of Cornmall, Eng.. 13 mi. W.S.W. of Falmouth by road. Pop. (1961) 7,085. Helston is the nearest railway station to the Lizard peninsula. May 8 is Furry (Flora) day, an old festival when church bells are rung early in the morning and processions dance through the streets and in and out of the houses to traditional music. As the capital of the Meneage district of Cornwall, the place was held by Earl Harold in the time of the Confessor and by William I at the Domesday survey. From 1298 to 1885 it returned two members to parliament. although in 1790 the electorate had dwindled to one person only. The town obtained its first charter (1201) from King John and in the 13th century it was the most important town in west Cornwall, having a harbour on the Cober, which now expands into Loe pool (2 mi. S.W.) banked up by Loe bar at the mouth. In Elizabeth I's time it was one of the four Cornish stannary towns and its main street is still called Coinagehall street. The mining industry is extinct, but agriculture and dairy farming flourish. There is a weekly cattle market. The small port of Porthleven, 3 mi. S.W., was included in the borough in 1034.

HELVETIC CONFESSIONS are two documents officially adopted as expressing the common belief of the Reformed Church in Switzerland. The First Helvetic Confession (less aptly called the Second Confession of Basel), consisting of 27 brief articles, was composed in 1536 by Heinrich Bullinger and delegates from several Swiss cities, with the participation of Martin Rucer of Strasbourg. Viewed favourably by Luther and sometimes criticized as too Lutheran for Keformed tastes, it nonetheless was the first Reformed creed of national authority. In 1562 Bullinger wrote for his private use a lengthy theological statement of 30 articles, which he later revised and attached to his will. This document, known as the Second Helvetic Confession, was published in 1566 as the official creed of the Swiss cantons (superseding the first. except in Basel) and was adopted also in the Palatinate where it had served the elector Frederick 111 the Pious as a defense against Lutherans. It was recognized in Scotland (1566), Hungary (1567), France (1571) and Poland (1578); was favourably

received in Holland and England, and was subsequently recognized as one of the most authoritative statements of Reformed theology.

The Second Helvetic Confession is a comprehensive and detailed statement of the ancient dogmas of the Trinity (art. 3) and Christology (11), as well as more specifically Reformation elaborations of Scripture as the sole norm of belief (1, 2), condemnation of the use of images in worship (4), discussions of law (12), gospel (13) and faith (15, 16). It contains in addition a more especially Reformed (*i.e.*, of the Calvinist rather than the Lutheran type) doctrine of providence (6), predestination (10) and the church. ministry and sacraments (17–21). By constant biblical citation, occasional reference to Augustine and other early writers and repeated assertion, the confession represents itself as at one with the earliest and purest form of Christian theology. Heresies, ancient and contemporary, are condemned by name. *See* also CONFESSIONS OF FAITH, PROTESTANT: *Reformed Churches.*

See Philip Schaff, *Creeds of Christendom,* vol iii (1919), for the Latin texts of both and the German text of the first. (E. A. DY.)

HELVETII, a Celtic people, whose original home was situated in the country between the Hercynian forest, the Rhine and the Main. In Caesar's time their boundaries were the Jura on the west, the Rhône and the Lake of Geneva on the south, the Rhine as far as Lake Constance on the north and east. They thus inhabited the western part of modern Switzerland. They were divided into four cantons *(pagi).* common affairs being managed by the cantonal assemblies. They possessed the elements of a higher civilization (gold coinage and the Greek alphabet), and, according to Caesar, were the bravest people of Gaul. The reports of gold and plunder spredd by the Cimbri and Teutones (*qq.v*) on their way to southern Gaul induced the Helvetii to follow their example. In 107 B.C., two of their tribes, the Tougeni and Tigurini, crossed the Jura and defeated the Romans under L. Cassius Longinus. In 102 B C. the Helvetii joined the Cimbri in the invasion of Italy, but after the defeat of the latter by Marius they returned home. In 58 B C.. hard pressed by the Germans and incited by one of their princes, Orgetorix, they resolved to found a new home west of the Jura. Joined by the Rauraci, Tulingi, Latobrigi and some of the Boii they agreed to meet at Geneva and to advance through the territory of the Allobroges. They were overtaken by Caesar at Bibracte, defeated and forced to submit.

Under Augustus, Helvetia *(ager Helvetiorum)* proper was included under Gallia Belgica. Two Roman colonies were founded at Noviodunum (Nyon) and at Augusta Rauracorum (Augst near Basle) to keep watch over the inhabitants. who were treated nith generosity by their conquerors. Under the name of *foederati* they retained their original constitution and division into four cantons. They were under an obligation to furnish a contingent to the Roman army for foreign service, but were allowed to maintain garrisons of their own, and their magistrates had the right to call out a militia; they managed their own local affairs and kept their own language, although Latin was used officially. Their chief towns were Aventicum (Avenches) and Vindonissa (Windisch). Under Tiberius, the Helvetii were separated from Gallia Belgica and made part of Germania Superior. After the death of Galba (A.D. 69). as they refused submission to Vitellius their land was devastated by Alienus Caecina. Under Vespasian they attained the height of their prosperity. He greatly increased the importance of Aventicum, where his father had carried on business. Its inhabitants obtained the *ius Latinum,* had a council of *decuriones,* flamens of Augustus, etc. *(see* MUNICIPIUM). After the extension of the eastern frontier. the troops were withdrawn, and Helvetia became completely romanized. Aventicum had an amphitheatre, a public gymnasium and an academy with Roman professors. Roads were made wherever possible, and commerce developed rapidly. The west of the country was more susceptible to Roman influence, and hence preserved its independence against barbarian invaders longer than its eastern portion. During the reign of Gallienus (A.D. 260–268) the Alamanni overran the country and it never regained its former prosperity. Under Honorius (A.D. 395–423) it was occupied by the Alamanni, except in the west, where the small portion remaining to the Romans was ceded in A.D. 436 by Aetius to the Burgundians.

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HELVÉTIUS, CLAUDE ADRIEN (1715–1771), French philosopher, noted for his emphasis on physical sensations, was born at Paris, Fr., on Jan. 26, 1715, the son of J. C. A. Helvetius, chief physician to Queen Maria Leszczynska, the wife of Louis XV of France. In 1738, at the queen's request, Helvétius was appointed farmer-general, a post of great responsibility and dignity. In 1751 he married, resigned his post and retired to his estate at Voré in Perche.

Helvétius proceeded to enjoy his leisure, producing a poem, *Le Bonheur* (published posthumously, with an account of Helvétius' life and works, by C F. de Saint-Lambert, 1772), and his famous philosophical study, *De l'esprit* (1758; Eng. trans. by W. Mudford, 1807), intended to be the rival of Montesquieu's *L'Esprit des Lois.* This attracted immediate attention and aroused the most formidable opposition, especially from the dauphin Louis, son of Louis XV. The Sorbonne condemned it as full of the most dangerous doctrines, and the author's three retractations did not save it from being publicly burned. Voltaire said that it was full of commonplaces and that what was original was false or problematical; Rousseau declared that the very benevolence of the author gave the lie to his principles. Helvétius visited England in 1764 and Berlin, on the invitation of Frederick the Great, in 1765. Returning to France. he passed the remainder of his life at Voré. He died on Dec. 26, 1771. In 1773 was published *De l'homme* (Eng. trans. by W. Hooper, 1777). in which he argues against Rousseau's *Émile* and holds that education can do everything.

The four chief contentions of Helvétius' hedonistic philosophy are: (1) all man's faculties may be reduced to physical sensation, even memory, comparison, judgment; (2) self-interest, founded on the love of pleasure and the fear of pain. is the spring of judgment, action, affection (self-sacrifice is prompted by the fact that the sensation of pleasure outweighs the accompanying pain); (3) all intellects are equal, their apparent inequalities are due to the unequal desire for instruction, and this desire springs from passions, of which all men commonly well-organized are susceptible to the same degree ("one becomes stupid as soon as one ceases to be passionate"); and (4) philosophical rulers may achieve an artificial identification of interests by suitably contrived legislation.

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HELVIDIUS PRISCUS (d. between A.D. 70 and 79), a Roman Stoic who, though the son of a centurion, rose to the senate in the reign of Nero. Nero banished him in 66 when his father-in-law, Thrasea Paetus (*q.v.*), was put to death. On Nero's fall (68) he returned and is recorded as demanding the punishment of Eprius Marcellus, who had encompassed Thrasea's death, openly opposing the emperor Vitellius in the senate (69) and later urging that the senate mark out the men it thought worthy of the emperor Vespasian's confidence and assume responsibility for rebuilding the Capitol and meeting the financial crisis of 70. His uncompromising freedom of speech brought him into conflict with Vespasian, perhaps because he opposed dynastic succession, and he was put to death; it later earned the admiration of the Stoics Epictetus and. significantly, Marcus Aurelius.

Helvidius can hardly have been a republican (as is often said); he accepted office as praetor in 70 and spoke of Vespasian with

honour. But he was a Stoic and. unlike most Stoics, did not seek refuge in retirement but was strengthened by his creed in adherence to political principles; he clearly held that the senate should discharge in reality the functions that it nominally possessed and that the emperor should act only with its consent and co-operation.

His son HELVIDIUS THE YOUNGER, a friend of the younger Pliny, became consul (date unknown) but in 93 or 94 was executed by order of the emperor Domitian, whose amours he had allegedly burlesqued.

See E. Groag and A. Stein, *Prosopographia Imperii Romani,* H 59, *60,* 2nd ed. (1958); C. Wirszubski, *Libertas as a Political Idea at Rome,* pp. 147 ff. (1950). (P. A. BR.)

HELWAN, a well-known health resort in the United Arab Republic, 16 mi S. of Cairo and connected with it by rail. Standing 150 ft. above the Nile level and surrounded by desert, it enjoys a dry equable climate especially suitable for invalids; it possesses strong sulfur and salt springs with a natural temperature of 91° F.

The Egyptian government opened a fully equipped thermal establishment in 1900, and the station was provided with hotels and all the usual forms of amusement familiar at European spas. An astronomical observatory was built there in 1903–04 to replace the former observatory at Al Abbasiyah. On the opposite bank of the river lie the ruins of Memphis and the famous pyramids of Saqqarah.

HELWYS, THOMAS (*c.* 1550–c. 1616), leader of the first General Baptist church in London, was born at Broxtowe hall in Nottinghamshire of a well-connected family and was a student of law at Gray's Inn. On his return home he showed strong Puritan sympathies. which ultimately led to his joining the separatist church in Gainsborough, of which his friend John Smyth (*q.v.*), an ordained clergyman, had become pastor. Helwys took a leading part in the migration of this church to Amsterdam in 1607 or 1608 and in 1609 followed Smyth in opposing infant baptism and in starting the first Baptist church. When Smyth entered into negotiation with the Mennonites. Helwys broke with him, refusing to repudiate the earlier steps they had taken together. Regretting their flight from persecution, he and a small group of followers returned to London in 1611 or 1612 and established themselves at Spitalfields. In Holland Helwys had published in 1612 A *Short Declaration of the Mistery of Iniquity,* which contains the first printed plea in English for complete religious freedom and toleration Appeal was made to King James I, but Helwys was imprisoned in Newgate and it was probably there that he died about 1616. He and his associates rejected the current Calvinist doctrines of election and original sin and became known as General or Arminian Baptists. *See* also BAPTISTS: *History.*

See W H Burgess, *John Smith, Thomas Helwys and the First Baptist Church in England* (1911); *A. C.* Underwood, *A History of the English Baptists* (1947). (E. A. PA)

HELY-HUTCHINSON, JOHN (1724–1794), Irish politician, was celebrated for his accumulation of offices and for his stormy tenure of the provostship of Trinity college, Dublin. He was the son of Francis Hely of County Cork and was educated at Trinity college, Dublin. Called to the Irish bar in 1748, he built up a large practice. He married Christiana Nickson in 1751 and when his wife inherited the estates of her uncle. Richard Hutchinson, he added the name of Hutchinson to his own. He entered the Irish house of commons in 1759 and remained a member until his death, representing first Lanesborough and then for almost 30 years, Cork city. Hely-Hutchinson held the offices of prime sergeant (1761–74), alnager (1762–75), provost of Trinity college, Dublin (1774–94), and secretary of state (1777–94).

An able debater, self-assured, alert and indefatigable. Hely-Hutchinson possessed a mastery of economic fact and parliamentary procedure. He often had an intelligent approach to political problems, advocating free trade and the removal of disabilities imposed on the Irish Catholics. He was also distinguished for the blatant persistence aith which he pressed his personal claims. Immediately after entering parliament he showed his mettle as a critic of the government. but he soon became a supporter of the administration and was for years one of the government's mainstays in debate.

On a few occasions, however, he showed signs of joining the opposition. When Viscount Townshend introduced his unpopular augmentation scheme in 1767, Hely-Hutchinson at first opposed it but was enticed back to the government ranks. In 1779, when nationalist sentiment was mounting, Hely-Hutchinson, who was genuinely concerned for Ireland's economic interests, published *Commercial Restraints of Ireland,* an able pamphlet against the trade restrictions in which he displayed an intelligent awareness of Adam Smith's theory of free trade. Finally he gambled in political futures by supporting the Whigs in the regency dispute of 1788–89. The lord lieutenant urged his dismissal but Hely-Hutchinson joined a strong group of officeholders who had chosen the wrong side in the crisis but who, by hanging together, managed to elbow their way back into the government's ranks.

As provost of Trinity college he was severely handicapped. He had no pretensions to scholarship and his appointment was bound to be resented by many of the fellows. Moreover he used his statutory powers in a very overbearing fashion. He uas determined to obtain one of the university seats for his family and at the elections of 1776 and 1790 he put forward a son as one of the candidates. These contests led to bitter electioneering and to some sensational and unedifying episodes. In addition he quarreled with the majority of the fellows over academic policy, contending (in the event unsuccessfully) that he had the right to veto the decisions of the governing body of the college. The controversial dust stirred up by these disputes has obscured his real services to the college. He was anxious to widen the curriculum. He instituted prizes at entrance for composition. was responsible for the foundation of professorships in modern languages, secured the act of parliament which marked the effective foundation of the medical school and obtained the grants which enabled the college to complete Parliament square and erect the public theatre.

He died at Buxton on Sept. 4, 1794, having obtained a peerage for his wife as Baroness Donoughmore, in 1783. His son Richard became Lord Donoughmore on his mother's death in 1788 and 1st Earl Donoughmore in 1800. (R. B. McD.)

HELYOT, PIERRE (1660–1716), Franciscan friar and historian, was born at Paris in Jan. 1660, and in 1683 entered the third order of St. Francis at Picpus, near Paris. During his travels to many parts of Europe on monastic business he collected materials for his great work, *L'Histoire des ordres monastiques, religieux, et militaires, et des congrégations séculières* (8 vol., 1714–21). Helyot died on Jan. 5, 1716, before the fifth volume appeared, but his friend Maximilien Bullot completed the edition.

The *Histoire* is a work of great historical importance, and is profusely illustrated by plates exhibiting the dress of the various orders. The material has been arranged in dictionary form in J. P. Migne's *Encyclope'die the'ologique,* under the title "Dictionnaire des ordres religieux" (4 vol., 1858). Helyot's only other noteworthy work is *Le Chre'tien mourant* (1695).

HEMANS, FELICLA DOROTHEA (1793–1835), English poetess, was born in Duke street, Liverpool, on Sept. 25, 1793, the daughter of George Browne, a Liverpool merchant of Irish extraction. Her mother seems to have been of Austrian origin. In 1806 the family moved to Gwrych, Denbighshire, and there Felicia grew up by the Welsh mountains and the seashore. When she was only 14, her *Juvenile Poems* were published by subscription, and were harshly criticized in the *Monthly Review.* Her *Domestic Affections and Other Poems* appeared in 1812, on the eve of her marriage to Capt. Alfred Hemans, adjutant of the Northamptonshire militia. While they lived at Bronwylfa, a house near St. Asaph, she published *The Restoration of Works of Art to Italy* (1816), *Modern Greece* (1817) and *Translations From Camoens and Other Poets* (1818).

Husband and wife separated in 1818, and though letters were interchanged concerning their five children, they never met again. Her next productions were *Tales and Historic Scenes in Verse* (1819), *The Sceptic* and *Stanzas to the Memory of the Late King* (1820), a volume of poems containing "The Siege of Valencia," "The Last Constantine" and "Belshazzar's Feast" (1823), and

The Forest Sanctuary and *Lays of Many Lands* (1825), which were two of her favourite works.

In 1828 Mrs. Hemans moved to Wavertree, near Liverpool. In the following summer she visited the Hamiltons of Chiefswood, where she enjoyed "constant. almost daily. intercourse" with Sir Walter Scott. who had written an epilogue for her play; *The Vespers of Palermo,* produced at Edinburgh in April 1824. It had been acted at Covent Garden on Dec. 12, 1823, but was withdrawn after the first performance. In 1830 she visited Wordsworth and the Lake country. and went again to Scotland. Her publications of this period include *Songs of the Affections* (1830), *Hymns for Childhood* (1834; had appeared in America in 1827), *National Lyrics* (1834), *Scenes and Hymns of Life* (1834) and a series of sonnets. *Thoughts During Sickness.* She died in Dublin on May 16, 1835.

Mrs. Hemans' poetry is the outcome of a beautiful hut singularly circumscribed life, a life spent in romantic seclusion. without much worldly experience. and warped by domestic unhappiness and physical suffering. Scott complained that it contained "too many flowers" and "too little fruit." Her reputation rests on her short poems, such as "The Treasures of the Deep," "The Better Land," "The Homes of England," "Casabianca," "The Palm Tree," "The Graves of a Household," "The Wreck," "The Dying Improvisatore," "The Lost Pleiad" and the "Landing of the Pilgrims," beginning:

The breakinc waves dashed high on a stern and rock bound coast.

Mrs. Hemans' *Poetical Works* were collected in 1832 (last ed., Oxford. 1914); her *Memorials,* etc., by *H.* F. Chorley (1836).

HEMATITE (HAEMATITE), a mineral consisting of ferric oxide. Fe_2O_3, containing 70% of iron. Hematite is the most important iron ore. both because of its high iron content and its abundance. The world's greatest production of hematite (nearly 100,000,000 tons in a single year) has been from the Lake Superior district. including Minnesota. Michigan, Wisconsin and Ontario. Enormous deposits of high-grade hematite have been found in Minas Gerais. Braz.; Cerro Bolivar, Venez.; Labrador; and Quebec. Other important localities are Yorkshire. Eng.; Lorraine, Prance; Birmingham. Ala.; Krivoi Rog. Donets basin. C.S.S.R.; India; Newfoundland; and Cuba.

The crystals of hematite are hexagonal with rhombohedra1 symmetry. The hardness is 5.5–6 and the specific gravity 5.26. The steel-gray crystals and coarse-grained varieties have a brilliant metallic lustre, and are known as specular iron ore. Thin scaly types are called micaceous hematite. Both have a characteristic red-brown streak. Much hematite occurs in a fine-grained earthy form (red ochre). and is nonmetallic in lustre and apparently soft. Intermediate between these types are conipact varieties. often with a reniform surface (kidney ore! and many times with a fibrous structure (pencil ore). Red ochre is used as a paint pigment, and a purified form. rouge, is used to polish plate glass. *See* also IRON; IRON AND STEEL: *Iron Ove.* (L. *S.* RL.)

HEMBYZE, JAN VAN (1513–1584). Calvinist leader of Ghent during the revolt of the Netherlands against Spain, was born in Ghent on July 9, 1513. of a patrician family. After adhering to the cause of the Gueux (*q.v.*), he supported William I the Silent, prince of Orange. in the negotiations for the Pacification of Ghent (*see* NETHERLANDS), but then together with Frans van de Kethulle. lord of Ryhove. took the lead of the combined factions of radical Calvinists and reactionary democrats in their native town. On Oct. 28. 1577, they arrested, among others, the stadholder of Flanders. Philippe de Croy, duke of Aerschot. The democratic form of municipal government that had prevailed beiore 1540 was then restored, hut the real power came to be wielded by a revolutionary committee of 18. set up on Nov. 1. William of Orange caused the stadholder to he released. but otherwise upheld the committee. Soon, however, excesses began. Monasteries were looted. images broken, monks and priests expelled and finally Roman Catholic worship was prohibited. True to its trnditions. Ghent tried to dominate the whole of Flanders. These activities. in contravention of the pacification. roused the Catholics and conservatives, especially in the Walloon provinces. and caused a rift in the national unity advocated by William. A civil war broke out. By playing the more moderate Ryhove off against Hembyze, William in Dec. 1578 secured religious freedom for the Catholics. but after a few months Hembyze and the fanatical Calvinist minister Petrus Dathenus again got the upper hand. Finally, but too late to conciliate the Walloons, William, with Ryhove's help, succeeded in removing Hembyze and his fellow radicals (Aug. 1579). Hembyze left the country, but was recalled in Aug. 1583 when Ghent needed a resolute leader against the threatening advance of Alessandro Farnese (*q.v.*). Hembyze fell short of expectations. Accused of corresponding with the enemy, he was executed in Ghent as a traitor on Aug. 4, 1584.

See V. Fris, *Histoire de Gand (1913*; 2nd ed., 1930); L. van der Essen, *Alexandre Farnèse, prince de Parme,* vol. iii *(1934).* (A. *G.* J.)

HEMEL HEMPSTEAD, a market town and municipal borough in the Hemel Hempstead parliamentary division of Hertfordshire, Eng., 23 mi. N.N.W. of London by road. Pop. (1961) 55.165.

Settlements in the neighbourhood of Hemel Hempstead, which is on the Gade and Bulbourn rivers near the Grand Junction canal. date from pre-Roman times, and a Roman villa has been discovered at Boxmoor. The manor, held by the count of Mortain in 1086, was granted by Edmund, earl of Cornwall. in 1285 to the house of Ashridge, and the town developed under monastic protection. In 1539 it was raised by charter to a bailiwick and other charters were granted in 1572, 1609, 1656, 1666 and 1693; it was recreated a borough in 1898. St. Mary's church, of clunch stone and flint, is Norman with Decorated additions. Part of Hemel Hempstead is being developed as a New Town (formed 1947) in the Greater London plan (see NEW TOWNS).

Great quantities of watercress are grown commercially in the rivers. Once a big market for wool and corn, Hemel Hempstead has modern industries including the manufacture of paper, fireworks and electrical and light engineering products.

HEMEROBAPTISTS: see JEWISH SECTS DURING THE SECOND COMMONWEALTH.

HEMEROCALLIS: see DAY LILY.

HEMICHORDATA, a subphylum of the Chordata, of which the vertebrates or Craniata are another subphylum. The term was introduced by W. Bateson in 1884. The Hemichordata are marine animals and include two classes, the Enteropneusta (see BALANOGLOSSUS) and the Pterobranchia (*q.v.*).

Vertebrates are distinguished by the presence of a notochord or dorsal supporting rod, separated from the roof of the embryonic gut, which gives the name to the phylum, by gill slits in the wall of the pharynx and by a dorsal tubular nervous system. Hemichordates possess all these characters in some measure. The notochord is a short tubular diverticulum of the fore-gut. The dorsal nerve cord is tubular for part of its length in the Enteropneusta, but is solid in the Pterobranchia. The gill slits are numerous in the Enteropneusta, few or absent in the 'Pterobranchia. (F. W. R. B.)

HEMIMORPHITE. This mineral is a hydrous zinc silicate and an important ore of zinc (*q.v.*), of which it contains 54.4%. Hemimorphite occurs as a secondary mineral formed from the alteration of sphalerite (zinc sulfide) and is associated with other zinc ores (smithsonite and sphalerite) in veins and beds in limestone. It is found in many zinc mines throughout the world. Well crystallized specimens have been found in Siberia, Rumania, Sardenia and Belgium. In the United States fine crystals have come from Sterling Hill, N.J.. and Elkhorn, Mont.

The mineral was formerly called calamine or electric calamine in the United States. It is orthorhombic and the name hemimorphite is given because of the hemimorphic development, that is, different terminations at the two ends of the prismatic crystals. Because of this polarity, the crystals, when subjected to changes in temperature, become positively charged at one end and negatively charged at the other (pyroelectricity). There is perfect cleavage parallel to the faces of the vertical prism. Crystals are usually colourless and transparent but may be yellowish or greenish; they have a vitreous lustre. The composition is $Zn_4Si_2O_7(OH)_2.H_2O$. The hardness is j, and the specific gravity 3.45. The mineral also occurs as stalactitic or botryoidal masses with a

fibrous structure, or in massive, cellular or granular aggregates intermixed with smithsonite and clay. It resembles smithsonite (zinc carbonate) but can be distinguished from it by a test with hydrochloric acid. Smithsonite readily effervesces in the cold acid, hemimorphite does not. (C. S. H.)

HEMINGBURGH, WALTER OF, also commonly. but erroneously, called Walter Hemingford, a Latin chronicler of the 14th century. was a canon regular of the Austin priory of Gisburn in Yorkshire. Hence he is sometimes known as Walter of Gisburn (Walterus Gisburnensis). Bale. seems to have been the first to give him the name by which he became more commonly known. His chronicle embraces the period of English history from the Conquest (1066) to the 19th year of Edward III, with the exception of the years 1316–26. In compiling the first part, Hemingburgh apparently used the histories of Eadmer, Hoveden, Henry of Huntingdon and William of Newburgh; but the reigns of the three Edwards are original.

There are several manuscripts of the history extant, the best, perhaps, being that presented to the College of Arms by the earl of Arundel.

The first three books were published by Thomas Gale in 1687, in his *Historiae Anglicanae scriptores quinque,* and the remainder by Thomas Hearne in 1731. The first portion was again published in 1848 by the English Historical society, under the title *Chronicon Walteri de Hemingburgh, vulgo Henzingford nuncupati, de gestis regum Angliae,* edited by *H.* C. Hamilton.

HEMINGE (HEMING. HEMMINGE, HEMMINGS, etc.). **JOHN** (*c.* 1556–1630), English actor and long-time colleague of William Shakespeare. He was an important and prosperous member of the theatrical company that eventually became the King's Men in 1603, apparently serving as business manager for over a quarter of a century. He was one of the original "housekeepers" of the Globe and Blackfriars theatres. Heminge, Henry Condell (*q.v.*), and Richard Burbage (*q.v.*) were closely associated with Shakespeare throughout his career. They are listed among the 26 "principal actor's" in his plays, and he left them token remembrances in his will. Heminge and Condell prepared and oversaw the *First Folio* (1623), and their prefatory letters of dedication make it clear that this was in part a gesture of love and respect toward their dead friend. (FK. C. B.)

HEMINGWAY, ERNEST MILLER (1899–1961). U.S. novelist and short-story writer, was born in Oak Park, Ill., on July 21, 1899. Educated in the local public schools, he skipped college to begin writing as a cub reporter on the *Kansas City Star.* Entering World War I with a U.S. ambulance unit. he was attached to the Italian infantry, until severely wounded by shrapnel near the village of Piave in northern Italy on the night of July 8. 1918. Following a period of recuperation in Milan, of trade-journal editing back home in Chicago, and of serious writing practice in northern Michigan, he resumed newspaper work and sailed for France on Dec. 8, 1921, as a foreign correspondent for the *Toronto Star.* Five hardworking apprentice years. during which he supported himself through journalism in France, Italy, Spain, Switzerland, Germany and Greece were enough to develop the succinct and lucid style which would subsequently exert so powerful an influence on American fiction.

Three Stories and Ten Poems (1923) and *in our time* (1924), published in Paris, prepared the way for the short-story collection In *Our Time* (New York, 1925). But his first notable success came in 1926 with *The Sun Also Rises,* a poignant fictional reminiscence of so-called "lost generation" expatriates in and out of a Pamplona fiesta. *The Torrents of Spring,* a parody of Sherwood Anderson's *Dark Laughter,* also appeared in 1926. Two more short-story collections, *Men Without Women* (1927) and *Winner Take Nothing* (1933), advanced Hemingway's reputation in this genre. His fame as a novelist was consolidated by *A Farewell to Arms* (1929) which incarnated his sense of war's immorality through the tragic story of a U.S. officer and a British nurse in wartime Italy and neutral Switzerland. Experimental works in nonfiction followed: *Death In the Afternoon* (1932), a bible of the Spanish bullfight which had fascinated Hemingway for ten years; and *The Green Hills of Africa* (1935). which employed certain fictional techniques to give a true account of the author's safari of 1933–34 in the big-game region of Tanganyika. To *Have and Have Not* (1937) is a novel about a Caribbean desperado, set against a background of low-class violence and upper-class decadence in Key West, Fla. Despite powerful passages. this is perhaps the least successful of Hemingway's experiments during the period of the 1930s.

Meantime the Spanish Civil war attracted Hemingway's interest. For *Whom the Bell Tolls* (1940), his greatest novel. tells of a U.S. volunteer who joins a guerrilla band behind the rebel lines in the vastness of the Guadarrama mountains. The story masterfully embodies Hemingway's sense of the tragic betrayal of the Spanish people by foreign Fascist and Communist forces, as well as by reactionary elements within Spain itself. (A stage melodrama, *The Fifth Column,* written under fire in wartime Madrid, had already appeared with the collected short stories in 1938.) He also edited. with a revealing introduction, *Men at War* (1942), an anthology of war stories both historical and fictional, including three of his own, *Across the River and Into the Trees* (1950) provides an account of the last three days in the life of a C.S. army officer in Venice and environs; the hero's comments partially summarize the author's sardonic reactions to World War II. in which he had participated at many levels. His short novel. *The Old Man and the Sea* (1952), is the heroic story of an aged Cuban fisherman's lone expedition after a great marlin in the Gulf stream north of the island. Following an extended and spirit-straining struggle. Santiago brings his huge quarry to the gaff. only to have it eaten by voracious sharks during the long voyage home. The novel won the Pulitzer prize in fiction for 1953, and was instrumental in winning Hemingway the Nobel prize for literature in 1954. The Nobel prize award committee praised his "forceful and style-making mastery of the art of modern narration."

Hemingway's death, the result of a self-inflicted gunshot wound, took place at his home in Ketchum, Ida.. on July 2. 1961. Whether the shooting was intentional or accidental was not determined.

Along with his achievement as a stylist, Hemingway's career as a writer was distinguished throughout by his ability to produce swift-moving narratives of action supported by complex structures of natural symbolism, a fact which, without sacrifice of dramatic verisimilitude, gave his best works the force of parables.

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HEMIPTERA (Gr. *emi,* half, and *pteron,* a wing), the name applied in zoological classification to that order of insects (*q.v.*) which includes true bugs. cicadas, aphides and scale insects. The name was first given by Linnaeus (1735), who applied it in allusion to the half-coriaceous and half-membranous character of the forewings in many species of the order. This expression, however. is not very well suited, as the forewings in many members are of a uniform texture; the most characteristic feature is afforded by the mouth parts, which form a beaklike proboscis with piercing and sucking stylets. This latter feature led J. C. Fahricius (1775) to substitute the name Rhynchota (Rhyngota), which is still used by some authorities. Hemiptera number about 51,000 described species; the great majority are plant feeders and rank among the most destructive of all insects. Two pairs of wings are generally present, the anterior pair being most often of harder consistency than the posterior pair! or with the apical region more membranous than the remainder. The mouth parts always are adapted for sucking and piercing. and the palpi are atrophied. Metamorphosis is incomplete (fig. 6) in most cases but. more rarely, complete in certain others (fig. 13). The insects comprising this order are mostly small or moderate in size although a few, such as the giant water bugs and cicadas, may be very large.

In general the colour patterns are not conspicuous, but some of the tropical forms especially are strikingly colourful.

General Structure.—The head is very variable in form and in most cases the sclerites are compactly fused with few noticeable sutures. As a rule the antennae have only 4 or 5 segments,

but in exceptional cases 10 (Psyllidae) or even 25 segments (males of a few Coccidae) may be present. The mouth parts are of an exceptionally uniform character throughout the order, a feature that is correlated with the universal habit of feeding by means

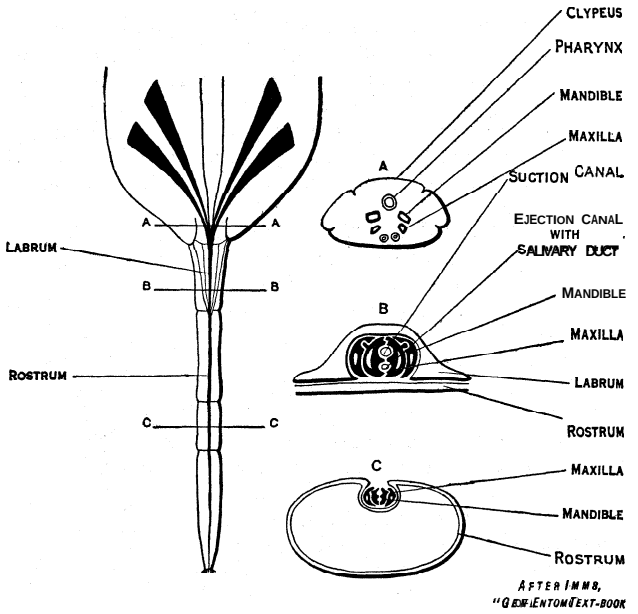


FIG. 1.—DIAGRAM OF MOUTH PARTS AND ADJACENT REGIONS OF HEAD OF HEMIPTERAL INSECT. AT RIGHT ARE TRANSVERSE SECTIONS ACROSS REGIONS BEARING CORRESPONDING LETTERING ON LEFT-HAND FIGURE. (THE MAGNIFICATION OF THESE SECTIONS IS NOT UNIFORM)

of piercing and sucking. The mandibles and maxillae are in the form of needlelike stylets and are held together intimately so as to function almost as one organ (fig. 1). Each maxilla bears two grooves separated by a longitudinal ridge, and the two maxillae are locked together so that the grooves form a pair of minute tubes. The upper tube so formed is the suction canal through which the food is imbibed, while the lower tube allows for the flow of the saliva into the plant and hence is termed the ejection canal. The labium takes the form of a segmented sheath or rostrum which is grooved above to form a slot in which the other mouth parts repose when at rest. The labium takes no part in feeding, and both pairs of palpi are wanting. In many members of the order the pronotum is a large, conspicuous shield as in beetles, the legs have three or fewer segments to the tarsi and the wings are exceedingly variable in character with relatively scanty venation. In the suborder Heteroptera the forewings are termed

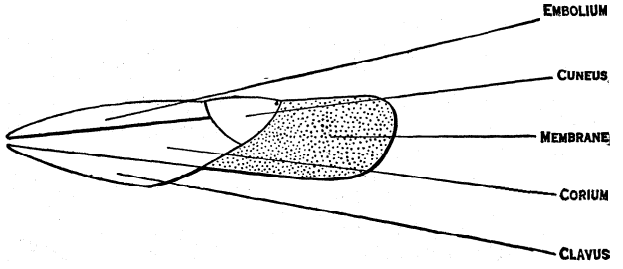


FIG. 2.—DIAGRAM OF THE FOREWING, OR HEMELYTRON, OF A HETEROPTEROUS BUG, SHOWING AREAS INTO WHICH IT IS DIVIDED

hemelytra (hemi-elytra) and their proximal area is horny or leathery, resembling an elytron, only the distal portion remaining membranous. The hind wings are always membranous and in repose are folded beneath the hemelytra. The hardened basal portion of the hemelytron is divided into a narrow posterior area or clavus and a broader main portion or corium. In some cases a narrow strip of the corium is marked off along the anterior margin to form the embolium, and in mirid bugs there is a triangular apical area to the corium which is termed the cuneus (fig. 2). In the suborder Homoptera the forewings are of uniform texture and frequently of harder consistency than the hind pair. Many species of Hemiptera are wingless, especially in aphides and the females of all scale insects. In other cases there are several degrees of wing development within a single species—wingless, fully winged and half-winged individuals being present. The meaning of this wing polymorphism is obscure. The abdomen sometimes exhibits indications of 11 segments, but reduction or suppression of one or more is the rule. In some Hemiptera a true ovipositor is well developed but in other groups it is inconspicuous or wanting.

Classification.—The order is divided into a large number of families which are grouped under two suborders as given below:

SUBORDER I. HETEROPTERA

Wings generally overlapping on the body when at rest, the forepair usually hardened, the apex only being membranous. Pronotum large; tarsi generally three-segmented. The Heteroptera include both terrestrial and aquatic families the most important of which are the following:

Series I. GYMNOCERATA.—Antennae conspicuous; terrestrial or in some cases living on the surface of water. The Pentatomidae or shield bugs are rather large and often brightly coloured insects, with five-segmented antennae and a large scutellum which sometimes covers the abdomen (fig. 3). The Coreidae have a smaller scutellum and the antennae are placed high upon the head; the squash bug (*Anasa tristis*) of the U.S. is a well-known example. The Lygaeidae are related to them, but the antennae are placed lower on the head; the American chinch bug (*Blissus* leucopterus) is well known and the family includes about 50 British species. The Pyrrhocoridae or red bugs differ from Lygaeidae in having no ocelli; most species have bright red, or green, and black coloration and the injurious cotton stainers (Dysdercus) are well-known examples. The Tingidae or lacebugs are small creatures, whose integument exhibits a beautiful netlike pattern and the tarsi are two-segmented. The Gerridae are a large family of pond skaters which are clothed below with silvery pubescence; the genus Halobates (fig. 4) occurs far out on the ocean in warm latitudes. The Reduviidae are a family of more than 2,500 species, with a prominently curved rostrum; they mostly live on the blood of other insects, while species of the Triatominae suck the blood of vertebrates. The Cimicidae (fig. 5) are the well-known bedbugs (*Cimex*), which are bloodsuckers of mammals and birds, and the Polyctenidae are curious parasites living on bats. The Miridae (Capsidae) are a large family in which the hemelytra have a cuneus and a linear undifferentiated embolium. More than 180 species are British and some are serious enemies of fruit trees.

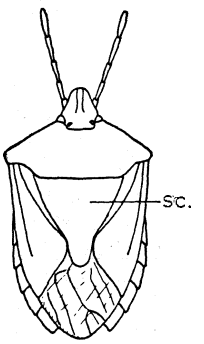
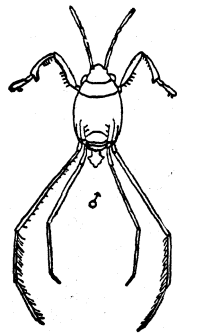


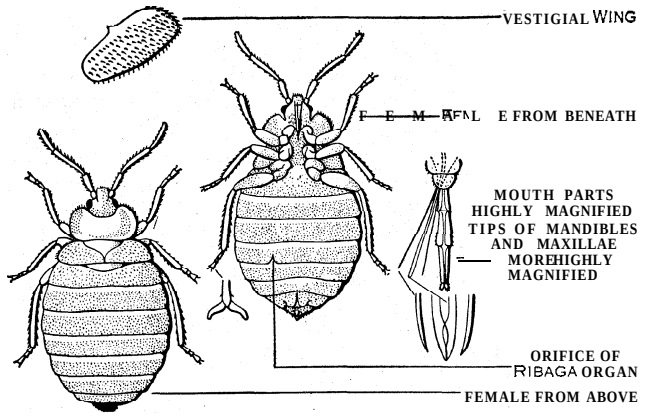
FIG. 3.—SOUTHERN GREEN STINKBUG (NEZARA VIRIDULA), A TYPICAL SHIELD BUG. SC = SCUTELLUM



FROM F. BUCHANAN WHITE, "SCIENTIFIC RESULTS OF THE VOYAGE OF H.M.S. CHALLENGER"

FIG. 4.—PELAGIC HEMIPTERON (HALOBATES SERICEUS) TAKEN IN MID-OCEAN IN BOTH ATLANTIC AND PACIFIC

Series II. CRYPTOCERATA.—Aquatic species with concealed antennae. Included here are the Belostomatidae or giant water bugs of the tropics which may exceed four inches in length. They feed upon small fish, tadpoles and other insects. but often take to the wing and are attracted to lights at night. The Nepidae or water scorpions (fig. 7) have an apical breathing tube at the extremity of the abdomen, raptorial forelegs and three-segmented antennae. The Notonectidae or back swimmers: also called water boatmen (*q.v.*), swim on their backs and when diving carry a supply of air on their abdominal venter. They are markedly predaceous and can inflict painful punctures when handled. The Corixidae or



FROM "BULLETIN OF ENTOMOLOGY" AFTER MARLATT (U.S. DEPARTMENT OF AGRICULTURE)

FIG. 5.— DORSALAND VENTRAL VIEWS OF THE FEMALE BEDBUG (CIMEX LECTULARIUS), WITH STRUCTURAL DETAILS

water boatmen (*q.v.*) are numerous in most countries and are largely bottom dwellers, notable for their lack of a typically segmented rostrum and their herbivorous feeding habits.

SUBORDER II. HOMOPTERA

Wings usually sloping roofwise over the sides of the body when at rest, the forepair of uniform consistency, but wingless forms are frequent. Pronotum small, tarsi one- to three-segmented. The greater number of the Hemiptera belong to this suborder and, with the exception of the cicadas and lantern flies, they are mostly small or very small, fragile insects. The Cicadidae or cicadas (*q.v.*) include more than 2,000 species of large insects with ample membranous wings and toothed femora to the forelegs. The males almost always have a sound-producing apparatus on each side of the base of the abdomen (fig. 8) and are very powerful stridulators. The nymphs live below ground at the roots of plants. The family is mainly tropical; 200 species occur in North America but there is only a single representative in Britain, where it is rarely found. The Fulgoroidea are an assemblage of about 18 families, the members of many of which secrete wax in various forms; the best-known examples are the large tropical lantern flies which, however, are not luminous. The Membracidae are remarkable on account of the development of the pronotum into variably shaped processes which extend far backward over the body. The Cercopidae comprise the cuckoo spit (*q.v.*) insects or froghoppers and the Cicadellidae include the leaf hoppers (fig. 9). Both families are exceedingly large groups of small insects, numerous in Britain and most parts of the world. The Psyllidae or jumping lice include the apple and pear suckers; they have usually ten-segmented antennae, and the forewings are of somewhat firmer consistency than the hind pair. The Aphididae (fig. 10) are the large and very important families of aphides (*q.v.*), which include many injurious species and undergo a highly complex life cycle; among the best-known forms are the woolly aphis of the apple and the vine *Phylloxera* (*q.v.*). The Aleyrodidae or white flies are minute fragile creatures dusted with a waxy powder; the greenhouse white fly (Trialeurodes *vaporariorum*) is the only species likely to attract notice. The Coccidae (fig. 12) form one of the most noxious groups of all insects and include the scale insects (*q.v.*) and mealy bugs. The females are degenerate wingless insects and cause most of the damage entailed by this family, while the males are very fragile creatures with a single pair of wings and no mouth parts.

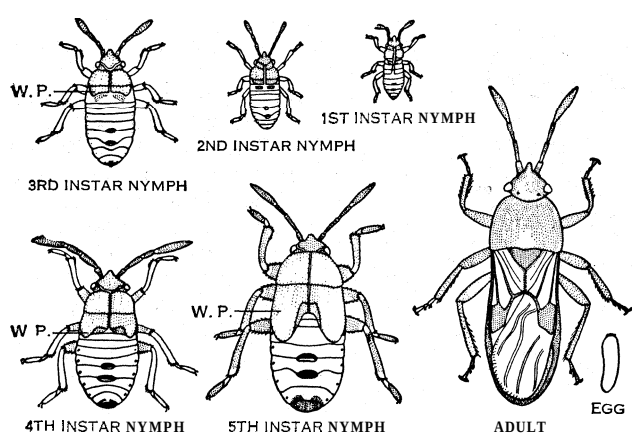


FIG. 6.— CHINCH BUG (BLISSUS LEUCOPTERUS), ILLUSTRATING GRADUAL OR INCOMPLETE METAMORPHOSIS CHARACTERISTIC OF HETEROPTERA. WING PADS (W.P.) INDICATED IN THIRD INSTAR NYMPH

Reproduction and Development.— In most Hemiptera the nymphs resemble the parents except for the absence of wings, and they are active through all stages of growth, feeding in a manner similar to the adults. The number of moults undergone is very variable and the wing rudiments appear among Heteroptera about the third instar (fig. 6). Cicadas are remarkable because the young insects are adapted for burrowing, and suck the sap from roots, while the adults are aerial. In male Coccidae an incipient pupal stage is passed through (fig. 13) and the same occurs in both sexes of Aleyrodidae; these families, therefore, afford a transition toward insects with complete metamorphosis.

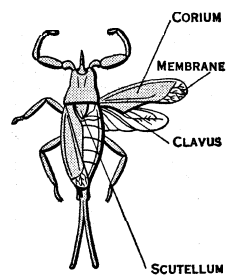


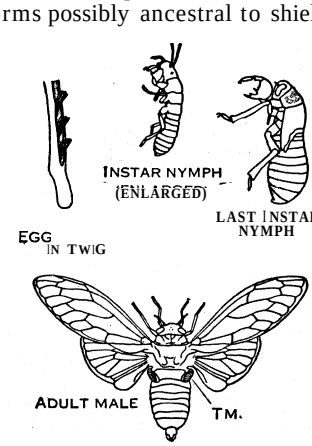
FIG. 7.— WATER SCORPION (NEPA CINEREA), NATURAL SIZE

Geographical Distribution.— Though very widely distributed, Hemiptera have not penetrated so far into remote and inhospitable regions as have some of the other orders. The Fulgoroidea and Cicadidae are more especially tropical groups and the Membracidae attain their greatest development in Central and South America, but many of the other large families are well represented in most countries. Some species such as the bedbug (*Cimex lectularius*) and the shield bug *Nezara* viridula are nearly world-wide, and a number of European species have found their way into North America.

Geological **Distribution.**—Hemiptera first appear in geological times in Lower Permian rocks of Kansas and Germany. The remarkable German fossil Eugeron has the typical Hemipterous mouth parts except that the labium is paired and unfused, while the wing venation is more like that of an early cockroach type. On these characters Eugeron has been referred to a separate extinct order, the Protohemiptera. In the Kansas rocks undoubted Homoptera occur, belonging to extinct families, and the first Heteroptera appear in the Upper Trias of Ipswich (Australia), where they are represented by forms possibly ancestral to shield bugs and Notonectidae. In Jurassic times both suborders are well represented and some of the dominant existing families differentiated. After the Jurassic period Hemiptera become more abundant as fossils, notably in the Miocene of Florissant and in Baltic amber.

(A. D. I.; H. B. HD.)

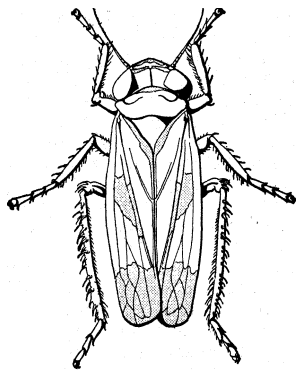
Natural History.— Most of the Heteroptera or true bugs attach their eggs to the plant host or some other support in their environment. However, the Miridae, the Nabidae, the Mesoveliidae, the Nepidae, some Notonectidae, some Tingidae and a few others insert their eggs in plant tissues. The toad bugs (Gelastocoris) and ground-inhabiting Reduviidae place their eggs in the ground. The females



FROM R. E. SNODGRASS, "INSECTS. THEIR WAYS AND MEANS OF LIVING"

FIG. 8.— THE 17-YEAR CICADA (MAGICICADA SEPTENDECIM), SHOWING EGG PUNCTURES IN TWIG. FIRST INSTAR NYMPH, LAST-STAGE NYMPH AND ADULT MALE SHOWING TYMPANA (TM.)

of the Coreid genus *Phyllomorpha* deposit their eggs on the concave, spine-protected dorsal surface of the males, while the Belostomatid females of the genera Belostoma, Abedus, *Sphaerodema* and *Diplonychus* glue their egg batches to the backs of the males. The curious Corixid Ramphocorixa attaches its eggs to crayfish. A few Pentatomidae are said to guard their eggs and newly hatched offspring. The Polyctenidae, which are peculiar ectoparasitic bugs on bats, bring forth their young relatively advanced in development, while all other true bugs or Heteroptera lay eggs. The hatching nymphs are enclosed in a diaphanous membrane which often is equipped with an egg burster. This membrane is shed upon the nymphs' emergence. There are usually five nymphal stages with the last three possessing wing pads. In most families of terrestrial Heteroptera the nymphs possess scent or stink glands that open on the abdominal dorsum. Some aquatic bugs, the Corixidae for example, possess such glands. In the adults these abdominal glands are replaced by thoracic glands that open on the venter. These produce the characteristic buggy odour of the Heteroptera so well known in the bedbug, chinch bug, squash bug and stinkbugs (Pentatomidae). While nearly all Hemiptera imbibe only food of a liquid nature, the water bugs of the family Corixidae may ingest long filaments of algae and other solid matter. Most families of terrestrial Heteroptera are plant feeders although some of them may include species that are predaceous upon other insects. Some terrestrial families, such as Reduviidae and Nabidae, are typically predaceous as are all the families of semiaquatic and aquatic Hemiptera except the Corixidae. Some Reduviidae and the families Cimicidae and Polyctenidae suck the blood of vertebrates.



FROM "MEMOIRS OF THE DEPARTMENT OF AGRICULTURE AFTER MISRA (HIGH COMMISSIONER FOR INDIA)

FIG. 9.—THE LEAF HOPPER (NEPHOTETTIX APICALIS)

In various Heteroptera sound is produced by some method of stridulation which is the rubbing of some portion of the body against another. Some Reduviidae scrape the beak against a roughened groove on the thoracic venter; notonectid males of the genera Buenoa and Anisops have stridulatory patches on the front legs that are rubbed over scrapers on the base of the beak to produce a chirping sound. Certain corixid males have patches of pegs on the bases of the femora of the front legs that are rasped over a sharp edge on the side of the head below the eyes to produce sounds that can be heard at some distance from these aquatic stridulators.

Some pentatomids, naucorids, nabids and veliids rub their legs against certain areas of the abdomen to produce sound, while one Naucorid scrapes the margin of one abdominal segment over a roughened area of the next. In most cases only the males possess stridulatory organs.

In the Homoptera are the familes Fulgoridae, Cicadidae, Membracidae, Cicadellidae and Cercopidae which, with few exceptions, insert their eggs in the tissues of plants. They have active nymphs, the most interesting of which are those of the Cicadidae, which burrow in the ground, feeding on the roots of plants, and those of the Cercopidae, which produce masses of spittle in which they live. All the families mentioned above have at least one generation a year except the Cicadidae, which may require several years to complete a cycle. The famous 17-year locust or periodical cicada Magicicada septendecim of the middle and eastern United States completes its life cycle in 17 years over most of its range but in the south requires only 13 years.

The mating calls of male cicadas are often loud, shrill and monotonous and more or less characteristic for the species. As a rule the females are mute but the sound-producing devices of the males are the most complicated organs of sound found in the animal kingdom.

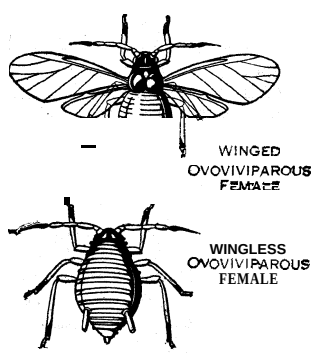
Other well-known families are the Psyllidae (jumping plant lice), Aleyrodidae (white flies), Aphididae (plant lice) and Coccidae (scale insects). These are all very small insects that may occur in astonishing numbers. The jumping plant lice and the white flies lay eggs that are attached to the host plant by a short stipe or a pedicel, and the nymphs are often so flattened that they are mistaken for scale insects. Some of the psyllid nymphs are gall formers, such as the one that makes galls on the leaves of hackberry in America. Others are naked or wax-covered and excrete quantities of honeydew. The sugar lerp insect of Australia produces enough of this material to warrant its being gathered by the natives for food. The Aleyrodidae nymphs upon hatching are motile, but with the first moult shed their legs and antennae, settle upon the leaves of the host plant and resemble soft, unarmoured scale insects. They may be naked or covered with waxy excretion or white cottony material, often with a fringe of white waxy plates or filaments about the margin. These young should be called larvae rather than nymphs. Beneath the last larval skin the larva changes to a pupa. The wing pads and legs which have been developing within the larva become external as in exarate pupae (fig. 13). The adult emerges through a T-shaped slit in the dorsum of the last larval skin or puparium. Both sexes are four-winged little insects with compound eyes, two ocelli and rostrum.

The superfamily Aphidoidea or plant lice present quite an array of forms within a species. They often have complex life histories involving a primary host and secondary hosts, or migrations from leaves to roots of the same plant or unrelated plants. In temperate regions a typical life history includes in the annual cycle one generation of males and females, called sexuales, which mate, the iemales then laying one or more eggs on the primary host. Many species pass the winter in the egg stage. The eggs then hatch into stem mothers (fundatrices) which may be winged but are usually apterous, usually ovoviviparous, parthenogenetic iemales. These give rise to a series oi generations of ovoviviparous, parthenogenetic females which may be wingless or include migrants or winged forms. Since each female may give birth to many young, each of which is mature in a week or two, the biotic potential is enormous. Late in the season sexuales are again produced. Under tropical conditions species that normally produce sexuales may not do so. Some aphides form galls on plants or cause extensive leaf curling. Many excrete honeydew that has led to their care and protection by ants. Some produce an abundant white waxy material that covers the whole colony.

The superfamily Coccoidea or scale insects are mostly small to minute insects that embrace some of the most highly specialized of all Hemiptera. The males are fragile insects without functional mouth parts. The adult females are always wingless; the males though usually with one pair of delicate wings, the second pair being greatly reduced, are sometimes wingless.

Scale insects may infest fruit, leaves, twigs, trunks or roots of plants. Some occur in the nests of ants and termites. A few live in galls, as does the giant Australian *Apiomorpha* duplex on eucalyptus. The mature female of this species may be 1½ in. long and its gall 3 in. in length.

The female is sometimes ovoviviparous, as in the San José scale and some mealy bugs, but she usually lays her eggs beneath her body, under her scale covering, or in a waxy ovisac behind her. The newly hatched young are active crawlers. Some, like the mealy bugs, may be able to move throughout life, but the majority soon settle down and become fixed. Some of them are naked scales, heavily sclerotized, while others are covered by a tough scale and are soft, delicate creatures beneath it. In the young six-legged crawlers the males and females are similar. Usually after the second moult the males form cocoons or remain under their scales, which are smaller and often different in shape and colour from the iemale scales, where they undergo a more complete metamorphosis. In the armoured scales the young lose their legs and antennae with their first moult and secrete wax to form the covering scale, which may be circular, linear or oystershell shaped, around or at the end of the moulted skin or exuvium (figs. 11 and 12).



FROM DAVIDSON, "BULLETIN ON ENTOMOLOGICAL RESEARCH" BY COURTESY OF THE IMPERIAL BUREAU OF ENTOMOLOGY

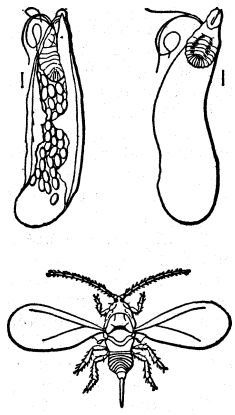
FIG. 10.— BEAN APHID (APHIS RUMICIS), A MEMBER OF THE APHIDIDAE

During the spring and summer a number of generations of virgin females are produced, some winged, some wingless. These individuals bring forth living young, and in autumn the true males and females appear

Many scale insects, as well as plant lice, Cicadellidae, Membracidae and others, void quantities of honeydew and, like them, are attended by ants which sometimes build shelters or sheds over them as they do over aphides. Among the Homoptera there appears to be an excess of sugars in the diet which is repeatedly voided from the anus in fluid drops. They possess a modification of the midgut, called a filter chamber, which is supposed to be associated with their habit of feeding on the copious watery juices of plants. This enables the excess fluid in the food to pass directly from the first part to the last part of the midgut, thus by-passing the main digestive section which receives only the necessary constituents of the plant juices.

Economic Importance. — Since the great majority of Hemiptera feed upon the juices of plants, their over-all damage to grasslands, trees, shrubs and agricultural crops is difficult to estimate. Neverthe-

less, nearly every species of plant is the host of plant lice, scale insects or true bugs that may occur in tremendous numbers and seriously weaken the plant host. This has led to the statement that the Hemiptera are more directly concerned with human welfare than any other insect order. In the Heteroptera the well-known chinch bug (*q.v.*) (*Blissus* leucopterus) causes vast losses to wheat, oats, barley and maize in the United States; the squash bug (Anasa *tristis*) on cucurbits and the harlequin bug (*q.v.*) (Murgantia *histrionica*) on cabbage are very destructive and difficult to control; the cotton stainers (Dysdercus spp.) injure cotton in various parts of the world; the lace bugs (Tingidae) damage trees, shrubs and some garden crops, including eggplants; the Miridae include destructive pests of rice, cotton, sugar cane, fruit trees and garden plants. The latter family also includes the genus Helopeltis, the species of which damage tea in eastern Asia. The famous tea mosquito (H. theivara) of India is one of these.



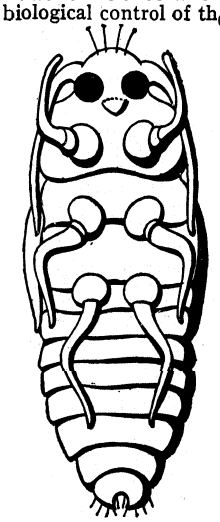
"YEAR BOOK," AFTER HOWARD (U.S. DEPARTMENT OF

FIGS. 11 AND 12.—THE APPLE SCALE INSECT (LEPIDOSAPHES ULMI) Above: female and eggs seen from beneath (left) and from above (right). Below: male apple scale. Magnified

In the Homoptera there is a host of destructive species. The leaf hoppers (Cicadellidae or Jassidae) include such pests as the grape, apple and potato leaf hoppers; the plant lice or aphides (Aphidoidea) are seriously destructive to trees, shrubs, field and garden crops, and include such well-known pests as the woolly aphis of the apple, the grape *Phylloxera* (*q.v.*) and the green bug (*Toxoptera graminum*) of wheat, oats, etc. The scale insects (Coccoidea) are most harmful and comprise many noxious species such as the mealy bugs, the cottony cushion scale, the oystershell scale and the San José scale. The white flies (Aleyrodidae) include the greenhouse white fly and the citrus white fly which share with the scale insects the major insect problems of the greenhouse and citrus crops. In fact, all families of Homoptera contain some injurious species. A considerable number of species of Homoptera are vectors of plant diseases. The Triatominae of the Heteropterous family Reduviidae are vectors of Chagas' disease of humans, and Triatoma sanguisuga has been found naturally infected by the virus of equine encephalomyelitis in Kansas. The Cimicidae, including the bedbug (*q.v.*), are blood suckers, and the predaceous families, such as some of the Reduviidae, Notonectidae, Naucoridae and Belostomatidae, can inflict painful wounds on humans. On the other hand, there are some Hemiptera that are beneficial. In the families Reduviidae, Nabidae, Anthocoridae. some Pentatomidae (*Brochymena* and Perillus, *e.g.*), and other families containing predaceous forms, there are many that feed upon destructive insects. The marsh treaders (Hydrometra) in Panama and in New Caledonia destroy many mosquito larvae, and the little mirid *Cyrtorhinus mundulus*, which feeds upon the eggs of the sugar-cane kaf hopper, was transported from Queensland and Fiji in 1920 by F. Muir to the Hawaiian Islands where it proved to be a highly successful factor in the biological control of the sugar-cane leaf hopper.

The Hemiptera have served as food of man in many places. The giant water bugs are eaten in Thailand, while the eggs of the water boatman (Corixidae) are eaten in Mexico, and cicadas are used as food by natives of Malaya and elsewhere. The biblical "manna of the wilderness" was produced by the tamarisk manna scale insect. The females of this species (Trabutina *mannipara*) secrete quantities of honeydew that in arid regions of Iraq and Asia Minor accumulates and solidifies to form the sweet food which was called "manna" or "gift of God" by the Israelites wandering in the wilderness of Sinai. This material is still used as sugar by the natives. Many Homoptera secrete wax that man has used. The Indian lac scale insect Laccifer *lacca* produces a wax or lac which is refined and marketed as shellac at the rate of about 50,000,000 lb. a year, while the Chinese wax scale Ericerus pela has provided wax for making candles for centuries. The province of Szechwan alone produces about 5,600,000 lb. annually.

Other Homoptera, especially scale insects, have provided dyes. The cochineal *Dactylopius* coccus of the western United States and Mexico feeds upon Opuntia cacti and produces a crimson dye now largely replaced by aniline dyes but still used for colouring cosmetics and some foods.



FROM RILEY AND H "INSECT LIFE" (U S DEPARTMENT OF AGRICULTURE)

FIG. 13.—PASSIVE NYMPH, OR PUPA, OF MALE SCALE INSECT (ICERYA)

The root-feeding Margarodes scales form wax cysts that are metallic gold in colour and which are worn as beads by natives in areas where they occur.

A few Hemiptera have been used in the folk medicine of various peoples. The idea that the common bedbug (Cimex *lectularius*) constitutes a sovereign remedy for malaria still persists in some places, and one of the older pharmacopoeias gives directions for making a tincture of Cimex for this purpose. The chuki or "blistering cicada" of China, now believed to be the fulgorid Lycroma delicatula, has long been thought to have therapeutic value.

The use of xenodiagnosis in the detection of chronic Chagas' disease became a standard practice. The difficulty of finding the causal organism of this disease (*Trypanosoma cruzi*) in the blood of the human host at such times, and the ease with which it can be cultured in the insect host, led to feeding uninfected clean Triatominae bugs (Reduviidae) upon the patient suspected of having Chagas' disease and ten days later examining the faeces of the bugs for trypanosomes. The multiplication of the trypanosomes in the digestive tract of the insect makes their detection in its faeces a relatively simple matter, and their presence gives a positive diagnosis. The common practice is to feed five hungry clean bugs on the patient, and it is quite usual to find all the bugs infected when they have fed on a person with Chagas' disease.

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See also G. Horvath and H. M. Parshley (eds.), A General Catalogue of the Hemiptera, 6 vol (1927–32). *G* Aulmann, *Psyllidorum* Catalogus (1913) (W. Junk); E M. Patch, ('Food Plant Catalogue of the Aphids of the World," *Maine Agricultural Experiment Station Bulletin 393* (1938). (H B. HD.)

HEMLOCK is the name commonly applied in North America to trees of the genus *Tsuga*, of the pine family (Pinaceae). The genus comprises ten species, six native to eastern Asia and four to temperate North America. They are tall, pyramidal evergreen conifers with cinnamon-red bark; slender horizontal or drooping branches; flat, narrowly linear, two-ranked leaves; and small, pendulous, persistent-scaled cones bearing winged seeds.

The eastern hemlock (*T. canadensis*), called also Canadian hemlock and hemlock spruce, grows in upland forests from Nova Scotia to Minnesota and south to Maryland, Indiana, Wisconsin and the mountains of Georgia and Alabama. It is a handsome tree, usually 60 to 80 ft. tall but sometimes 100 ft. tall, 4 ft. in diameter. The dark green leaves, to three-quarters of an inch long, are grooved above and marked with two whitish bands beneath. The bark contains tannin used in tanning; the soft, coarse-grained, splintery wood, though inferior to pine or spruce, is used for building purposes. Young eastern hemlocks, introduced into England in 1736, are ornamental and several varieties are cultivated. The smaller Carolina hemlock (T. caroliniana), sometimes 70 ft. tall, a beautiful but local tree in the southern Alleghenies from Virginia to Georgia, is used also as an ornamental. The mountain hemlock (*T.* mertenszana), 20 to rarely 90 ft. tall, with leaves crowded densely around the branchlets, occurs on high mountains from southern Alaska to Montana and California.

The western hemlock (T. *heterophylla*), called also hemlock fir and Prince Albert's fir, is often 200 ft. tall, with a trunk 6 to 10 ft. in diameter. It grows from southeastern Alaska to California and Montana. The wood of the western hemlock is superior to that of all other hemlocks, comparing favourably with that of pine and spruce. Over 75% of the total cut of hemlock in the U.S. is this species, with Oregon and Washington supplying 95% of the hemlock lumber cut in the U.S. Huge timbers, some 24 in. square and

up to 20 ft. long, come from the better stands of western hemlock.

Siebold's hemlock (T. *sieboldii*) attains 100 ft. in height, and the Japanese hemlock (T. diversifolia) grows to 80 ft. in height on good sites. Both are natives of Japan and are used as ornamentals in North America and Europe.

Various poisonous plants of the parsley family (Umbelliferae) also are called hemlock; *e.g.*, poison hemlock and the water hemlock. The fool's-parsley (Aethusa *cynapium*) is known as small hemlock (*see* UMBELLIFERAE). American yew (*Taxus canadensis*) is called ground hemlock because its foliage resembles that of the eastern hemlock (see YEW).

See W. Dallimore and A. B. Jackson, *A Handbook of Coniferae* (1948); W. M. Harlow and E. S. Harrar, *Textbook of Dendrology* (1958). (I. L. W.)

HÉMON, LOUIS (1880–1913), French author of the best-known novel of French-Canadian pioneer life, Maria *Chapdelaine*, was born in Brest, France, on Oct. 12, 1880. Educated in Paris, Hémon moved in 1903 to England, uhere he wrote numerous short stories and articles for French sporting and automotive magazines; he also composed three novels, which were published posthumously. Seeking new surroundings. Hémon sailed for Canada in Oct. 1911. After spending the winter in Montreal, he went north to Lac Saint-Jean. becoming a hired man on the farm of Samuel Bédard near Péribonka. There he found the materials for Maria *Chapdelaine*. First published as a serial in *Le* Temps (Paris) in 1914, the novel had hundreds of editions and was translated into all the major languages. Hémon did not live to see its success: he was killed by a train near Chapleau, Ont., on July 8, 1913.

Despite some resentment over Hémon's failure to idealize French-Canadian life, Maria *Chapdelaine* soon became a model for Canadian regionalistic writers, and Hémon's influence was apparent for more than a generation. It reached its peak in Abbé F.-A. Savard's novel Menaud, *maître-draveur* (*Boss of the River*) in 1937, and later declined as French-Canadian novelists turned to urban settings in the 1940s.

See Allan McAndrew, *Louis Hémon, sa vie et son oeuvre* (1936); Louvigny de Montigny, *La revanche de Maria Chapdelaine* (1937); Damase Potvin, *Le roman d'un roman* (1950). (D. M. HE.)

HEMORRHOIDS: see HAEMORRHOIDS.

HEMP. Although there is but one species of true hemp (Cannabis sativa), there is much confusion about its common name because many other fibre-producing plants, and the commercial fibres obtained from them, have been incorrectly termed "hemp"; among these are Manila hemp, sisal hemp, New Zealand hemp, Mauritius hemp, bowstring hemp, sunn hemp and ambari hemp, none of which is true hemp or has any botanical relationship to true hemp.

Description of the Hemp Plant.— The *Cannabis sativa* plant is an annual propagated by seed, is cross-pollinated, has a deep taproot system and is adapted to many countries throughout the temperate zones. The seed-producing flowers are borne on separate plants from those which produce pollen. The plants which produce seed are termed pistillate or "female" plants and those that produce pollen are termed staminate or "male" plants. There are rare variants which produce both kinds of flowers on the same plant. When the crop is produced under natural conditions the proportion of female to male plants is about equal. The male plants die soon after the pollen is shed, but the female plants continue to live until the seed is mature or until killed by frost.

When seeded broadcast or in close drills for the production of fibre, the fibre varieties produce relatively tall, slender, whiplike plants that are free from branches except at the tops. When spaced in rows or hills for seed production, the plants produce long, coarse branches from nearly every node, and the main stem (stalk) becomes very thick. The tallest-growing varieties, when spaced for seed production and when grown under favourable soil and climatic conditions, may reach a height of 16 ft. When seeded thickly for commercial fibre production the usual height is from five to ten feet. The varieties used primarily for producing oilseed in northeastern U.S.S.R. and northern China are relatively short and much branched; likewise the so-called drug-producing strains in India, Arabia and northern Africa are short-stemmed and extremely branched.

The stem of the hemp plant is hollow except at the base and tip. The thickness of the tissues that surround the hollow varies greatly among the different types, varieties and strains. The cells which produce the fibre of commerce are formed in the stems between the cambium and the epidermis, and specifically occur in the phloem and pericycle. In other words, the fibre is in that part of the stem which is commonly called bark. The staminate flowers are readily seen, while the pistillate flowers are so small that they are very difficult to observe. The male plants cannot be distinguished from the female plants, either in the seed or in the seedling plants, until the flower buds are considerably developed. The seeds are about the size of wheat grains but more nearly round and are produced in clusters at the top of the main stem or at the tips of branches or at the nodes along the branches. Some strains produce seed much more abundantly than others, and there is a wide variation as to the time required to mature seed; some kinds will mature as much as 60 days earlier than others.

Origin and Distribution.— It is thought that hemp originated in the general region just north of the Himalayas, and ancient writings indicate that in 2800 B.C. the plant was used for fibre in China. Evidently hemp is one of the first fibre plants used by man, and it is probable that both hemp and flax fibre were used long before man learned to write. It is supposed that hemp spread from Asia to eastern and southern Europe and that it reached western Europe in about A.D. 500. It is known that it was introduced into Chile about 1545 and into New England and Virginia about 100 years later. By the 20th century it was known as either a wild or cultivated plant in practically every country in the north temperate zone and also in several countries of the south temperate zone. As a cultivated fibre crop it is grown in the U.S.S.R., Italy, China, Yugoslavia, Rumania, Korea, Poland. Turkey, Hungary, Japan, Germany, Czechoslovakia, France, Bulgaria, Chile and the U.S.

Cultivation for Fibre Production.— There is wide variation in the methods used in growing and handling hemp in the many producing countries, but there are some general procedures that are common to nearly all. Thus it is common practice to seed the crop early in the growing season; to use a well-prepared and firm seed bed; to select the most fertile soil available; and to seed thickly by broadcasting or drilling. The rate of seeding varies perhaps as much within any one country as it does from one country to another and usually ranges from 33 lb. (three pecks) to fully 66 lb. (six pecks) per acre. The use of as much as 88 lb. (eight pecks) has been reported in Belgium and northern France. In all producing countries shallow seeding is practised (½ to 1 in. deep); no subsequent cultivation (intertillage) is given, and except for a few areas in Europe no weeding by hand or machines is practised. In nearly every producing country it is thought that when grown for fibre, hemp is ready for harvesting as soon as the male plants are in full blossom and are freely shedding pollen. It is generally believed that the softest and finest (though weakest) fibre is obtained from plants harvested immediately after the shedding of pollen begins and that the greatest yield of strongest fibre (though more coarse and harsh) is obtained from the more completely matured plants. In some areas in Europe hemp is pulled (uprooted) by hand, but in nearly all producing countries the crops are harvested by cutting a few inches above the ground—either with a hand sickle, a self-rake reaper or a special hemp harvesting machine.

Retting Hemp Straw.— After the hemp stalks are harvested they must be retted. which means that they must be subjected to a partial decomposition or rotting in order to make possible the separation of the fibre. Methods of retting vary greatly among the producing countries; in some areas water retting is practised, while in others the dew retting method is used.

Much of the Soviet crop and all of that grown in the United States is dew retted. In most other countries water retting is common. In dew retting, the harvested hemp straw is spread in thin layers on the stubble of the fields where it grew. The straw remains there until the moisture from rain and dew (and sometimes snow) has made it possible for micro-organisms (bac-

teria and fungi) partially to decompose those plant tissues which surround the fibres. Such partial decomposition permits the mechanical separation of the fibre from the other tissues. The time required for dew retting is determined by weather conditions and may vary from a week to many weeks and in some instances several months. When retting is completed, the straw is lifted and set up in open shocks (stooks) to dry.

In water retting, the freshly harvested straw is allowed to become thoroughly dry and is then immersed in water, where it is left until the combined action of bacteria and the water have partially decomposed and dissolved the tissues and substances which surround the fibre. The time necessary for water retting is determined by the temperature of the water and usually varies from 10 to 20 days, but in temperature-controlled tank retting the process may be completed in 3 to 5 days (using temperatures of around 90° F.). Both natural and artificially constructed pools and ponds are used, as well as small streams, rivers and tanks of varicus kinds.

In some countries the dew-retted straw is not bundled, but in the northern United States it is picked up and tied into bundles with a specially designed machine termed a gather binder. The shocks are so built that the air circulates freely through them. No drying other than that which occurs during shocking in the fields is practised except in the United States, where drying is accomplished by artificial methods.

Separating and Cleaning the Fibre.—When the retted hemp straw is sufficiently dried, it is subjected to one of many mechanical methods for separating the fibre from other parts of the straw. The mechanical devices are termed brakes (because they break or crush the woody part of the straw), and the process itself is called breaking. After breaking, the crushed mass must be so handled as to separate the fibre from the broken woody core (termed hurds). This shaking, brushing and combing process is called scutching.

Hand brakes are used in some European countries. However, power-driven mechanical breaking machines are in common use in most countries where hemp is grown as a commercial crop. Nearly all the various kinds of mechanical brakes consist essentially of pairs of fluted rolls through which the retted straw is fed (usually lengthwise) and by means of which the woody portion (core) of the stalks is broken in short pieces (hurds).

The broken material (fibre and hurds) is either shaken by hand or subjected to a mechanical scutching machine, of which many kinds hdve been developed. Such machines separate the hurds from the fibre and in doing so also remove a considerable proportion of short, tangled and broken fibre which is termed tow. The long, reasonably straight fibre from which the hurds and tow have been removed is termed line.

Yields.—Acre yields of total fibre (line and tow) vary greatly among the producing countries but may be approximated as ranging from about 500 lb. to as much as 1,800 lb. Lowest average yields are obtained in the U.S.S.R. and highest yields in northern Italy. In the United States acre yields of fully 1,600 lb. frequently have been reported, but the average over a ten-year period is probably not more than 850 lb.

Uses as a Fibre Plant.—In Asia and Europe hemp fibre at one time or another has been used for making a wide range of textile products, from fine fabrics to coarse ropes. Such general uses of hemp continued to be made in those countries where peasants did their own spinning and weaving. In North America the only hemp products of commercial importance manufactured in the period between World Wars I and II aere hemp twines, but during the actual war periods hemp fibre was used extensively for making a variety of threads, twines and ropes; after 1950 considerable hemp fibre was used in the United States for making artificial sponges.

Hemp as an Oil and Feed Crop.—Hemp oil (of which the seed contains about 30%) is usable for making paints, varnishes and soaps; but the commercial use of hempseed oil has never been of any considerable importance. Hempseed was much used in ready-mixed feed for caged birds and continued to be used to some extent for that purpose.

Hemp as a Drug Plant.—The leaves and other tissues of the hemp *(Cannabis)* plant produce a resin from which the cannabis drug is obtainable. This drug is not recognized as a medicine in either the British or the United States pharmacopoeia, yet, if stable preparations of the drug could be obtained, it might be worthy of attention in medicine. As a narcotic, it is either smoked or eaten and is known as bhang, charas or ghanga in India, as hashish in Egypt and Asia Minor, as kif in northern Africa and as marijuana in the western hemisphere. After 1938 outstanding research was done on the chemistry of hemp drugs and their biological activity. While such research clarified the subject, much still remained unknown in the latter 1950s. It appears that the primary action of the drug is on the central nervous system; that it produces such symptoms as a "feeling of well-being" and various hallucinations; that it is not physically habit forming; that it is not an alkaloid; and that it is not a single substance but a complex mixture. There are no proved chemical tests for measuring the potency of the drug, and biological assays by the use of animals, though used, are not considered entirely reliable. Probably the potency varies in different regions and the most potent preparations may be from plants grown in hot, relatively dry climates.

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HEMPSTEAD, a village in Nassau county, Long Island, N.Y., U.S., 5 mi. E. of New York city limits and a terminal of a branch of the Long Island railroad. The area, known as the Hempstead plains, was first settled in the 1640s and experienced slow but steady rural grouth until the mid-19th century. The village was incorporated in 1853 and is now primarily residential. Hempstead is the hub of a large retail trade area of populous Nassau county. It is the home of Hofstra college, founded in 1935 and named for William S. Hofstra, a lumber merchant, whose widow willed the Hofstra estate for-such a general use. Once an affiliate of New York university but independent since 1939, its enrollment is more than 8.000. A reservoir known as Hempstead Lake State park (903 ac.) is located nearby.

For comparative population figures *see* table in *NEW YORK: Population.* *(M. H. LE.)*

HEMSTERHUIS, FRANÇOIS (1721–1790). Dutch writer on aesthetics and moral philosophy, was born at Franeker on Dec. 27, 1721. Educated at the University of Leiden, he was for many years secretary to the state council of the United Provinces. He died at The Hague, July 7, 1790. His philosophy, strongly Platonic. was founded on the desire for self-knowledge and truth. His chief works are *Lettre sur la sculpture* (1769), in which occurs the well-known definition of the Beautiful as "that which gives us the greatest number of ideas in the shortest space of time"; its continuation, *Lettre sur les désirs* (1770); *Lettre sur l'homme et ses rapports* (1772); *Sopyle* (1778), an attack on materialism; *Aristée* (1779), the "theodicy" of Hemsterhuis; *Simon* (1787), discussing the will, the imagination, the moral principle; *Alexis* (1787); *Lettre sur l'athéisme* (1787).

HENAULT, CHARLES JEAN FRANÇOIS (1685–1770), French man of letters, was born in Paris on Feb. 8, 1685. He became a councillor of the *parlement* of Paris (1705), president of the chamber of *enquêtes* (1710) and superintendent of the household of the queen (1753). But he became most famous as a man of varied literary talents and attended the salon of Mme. du Deffand over a period of 40 years. He wrote tragedies, comedies, ballets, poetry and *Mémoires* (published 1855). His highly original *Abrégé chronologique de l'histoire de France* (1744) ran through eight editions during his lifetime and uas translated into several languages, including Chinese. He died on Nov. 24, 1770.

HENBANE, the common name of the plant *Hyoscyamus niger*, a member of the family Solanaceae (*q.v.*), indigenous to Great Britain. It is found growing uild in waste places and on rubbish heaps. It occurs also in central and southern Europe and in western Asia extending to India and Siberia, and has long been naturalized in the United States. There are two forms of the plant,

an annual and a biennial. The annual grows during the summer to a height of one to two feet, then flowering and seeding. The biennial produces during the first season only a tuft of radical leaves, which disappear in winter, leaving underground a thick fleshy root, from the crown of which arises in spring a branched flowering stem, usually much taller and more vigorous than the flowering stems of the annual plants.

The biennial form is that which is of pharmaceutical interest. The radical leaves of this biennial plant spread out flat on all sides from the crown of the root; they are ovate-oblong, acute, stalked and more or less incisely toothed, of a grayish-green colour, and covered with sticky hairs; these leaves perish at the approach of winter. The flowering stem pushes up from the root crown in spring, ultimately reaching from three to four feet in height. As it grows it becomes branched and furnished with alternate sessile leaves, which are stem-clasping, oblong, unequally lobed, clothed with glandular clammy hairs and of a dull gray-green. The whole plant has a powerful nauseous odour. The flowers are short-stalked, the lower ones growing in the fork of the branches; the upper ones sessile in one-sided leafy spikes which are rolled back at the top before flowering, the leaves becoming smaller upward and taking the place of bracts. The flowers have an urn-shaped calyx which persists around the fruit and is strongly veined, with five stiff, broad, almost prickly lobes. The corollas are obliquely funnel-shaped, of a dirty yellow or buff, marked with a close netaork of purple veins. The capsule opens transversely by a convex lid and contains numerous seeds.

JOHN MARKHAM

HENBANE (HYOSCYAMUS NIGER), SOURCE OF A POISONOUS ALKALOID

Commercial henbane, which consists of the dried leaves of *Hyoscyamus niger,* and sometimes of *H. muticus* of Egypt, is the source of two dangerous narcotics, atropine and hyoscyamine (*qq.v.*). Atropine is also produced by the belladonna (*q.v.*), but the chief source is henbane. The major sources of supply of these leaves are Hungary, the U.S.S.R., Egypt and the United States, in all of which it is grown commercially. In France another species of henbane, H. *albus,* is used for the same purpose.

The dangerous alkaloid hyoscyamine, besides being used for the extraction of atropine, is a potent narcotic used in illicit preparations of smoking mixtures and, in India, as a beverage. Also in India the seeds (which contain more alkaloid than the foliage) are employed as a somewhat dangerous remedy for toothache.

Medical use of henbane, as an extract, fluid extract and tincture, is complicated by the fact that the leaves also contain scopolamine (*q.v.*), another dangerous alkaloid. The isolated and purified drugs derived from henbane are valuable remedies for spasmodic muscular contractions, nervous irritation and hysteria. See also ALKALOIDS. (N. TR.)

HENCH, PHILIP SHOWALTER (1896–), U.S. physician and Nobel laureate, was born in Pittsburgh, Pa., Feb. 28, 1896. He studied at Lafayette college, Easton, Pa., and at the University of Pittsburgh (M.D., 1920). In 1921 he became a fellow in medicine in the Mayo foundation, Rochester, Minn., and in 1923 first assistant and member of the staff of the Mayo clinic. In 1926 he became a consultant in the division of medicine and head of a new section on rheumatic diseases at the Mayo clinic.

Hench noticed that during pregnancy and in the presence of jaundice, the severe pain of arthritis has a tendency to abate, and in some cases to disappear. This fact was well known to other workers, but Hench, in association with Edward C. Kendall (*q.v.*), also of the Mayo clinic, pursued studies of endocrinologic factors in rheumatic diseases. Together, they evolved and applied cortisone to the treatment of rheumatoid arthritis late in 1948 and early in 1949. For this work Hench and Kendall, in company with Tadeus Reichstein of Switzerland, were awarded the 1950 Nobel prize in physiology and medicine. (J. R. EN.)

HENDERSON, ALEXANDER (1583–1646), Scottish ecclesiastic, born at Criech. Fifeshire, graduated at the University of St. Andrews in 1603, and in 1610 was appointed professor of rhetoric and philosophy and questor of the faculty of arts. Shortly after this he was presented to the living of Leuchars. As Henderson was forced upon his parish by Archbishop George Gladstanes, and was known to sympathize with episcopacy. his settlement was at first extremely unpopular; but he subsequently became a presbyterian in doctrine and church government, and one of the most esteemed ministers in Scotland. He was one of the petitioners against the "five acts" and later against the introduction of a service book and canons drawn up on the model of the English prayer book. On March 1. 1638, the public signing of the National Covenant began in Greyfriars church. Edinburgh. Henderson was mainly responsible for the final form of this document. He was moderator of the famous assembly which met in Glasgow on Nov. 21, 1638. Henderson was then transferred to Edinburgh.

In the negotiations for peace at Birks after the "First Bishops' War" Henderson was one of the Scottish commissioners. In 1640 he was elected by the town council rector of Edinburgh university—an office to which he was annually re-elected till his death. The Pacification of Birks had been wrung from the king: and the Scots, seeing that he was preparing for the "Second Bishops' War," took the initiative, and pressed into England so vigorously that Charles had again to yield everything. The maturing of the treaty of peace took time, and Henderson again took part in the negotiations. first at Ripon (Oct. 1) and afterward in London. During Charles's second state visit to Scotland, in the autumn of 1641, Henderson acted as his chaplain, and managed to get the funds. formerly belonging to the bishopric of Edinburgh, applied to the metropolitan university.

At the meeting of the general assembly held in Xug. 1643, Henderson was again elected moderator. He presented a draft of the famous Solemn League and Covenant. which was received with enthusiasm. Unlike the National Covenant of 1638, which applied to Scotland only. this document was common to the two kingdoms. Henderson, Baillie, Rutherford and others were sent to London to represent Scotland in the assembly at Westminster. The Solemn League and Covenant passed the two houses of parliament and the Westminster assembly. and thus became law for the two kingdoms. As Scottish commissioner to the Westminster assembly. Henderson was in England from Aug. 1643 till Xug. 1646; his principal work was the drafting of the directory for public worship. In Aug. 1646. failing in health. he sailed to Scotland, where he died Aug. 19. eight days after his arrival. A document was published in London purporting to be Henderson's death bed declaration. and although this paper was disowned, denounced and shown to be false in the general assembly of Aug. 1648, the document was used by Clarendon as giving the impression that Henderson had recanted. Its foundation was probably certain expressions lamenting Scottish interference in English affairs.

Henderson is one of the greatest men in the history of Scotland and. next to Knox, is certainly the most famous of Scottish ecclesiastics. He is justly considered the second founder of the Reformed Church in Scotland.

See J. Aiton, *Life and Times of Alexander Henderson* (1836); *T.* McCrie, *Life of Alexander Henderson* (1836); *J.* P. Thornson, *Alexander Henderson, the Covenanter* (1912); *R.* L. Orr, *dlexaader Henderson, Churchman and Statesman* (1919); also *The Letters and Journals of Robert Baillie* (1841–42), an exceedingly valuable work from an historical point of view; J. H. Burton, *History of Scotland,* 2nd ed., 8 vol. (1873); D. Masson, *Drummond of Hawthornden* (1873) and *Life of Milton,* 7 vol. (1859–94); Andrew Lang, *History of Scotland,* vol. iii (1907). Henderson's own works are chiefly contributions to current controversies, speeches and sermons.

HENDERSON, ARTHUR (1863–1935), British politician, was born in Glasgow, Scot. Sept. 15, 1863, but his work and interests subsequently lay at Nencastle and in the county of Durham. He became prominent in the trade-union movement. He nas for some years a member of the Newcastle city council and the Darlington borough council. He was mayor in 1903, and was made

a magistrate for the county of Durham. He entered parliament for Barnard Castle, as a Labour member. at a by-election in 1903, and soon made his mark. In 1908 he was elected chairman of the party, a post which he held for two years and to which he was re-elected after the outbreak of war in 1914, when the then chairman. Ramsay MacDonald, had to resign because of his pacifist views.

When the first coalition ministry was formed by H. H. Asquith in 1915, Henderson was included in the cabinet mainly as adviser of the government on labour questions arising out of World War I. with the office first of president of the board of education and afterward of paymaster general. He showed himself resolved on a strenuous prosecution of the war. strongly advocating the Munitions bill. the Registration bill and compulsory service. He followed up this action by urging the Labour party to rally in Dec. 1916 to Lloyd George. and by accepting himself the position of an original member of the war cabinet of four without portfolio. In 1917 he visited Russia. just after the Revolution, on behalf of the British government, and found the provisional government strongly in favour of an international labour and socialist conference, which was to meet at Stockholm under the auspices of the International Socialist bureau. It mas Henderson's view that, provided the conference were merely consultative, it would be better for British representatives to attend than to permit Russian representatives to meet German representatives alone. He could not obtain the endorsement of his fellow cabinet members to his proposal. however, and he therefore resigned.

Henderson espoused the Labour decision of the latter part of 1918 to take the Labour men out of the government and to appeal for support on a purely Labour platform. This cost him his seat in parliament at the general election of Dec. 1918. Indeed. ill luck pursued him also at the next two general elections, in 1922 and 1923; but in all three cases he returned to the house of commons a few months later at a by-election. In the parliament of 1923–24 he had the satisfaction of having two sons as fellow members, though they were both defeated in the autumn of 1924. In MacDonald's ministry he was secretary of state for home affairs. He actively endorsed the policy of his party in 1925–26 in severing themselves definitely from the Communists. In the Socialist government of 1929–31 Henderson was secretary of state for foreign affairs; but on the formation of the National government in 1931 he went into opposition. He was defeated in the general election of that year, but was elected for the Clay Cross division in 1933. He was president of the World Disarmament conference at Geneva. 1932–33. He was awarded the Nobel peace prize for 1934. He died October 20, 1935.

HENDERSON, LAWRENCE JOSEPH (1878–1942), U.S. physiologist, biochemist and sociologist. He attended Harvard college and medical school, then studied in Strasbourg. Returning to Harvard university as instructor in biological chemistry in 1904, he remained on the medical faculty until 1911 when he transferred to the arts and sciences faculty. There he pioneered a famous course in the history of science and one in biochemistry. In 1920 he founded the laboratory of physical chemistry in the medical school. In 1927 he organized the fatigue laboratory in the business school as another means of interdisciplinary study.

Henderson's initial investigations of acid-base equilibria in blood plasma led him to recognize physical properties of matter uniquely related to the existence of life. His first book was *The Fitness of the Environment* (1913). In *The Order of Nature* (1917) he stressed the uniqueness of organisms. In 1919 he began to synthesize the reciprocal interrelations of oxygen, carbon dioxide and other components in blood. His Silliman lectures at Yale university summarized these researches in *Blood* (1928). In 1927 he first read the work of V. Pareto on social equilibriums. In it he found general concepts concerning multivariate systems. He thereupon extended his thinking to social phenomena. He lectured on Pareto at the University of California, Berkeley, in 1931, and in subsequent years conducted the Pareto seminar at Harvard, which resulted in his *Pareto's General Sociology* (1935).

Henderson admired French culture and British science, and frequently visited Europe. In 1932 he organized the Society of Fellows at Harvard; 24 junior fellows are thereby freed for independent studies. Henderson stimulated colleagues and students to exactitude and depth of concepts.

See Biographical *Memoirs,* National Academy of Sciences, 23:31–58 (1945). (E. F. AH.)

HENDERSON, SIR NEVILE MEYRICK (1882–1942), British diplomat, who, as British ambassador in Berlin from 1937 to 1935, was closely associated with Neville Chamberlain's policy of appeasement toward Hitler's Germany, was born on June 10, 1882. He was educated at Eton college and joined the diplomatic service in 1905.

After serving in various subordinate posts, Henderson became British minister in Egypt (1924–28), France (1928–29) and Yugoslavia (1929–35). At this point he was recommended to the then foreign secretary, Sir Samuel Hoare (afterward Lord Templewood), as "the coming young diplomat in the foreign service." Promoted ambassador to Argentina in 1935, he was transferred in 1937 to Germany, where he stayed until the start of World War II in 1939. In Berlin he worked under severe nervous strain and was seriously ill in the winter of 1938. Some observers considered that he supported the appeasement policy even more vehemently than Chamberlain himself. Afterward he published his own account of the final phase of Nazi aggression in *Failure of a Mission* (1940). *He* was knighted in 1932 and made a privy councilor in 1937. He died in London on Dec. 30, 1942. His autobiography, *Water Under the Bridges,* was published posthumously in 1945. (J. F. B.)

HENDERSON, WILLIAM JAMES (1855–1937), U.S. music critic and author, who with Richard Aldrich, James Huneker and Henry E. Krehbiel established himself as one of the foremost critics of his day, was born at Newark, N.J., on Dec. 4, 1855. Graduating from Princeton (1876), he was on the *New York Times* (1883–1902) and the *New York Sun* (1902–37) as music critic. His works include: *The Story of Music* (1889); *The Elements of Navigation* (1892); *Richard Wagner* (1901); *Pipes and Timbrels* (1905); and *The Art of the Singer* (1906).

HENDIADYS, a rhetorical figure in which two words connected by a conjunction are used of a single idea; usually the figure takes the form of two substantives instead of a substantive and adjective, as in the classical example *pateris libamus et auro* (Virgil. *Georgics,* ii, 192), "we pour libations in cups and gold" for "cups of gold."

HENDON, a municipal (1932) and parliamentary borough (returning two members) of Middlesex, Eng.. on the Brent. 8 mi. N.W. of St. Paul's cathedral. London. Served by electric trains of the London Passenger Transport board, Hendon grew rapidly as a residential area in the period after World War I. Pop. (1961) 15'1,500. Hendon airfield was bought by Claude Grahame-White in 1910 and there he founded the London Flying club. In 1511 the first United Kingdom airmail service was flown from there. In 1923 the air ministry took it over and during both world wars it was used for military purposes. It was closed to flying in 1957. The Metropolitan Police college was established at Hendon in 1934; there is a large technical college (1937) and a local history museum at Chalk Farm house. For nearly six centuries Hendon belonged to the abbot and monks of Westminster and they acquired for it two charters of liberty from Edward the Confessor and William the Conqueror. St. Mary's parish church is partly Norman. David Garrick lived at Hendon hall (now a hotel) when he was lord of the manor.

Industries include the making of motor bodies and aircraft products. By the mid-1950s there were about 1.600 ac. of open spaces including a part of Hampstead heath and Golders Hill park (with deer) and green-belt land. In the northern part of the borough is Mill Hill. with a Roman Catholic missionary college, and a large boys' school founded by Nonconformists in 1660 and refounded in 180;. The borough also contains Edgware, Temple Fortune, Burnt Oak, C'olindale (with the British Museum's newspaper section). Golders Green with its Hippodrome and part of Hampstead Garden suburb, founded in 1906.

HENDRICKS, THOMAS ANDREWS (1819–1885), U.S. political leader, vice-president of the United States in 1885, was

born near Zanesville, O., on Sept. 7, 1819. He graduated at Hanover college, Hanover, Ind., in 1841, and began in 1843 a successful career at the bar. Identifying himself with the Democratic party, he served in the state house of representatives in 1848, and was a prominent member of the convention for the revision of the state constitution in 1850–51, a representative in congress (1851–55), commissioner of the C.S. general land office (1855–59), a U.S. senator (1863–69) and governor of Indiana (1873–77). From 1868 until his death he was put forward for nomination for the presidency at every national Democratic convention save in 1872. Both in 1876 and 1884 after his failure to receive the nomination for the presidency. he was nominated by the Democratic convention for vice-president. In 1876. with S. J. Tilden, he lost the disputed election by the decision of the electoral commission, but he was elected with Grover Cleveland in 1884. He died at Indianapolis on Nov. 25, 1885.

HENGELO, a town in the province of Overyssel. Neth.. and a junction station 5 mi. N.W. of Enschede hy rail. Pop. (1947) 43,431. The town is the centre of the flourishing industries of the Twente district. The manufacture of cotton is carried on. and there are dye works. railway works and breweries. Five miles from Hengelo is the superb mediaeval castle of Twickel, seat of the baronial family Van Heeckeren van Wassenaer.

HENGEST AND HORSA, the brother chieftains who led the first Saxon bands which settled in England. They were apparently called in by the British king Vortigern (*q.v.*) to defend him against the Picts. Their landing place is said to have been Ebbsfleet in Kent. Its date is not certainly known, 450–455 being given by the English authorities. 428 by the Welsh (*see* KENT). The settlers of Kent are described by Bede as Jutes (*q.v.*), and there are 'traces in Kentish custom of differences from the other Anglo-Saxon kingdoms. Hengest and Horsa were given the island of Thanet as a home, but soon quarrelled with their British allies, and gradually acquired what became the kingdom of Kent. In 455 the *Saxon Chronicle* records a battle between Hengest and Horsa and Vortigern at a place called Aegaels threp. in which Horsa was slain. Thenceforward Hengest reigned in Kent. together with his son Aesc (Oisc). Both the *Saxon Chronicle* and the *Historia Brittonum* record three subsequent battles, though they disagree as to their issue. There is no doubt, however, that the net result was the expulsion of the Britons from Kent. According to the *Chronicle*, probably based on a lost list of Kentish kings, Hengest died in 488, while his son Aesc continued to reign until 512.

Bede, *Hist. Eccl.* (Plummer, 1896), i, 15, ii, 5; *Saxon Chronicle* (Earle and Plummcr, 1899), s.a. 449, 455, 457, 465, 473; Nennius, *Historia Brittonum* (San Marte, 1844), §§ 31, 37, 38, 43-46, 58.

HENGSTENBERG, ERNST WILHELM (1802–1869), German Lutheran divine and theologian, was born at Fröndenberg, Westphalia, on Oct. 20, 1802. He studied at the universities of Bonn and Berlin. and in 1826 became professor extraordinarius and in 1828 professor of theology at Berlin. In July 182; he started the *Evangelische Kirchenzeitung*, a strictly orthodox journal. In 1830 an anonymous article (by E. L. von Gerlach) appeared in this journal which charged Wilhelm Gesenius and J. A. L. Wegscheider with infidelity and profanity. and advocated the interposition of the civil power, thus giving rise to the *Hallische Streit*. He died on May 28, 1869.

His principal work is *Christologie des Alten Testaments* (1829–35; 2nd ed.. 1854–57; Eng. trans. by R. Keith, 1835–39, also in Clark's "Foreign Theological Library," by T. Meyer and J. Martin, 1854–58). Of his other works, the chief are: *Beiträge zur Einleitung in das Alte Testament* (1831–39; Eng. trans. 1848); *Commentar über die Psalmen* (1842–47; Eng. trans. 1844–48); *Die Offenbarung Johannis erlazrtert* (1849–51; Eng. trans.? 1851–52) and *Das Evangelium Johannis erläutent* (1861–63).

See J. Bachmann's *Ernst Wilhelm Hengstenberg*, 3 vol. (1876–92); also his article in Herzog-Hauck, *Realenzyklopädie* (1899); and F. Lichtenberger, *History of German Theology in the Nineteenth Century* (1889).

HENKE, HEINRICH PHILIPP KONRAD (1752–1809), German theologian, was born at Hehlen. Brunswick, on July 3, 1752. He studied at Helmstädt, and from 1778 to 1809 he was professor, first of philosophy, then of theology, in that university. He died on May 2, 1809. Henke belonged to the rationalistic school. His principal work *(Allgemeine Geschichte der christl. Kirche*, 6 vol., 1788–1804; 2nd ed., 1795–1806) is commended by F. C. Baur for fullness, accuracy and artistic composition.

HENLE, FRIEDRICH GUSTAV JAKOB (1809–1885), German pathologist and anatomist, was the first to treat physiology and pathology as branches of one science. He was born in July 1809, at Fürth, in Franconia. After studying medicine at Heidelberg and at Bonn, where he took his doctor's degree in 1832, he became prosector in anatomy to Johannes Müller at Berlin. He published three monographs on new species of animals, and papers on the structure of the lacteal system, the distribution of epithelium in the human body, the structure and development of the hair, the formation of mucus and pus, etc. In 1840 he became professor of anatomy at Zurich. in 1844 he was called to Heidelberg, where he taught not only anatomy! but physiology and pathology. About this period he was engaged on his complete system of general anatomy, which formed the sixth volume of the new edition of S. T. von Sömmerring's treatise. He published a zoological monograph on the sharks and rays, in conjunction with his teacher, Müller. His famous *Manual of Rational Pathology*, 2 vol. (1846–55) marked the beginning of a new era in pathological study. The facts of disease were systematically considered with reference to their physiological relations. *The Handbook of Systematic Human Anatomy*, 3 vol. (1855–76) was of great scientific merit and of epoch making importance. During the latter half of his life Henle's researches were mainly histological in character, his investigations embracing the minute anatomy of the blood vessels, serous membranes, kidney, eye, nails, central nervous system, etc. Henle died at Gottingen on May 13. 188j.

See F. H. Garrison, *Introduction to the History of Medicine*, 4th ed. (Philadelphia, 1929); N. Robinson, *The Life of Jacob Henle* (1921).

(A. L. A.)

HENLEY, JOHN (1692–1759), English eccentric, commonly called "Orator Henley," rebelled against orthodox ways of preaching. The son of a curate, he was born at Melton Mowbray on Aug. 3, 1692. Educated at St. John's college, Oxford. and ordained (1716), he held several cures before opening his own "oratory chapel" in London (1726). Sir Robert Walpole paid him £100 a year (1730–41) to edit the weekly *Hyp-doctor* in answer to attacks by the *Craftsman*. Alexander Pope satirized Henley in the *Dunciad* and William Hogarth portrayed him in prints.

See I. Disraeli, *Calamities of Authors*, (ed.) *B.* Disraeli (London, 1881).

HENLEY, WILLIAM ERNEST (1849–1903), British poet, critic and editor, was born at Gloucester and educated at the Crypt grammar school where he had the good fortune to have T. E. Brown (*q.v.*) as headmaster for a time. Henley contracted tuberculosis as a child, and one foot had to be amputated. He was placed in Edinburgh infirmary in 1874, to be under Lister's care, and from his bed there he sent to the *Cornhill Magazine* poems in irregular rhythms, describing with poignant force his experiences in hospital. Leslie Stephen, then editor, being in Edinburgh, took Robert Louis Stevenson: another recruit of the *Cornhill*, to see him in hospital. This meeting was the beginning of a famous friendship.

In 1877 Henley went to London and began a long and distinguished journalistic career. He edited *London* (1877–82), the *Magazine of Art* (1882–86), and in 1888 became literary editor and in 1889 editor of the *Scots Observer*, transferred to London as the *National Observer*. In this paper appeared Kipling's *Barrack Room Ballads*. In 1880 appeared Henley's own *Book of Verse*, which included the verses written in hospital at Edinburgh, and in 1890 *Views and Reviews*. The criticisms, covering a wide range of authors (except Heine and Tolstoy, all English and French), though wilful and often one-sided were terse; trenchant and picturesque. There followed *The Song of the Sword* (1892), another volume of verse renamed in 1893 *London Voluntaries;* three plays in 1892 written with Stevenson—Beau *Austin, Deacon Brodie* and *Admiral Guinea;* and *Macaire* (1895). In 1898 Henley published a collection of his *Poems* and in 1901 a second volume of collected

poetry with the title *Hawthorn and Lavender.* He projected the excellent series of "Tudor Translations" and was engaged on the preface to the Authorized Version of the Bible in that edition when he died. He also prepared, with T. F. Henderson, the centenary edition of the poems of Robert Burns, contributing an essay on the poet to the last volume. He died on July 11, 1903. A portrait-bust of him by Rodin was presented by his widow to the National Portrait Gallery in 1913. His fame rests on his poetry. He excelled alike in his delicate experiments in complicated metres, and the strong impressionism of *Hospital Sketches* and *London Voluntaries.* The influence of Heine may be discerned in these "unrhymed rhythms"; but he was perhaps a truer and more successful disciple of Heine in his snatches of passionate song, the best of which should retain their place in English literature.

See also references in *Stevenson's Letters; Cornhill Magazine* (1903) (Sidney Low); *Fortnightly Review* (Aug. 1892) (Arthur Symons); and for bibliography, *English Illustrated Magazine,* vol. xxix, p. 548.

HENLEY-ON-THAMES, a market town and municipal borough in the Henley parliamentary division of Oxfordshire, Eng., on the left bank of the Thames, 35 mi. W. of London by road and 57½ mi. by river. Pop. (1951) 7,982. Area 2.2 sq.mi. It lies at the foot of the Chiltern hills where the river is crossed by a stone bridge of five arches built in 1786. Henley is celebrated for the annual Henley Royal regatta, the principal gathering in England of amateur oarsmen from all over the world, first held in 1839 and usually taking place in the first week of July. The parish church (Decorated and Perpendicular) has a tower of intermingled flint and stone. attributed to Cardinal Wolsey but more probably erected by Bishop John Longland; next to it is the 14th-century Chantry house.

Henley-on-Thames was a manor of the crown in Domesday Book and was granted (1337) to John de Molyns, whose family held it for about 250 years. It was incorporated in 1526. Henley suffered from both parties in the Civil War; later. in 1688, William III in his march on London received there a deputation from the lords. The prosperity of the 17th and 18th centuries was attributable to glass, lace and malt and to the corn and wool trade. Modern Henley is mainly a riverside resort, with market gardening, brewing and engineering industries. There is considerable river fishing.

The Thursday market was granted by King John and the Corpus Christi fair by Henry VI. At Shiplake-on-Thames, 3½ mi. upstream, is the Andrew Duncan convalescent home for boys, opened in 1950.

HENNA is the Persian name for a small shrub found in India, Iran and along the African coasts of the Mediterranean, where it is frequently cultivated. It is the *Lawsonia inermis* of botanists, so called because young trees are spineless, while older ones have the branchlets hardened into spines. It forms a slender shrubby plant of from 8 ft. to 10 ft. high, with opposite lance-shaped smooth leaves. which are entire at the margins, and bears small white four-petaled sweet-scented flowers disposed in panicles. Its Egyptian name is *Khenna,* its Arabic name *Al Khanna,* its Indian name *Mendee,* while in England it is called *Egyptian privet,* and in the West Indies, where it is naturalized, *Jamaica mignonette.*

Henna or Henné is of ancient repute as a cosmetic. This consists of the leaves of the *Lawsonia* powdered and made up into a paste; it has been used by Egyptian and Indian women to dye their fingernails and other parts of their hands and feet an orange-red colour, which is considered to add to their beauty. The colour lasts for three or four weeks, when it requires to be renewed. It is moreover used for dyeing the hair and beard, and even the manes of horses; and the same material is employed for dyeing skins and morocco leather a reddish yellow, but it contains no tannin. The practice of dyeing the nails was common among the Egyptians, and not to conform to it would have been considered indecent. It has descended from very remote ages, as is proved by the evidence afforded by Egyptian mummies, the nails of which are most commonly stained a reddish hue. Henna is also said to have been held in repute among the Hebrews. considered to be the plant referred to as camphire in the Bible (Song of Solomon i, 14; iv. 13). "The custom of dyeing the nails and palms of the hands and soles of the feet of an iron-rust colour with henna," observed Dr. J. Forbes Royle, "exists throughout the East from the Mediterranean to the Ganges, as well as in northern Africa. In some parts the practice is not confined to women and children, but is also followed by men, especially in Persia. In dyeing the beard the hair is turned to red by this application, which is then changed to black by a preparation of indigo. In dyeing the hair of children, and the tails and manes of horses and asses. the process is allowed to stop at the red colour which the henna produces." Mohammed, it is said, used henna as a dye for his beard, and the fashion was adopted by the caliphs. The preparation of henna consists in reducing the leaves and young twigs to a fine powder, catechu or lucerne leaves in a pulverized state being sometimes mixed with them. When required for use, the powder is made into a pasty mass with hot water, and is then spread upon the part to be dyed, where it is generally allowed to remain for one night. The distilled water from the flowers is used as a perfume.

HENNEBONT, a town of western France, in the *département* of Morbihan, 6 mi. N.E. of Lorient. Pop. (1954) 5,913. Hennebont is famed for the resistance which it made, under the widow of Jean de Montfort, when besieged in 1342 by the armies of Philip of Valois and Charles of Blois during the War of the Succession in Brittany *(see* BRITTANY). It is near the mouth of the Blavet, which divides it into the Ville Close, the medieval military town, and the Ville Neuve on the left bank and the Vieille Ville on the right bank. The Ville Close, surrounded by ramparts and entered by a massive gateway flanked by machicolated towers, consists of narrow streets bordered by 16th- and 17th-century houses. The Ville Neuve, nearer the river, developed during the 17th century. The Gothic church of Notre Dame de Paradis (16th century) has a tower with ornamented stone spire. There are scanty remains of the old fortress.

Hennebont has a small but busy river port accessible for small vessels. Hennebont is a market town for grain, cheese and agricultural produce and has an important foundry manufacturing tin plate. Other industries are tanning, distilling and the manufacture of earthenware. Granite is worked in the neighbourhood.

HENNEPIN, LOUIS *(c.* 1640–after 1701), Franciscan missionary and explorer, was born at Ath, in Hainaut. While quite young he joined the Franciscan order. In 1675 he went to Canada in company with a Recollet mission, crossing in the same ship with R. Cavelier de la Salle, whose chaplain he became. From Quebec he carried on his missionary work (in 1678 among the Iroquois). In 1679 he accompanied La Salle on his expedition to the west. They reached the site of Peoria (Jan. 1, 1680), when La Salle was compelled to return to Fort Frontenac for supplies; Hennepin and the remainder of the party were dispatched to explore the upper Mississippi. They were captured by Sioux Indians in April and accompanied them on several hunting expeditions, during the course of which they reached the falls of St. Anthony, where the modern Minneapolis stands. Hennepin was rescued by Graysolon du Lhut (Duluth) in July 1680 and went to Quebec. Returning to France in 1682, he published his *Description de la Louisiane* (Paris, 1683; new Eng. trans., Minneapolis. 1938), a full account of his exploits; but after La Salle's death (1687) he brought out a revised account, *Nouvelle de'couverte d'un trks grand pays situé dans l'Amérique* (Utrecht, 1697; Eng. trans., 1698, ed. by R. G. Thwaites, Chicago, 1903), in which he claimed to have explored the Mississippi to its mouth. This bold assumption was soon discredited, and Hennepin's otherwise valuable contributions to the history of New France and to American ethnology are looked upon with suspicion. He incurred his order's displeasure by refusing to return to America and spent his last years in obscurity.

See Justin Winsor, *Narrative and Critical History of America (1889);* Hugolin *(i.e.,* Stanislas le May), *Bibliographie du Père Louis Hennepin* (1937).

HENNER, JEAN JACQUES (1829–1905), French painter, best known for his rather sensuous pictures of nymphs and naiads in vague landscape settings, and of idealized, almost symbolist, heads of young women and girls. He also painted a number of

portraits in a straightforward naturalistic manner. Henner was born on March 5, **1829,** at Bernweiler, Alsace, and studied at Strasbourg and at the École des Beaux Arts in Paris under Michel Drolling. In 1858 he won the Prix de Rome, and he spent the years 1859–65 in Italy where the chiaroscuro, colour and sentiment of the paintings of Correggio and Giorgione made a lasting impression on him.

Henner exhibited regularly at the Paris salon and was one of the most successful artists of his day, but his reputation was already in decline at the time of his death in Paris on July 23, 1905.

See **L.** Benedite, articles in Gazette des ***Beaux*** *Arts,* i and ii (1906), ii (1907) and i and ii (1908). **(A. Bs.)**

HENOGAMY, a term used to denote the custom by which one, and only one. member of a family or stock is permitted to marry, or is required to marry according to definite rules which are not binding on other members of the family. Thus, among the Nambutiri Brahmins of Malabar "the eldest son alone marries. The accepted practice, as well as the recognized principle among them! seems to be in consonance with the directions expounded by Manu, viz., immediately on the birth of his firstborn male child, a man is the father of a son, and is free from the debt to the Manes. That son is, therefore. worthy to receive the whole estate. That son alone. on whom he throws his debt. is begotten for (the fulfillment of) the law. And the next they consider the offspring of desire. . . . Should a Nambutiri eldest son die. the next marries and so on." (E. Thurston, *Tribes and Castes of Southern India,* 1909, vol. **V,** p. 175.)

This custom, it is observed, has long been in force to keep the family property intact and to prevent its disintegration by partition which the marriage of the younger sons might necessitate (A. N. Krishna Iyer, *The Cochin Tribes and Castes,* **1912,** vol. ii, p. **183).** Polygamy "is often indulged in by the Nambutiris, owing partly to their desire to have a son to perform funeral and other ceremonies for the spirits of the departed. and partly to dispose of the superfluous number of girls." *(Ibid.,* p. 210.) The younger males contract alliances with Nayar women. Their children belong to the *Tarwad,* a matrilineal group of their mothers and pollute their Brahmin fathers. This dislocation of the social order extends far down in Malabar society, and is ultimately traceable to the practice of henogamy among the patrilineal Brahmins.

The belief in direct and specific reincarnation which is embodied in the teaching of Manu is connected with customs in the Punjab, where "the position of the firstborn is probably due to the fact that, if a son, his father is born again in him, so that the father is supposed to die at his birth, and in certain Khatri sections, *e.g.,* the Kochhar. his funeral rites are actually performed—in the fifth month of the mother's pregnancy. Probably herein lies the explanation of the *dev-kaj,* or divine nuptials, a ceremony which consists in a formal remarriage of the parents after the birth of their first son" (*Punjab. Census Report,* 1901, part *I,* **p.** 215).

Among the matrilineal Garos *(see* GARO HILLS) the youngest daughter is reserved for marriage with her father's brother's son, after he has married her own mother who, under the dual system. is also his paternal aunt (A. Playfair. *The Garos,* 1909, **p.** 67; *Assam Census Report,* **1891,** p. **229).** The elder daughters make their own arrangements for marriage.

There are other instances in India and elsewhere of rules by which special status—as regards inheritance and succession—is conferred by marriage betneen specified persons, as if one mode or set of rites gave peculiar dignity and validity. These devices mark decisively a change from a social order in which inheritance and succession are determined by the principle of social equivalence. as in the levirate (*q.v.*) or sororate (q *v.*), which is expressed in terms of a classificatory system. to that order in which one line is selected, one son preferred, for transmission. The economic results which in history have accrued from the emergence of the principle of unilinealism have been, and still are, considerable.

The custom of henogamy, if extended to cover the case where special rites and conditions are used for the marriage of the eldest son, is of wide occurrence, and the survival in India of the strict logical form has, therefore, special interest.

HENRI, ROBERT (1865–1929), U.S. painter, the leader of the Ash Can school and one of the most influential teachers in the history of American art, was born in Cincinnati, O., June 25, **1865.** He studied at the Pennsylvania Academy of Fine Arts, Philadelphia, and in Paris, and on returning to the United States became in **1891** an instructor at the Women's School of Design in Philadelphia. His vigorous ideas attracted a group of young illustrators for the Philadelphia press: J. Sloan, E. Shinn, G. Luks and W. Glackens. From **1896** to 1900 he was again in Paris, and exhibited at the salon. He settled in New York city. where in 1908 he was among the painters who exhibited together and came to be known as The Eight. During an extremely active life as an artist. Henri exercised considerable influence as a portrait painter. From 191**j** to 1923 he taught at the Art Students' league, New York city.

Henri's book, *The Art Spirit,* embodying his conception of art as an expression of love for life. was first published in 1923, and maintained a continuing popularity among artists and art students. He died in New York city, July 12, 1929.

HENRIETTA MARIA (1609–1669), queen of Charles I of England, daughter of Henry IV of France. was born on Nov. 15, **1609.** The first serious overtures for her hand were made in the spring of **1624.** on behalf of Charles, prince of Wales. Her brother. Louis XIII. consented to the marriage on the condition that the English Roman Catholics were relieved from the operation of the penal laws. On May 1. 162**j.** in Paris, she was married by proxy to Charles. who was non- king, and set out for England in June.

The early years of their married life were unhappy. Charles soon broke his promise to relieve the English Catholics and his young wife was deeply offended. The favourite Buckingham stirred the flames of his master's discontent. After the assassination of Buckingham (1628) the barrier between the married pair was broken down, but Charles caused much discontent by his favourable treatment of the Catholic subjects whom he had formerly persecuted. The children of the marriage were Charles II (b. 1630), Mary, princess of Orange (b. 1631), James II (b. 1633), Elizabeth (b. **1635).** Henry, duke of Gloucester (b. 1639), and Henrietta. duchess of Orléans (b. **1644).**

For several years Henrietta Maria's chief interests lay in the amusements of a brilliant court, and she took no part in politics. Her participation in the private rehearsals of the *Shepherd's Pastoral* probably drew down upon her the savage attack of William Prynne. Her coreligionists found little aid from her till **1636.** She had then recently opened a diplomatic communication with the see of Rome, and under the influence of a papal agent. a Scotsman named George Conn, accredited to her, thwarted Archbishop William Laud's proclamation against the Catholic recusants. Her court became the centre of a Catholic revival.

When the Scottish troubles broke out in **1639,** she raised money from her fellow Catholics to support the king's army on the borders. During the session of the Short Parliament in the spring of **1640** the queen urged the king to oppose himself to the house of commons in defense of the Catholics. She was generally believed to be the instigator of the army plot to bring the forces in the north to London, hut she was probably acting on the suggestion of her adviser Henry Jermyn.

She threw herself heart and soul into this scheme for rescuing Strafford and coercing the parliament. and the impeachment of the five members on the charge of treason was brought about partly by her influence over the king.

In Feb. **1642** the queen went to the continent to try to raise arms and money. Her intrigues to introduce foreign armies into England lasted throughout the Civil War and being discovered had no small share in her husband's execution. In Feb. **1643** she landed at Bridlington quay with a large sum of money but no foreign troops. She joined the king near Oxford. which they entered together on July 14. By July **1644,** however. her position had become so insecure that she again took refuge in France, where she received a pension of 12.000 crowns a month from the queen regent. As long as her husband was alive the queen never ceased to encourage his resistance. and she continued to hope for success

until his execution in 1649.

She brought up her youngest child, Henrietta, in her own faith, but failed to convert her youngest son. the duke of Gloucester. When after the Restoration (Oct. 1660) she returned to England, she found that she had no place in the new uorld. She received from parliament a grant of £30,000 a year, and the king added a similar yearly sum. In Jan. 1661 she returned to France for the marriage of her daughter Henrietta to the duke of Orléans. She set out again for England in July 1662, but in 1665 she returned to France, and died on August 21, 1669, at Colombes, not far from Paris. Rumours that she married Jermyn some time after 1649 are probably unfounded.

See I. A. Taylor, *The Life* of *Queen Henrietta Maria* (London, 1905); and Carola Oman, *Henrietta Maria* (New York, London, 1936), which has a bibliography. Her letters have been edited by M. A E Green (London, 1857). (G. Ds.)

HENRY, "prince of the house" (Fr. *Henri;* Span. *Enrique;* Ger. *Heinrich*). The name of many European sovereigns.

HENRY (HENRY BENEDICT MARIA CLEMENT STUART) (1725–1807), usually known as Cardinal York, the last prince of the royal house of Stuart, younger son of James Stuart, was born in the Palazzo Muti at Rome on March 6, 1725. He was created duke of York by his father soon after his birth, and by this title he was always alluded to by Jacobite adherents of his house. In support of the Young Pretender's campaign in Scotland, Henry was despatched in the summer of 1745 to France, where he was placed in nominal command of French troops at Dunkirk, with which the marquis d'Argenson had some idea of invading England. Seven months after Charles's return from Scotland Henry, who had joined his brother in Paris, secretly left for Rome and, with his father's approval, but to his brother's disgust, was created a cardinal deacon under the title of the cardinal of York by Pope Benedict XIV. on July 3, 1747. In the following year he was ordained priest, and nominated arch-priest of the Vatican Basilica. In 1759 he was consecrated archbishop of Corinth *in partibus,* and in 1761 bishop of Frascati (the ancient Tusculum) in the Alban Hills near Rome, where he founded an ecclesiastical seminary. In 1763 he became vice-chancellor of St. Peter's. Henry Stuart held sinecure benefices in France, Spain and Spanish America, so that he became one of the wealthiest churchmen of the period, his annual revenue being said to amount to £30,000 sterling. On the death of his father, James Stuart, Henry tried unsuccessfully to induce Pope Clement XIII, to acknowledge his brother Charles as legitimate king of Great Britain. On Charles's death in 1788 Henry issued a manifesto asserting his hereditary right to the British crown. At the outbreak of the French Revolution he lost two rich French livings and his pension from Spain, and in Feb. 1798, at the approach of the invading French forces, he was forced to fly to Naples, whence he sailed to Messina. At this time he disposed of his family heirlooms to help the pope raise the tribute demanded by Napoleon. From Messina he proceeded by sea in order to be present at the expected conclave at Venice, where he arrived in the spring of 1799, aged, ill and almost penniless. George III., on the recommendation of Prince Augustus Frederick, duke of Sussex, gave a pension of £4,000 a year to the last of the royal Stuarts. Henry received this assistance gratefully, and subsequently left by his will certain British crown jewels in his possession to the prince regent. In 1800 Henry was able to return to Rome, and in 1803, being senior cardinal bishop, he became *ipso facto* dean of the sacred college and bishop of Ostia and Velletri. He died at Frascati on July 13, 1807, and was buried in the *Grotte Vaticane* of St. Peter's in an urn bearing the title "Henry IX."; he is also commemorated in Canova's well-known monument to the royal Stuarts *(see* JAMES). The Stuart archives, once the property of Cardinal York, were presented by Pope Pius VII. to the prince regent, who placed them in the royal library at Windsor Castle.

See B. W. Kelly, *Life of Cardinal York;* H. *M.* Vaughan, *Last* of *the Royal Stuarts; A.* Shield, *Henry Stuart, Cardinal of York, and his Times* (1908); *T.* F. Henderson, *The Royal Stuarts* (1914).

HENRY II. (973–1024), surnamed the "Saint," Roman emperor, son of Henry II., the Quarrelsome, duke of Bavaria, and Gisela, daughter of Conrad, king of Burgundy, or Arles (d. 993), and great-grandson of the German king Henry I., was born on May 6, 973, and was educated at Hildesheim and at Regensburg. He became duke of Bavaria on his father's death in 995, and about 1001 married Kunigunde (d. 1037), daughter of Siegfried, count of Luxemburg. When Otto III. died childless in 1002, Henry was chosen German king by the Franks and Bavarians on June 7, 1002, and subsequently crowned by Willigis, archbishop of Mainz. He purchased the allegiance of the Thuringians and the Saxons; and when shortly afterwards the nobles of Lorraine did homage and Hermann of Swabia, his rival, submitted, he was generally recognized as king. An incipient war with Boleslaus I., the Great, king of Poland, who had extended his authority over Meissen and Lusatia, seized Bohemia, and allied himself with some discontented German nobles, including the king's brother, Bruno, bishop of Augsburg, was abandoned in favour of an expedition into Italy, where Arduin, margrave of Ivrea, had been elected king. Crossing the Alps Henry met with no resistance from Arduin, and in May 1004 was crowned king of the Lombards at Pavia. He then freed Bohemia from the rule of the Poles, led an expedition into Friesland, and compelled Boleslaus to sue for peace in 1005. A struggle with Baldwin IV, count of Flanders, in 1006 and 1007 was followed by trouble with the king's brothers-in-law, Dietrich and Adalbero of Luxemburg, who had seized respectively the bishopric of Metz and the archbishopric of Trier (Treves). In 1013, peace was made with Boleslaus and later in the year, the king went to Rome where, having recognized Benedict VIII. as the rightful pope, he was crowned emperor on Feb. 14, 1014. But the struggle with the Poles broke out afresh, and in 1015 and 1017 Henry led formidable armies against Boleslaus. On Jan. 30, he made peace at Bautzen, Boleslaus retaining Lusatia. As early as 1006 Henry had concluded a succession treaty with his uncle Rudolph III., the childless king of Burgundy, or Arles; but when Rudolph desired to abdicate in 1016 Henry's efforts to secure possession of the crown were resisted by the nobles. In 1020 the emperor was visited at Bamberg by Pope Benedict, in response to whose entreaty for assistance against the Greeks of southern Italy he crossed the Alps in 1021 for the third time. With the aid of the Normans he crippled the Greeks, but was compelled by pestilence among his troops to return to Germany in 1022. He died on July 13, 1024 at Grona near Gottingen.

Henry was an enthusiast for church reform, and under the influence of his friend Odilo, abbot of Cluny, sought to further the principles of the Cluniacs, and seconded the efforts of Benedict VIII. to prevent clerical marriage and the sale of spiritual dignities. Nevertheless he appointed bishops without the formality of an election, and sometimes attacked clerical privileges. He held numerous diets and issued frequent ordinances for peace, but feuds among the nobles were common, and the frontiers of the empire were insecure. Henry, who was the last emperor of the Saxon house, was the first to use the title "King of the Romans." He was canonized in 1146 by Eugenius III.

See Adalbold of Utrecht, *Vita Heinrici II.,* Thietmar of Mersehurg, *Chronicon,* both in the *Monum. Germ. hist. Scriptores,* iii. and iv. (1826 *seq.*); W. von Giesebrecht, *Geschichte der deutschen Kaiserzeit* (Leipzig, 1881–90); S. Hirsch, *Jahrbücher des deutschen Reichs unter Kaiser Heinrich II.* (Leipzig, 1874); A. Cohn, *Kaiser Heinrich ZI.* (Halle, 1867); H. Zeissberg, *Die Kriege Kaiser Heinrichs ZZ. mit Boleslaw I. von Polen* (Vienna, 1868); and G. Matthaei, *Die Klosterpolitik Kaiser Heinrichs II.* (Gottingen, 1877). Further bibliography in *Camb. Mediaeval Hist.* **vol.** iii.

HENRY III. (1017–1056), surnamed the "Black," Roman emperor, only son of the emperor Conrad II., and Gisela, widow of Ernest I., duke of Swabia, was born on Oct 28, 1017, designated as his father's successor in 1026, and crowned German king at Aix-la-Chapelle on April 14, 1028. In 1027 he was appointed duke of Bavaria, where he had been educated under Bruno, bishop of Augsburg and under Egilbert, bishop of Freising. In 1032 he took part in a campaign in Burgundy; in 1033 led an expedition against Ulalrich, prince of the Bohemians; and in June 1036 married Gunhilda, afterwards called Kunigunde, daughter of Canute, king of Denmark and England. In 1038 the emperor

formally handed over to him the kingdom of Burgundy, or Arles, and appointed him duke of Swabia.

When Conrad died in June 1039, Henry became sole ruler of the empire. A struggle soon broke out with Bretislaus, prince of the Bohemians, who revived the idea of an independent Slavonic state, and conquered various Polish towns. After suffering two defeats in 1040, in the following year Henry was able to compel Bretislaus to sue for peace and to do homage for Bohemia. In 1042 he received the homage of the Burgundians and his attention was then turned to the Hungarians, who had driven out their king Peter, and set up one Aba Samuel, or Ovo, who attacked eastern Bavaria. During 1043–45 Henry restored Peter, and brought Hungary completely under the German king.

In 1038 Queen Kunigunde had died and in 1043 the king married Agnes, daughter of William V., duke of Guienne. In 1044 Gothelon (Gozelo), duke of Lorraine, died, and some disturbance arose over Henry's refusal to grant the whole of the duchy to his son Godfrey, called the Bearded. Godfrey took up arms, but after a short imprisonment was confirmed in the possession of Upper Lorraine in 1046 which, however, he failed to secure. About this time, the rival popes were deposed, and the king secured the election of Suidger, bishop of Bamberg, who crowned Henry emperor on Dec. 25, 1046. He was immediately recognized by the Romans as *Patricius,* an office which carried with it at this time the right to appoint the pope. Supreme in church and state alike, ruler of Germany, Italy and Burgundy, overlord of Hungary and Bohemia, Henry occupied a commanding position. He made a victorious progress in southern Italy, where he restored Pandulph IV. to the principality of Capua, and asserted his authority over the Normans in Apulia and Aversa. Returning to Germany in 1047 he appointed two popes, Damasus II. and Leo IX., in quick succession, and faced a threatening combination in the west of the empire, where Godfrey of Lorraine was again in revolt, and with Baldwin V., count of Flanders and Dirk IV., count of Holland, who had previously caused trouble, was ravaging the emperor's lands in Lorraine. Assisted by the kings of England and Denmark, Henry subdued the rebels in 1050. Godfrey was deposed; but Baldwin in 1054 again revolted.

Meanwhile a reaction against German influence had taken place in Hungary. King Peter had been replaced in 1046 by Andreas I., and inroads into Bavaria followed. A brief peace was secured in 1053, but the emperor, occupied elsewhere, soon lost his authority in the east. On pope Leo's death, Henry nominated Gebhard, bishop of Eichstadt, to the vacant chair. In 1055 the emperor went a second time to Italy, where his authority was threatened by Godfrey of Lorraine, who had married Beatrice, widow of Boniface III., margrave of Tuscany, and was ruling her vast estates. Godfrey fled, however, on the appearance of Henry, who only remained a short time in Italy, during which he granted the duchy of Spoleto to the pope. During his absence, the deposed Conrad III., duke of Bavaria, Welf, duke of Carinthia, and Gebhard III., bishop of Regensburg, formed an unsuccessful conspiracy against him. The emperor died at Bodfeld on Oct. j, 1056. He was a peace-loving prince, who favoured church reform and sought to suppress private warfare. But he alienated the sympathies of the nobles as a class, and, by allowing the southern duchies to pass into other hands, restored a power which was not always friendly to the royal house. Henry was a patron of learning, a founder of schools, and completed cathedrals at Spires, Worms and Mainz.

The chief original authorities are the *Chronicon* of Herimann of Reichenau, the *Annales Sangallenses majores,* the *Annales Hildesheimenses,* all in the *Monumenta Gernzaniae historica. Scriptores* (1826 fol.). *See* W. von Giesebrecht, *Geschichte der deutschen Kaiserzeit, Bd.* ii. (Leipzig, 1888); M. Perlbach, "Die Kriege Heinrichs III. gegen Bohmen," in *Forschungen zur deutschen Geschichte,* vol. x. (Gottingen 1862–86); E. Steindorff, *Jahrbücher des deutschen Reichs unter Heinrich III.* (Leipzig, 1874–81); F. Steinhoff, *Das Königthum und Kaiserthum Heinrichs ZII.* (Gottingen, 1865); E. Mueller, *Das Itinerar Kaiser Heinrichs III.* (1901) and further bibliography in *Cainb. Mediaeval Hist.* vol. 3.

HENRY IV. (1050–1106), Roman emperor, son of the emperor Henry III. and Agnes, daughter of William V., duke of Guienne, was born on Nov. 11, 1050, chosen German king at Tribur in 1053, and crowned at Aix-la-Chapelle on July 17, 1054. In 1055 he was appointed duke of Bavaria, and on his father's death in 1056 inherited the kingdoms of Germany, Italy and Burgundy. These territories were governed in his name by his mother, who was compelled in 1062 to hand over her control to Anno, archbishop of Cologne, and to Adalbert, archbishop of Bremen. In March 1065 Henry was declared of age, and in the following year married Bertha, daughter of Otto, count of Savoy.

In 1069 the king led expeditions against the Liutii, and against Dedo or Dedi II., margrave of a district east of Saxony; and soon afterwards quarrelled with Rudolph, duke of Swabia, and Berthold, duke of Carinthia. His struggle with Otto of Nordheim, duke of Bavaria, who was accused in 1070 of being privy to a plot to murder the king, ended in the duke's submission in 1071. Henry aroused the hostility of the Thuringians by supporting Siegfried, archbishop of Mainz, in his efforts to exact tithes from them, and the enmity of the Saxons by ordering a restoration of all crown lands in Saxony, by ravaging the country to supply the needs of his courtiers, and by holding its duke Magnus a prisoner. In 1073 the Thuringians joined the Saxons, and the war, which lasted with slight intermissions until 1088, exercised a potent influence upon Henry's fortunes elsewhere *(see* SAXONY). For Henry's dispute with Hildebrand (Pope Gregory VII.), his excommunication and his famous visit to Canossa *see* GREGORY VII.

Henry left Italy to find that in his absence Rudolph, duke of Swabia, had been chosen German king; and although Hildebrand had taken no part in this election, Henry sought to prevent the pope's journey to Germany, and tried to recover his former position. Though supported by most of the German bishops and by the Lombards and recognized in Burgundy, Bavaria and Franconia, Henry suffered defeat at Mellrichstadt in 1078 and at Flarchheim in 1080. Gregory's attitude remained neutral, in spite of appeals from both sides, until March 1080, when he again excommunicated Henry. At Henry's initiative, Gregory was declared deposed on three occasions, and an anti-pope was elected in the person of Wibert, archbishop of Ravenna, who took the name of Clement III.

The death of Rudolph, the rival German king, in Oct. 1080, left the king at liberty to go to Italy early in 1081. He found considerable support in Lombardy; placed Matilda, marchioness of Tuscany, the faithful friend of Gregory, under the imperial ban; took the Lombard crown at Pavia; and secured the recognition of Clement by a council. After two unsuccessful attacks he took Rome in 1082, and a treaty was concluded with the Romans. who agreed that the quarrel between king and pope should be decided by a synod, and secretly bound themselves to induce the pope to crown Henry as emperor, or to choose another pope. The synod was a failure, and in March 1084 Gregory was declared deposed and Clement was recognized by the Romans. On March 31, 1084 Henry was crowned emperor by Clement, and received the patrician authority. His next step was to attack the fortresses still in the hands of the pope, but the advance of Robert Guiscard, duke of Apulia, compelled him to return to Germany.

hfeanwhile the German rebels had chosen a fresh anti-king, Hermann, count of Luxemburg. In 1086 Henry was defeated near Würzburg, but in 1088 Hermann abandoned the struggle and the emperor was generally recognized in Saxony. Although Henry's power was in the ascendent, a few powerful nobles adhered to the cause of the new pope, Urban II. Among them was Welf, son of the deposed duke of Bavaria, whose marriage with Matilda of Tuscany rendered him formidable. The emperor accordingly returned to Italy in 1090, where Mantua and Milan were taken, and Pope Clement was restored to Rome.

Henry's first wife had died in 1087, and in 1089 he had married a Russian princess Praxedis, afterwards called Adelaide. Her conduct soon aroused his suspicions, and his own eldest son, Conrad, who had been crowned German king in 1087, was thought to be a partner in her guilt. Adelaide fled to Henry's enemies and brought charges against him; and the papal party induced Conrad to desert his father and to be crowned king of Italy at Monza in 1093. After five years of inactivity Henry returned to Germany where his position was stronger than ever. Welf had submitted

and had been restored to Bavaria; the diet assembled at Mainz in 1098 declared Conrad deposed, and chose the emperor's second son, Henry, afterwards the emperor Henry V., as German king, and the crusade of 1096 had freed Germany from many turbulent spirits. But the younger Henry, in 1104, encouraged by the adherents of the pope, declared he owed no allegiance to an excommunicated father. Saxony and Thuringia were soon in arms and in 1105, the emperor became a prisoner in the hands of his son. A diet at Mainz in December compelled him to abdicate, but contrary to the conditions, he was detained at Ingelheim and denied his freedom. Escaping to Cologne, he entered into negotiations with England, France and Denmark, and was engaged in collecting an army when he died at Liége on Aug. 7, 1106.

After a licentious youth, Henry displayed much diplomatic ability, and his abasement at Canossa may fairly be regarded as a move of policy to weaken the pope's position at the cost of a personal humiliation to himself. He was a friend of the lower orders, was capable of generosity, and sho ed considerable military skill. Unfortunate in the troubles with which he had to contend, he ably resisted the pretensions both of the papacy and of the ambitious feudal lords of Germany.

The authorities are Lambert of Hersfeld, *Annales;* Bernold of Reichenau, *Chronicon;* Ekkehard of Aura, *Chronicon;* and Bruno, *De bello Saxonico,* all in the *Monumenta Germaniae historica. Scriptores,* v. and vi. (1826–92). An anonymous *Vita Heinrici IV.* was edited by W. Wattenbach (Hanover, 1876). *See* G. Meyer von Knonau, *Jahrbücher des deutschen Rriches unter Heinrich IV.* (Leipzig. 1890); H. Floto, *Kaiser Heinrich IV.* (Stuttgart, 1855); E. Kilian, *Itinerar Kaiser Heinrichs IV.* (Karlsruhe, 1886); K. W. Nitzsch, "Das deutsche Reich und Heinrich IV.," in the *Historische Zeitschrift*, Band xlv. (Munich, 1859); H. Ulmann, *Zum Verstandniss der sächsischen Erhebung gegen Heinrich IV.* (Hanover, 1886), W. von Giesebrecht, *Geschichte der deutschen Kaiserzeit* (Leipzig, 1881–90); B. Gebhardt, *Handbuch der deutschen Geschichte* (1901); E. Hoehne, *Kaiser Heinrich IV.* (1906); C. Labarum, *The Victory of Henry IV. at Canossa* (1913) and B. Schmeidler, *Kaiser Heinrich IV. und seine Helfer im Investiturstreit* (1927). Further bibliography in Dahlmann-Waitz, *Quellenkunde der deutschen Geschichte* (Gottingen, 1894); and in *Camb. Mediaeval Hist.*, vol. 5.

HENRY **V.** (1081–1125), Roman emperor, son of the emperor Henry IV., was born on Jan. 8, 1081, and after the deposition of his elder brother, the German king Conrad (d. 1101), was chosen as his successor in 1098. In spite of his oath to take no part in the business of the empire during his father's lifetime, Henry was induced by his father's enemies to revolt in 1104, and some of the princes did homage to him at Mainz in Jan. 1106. In August of the same year the elder Henry died, when his son became sole ruler. In 1107 a campaign to restore Bofiwoj II. to the dukedom of Bohemia was partially successful, and in the year following the king led his forces into Hungary, where he failed to take Pressburg. In 1109 he was unable to compel the Poles to renew their accustomed tribute, but in 1110 he succeeded in securing the dukedom of Bohemia for Ladislaus I.

The main interest of Henry's reign centres in the controversy over lay investiture which had been thrice prohibited by Paschal II. In 1110 Henry went to Italy with a large army, and at Sutri concluded an arrangement with Paschal by which he renounced the right of investiture in return for a promise of coronation, and the restoration to the empire of all lands given by kings, or emperors, to the German church since the time of Charlemagne. The king presented himself at St. Peter's on Feb. 12, 1111, for his coronation and the ratification of the treaty. The words commanding the clergy to restore the fiefs of the Crown to Henry were read amid a tumult of indignation, whereupon the pope refused to crown the king, who in return declined to renounce the right of investiture. Henry then left the city carrying the pope with him; and Paschal's failure to obtain assistance drew from him a confirmation of the king's right of investiture and a promise to crown him emperor.

In 1112 Lothair, duke of Saxony, rose against Henry, but was easily quelled. In 1113, however, a quarrel over the succession to the counties of Weimar and Orlamünde gave occasion for a fresh outbreak on the part of Lothair, whose troops were defeated at Warnstadt. Having been married in 1114 to Matilda, or Maud, daughter of Henry I. of England, the emperor was confronted with a further rising, initiated by the citizens of Cologne, who were soon joined by the Saxons and others. Henry's forces were defeated at Welfesholz in 1115, and complications in Italy compelled him to leave Germany to the care of Frederick II. of Hohenstaufen, duke of Swabia, and his brother Conrad. After the departure of Henry from Rome in 1111 a council declared the privilege of lay investiture, which had been extorted from Paschal, to be invalid, and Guido, archbishop of Vienne, excommunicated the emperor, but the pope refused to ratify this sentence. The quarrel entered upon a new stage in 1115 when Matilda, daughter and heiress of Boniface, margrave of Tuscany, died leaving her vast estates to the papacy. Crossing the Alps in 1116, Henry took possession of Matilda's lands. By this time Paschal had withdrawn his consent to lay investiture and the excommunication had been published. The pope was compelled to fly and the emperor was crowned a second time by Burdinas, archbishop of Braga. Paschal was succeeded by Gelasius II. in Jan. 1118, but Henry secured the election of an antipope who took the name of Gregory VIII. Finally in the concordat of Worms (Sept. 1122) Henry renounced the right of investiture with ring and crozier, recognized the freedom of election of the clergy and promised to restore all church property. The new pope Calixtus II. agreed to allow elections to take place in presence of the imperial envoys, and the investiture with the sceptre to be granted by the emperor as a symbol that the estates of the church were held under the Crown. Henry was received again into the communion of the church, after he had abandoned his nominee, Gregory, to defeat. The emperor's concluding years were occupied with a campaign in Holland, and with a quarrel over the succession to the margraviate of Meissen. In 1124 he led an expedition against King Louis VI. of France and turned his arms against the citizens of Worms. He died at Utrecht on May 23, 1125.

See W. von Giesebrecht, *Geschichte der deutschen Kaiserzeit, Bd.* iii. (Leipzig, 1881–90); L. von Ranke, *Weltgeschichte,* pt. vii. (Leipzig, 1886) M. Manitius, *Deutsche Geschichte* (Stuttgart, 1889); C. Stutzer, "Zur Kritik der Investiturverhandlungen im Jahre 1119," in the *Forschungen zur deutschen Geschichte,* Bd. xviii. (Göttingen, 1862–86); T. von Sickel and H. Bresslau, "Die kaiserliche Ausfertigung des Wormser Konkordats," in the *Mittheilungen des Instituts fur österreichische Geschichtsjorschung* (Innsbruck, 1880); B. Gebhardt, *Handbuch der deutschen Geschichte,* Bd. i. (1901), and E. Bernheim, *Zur Geschichte des Wormser Konkordats* (Gottingen, 1878).

HENRY **VI.** (1165–1197), Roman emperor, son of the emperor Frederick I. and Beatrix, daughter of Renaud III., count of upper Burgundy, was educated under Conrad of Querfurt, afterwards bishop of Hildesheim and Wiirzburg. Chosen German king at Bamberg in June 1169, he was crowned at Xix-la-Chapelle on Aug. 15, 1169, and invested with lands in Germany in 1179. In 1184 his father sought to procure his coronation from Pope Lucius III., but the pope refused because of the marriage arranged between Henry and Constance, daughter of the late king of Sicily, Roger II., a step which threatened to unite Sicily with Germany. This marriage took place at Milan in Jan. 1186, and soon afterwards Henry was crowned king of Italy. Having been recognized by the pope as Roman emperor elect, Henry returned to Germany, where a campaign against Henry the Lion, duke of Saxony, was followed by a peace made at Fulda in July 1190.

A promise of his coronation from Pope Clement III. led Henry to cross the Alps in the winter of 1190. He purchased the support of the cities of northern Italy, but on reaching Rome found Clement was dead and his successor, Celestine III., disinclined to carry out the coronation. However, the strength of the German army and a treaty made between the king and the Romans induced him to crown Henry on April 14, 1191. Meanwhile a party in Sicily had chosen Tancred, an illegitimate son of Roger, son of King Roger II., as king. Henry marched to Naples, but was compelled to raise the siege and return to Germany. There the Welfs and their earlier opponents were united against the emperor, vacancies in various bishoprics added to the confusion, and Henry was suspected of being implicated in the murder of Albert, bishop of Liége. His salvation came from the captivity of Richard I., king of England, and the skill with which he used this event to make peace with his foes. When Henry the Lion came to terms in March 1194, order was restored to Germany.

In the following May, Henry went again to Italy, where Pope Celestine had espoused the cause of Tancred. When he reached Sicily he found Tancred dead, and, meeting with little resistance, entered Palermo, where he was crowned king on Dec. 25, 1194. Leaving his wife, Constance, as regent, he returned to Germany in June 1195.

Having established his position in Germany and Italy, Henry began to cherish ideas of universal empire. Richard of England had already owned his supremacy, and declaring he would compel the king of France to do the same Henry sought to stir up strife between France and England. Nor did the Spanish kingdoms escape his notice. Tunis and Tripoli were claimed, and when the eastern emperor, Isaac Angelus, asked his help, he demanded in return the cession of the Balkan peninsula. The kings of Cyprus and Armenia asked for investiture at his hands. To complete his scheme two steps were necessary, a reconciliation with the pope and the recognition of his young son, Frederick, as his successor in the empire. The first was easily accomplished; the second was more difficult.

Henry met the princes at Worms in Dec. 1195 and by threats or negotiations won the consent of about 50 of them; but though the diet which met at Wurzburg in April **1196** agreed to the scheme, the vigorous opposition of Adolph, archbishop of Cologne, and others rendered it inoperative. In June **1196** Henry went again to Itaiy to persuade the pope to crown his son who had been chosen king of the Romans at Frankfort. Celestine refused, and the emperor then went to the south, where the oppression of his German officials had caused an insurrection, which was put down with terrible cruelty. At Messina on Sept. **28,** 1197, Henry died from a cold caught whilst hunting.

Henry's poems appeared in F. H. von der Hagen's *Minnesinger* (Leipzig, 1838). The chief authorities for his life are Otto of Freising, *Chronicon,* continued by Otto of St. Blasius; Godfrey of Viterbo, *Gesta Frzdericz I.* and *Gesta Heinrici VI.;* Giselbert of Mons, *Chronicon Hanoniense,* all of which appear in the *Monum. Germ. hist. Scriptores,* Bde. xx., xxi., xxii. (1826–92). *See* also W. von Giesebrecht, *Geschichte der deutschen Kaiserzeit,* Bd. iv. (Brunswick, 1877); T. Toeche, *Kaiser Heznrich VI.* (Leipzig, 1867); H. Bloch, *Forschungen zur Politik Kaiser Heinrichs VI.* (1892); *K. A.* Kneller, *Des Richard Lowenherz deutsche Gefangenschaft* (Freiburg, 1893); F. Gerlich, *Das Testament Heinrichs VI.* (1907); *V.* Pfaff, *Kaiser Heinrichs VI. hochstes Angebot an die römische Kurie, 1196* (1927), and ***Camb.*** *Mediaeval Hist.* vol. 5.

HENRY VII. (c. 1269–1313), Roman emperor, son of Henry III., count of Luxemburg, passed his early days under French influences. In **1288** he succeeded his father, and four years later married Margaret (d. 1311), daughter of John I., duke of Brabant. After the death of the German king, Albert I., he was elected to the vacant throne on Nov. **27, 1308.** The Rhenish archbishops were pacified by the restoration of the Rhine tolls, negotiations were begun with Philip IV., king of France, and with Robert, king of Naples, and the Habsburgs were confirmed in their possessions. At this time Bohemia was ruled by Henry V., duke of Carinthia, but the prevailing disorder induced some of the Bohemians to offer the crown, together with the hand of Elizabeth, daughter of the late king Wenceslas II., to John, the son of the German king. Henry accepted the offer, and in Aug. 1310 John was invested with Bohemia and his marriage was celebrated.

Meanwhile Henry had crossed the Alps, with the hope of reuniting Germany and Italy, and of restoring the empire of the Hohenstaufen. Having entered Milan he placed the Lombard crown upon his head on Jan. **6,** 1311. But trouble soon showed itself. His poverty compelled him to exact money from the citizens; the peaceful professions of the Guelphs were insincere, and Robert, king of Naples, watched his progress with suspicion. Risings took place and, after the capture of Brescia, Henry marched to Rome only to find the city in the hands of the Guelphs and the troops of King Robert. The king, unable to obtain possession of St. Peter's, was crowned emperor on June **29,** 1312, in the church of St. John Lateran by some cardinals who declared they acted under compulsion. Failing to subdue Florence, the emperor allied himself with Frederick III., king of Sicily, and, with the Venetians, set out to attack Robert of Naples. On the march he was taken ill, and died at Buonconvento near Siena on Aug. **24,** 1313. Henry was hailed by Dante as the deliverer of Italy, and in the *Paradiso* the poet reserved for him a place marked by a crown.

Many of the contemporary documents for the life of Henry VII. are found in the *Rerum Italicarum scriptores,* ed. L. *A.* Muratori (Milan; 1723–51), in *Fontes rerum Germanicarum,* ed. *J.* F. Bohmer (Stuttgart, 1843–68), and in *Die Geschichtsschreiber der deutschen Vorzeit,* Bde. 79 and 80 (Leipzig, 1884). *See* also *Acta Henrici VII. imperatoris Romanorum,* ed. G. Donniges (1839); F. Bonaini, *Acta Henrici VII. Romanorum imperatoris* (Florence, 1877); T. Lindner, *Deutsche Geschichte unter den Habsburgern und Luxemburgern* (Stuttgart, 1888–93); J. Heidemann, "Die Konigswahl Heinrichs von Luxemburg," in the *Forschungen zur deutschen Geschichte,* Bd. xi. (Göttingen, 1862–86). B. Thomas, *Zur Königswahl des Grafen Heinrich von Luxemburg* (Strasbourg, 1875); D. König, *Kritische Erörterungen zu einigen italienischen Quellen fur die Geschichte des Romerzuges Königs Heinrich VII.* (Gottingen, 1874); K. Wenck, *Clemens V. und Heinrich VII.* (Halle, 1882); F. W. Barthold, *Der Römerzug König Heinrichs von Lützelburg* (Königsberg, 1830–31); R. Pohlmann, *Der Römerzug König Heinrichs VII. und die Politik der Kurie* (Nuremberg, 1875); W. Donniges, *Kritik der Quellen fur die Geschichte Heinrichs VII. des Luxemburgers* (1841), G. Sommerfeldt, *Die Romjahrt Kaiser Heinrichs VII.* (Konigsberg, 1888), C. Graefe, *Die Persönlichkeit Kaiser Heinrichs VII.* (1911); and F. Schneider, *Kaiser Heinrichs VIZ.* (1924).

HENRY (c. 1174–1216), emperor of Romania, or Constantinople, was a younger son of Baldwin, count of Flanders and Hainaut (d. **1195).** Having joined the Fourth Crusade about 1201, he distinguished himself at the siege of Constantinople in 1204 and elsewhere, and soon became prominent among the princes of the new Latin empire of Constantinople. When his brother, the emperor Baldwin I., was captured at the battle of Adrianople in April **1205,** Henry was chosen regent of the empire, succeeding to the throne when the news of Baldwin's death arrived. He was crowned on Aug. **20, 1205.** Henry was **a** wise ruler, whose reign was largely passed in successful struggles with the Bulgarians and with his rival, Theodore Lascaris I., emperor of Nicaea. Henry appears to have been brave but not cruel, and tolerant but not weak; possessing "the superior courage to oppose, in a superstitious age, the pride and avarice of the clergy." He died, poisoned, it is said, by his Greek wife, on June 11, 1216.

See Gibbon's *Decline and Fall of the Roman Empire,* vol. vi. (ed. J. B. Bury, 1898).

HENRY I. (1207?–1217), king of Castile, son of Alphonso VIII. of Castile and Eleanor of Aquitaine, daughter of Henry II. of England, born c. 1207. He was killed by the fall of a tile.

HENRY II. OF TRASTAMARA (1333–1379), king **(1369)** of Castile, eldest son of Alphonso XI. and his mistress, Leonora de Guzman. His father endowed him with great lordships in northern Spain, and made him count of Trastamara. After the accession of Alphonso's legitimate son, Peter the Cruel, Henry fled **(1356)** to France. In **1366** he persuaded the mercenary soldiers paid off by the kings of England and France to join him on an expedition to drive out Peter. The expedition was successful, but the Black Prince intervened on behalf of Peter and defeated Henry at Nájera (April **3, 1367).** Henry fled to Aragon, returned with French soldiers of fortune under du Guesclin, besieged Peter in Montiel (La Mancha), tempted him out and killed him on March **23, 1369.** Through his ten years' reign Henry remained a strong ally of the French king in his wars with the English, who supported the claims of Peter's natural daughters. To support his own, he made vast grants and concessions to nobles and cities, hence his title *El de las Mercedes* —he of the largesse.

HENRY III. (1379–1406), king **(1390)** of Castile, "El Doliente" (the Sufferer), was the son of John I., of Castile and Leon, and Eleanor, daughter of Peter IV of Aragon. Though delicate and a minor, he succeeded, by the generous support of the cities, in regaining (1393) his crown lands from the nobles. In 1394 he summoned the Cortes at Madrid, and established a practically despotic royal authority, based on the consent of the commons. His marriage with Catherine, granddaughter of Peter the Cruel, united the rival claims of the descendants of Peter and of Henry of Trastamara. He died on Dec. **25, 1406.**

HENRY IV. (1425–1474), king of Castile, "the Impotent," was the son of John II. of Castile and Leon and of Mary. daughter of Ferdinand I. of Aragon and Sicily. Born at Valladolid on

Jan. 6, 1425, he was weak and vacillating in character, and his reign was marked by incidents of the most ignominious kind. He divorced (1453) his wife Blanche of Navarre on the ground of mutual impotence, married Joan of Portugal in 1468, repudiated the daughter that she bore him, then claimed her for his own. Deposed in favour of his brother Alphonso in 1468, he was restored at the latter's death in the same year. He died at Madrid on Dec. 12, 1474.

HENRY I. (1068–1135), king of England, nicknamed Beauclerk, the fourth and youngest son of William I. by his queen Matilda of Flanders, was born in 1068 on English soil. Of his life before 1086, when he was solemnly knighted by his father at Westminster, we know little. He was his mother's favourite, and she bequeathed to him her English estates, which, however, he was not permitted to hold in his father's lifetime. Henry was given an excellent education, of which in later life he was proud. His attainments included Latin, which he could both read and write; he knew something of the English laws and language, and it may have been from an interest in natural history that he collected, during his reign, the Woodstock menagerie which was the admiration of his subjects. But from 1087 his life was one of action and vicissitudes which left him little leisure. Receiving, under the Conqueror's last dispositions, a legacy of 5,000 pounds of silver, but no land, he traded upon the pecuniary needs of Duke Robert of Normandy, from whom he purchased, for the small sum of £3,000, the district of the Cotentin. He negotiated with Rufus to obtain the possession of their mother's inheritance, but only incurred thereby the suspicions of the duke, who threw him into prison. In 1090 the prince vindicated his loyalty by suppressing, on Robert's behalf, a revolt of the citizens of Rouen which Rufus had fomented. But when his elder brothers were reconciled in the next year they combined to evict Henry from the Cotentin. He dissembled his resentment for a time, and lived for nearly two years in the French Vexin in great poverty. He then accepted from the citizens of Domfront an invitation to defend them against Robert of Belesme; and subsequently, coming to an agreement with Rufus, assisted the king in making war on their elder brother Robert. When Robert's departure for the First Crusade left Normandy in the hands of Rufus (1096) Henry took service under the latter, and he was in the royal hunting train on the day of Rufus's death (Aug. 2, 1100).

Had Robert been in Normandy the claim of Henry to the English crown might have been effectually opposed. But Robert only returned to the duchy a month after Henry's coronation. In the meantime the new king, by issuing his famous charter, by recalling Anselm, and by choosing the Anglo-Scottish princess Edith-Matilda, daughter of Malcolm III., king of the Scots, as his future queen, had cemented that alliance with the church and with the native English which was the foundation of his greatness. Anselm preached in his favour, English levies marched under the royal banner both to repel Robert's invasion (1101) and to crush the revolt of the Montgomeries headed by Robert of Belesme (1102). The alliance of crown and church was subsequently imperilled by the question of Investitures (1103–1106). Henry was sharply criticized for his ingratitude to Anselm (*q.v.*), in spite of the marked respect which he showed to the archbishop. At this juncture a sentence of excommunication would have been a dangerous blow to Henry's power in England. But the king's diplomatic skill enabled him to satisfy the church without surrendering any rights of consequence (1106); and he skilfully threw the blame of his previous conduct upon his counsellor, Robert of Meulan. Although the *Peterborough Chronicle* accuses Henry of oppression in his early years, the nation soon learned to regard him with respect. William of Malmesbury, about 1125, already treats Tinchebrai (1106) as an English victory and the revenge for Hastings. Henry was disliked but feared by the baronage, towards whom he showed gross bad faith in his disregard of his coronation promises. In 1110 he banished the more conspicuous malcontents, and from that date was safe against the plots of his English feudatories.

With Normandy he had more trouble, and the military skill which he had displayed at Tinchebrai was more than once put to the test against Norman rebels. His Norman, like his English administration, was popular with the non-feudal classes, but doubtless oppressive towards the barons. The latter had abandoned the cause of Duke Robert, who remained a prisoner in England till his death (1134); but they embraced that of Robert's son William the Clito, whom Henry in a fit of generosity had allowed to go free after Tinchebrai. The Norman conspiracies of 1112, 1118 and 1123–24 were all formed in the Clito's interest. Both France and Anjou supported this pretender's cause from time to time; he was always a thorn in Henry's side till his untimely death at Alost (1128), but more especially after the catastrophe of the White Ship (1120) deprived the king of his only lawful son. But Henry emerged from these complications with enhanced prestige. His campaigns had been uneventful, his chief victory (Brémule, 1119) was little more than a skirmish. But he had held his own as a general, and as a diplomatist he had shown surpassing skill. The chief triumphs of his foreign policy were the marriage of his daughter Matilda to the emperor Henry V. (1114) which saved Normandy in 1124; the detachment of the pope, Calixtus II., from the side of France and the Clito (1119), and the Angevin marriages which he arranged for his son William Aetheling (1119) and for the widowed empress Matilda (1129) after her brother's death. This latter match, though unpopular in England and Normandy, was a fatal blow to the designs of Louis VI., and prepared the way for the expansion of English power beyond the Loire. After 1124 the disaffection of Normandy was crushed. The severity with which Henry treated the last rebels was regarded as a blot upon his fame; but the only case of merely vindictive punishment was that of the poet Luke de la Barre, who was sentenced to lose his eyes for a lampoon upon the king, and only escaped the sentence by committing suicide.

Henry's English government was severe and grasping; but he "kept good peace" and honourably distinguished himself among contemporary statesmen in an age when administrative reform was in the air. He spent more time in Normandy than in England. But he showed admirable judgment in his choice of subordinates; Robert of Meulan, who died in 1118, and Roger of Salisbury, who survived his master, were statesmen of no common order; and Henry was free from the mania of attending in person to every detail, which was the besetting sin of mediaeval sovereigns. As a legislator Henry was conservative. He issued few ordinances; the unofficial compilation known as the *Leges Henrici* shows that, like the Conqueror, he made it his ideal to maintain the "law of Edward." His itinerant justices were not altogether a novelty in England or Normandy. It is characteristic of the man that the exchequer should be the chief institution created in his reign. The eulogies of the last *Peterborough Chronicle* on his government were written after the anarchy of Stephen's reign had invested his predecessor's "good peace" with the glamour of a golden age. Henry was respected and not tyrannous. He showed a lofty indifference to criticism such as that of Eadmer in the *Historia novorum*, which was published early in the reign. He showed, on some occasions, great deference to the opinions of the magnates. But dark stories, some certainly unfounded, were told of his prison-houses. Men thought him more cruel and more despotic than he actually was.

Henry was twice married. After the death of his first wife, Matilda (1080–1118), he took to wife Adelaide, daughter of Godfrey. count of Louvain (1121), in the hope of male issue. But the marriage proved childless. and the empress Matilda was designated as her father's successor, the English baronage being compelled to do her homage both in 1127, and again, after the Angevin marriage, in 1131. He had many illegitimate sons and daughters by various mistresses. Of these bastards the most important is Robert, earl of Gloucester, upon whom fell the main burden of defending Matilda's title against Stephen.

Henry died near Gisors on Dec. 1, 1135, in the 36th year of his reign, and was buried in the abbey of Reading which he himself had founded.

ORIGINAL AUTHORITIES.—The *Peterborough Chronicle* (ed. Plummer, 1882–1889); *Florence of Worcester* and his first continuator (ed. B. Thorpe, 1848–49); Eadmer, *Historia novorum* (ed. Rule, Rolls

Series, 1884); William of Malmesbury, *Gesta regum* and *Historia novella* (ed. Stubbs, Rolls Series, 1887–1889); Henry of Huntingdon, *Hzstorza Anglorum* (ed. Arnold, Rolls Series, 1879); Simeon of Durham (ed. Arnold, Rolls Series, 1882–85); Orderic Vitalis, *Historia ecclesiastzca* (ed. le Prevost, Paris, 1838–1855); Robert of Torigni, *Chronica* (ed. Howlett, Rolls Series, 1889), and *Continuatio Willelmi Gemmeticensis* (ed. Duchesne, *Hist. Normannorum scriptores,* pp. 215–317, Paris, 1619). *See* also the Pipe Roll of 31 H. I. (ed. Hunter, *Record Commission,* 1833); the documents in W. Stubbs's *Select Chapters* (1895); the *Leges Henrici* in Liebermann's *Gesetze der Angel-Sachsen* (Halle, 1898, etc.); and the same author's monograph, *Leges Henrzci* (Halle, 1901); the treaties, etc., in the Record Commission edition of Thomas Rymer's *Foedera,* vol. i. (1816).

MODERN AUTHORITIES.—E. A. Freeman, *History of the Norman Conquest,* vol. v.; J. M. Lappenberg, *History of England under the Norman Kings* (tr. Thorpe, 1857); Kate Norgate, *England under the Angevin Kings,* vol. i. (1887); Sir James Ramsay, *Foundations of England,* vol. ii.; W. Stubbs, *Constitutional History,* vol. i.; H. W. C. Davis, *England under the Normans and Angeains;* Hunt and Poole, *Political History of England,* vol. ii. (H. W. C. D.)

HENRY II. (1133–1189), king of England, son of Geoffrey Plantagenet, count of Anjou, by Matilda, daughter of Henry I., was born at Le Mans on March 2j, 1133. He was brought to England during his mother's conflict with Stephen (1142), and was placed under the charge of a tutor at Bristol He returned to Normandy in 1146. He next appeared on English soil in 1149[1] when he came to court the help of Scotland and the English baronage against King Stephen. The second visit was of short duration. In 1150 he was invested with Normandy by his father, whose death in the next year made him also count of Anjou In 1152 by a marriage with Eleanor of Aquitaine, the divorced wife of the French king Louis VII., he acquired Poitou, Guienne and Gascony; but in doing so incurred the ill-will of his suzerain from which he suffered not a little in the future. Lastly in 1153 he was able, through the aid of the Church and his mother's partisans, to extort from Stephen the recognition of his claim to the English succession; and this claim was asserted without opposition immediately after Stephen's death (Oct. 25, 1154).

The first years of the reign were largely spent in restoring the public peace and recovering for the crown the lands and prerogatives which Stephen had bartered away. Amongst the older partisans of the Angevin house the most influential were Archbishop Theobald, whose good will guaranteed to Henry the support of the Church, and Nigel, bishop of Ely, who presided at the exchequer. But Thomas Becket, archdeacon of Canterbury, a younger statesman whom Theobald had discovered and promoted, soon became all-powerful. Becket lent himself entirely to his master's ambitions, which at this time centred round schemes of territorial aggrandizement. In 1155 Henry asked and obtained from Adrian IV. a licence to invade Ireland, which the king contemplated bestowing upon his brother, William of Anjou. This plan was dropped; but Malcolm of Scotland was forced to restore the northern counties which had been ceded to David; North Wales was invaded in 1157; and in 1159 Henry made an attempt, which was foiled by the intervention of Louis VII., to assert his wife's claims upon Toulouse. After vainly invoking the aid of the emperor Frederick I., the young king came to terms with Louis (1160), whose daughter was betrothed to Henry's namesake and heir. The peace proved unstable, and there was desultory skirmishing in 1161. The following year was chiefly spent in reforming the government of the continental provinces. In 1163 Henry returned to England, and almost immediately embarked on that quarrel with the Church which is the keynote to the middle period of the reign.

Henry had good cause to complain of the ecclesiastical courts, and had only awaited a convenient season to correct abuses which were admitted by all reasonable men. But he allowed the question to be complicated by personal issues. He was bitterly disappointed that Becket, on whom he bestowed the primacy, left vacant by the death of Theobald (1162), at once became the champion of clerical privilege; he and the archbishop were no longer on speaking terms when the Constitutions of Clarendon came up for debate. The king's demands were not intrinsically irreconcilable with the canon law, and the papacy would probably have allowed them to take effect *sub silentio,* if Becket (*q.v.*) had not been goaded to extremity by persecution in the forms of law. After Becket's flight (1164), the king put himself still further in the wrong by impounding the revenues of Canterbury and banishing at one stroke a number of the archbishop's friends and connections. He showed, however, considerable dexterity in playing off the emperor against Alexander III. and Louis VII., and contrived for five years, partly by these means, partly by insincere negotiations with Becket, to stave off a papal interdict upon his dominions. When, in July 1170, he was forced by Alexander's threats to make terms with Becket, the king contrived that not a word should be said of the Constitutions. He undoubtedly hoped that in this he would have his way when Becket should be once more in England and within his grasp. For the murder of Becket (Dec. 29, 1170) the king cannot be held responsible, though the deed was suggested by his impatient words. It was a misfortune to the royal cause; and Henry was compelled to purchase the papal absolution by a complete surrender on the question of criminous clerks (1172). When he heard of the murder he was panic-stricken; and his expedition to Ireland (1171), although so momentous for the future, was originally a mere pretext for placing himself beyond the reach of Alexander's censures.

Becket's fate, though it supplied an excuse, was certainly not the real cause of the troubles with his sons which disturbed the king's later years (1173–1189). But Henry's misfortunes were largely of his own making. Queen Eleanor, whom he alienated by his faithlessness, stirred up her sons to rebellion; and they had grievances enough to be easily persuaded. Henry was an affectionate but a suspicious and close-handed father. The titles which he bestowed on them carried little power, and served chiefly to denote the shares of the paternal inheritance which were to be theirs after his death. The excessive favour which he showed to John, his youngest-born, was another cause of heart-burning; and Louis, the old enemy, did his utmost to foment all discords. It must, however, be remembered in Henry's favour, that the supporters of the princes, both in England and in the foreign provinces, were animated by resentment against the soundest features of the king's administration; and that, in the rebellion of 1173, he received from the English commons such hearty support that any further attempt to raise a rebellion in England was considered hopeless. Henry, like his grandfather, gained in popularity with every year of his reign. In 1183 the death of Prince Henry, the heir-apparent, while engaged in a war against his brother Richard and their father, secured a short interval of peace. But in 1184 Geoffrey of Brittany and John combined with their father's leave to make war upon Richard, now the heir-apparent. After Geoffrey's death (1186) the feud between John and Richard drove the latter into an alliance with Philip Augustus of France. The ill-success of the old king in this war aggravated the disease from which he was suffering; and his heart was broken by the discovery that John, for whose sake he had alienated Richard, was in secret league with the victorious allies. Henry died at Chinon on July 6, 1189, and was buried at Fontevraud. By Eleanor of Aquitaine the king had five sons and three daughters. His eldest son, William, died young; his other sons, Henry, Richard, Geoffrey and John, are all mentioned above. His daughters were: Matilda (1156–1189), who became the wife of Henry the Lion, duke of Saxony; Eleanor (1162–1214), who married Alphonso VIII., king of Castile; and Joanna, who, after the death of William of Sicily in 1189, became the wife of Raymund VI., count of Toulouse, having previously accompanied her brother, Richard, to Palestine. He had also three illegitimate sons: Geoffrey, archbishop of York; Morgan; and William Longsword, earl of Salisbury.

Henry's power impressed the imagination of his contemporaries, who credited him with aiming at the conquest of France and the acquisition of the imperial title. But his ambitions of conquest were comparatively moderate in his later years. He attempted to secure Maurienne and Savoy for John by a marriage-alliance, for which a treaty was signed in 1173. But the project failed through the death of the intended bride; nor did

[1] For a supposed visit in 1147, *see* J. H. Round in *English Historical Review,* v, 747.

the marriage of his third daughter, the princess Joanna (1165–1199), with William II., king of Sicily (1177) lead to English intervention in Italian politics. Henry once declined an offer of the empire, made by the opponents of Frederick Barbarossa; and he steadily supported the young Philip Augustus against the intrigues of French feudatories. The conquest of Ireland was carried out independently of his assistance, and perhaps against his wishes. He asserted his suzerainty over Scotland by the treaty of Falaise (1175), but not so stringently as to provoke Scottish hostility. This moderation was partly due to the embarrassments produced by the ecclesiastical question and the rebellions of the princes. But Henry, despite a violent and capricious temper, had a strong taste for the work of a legislator and administrator. He devoted infinite pains and thought to the reform of government both in England and Normandy. The legislation of his reign was probably in great part of his own contriving. His supervision of the law courts was close and jealous; he transacted a great amount of judicial business in his own person, even after he had formed a high court of justice which might sit without his personal presence. To these activities he devoted his scanty intervals of leisure. His government was stern; he over-rode the privileges of the baronage without regard to precedent; he persisted in keeping large districts under the arbitrary and vexatious jurisdiction of the forest-courts. But it is the general opinion of historians that he had a high sense of his responsibilities and a strong love of justice; despite the looseness of his personal morals, he commanded the affection and respect of Gilbert Foliot and Hugh of Lincoln, the most upright of the English bishops.

ORIGINAL AUTHORITIES.—Henry's laws are printed in W. Stubbs's *Select Charters* (Oxford, 1895). The chief chroniclers of his reign are William of Newburgh, Ralph de Diceto, the so-called Benedict of Peterborough, Roger of Hoveden, Robert de Torigni (or de Monte), Jordan Fantosme, Giraldus Cambrensis, Gervase of Canterbury; all printed in the Rolls Series. The biographies and letters contained in the 7 vols. of *Materials for the History of Thomas Becket* (ed. J. C. Robertson, Rolls Series, 1875–85) are valuable for the early and middle part of the reign. For Irish affairs the *Song of Dermot* (ed. Orpen, Oxford, 1892), for the rebellions of the princes the metrical *Histoire de Guillaume le Maréchal* (ed. Paul Meyer, 3 vols., Paris, 1891, etc.) are of importance. Henry's legal and administrative reforms are illustrated by the *Tractatus de legibus* attributed to Ranulph Glanville, his chief justiciar (ed. G. Phillips, Berlin, 1828); by the *Dialogus de scaccario* of Richard fitz Nigel (Oxford, 1902); the *Pipe Rolls*, printed by J. Hunter for the Record Commission (1844) and by the Pipe-Roll Society (1884, etc.) supply valuable details. The works of John of Salisbury (ed. Giles, 1848), Peter of Blois (ed. Migne), Walter Map (Camden Society, 1841, 1850) and the letters of Gilbert Foliot (ed. J. A. Giles, 1845) are useful for the social and Church history of the reign.

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HENRY III (1207–1272), king of England, was the eldest son of King John by Isabella of Angoulême. Born on Oct. 1, 1207, the prince was but nine years old at the time of his father's death. The greater part of eastern England being in the hands of the French pretender, Louis, afterward Louis VIII, and the rebel barons, Henry was crowned at Gloucester, the western capital, on Oct. 28, 1216. John had committed his son to the protection of the Holy See; and a share in the government was accordingly allowed to the papal legares. Gualo and Pandulph, both during the civil war and for some time afterward. But the title of regent was given by the loyal barons to William Marshall, the aged earl of Pembroke (d. 1219); and Peter des Roches, the Poitevin bishop of Winchester, received the charge of the king's person. The cause of the young Henry was fully vindicated by the end of 1217. Defeated both by land and sea, the French prince renounced his pretensions and left England, leaving the regency to deal with the more difficult questions raised by the lawless insolence of the royal partisans. Henry remained a passive spectator of the measures by which Marshall and his successor, the justiciar Hubert de Burgh, asserted the royal prerogative against native barons and foreign mercenaries. In 1223, Pope Honorius III declared the king of age, but this was a mere formality, intended to justify the resumption of the royal castles and demesnes which had passed into private hands during the civil war.

The personal rule of Henry III began in Jan. 1227, when lie proclaimed himself of age. Even then he remained for some time under the influence of Hubert de Burgh, whose chief rival, Peter des Roches, found it expedient to quit the kingdom for four years. But Henry was ambitious to recover the continental possessions which his father had lost. Against the wishes of the justiciar he planned and carried out an expedition to the west of France (1230) and, when it failed, laid the blame upon his minister. Other differences arose soon afterward. Hubert was accused, with some reason, of enriching himself at the expense of the crown, and of encouraging popular riots against the alien clerks for whom the papacy was providing at the expense of the English church. He was disgraced in 1232; and power passed for a time into the hands of Peter des Roches, who filled the administration with Poitevins (Poitou having been acquired through Henry II's marriage with Eleanor of Aquitaine). So began the period of misrule by which Henry III is chiefly remembered. The Poitevins fell in 1234; they were removed at the demand of the barons and the primate Edmund Rich, who held them responsible for the tragic fate of the rebellious Richard Marshall. But the king replaced them with a new clique of servile and rapacious favourites. Disregarding the wishes of the great council, and excluding all the more important of the barons and bishops from omce, ne acted as his own chief minister and never condescended to justify his policy except when he stood in need of subsidies. When these were refused. he extorted aids from the towns, Jews or clergy. Always in straits through his extravagance, he pursued a foreign policy which would have been expensive under the most careful management. He hoped not only to regain the French possessions but to establish members of his own family as sovereigns in Italy and the empire. These plans were artfully fostered by the Savoyard kinsmen of Eleanor, daughter of Raymond Berenger, count of Provence, whom he married at Canterbury on Jan. 14, 1236, and by his half brothers, the sons of Queen Isabella and Hugo, count of la Marche. These favourites, not content with pushing their fortunes in the English court! encouraged the king in the wildest designs. In 1242 he led an expedition to Gascony which terminated disastrously with the defeat of Taillebourg; and hostilities with France were continued intermittently for 17 years. The Savoyards encouraged his natural tendency to support the, papacy against the empire; early in the period of misrule he entered into a close alliance with Rome, which resulted in heavy taxation of the clergy and gave great umbrage to the barons. A cardinal legate was sent to England at Henry's request, and during four years (1237–41) administered the English church in a manner equally profitable to the king and the pope. After the recall of the legate Otho the alliance was less open and less cordial. Still the pope continued to share the spoils of the English clergy with the king, and the king to enforce the demand; of Roman tax collectors.

Circumstances favoured Henry's schemes. Archbishop Edmund Rich was timid and inexperienced; his successor, Boniface of Savoy, was a kinsman of the queen; Robert Grosseteste, the most eminent of the bishops, died in 1253, when he was on the point of becoming a popular hero. Among the lay barons. the first place naturally belonged to Richard of Cornwall who, as the king's brother. was unwilling to take any steps which might impair the royal prerogative; while Simon de Montfort, earl of Leicester, the ablest man of his order, was regarded with suspicion as a foreigner, and linked to Henry's cause by his marriage with the princess Eleanor. Although the great council repeatedly protested against the king's misrule and extravagance, their remonstrances came to nothing for want of leaders and a clear-cut policy. But between 1248 and 1252 Henry alienated Montfort from his cause by taking the side of the Gascons, whom the earl had

provoked to rebellion through his rigorous administration of their duchy. A little later. when Montfort was committed to opposition, Henry foolishly accepted from Pope Innocent IV the crown of Sicily for his second son Edmund Crouchback (1255). Sicily was to be conquered from the Hohenstaufen at the expense of England; and Henry pledged his credit to the papacy for enormous subsidies, although years of comparative inactivity had already overwhelmed him with debts. On the publication of the ill-considered bargain the baronage at length took vigorous action. They forced upon the king the Provisions of Oxford (q v.) (1258), which placed the government in the hands of a feudal oligarchy; they reduced expenditure, expelled the alien favourites from the kingdom, and insisted upon a final renunciation of the French claims. The king submitted for the moment, but at the first opportunity endeavoured to cancel his concessions. He obtained a papal absolution from his promises; and he tricked the opposition into accepting the arbitration of the French king, Louis IX, whose verdict was a foregone conclusion. But Henry was incapable of protecting with a strong hand the rights he had recovered by his double-dealing. Ignominiously defeated by Montfort at Lewes (1264) he fell into the position of a cipher, equally despised by his opponents and supporters. He acquiesced in the earl's dictatorship; left to his eldest son, Edward, the difficult task of reorganizing the royal party; marched with the Montfortians to Evesham; and narrowly escaped sharing the fate of his jailer. After Evesham (1265) he is hardly mentioned by the chroniclers. The compromise with the surviving rebels was arranged by his son in concert with Richard of Cornwall and the legate Ottobuono; the statute of Marlborough (1267), which purchased a lasting peace by judicious concessions, was similarly arranged between Edward and the earl of Gloucester. Edward was king in all but name for some years before the death of his father, by whom he was alternately suspected and adored.

Henry had in him some of the elements of a fine character. His mind was cultivated; he was a discriminating patron of literature, and Westminster abbey is an abiding memorial of his artistic taste. His personal morality was irreproachable, except that he inherited the Plantagenet taste for crooked courses and dissimulation in political affairs. His reputation has suffered unduly at the hands of Matthew Paris, whose literary skill is only equaled by his malice. The ambitions which Henry cherished. if extravagant, were never sordid. Some of his worst actions as a politician were due to a sincere. though exaggerated, gratitude for the support which the papacy had given him during his minority. But he had neither the training nor the temper of a statesman. Many of his civil servants, such as John Mansel and Robert Waleraund, were men of great competence, but he could not control the complex administrative machine created by his predecessors. Matthew Paris said that he had a heart of wax, Dante relegated him to the limbo of ineffectual souls; and later generations have endorsed these scathing judgments.

Henry died at Westminster on Nov. 16. 1272; his widow, Eleanor, took the veil in 1276 and died at Amesbury on June 25, 1291. Their children were: the future king Edward I; Edmund, earl of Lancaster; Margaret (1240–75), wife of Alexander III, of Scotland; Beatrice; and Katherine.

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(H. W C D.; N. D-Y.)

HENRY IV. (1367–1413), king of England, son of John of Gaunt, by Blanche, daughter of Henry, duke of Lancaster, was born on April 3, 1367, at Bolingbroke in Lincolnshire. As early as 1377 he is styled earl of Derby, and in 1380 he married Mary de Bohun (d. 1394) one of the co-heiresses of the last earl of Hereford. In 1387 he supported his uncle Thomas, duke of Gloucester, in his armed opposition to Richard II. and his favourites. Afterwards, probably through his father's influence, he changed sides. He was already distinguished for his knightly prowess, and for some years devoted himself to adventure. He thought of going on the crusade to Barbary; but instead, in July 1390, went to serve with the Teutonic knights in Lithuania. He came home in the following spring, but next year went again to Prussia, whence he journeyed by way of Venice to Cyprus and Jerusalem. After his return to England he sided with his father and the king against Gloucester, and in 1397 was made duke of Hereford. In Jan. 1398 he quarrelled with the duke of Norfolk, who charged him with treason. The dispute was to have been decided in the lists at Coventry in September; but at the last moment Richard intervened and banished them both.

When John of Gaunt died in Feb. 1399 Richard, contrary to his promise, confiscated the estates of Lancaster. Henry then felt himself free, and made friends with the exiled Arundels. Early in July, whilst Richard was absent in Ireland, he landed at Ravenspur in Yorkshire. He was at once joined by the Percies; and Richard, abandoned by his friends, surrendered at Flint on Aug. 19. On Richard's abdication Henry claimed the crown by right of blood from King Henry III., and through his right to recover the realm which was in point to be undone for default of governance and good law. Parliament formally accepted him, and thus Henry became king, "not so much by title of blood as by popular election" (Capgrave). The new dynasty had consequently a constitutional basis. But though the revolution of 1399 was popular in form, its success was due to an oligarchical faction. From the start Henry was embarrassed by the power and pretensions of the Percies. Nor was his hereditary title so good as that of the Mortimers. To domestic troubles was added the complication of disputes with Scotland and France. The first danger came from the friends of Richard, who plotted prematurely, and were crushed in Jan. 1400. During the summer of 1400 Henry made a not over-successful expedition to Scotland. The French court would not accept his overtures, but in the summer of 1401 a truce was patched up by the restoration of Richard's child-queen, Isabella of Valois. Meantime in 1400 and again in each of the two following autumns Henry tried in vain to subdue the revolt of Owen Glendower (*q.v.*). The success of the Percies over the Scots at Homildon Hill (Sept. 1402) was no advantage. Henry Percy (Hotspur) and his father, the earl of Northumberland, thought their services ill-requited, and finally made common cause with the partisans of Mortimer and the Welsh. The plot was frustrated by Hotspur's defeat at Shrewsbury (July 21, 1403); and Northumberland for the time submitted. Henry had, however, no one on whom he could rely outside his own family, except Archbishop Arundel. The Welsh were unsubdued; the French were plundering the southern coast; Northumberland was fomenting trouble in the north. In 1405 a plot to carry off the young Mortimers was defeated; but Mowbray, the earl marshal, who had been privy to it, raised a rebellion in the north supported by Archbishop Scrope of York. Mowbray and Scrope were taken and beheaded; Northumberland escaped into Scotland. For the execution of the archbishop Henry was personally responsible, and he could never free himself from its odium. Popular belief regarded his subsequent illness as a judgment for his impiety. Apart from ill-health and unpopularity Henry had succeeded—relations with Scotland were secured by the capture of James, the heir to the crown; Northumberland was at last crushed at Bramham Moor (Feb. 1408); and a little later the Welsh revolt was mastered.

Henry, stricken with sore disease, was unable to reap the advantage. His necessities had all along enabled the Commons to extort concessions in parliament, until in 1406 he was forced to nominate a council and govern by its advice. However, with Archbishop Arundel as his chancellor, Henry still controlled the government. But in Jan. 1410 Arundel had to give way to the king's half-brother, Thomas Beaufort. Beaufort and his brother Henry, bishop of Winchester, were opposed to Arundel and supported by the prince of Wales. For two years the real government rested with the prince and the council. Under the prince's influence the English intervened in France in 1411 on the side of Burgundy. In this, and in some matters of home politics, the king disagreed with his ministers. There is good reason to suppose that the Beauforts had gone so far as to contemplate a forced abdication on the score of the king's ill-health. However, in Nov. 1411 Henry showed that he was still capable of vigorous action by discharging the prince and his supporters. Arundel again became chancellor, and the king's second son, Thomas, took his brother's place. The change was further marked by the sending of an expedition to France in support of Orleans. But Henry's health was failing steadily. On March 20, 1413, whilst praying in Westminster Abbey he was seized with a fainting fit, and died that same evening in the Jerusalem Chamber. He was buried at Canterbury.

By Mary de Bohun Henry had four sons: his successor Henry V., Thomas, duke of Clarence, John, duke of Bedford, and Humphrey, duke of Gloucester; and two daughters, Blanche, who married Louis III., elector palatine of the Rhine, and Philippa, who married Eric XIII., king of Sweden. Henry's second wife was Joan, or Joanna (c. 1370–1437), daughter of Charles the Bad, king of Navarre, and widow of John IV. or V., duke of Brittany, who survived until July 1437. By her he had no children.

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(C. L. K.)

HENRY V. (1387–1422), king of England, son of Henry IV. by Mary de Bohun, was born at Monmouth, in Aug. 1387. On his father's exile in 1398 Richard II. took the boy into his own charge, and treated him kindly. Next year the Lancastrian revolution forced Henry into precocious prominence as heir to the throne. From Oct. 1400 the administration of Wales was conducted in his name; less than three years later he was in actual command of the English forces and fought against the Percies at Shrewsbury. The Welsh revolt absorbed his energies till 1408. Then through the king's ill-health he began to take a wider share in politics. (See HENRY IV.) In Nov. 1411 the king discharged the prince from the council. The quarrel of father and son was political only. It may be to that political enmity that the tradition of Henry's riotous youth, immortalized by Shakespeare, is partly due. To that tradition Henry's strenuous life in war and politics is a sufficient general contradiction. The most famous incident, his quarrel with the chief-justice, has no contemporary authority and was first related by Sir Thomas Elyot in 1531. The story of Falstaff originated partly in Henry's early friendship for Oldcastle (*q.v.*). That friendship, and the prince's political opposition to Archbishop Arundel, perhaps encouraged Lollard hopes. If so, their disappointment may account for the statements of ecclesiastical writers, like Walsingham, that Henry on becoming king was changed suddenly into a new man.

Henry succeeded his father on March 20, 1413. He had to deal with three main problems—the restoration of domestic peace, the healing of schism in the Church and the recovery of English prestige in Europe. Henry grasped them all together, and gradually built upon them a yet wider policy. From the first he made it clear that past differences were to be forgotten. Richard II. was honourably re-interred; the young Mortimer was taken into favour; the heirs of those whc had suffered in the last reign were restored gradually to their titles and estates. With Oldcastle Henry used his personal influence in vain, and the gravest domestic danger was Lollard discontent. But the king's firmness nipped the movement in the bud (Jan. 1414), and made his own position as ruler secure. Save for the abortive Scrope and Cambridge plot in favour of Mortimer in July 1415, the rest of his reign was free from serious trouble at home.

Henry could now turn his attention to foreign affairs. Old commercial disputes and the support which the French had lent to Glendower gave a pretext for war with France. The campaign of 1415, with its brilliant conclusion at Agincourt (Oct. 25), was only the first step. Two years of patient preparation followed. The command of the sea was secured by driving the Genoese allies of the French out of the Channel. A successful diplomacy detached the emperor Sigismund from France, and by the Treaty of Canterbury paved the way to end the schism in the Church. In 1417 the war was renewed on a larger scale. Lower Normandy was quickly conquered, Rouen cut off from Paris and besieged. The French were paralysed by the disputes of Burgundians and Armagnacs. Henry skilfully played them off one against the other, without relaxing his warlike energy. In Jan. 1419 Rouen fell. By August the English were outside the walls of Paris. The intrigues of the French parties culminated in the assassination of John of Burgundy by the dauphin's partisans at Montereau (Sept. 10, 1419). Philip, the new duke, and the French court threw themselves into Henry's arms. After six months' negotiation Henry was, by the Treaty of Troyes, recognized as heir and regent of France, and on June 2, 1420, married Catherine, the king's daughter. He was now at the height of his power. His eventual success in France seemed certain. He shared with Sigismund the credit of having ended the Great Schism by obtaining the election of Pope Martin V. All the states of western Europe were being brought within the web of his diplomacy. The headship of Christendom was in his grasp, and schemes for a new crusade began to take shape. He actually sent an envoy to collect information in the East; but his plans were cut short by death. A visit to England in 1421 was interrupted by the defeat of Clarence at Baugé. The hardships of the longer winter siege of Meaux broke down his health, and he died at Bois de Vincennes on Aug. 3, 1422.

Henry's last words were a wish that he might live to rebuild the walls of Jerusalem. They are significant. His ideal was founded consciously on the models of Arthur and Godfrey as national king and leader of Christendom. So he is the typical mediaeval hero. For that very reason his schemes were doomed to end in disaster, since the time was come for a new departure. Yet he was not reactionary. His policy was constructive: a firm central government supported by parliament; church reform on conservative lines; commercial development; and the maintenance of national prestige. His aims in some respects anticipated those of his Tudor successors, but he would have accomplished them on mediaeval lines as a constitutional ruler. His success was due to the power of his personality. He could train able lieutenants, but at his death there was no one who could take his place as leader. War, diplomacy and civil administration were all dependent on his guidance. His dazzling achievements as a general have obscured his more sober qualities as a ruler, and even the sound strategy, with which he aimed to be master of the narrow seas. If he was not the founder of the English navy he was one of the first to realize its true importance. Henry had so high a sense of his own rights that he was merciless to disloyalty. But he was scrupulous of the rights of others, and it was his eager desire to further the cause of justice that impressed his French contemporaries. He has been charged with cruelty as a religious persecutor; but in fact he had as prince opposed the harsh policy of Archbishop Arundel, and as king sanctioned a more moderate course. Lollard executions during his reign had more often a political than a religious reason. To be just with sternness was in

his eyes a duty. In his personal conduct Henry was chaste, temperate and sincerely pious. He delighted in sport and all manly exercises. He was cultured with a taste for literature, art and music. Henry lies buried in Westminster Abbey. His tomb was stripped of its splendid adornment during the Reformation. The shield, helmet and saddle, which formed part of the original funeral equipment, still hang above it.

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HENRY VI. (1421–1471), king of England, son of Henry V. and Catherine of Valois, was born at Windsor on Dec. 6, 1421. He became king of England on Sept. 1, 1422, and a few weeks later, on the death of his grandfather Charles VI., was proclaimed king of France also. Henry V. had directed that Richard Beauchamp, earl of Warwick (*q.v.*), should be his son's preceptor. As early as 1423 the baby king was made to appear at public functions and take his place in parliament. He was knighted by his uncle Bedford at Leicester in May 1426, and on Nov. 6, 1429, was crowned at Westminster. Early in the next year he was taken over to France, and after long delay crowned in Paris on Dec. 16, 1431. His return to London Feb. 14, 1432 was celebrated with a great pageant devised by Lydgate.

During these early years Bedford ruled France wisely and at first with success, but he could not prevent the mischief which Humphrey of Gloucester caused both at home and abroad. Even in France the English lost ground steadily after the victory of Joan of Arc before Orleans in 1429. The climax came with the death of Bedford, and defection of Philip of Burgundy in 1435. This closed the first phase of Henry's reign. There followed 15 years of vain struggle in France, and growing disorder at home. The determining factor in politics was the conduct of the war. Cardinal Beaufort, and after him Suffolk, sought by working for peace to secure at least Guienne and Normandy. Gloucester courted popularity by opposing them throughout; with him was Richard of York, who stood next in succession to the crown. Beaufort controlled the council, and it was under his guidance that the king began to take part in the government. Thus it was natural that as Henry grew to manhood he seconded heartily the unpopular and difficult peace policy. Henry was unfortunate in his advisers. The cardinal was old, his nephews John and Edmund Beaufort were incompetent, Suffolk was tactless. Suffolk, however, achieved a great success by negotiating the marriage of Henry to Margaret of Anjou (*q.v.*) in 1445. Humphrey of Gloucester and Cardinal Beaufort both died early in 1447. Suffolk was now all-powerful in the favour of the king and queen. But his home administration was unpopular, whilst the incapacity of Edmund Beaufort ended in the loss of all Normandy and Guienne. Suffolk's fall in 1450 left Richard of York the foremost man in England. Henry's reign then entered on its last phase of dynastic struggle. Cade's rebellion suggested first that popular discontent might result in a change of rulers. But York, as heir to the throne, could bide his time. The situation was altered by the mental derangement of the king, and the birth of his son in 1453. York after a struggle secured the protectorship, and for the next year ruled England. Then Henry was restored to sanity, and the queen and Edmund Beaufort, now duke of Somerset, to power. Open war followed (see ROSES, WARS OF THE), with the defeat and death of Somerset at St. Albans on May 22, 1455. Nevertheless a hollow peace was patched up, which continued during four years with lack of all governance. In 1459 war broke out again. On July 10, 1460 Henry was taken prisoner at Northampton, and forced to acknowledge York as heir, to the exclusion of his own son. Richard of York's death at Wakefield (Dec. 29, 1460), and the queen's victory at St. Albans (Feb. 17, 1461), brought Henry his freedom and no more. Edward of York had himself proclaimed king, and by his decisive victory at Towton on March 29, put an end to Henry's reign. For over three years Henry was a fugitive in Scotland. He returned to take part in an abortive rising in 1464. A year later he was captured in the north, and brought a prisoner to the Tower. For six months in 1470–1471 he emerged to hold a shadowy kingship as Warwick's puppet. Edward's final victory at Tewkesbury was followed by Henry's death on May 21, 1471, certainly by violence, perhaps at the hands of Richard of Gloucester.

Henry was the most hapless of monarchs. He was so honest and well-meaning that he might have made a good ruler in quiet times. But he was crushed by the burden of his inheritance. He had not the genius to find a way out of the French entanglement or the skill to steer a constitutional monarchy between rival factions. Henry's very virtues added to his difficulties. He was so trusting that any one could influence him, so faithful that he would not give up a minister who had become impossible. Thus even in the middle period he had no real control of the Government. Religious observances and study were his chief occupations. For education he was really zealous. The planning of his great foundations at Eton (1440) and King's college, Cambridge (1441), was the one thing which absorbed his interest. To both he was more than a royal founder, and the credit of the whole scheme belongs to him.

Henry's only son was Edward, Prince of Wales (1453–1471), who, having shared the many journeys and varying fortunes of his mother, Margaret, was killed after the battle of Tewkesbury (May 4, 1471) by some noblemen in attendance on Edward IV.

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HENRY VII (1457–1509), king of England, son of Edmund Tudor, earl of Richmond, and Margaret Beaufort, only daughter of John, duke of Somerset, was born at Pembroke castle on Jan. 28, 1457, two months after his father's death. His father was half-brother of Henry VI, being the son of Owen Tudor. who had married Catherine, daughter of Charles VI of France and widow of Henry V of England. His mother was the granddaughter of John of Beaufort, duke of Somerset, son of John of Gaunt, duke of Lancaster, and Catherine Swinford. John Beaufort had been born before his parents' marriage but legitimated by act of parliament under Richard II. This legitimation was confirmed by a patent of Henry IV which, however, professed to exclude the Beauforts from the succession to the throne. Henry of Richmond's fortunes were thus bound up from birth with the fortunes of the Lancastrian party in the Wars of the Roses. Until he was 11 he lived in Wales under the protection of his uncle, Jasper Tudor, earl of Pembroke. Then with the surrender of Harlech castle, the last Lancastrian stronghold, in 1468, he fell into the hands of the Yorkist William, Lord Herbert, until the brief restoration of Henry VI in 1470 restored him to Jasper's care. Next year the murders of Henry VI and Prince Edward, after the Yorkist triumph at Tewkesbury, left him head of the house of Lancaster. He was still a mere boy, and his claim was weakened by the fact that few—apparently not even he himself—knew that the clause in Henry IV's patent barring the Beauforts from the throne was an interpolation not found in the original act legitimating them, Nevertheless, the

final victory of Edward IV (May 4, 1471) made England, and even Wales, unsafe for him, and his uncle took him to Brittany. Duke Francis II readily gave him asylum. and there he remained until the usurpation of Richard III split the I orkist party and at length opened the way for new attempts to assert the Lancastrian claim.

The first attempt, in 1483, was planned in concert with the duke of Buckingham's rebellion *(see* BUCKINGHAM, HENRY STAFFORD, 2nd duke of), but failed. largely because of bad weather. But the conspiracy continued. The coalition betu-een Lancastrians and malcontent Yorkists was confirmed by Henry's sworn undertaking to marry Elizabeth of York. eldest daughter and (since the murder of her tno young brothers) heiress of Edward IV. On the basis of this coalition and with French support, Henry in 1485 tried again and, thanks largely to the Stanleys' desertion to him, succeeded in defeating and slaying Richard at Bosworth on Aug 22 *(see* BOSWORTH FIELD, BATTLE OF). After his coronation (Oct. 30). followed by formal recognition from parliament, had manifested his claim to be king in his own right. he fulfilled his bargain with his Yorkist allies by marrying Elizabeth on Jan. 18. 1486.

Opposition from Yorkists who had adhered to Richard III was, however, by no rneans at an end. They were hampered by lack of a suitable claimant, for Henry, besides marrying Elizabeth, had imprisoned the boy Edmard, earl of Warwick, the duke of Clarence's son. Nevertheless, they could always rely upon support from the dowager duchess of Burgundy, Edward IV's sister Margaret; they could hope for ready help from Yorkist Ireland; and they knew that France and Scotland were not eager to see Henry VII or any English king, too firmly settled upon his throne. With the iorces that such sympathizers might provide, the malcontents could still hope to succeed in an England grown weary of wars and inclined to stand by until the issue of the first battle clearly indicated the probable victor. So, ior 12 years after Bosworth, Henry was troubled and sometimes endangered by Yorkish conspiracies. The ill-concerted and aimless rising of Lord Lovell and the young Staffords in 1486 was dangerous only because it took Henry by surprise. But more threatening plots mere then organized around the impostors Lambert Simnel, who impersonated Warwick, in 1487, and Perkin Warbeck, who impersonated Richard of York, the younger oi the princes in the Tower, between 1492 and 1497. Simnel was partly financed by Margaret of Burgundy; John de la Pole, earl of Lincoln, whom Richard III had named as his heir, deserted Henry to join him; Ireland welcomed him as king; the queen dowager was apparently suspected of a hand in the plot; and Simnel's invasion of England was defeated only after three hours' hard fighting at Stoke (June 16).

Warbeck iound still wider support abroad, at first probably from France, then in the Netherlands from the regent Maximilian, as well as irom Margaret, and finally from James IV of Scotland. Thanks to Sir Edward Poynings' work as lord deputy, Ireland would not declare for him as it had ior Simnel, and the execution of Sir William Stanley damped any English ardour in his cause. Yet for five years he gravely complicated Henry's foreign policy even if he never seriously menaced his throne. Warbeck's execution, along with the uniortunate Warwick, in 1499 seems to have been part of the price paid by Henry for cementing his alliance with Spain by the marriage of his eldest son, Arthur, to Catherine of Aragon. For hitherto he had been surprisingly lenient toward pretenders and had made their supporters pay for their rebellions more often with their property than with their lives. At all events, aiter 1497 there were no more Yorkist insurrections, though the activities of the younger De la Poles occasionally troubled Henry's mind and even deflected his policy.

Henry, however, was not content merely to detect conspiracies and suppress rebellions. He sought also to remedy the weaknesses in government that made such things possible; to give strength to royal justice, authority and efficiency to royal administration, and above all riches to the royal coffers. He was not afraid to choose able men to serve him; and generally they served him well, for powerful as his councillors became, they drew their power from him and he remained always their master. Among them were noblemen such as the earls of Derby, Surrey and Oxford; but he trusted most ecclesiastics such as Archbishop John Morton, his lord chancellor, and Bishop Richard Fox, his lord privy seal, or officials of middling fortune such as Reginald Bray, Thomas Lovell and later Richard Empson and Edmund Dudley. The power of the council to deal promptly and efficiently with riot and unlawful practices such as maintenance were reasserted by the so-called Star Chamber act of 1487. By that act and in other ways special responsibility was placed upon particular councillors for particular aspects of the council's work; groups of councillor mere again, as in Yorkist times, sent to York and Ludlow to invigorate royal authority in the north and in the Welsh marches; and a series of measures placed new responsibilities upon the local justices of the peace, while at the same time bringing them more closely under the council's control It is not possible to say how far these improvements in justice and administration were Henry's own idea and how far they originated uith his councillors. However, it may be said at least that their effectiveness was attributable not to any intrinsic novelty but to the persistence with which they were applied, and ior that the credit must go chiefly to the king himself.

In the work of enriching the royal coffers, on the other hand, it is clear that Henry took a detailed and constant interest. That enrichment came quite as much from careful administration as from spectacular measures such as the Act of Resumption of 1485 And Henry's hand is constantly apparent in the development of speedier, less iormal methods of receiving and issuing money and of auditing accounts that grew up outside the old exchequer around the treasurer of the chamber and the general surveyors He himself audited the treasurer's books almost daily and exercised a direct control in matters of finance which none of his predecessors had equalled and none of his successors was to imitate Yet here again there was no great novelty in the methods used. Success was chiefly attributable to the king's own persistent application to business The success was remarkable By 1490 Henry had become a lender rather than a borrower; after 1497 he had no need oi grants from parliament; and he died one oi the richest kings in Christendom Many of his acd his ministers' devices for raising money were not popular, and Empson and Dudley in his later years aroused much resentment. Yet he knew how to appear magnificent, e\en if he was seldom generous; and his court, though modest by comparison with his son's, maintained the state expected oi a king He knew when to spend as well as how to save, but he never forgot that his power depended upon his saving and could easily he undermined by lavish spending

For this reason he avoided foreign wars. He did go to war with France early in his reign to preserve the independence oi Brittany, and when his allies, Spain and Maximilian, failed him, he made a show of invading France. But in Nov. 1492 he readily came to terms, wisely preferring to leave the French in Brittany rather. than overstrain his resources by renewing the Hundred Years' War. The preoccupation of the French with the Italian wars made friendly relations possible thereafter, but the activities of Perkin Warbeck and fear lest French ambition might turn back toward Flanders prevented Henry from relapsing into an isolationist policy. The support which first Maximilian and then James IV gave to Warbeck led to sharp quarrels with the Netherlands and Scotland. By economic measures Henry was able to induce Maximilian and the Netherlands government to abandon the pretender and make a treaty of peace and friendship in 1496. This, and the alliance with Spain which he had made in 1489, gave him an insurance not only against continental support of Yorkist conspiracies but also against any revival of French designs upon Flanders. He was thus able to concentrate upon Scotland and by threats oi war combined with generous offers to obtain in 1499 a peace which was consolidated in 1503 by the marriage of his eldest daughter, Margaret, to James IV. The marriage of his eldest son, Arthur, to Catherine of Aragon in 1501 seemed to set the seal of success on his ioreign policy. The death of Arthur (1502) and of Catherine's mother, Isabelia of Castile (1504), with the resultant rivalry for control of Castile between her father, Ferdinand of Aragon, and her brother-in-law the archduke Philip of Burgundy, jeopardized Henry's system oi alliances and involved him in new and sometimes strange combinations. Yet, as the rivalry oi the powers oi Europe remained centred upon Italy, he could still avoid any deep commitments. Indeed, the skill with which he had all along taken advantage oi thi's situation to give England a breathing space from foreign wars was in no small measure responsible ior his success in rebuilding the strength of the monarchy at home. The success was all the greater because, when dynastic interests did not overrule it, he used his diplomacy vigorously to further the prosperity of English overseas trade. For, as Francis Bacon wrote of him, "he could not endure to see trade sick."

He was, indeed, to quote Bacon again, "a wonder for wise men." The judicious moderation of his policies at home and abroad, his grasp oi essentials and his persistence in concentrating upon them made him perhaps the greatest, if also the least heroic, of the Tudor sovereigns. He had the presence and personality to command respect; he chose his servants wisely and was notably well served. He had a pleasantly sardonic humour and though cool-headed was not cold-blooded. He lacked the popular appeal of a bluff king Henry VIII or an artful Elizabeth I, but he possessed in full measure the solid virtues that his times required.

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HENRY VIII (1491–1547), king of England and Ireland, the third child and second son of Henry VII and Elizabeth of York, was born at Greenwich on June 28. 1491. He was the first English monarch to be educated under the influence of the Renaissance, and his tutors included the poet John Skelton. He became an accom-

plished scholar, linguist, musician and athlete. The death of his elder brother, Arthur, in 1502 made him heir apparent, and in 1503 he mas betrothed to Arthur's widow, Catherine of Aragon. His father, however, delayed the marriage and even made him enter a protest against it, while some doubts were expressed about its validity in canon law *(see* ENGLISH HISTORY). Nevertheless one of Henry VIII's earliest acts after his accession (April 22, 1509) was to marry Catherine.

The young king at first displayed little of his father's application to business, and for two years and more affairs were managed by the pacific Richard Fox and Archbishop William Warham. Yet, although preoccupied with sport and other amusements. he showed a keen interest in learning and in the navy, while his inborn pride and thirst for fame soon made him listen to the warlike counsels of his father-in-law, Ferdinand of Aragon, and of his almoner Thomas Wolsey. In Nov. 1511 he committed himself to a, policy of war with France and in 1513 crossed the channel with an army and took part in the successful sieges of Thérouanne and Tournai and in the battle of Guinegate. Then. deserted by Ferdinand. he made peace with Louis XII. who married his sister Mary (1514). It was even reported from Paris that he would divorce Catherine, whose issue had so far been attended with fatal misfortune, and take a French wife. It seems unlikely that he had in fact yet thought of such a course, and, in any case, the renewed antagonism between England and France upon the accession of Francis I (1515) led to a *rapprochement* with Ferdinand, while the birth of Princess Mary to Catherine (1516) held out hopes of the male issue which Henry so much desired. Rforeover, Ferdinand died in 1516 and the emperor Maximilian in 1519. Their grandson Charles V succeeded .them both in all their realms and dignities, in spite of Henry's hardly serious candidature for the empire; and a lifelong rivalry broke out between Charles and Francis. Both monarchs courted England's favour in 1520, Francis at the Field of Cloth of Gold and Charles more quietly in Kent. At the conference of Calais in 1521 English influence reached its zenith. but the resulting alliance with Charles destroyed the balance on which that influence depended. Charles. sure of English help, concentrated his efforts on Italy, while English campaigns in northern France, lacking adequate imperial support. bore little fruit. Parliament's refusal of Wolsey's demands for money (1523) put an end to these campaigns and drove Henry into underhand negotiations with France (1524). Nevertheless Francis was overweighted by the Anglo-imperial alliance, and his defeat at Pavia (1525) left the emperor supreme. Henry at once urged Charles to join him in partitioning France. However, violent popular resistance to the "amicable grant," which Henry demanded from his subjects in order to prosecute the war against France, again prevented any English invasion of France, and Charles, satisfied with his victory, not only rejected the English proposals but also asked to be released from his promise, made in 1521, to marry Princess Mary.

This brought the question of the succession to the fore and gave Henry an urgent personal interest in politics. He had shown. at least as early as 1519, his anxiety about his lack of a son. and each succeeding year made it more certain that he could not hope for more children by Catherine. There was. of course. Mary; hut no queen regnant had yet ruled in England. Margaret Beaufort had been passed over in favour of her son in 1485 and there was a popular impression that women were excluded from the throne. Mary's marriage to the emperor might have solved the problem, but now that Charles had broken his engagement. her accession (or that of any other living candidate) seemed likely to mean a recurrence of civil war. Henry's first reaction (1525) was to bring out of obscurity his only illegitimate son. create him duke of Richmond and Somerset and give him precedence over Mary. Soon, however, he adopted a more drastic policy. The unexampled fatality which had attended his issue revived the theological scruples about his marriage to Catherine; the quarrel with Charles sharpened them; and all these considerations were magnified by Henry's passion for Anne Boleyn, though she nas not the sole or the main cause of the divorce. That the succession was the main point is proved by the fact that Henry's efforts were all directed to securing a wife and not a mistress. Wolsey persuaded him that the necessary divorce could be obtained irom Rome, as it had been in the cases of Louis XII of France and Margaret of Scotland. A French alliance was made, to increase the pressure on the pope; for a time Clement VII seemed inclined to concede the demand, and in 1528 Lorenzo Cardinal Campeggio mas given ample powers to try the case in England. But the prospect of French success in Italy, which had encouraged the pope, proved delusive, and in 1529 he had to submit to the emperor's yoke. This made it difficult for him to grant the divorce, for Charles mould not readily allow the casting aside oi his aunt, the disinheriting oi his cousin and perhaps the eventual succession of the son of a French princess to the English throne. Campeggio was therefore recalled in July 1529.

Wolsey fell when Campeggio was recalled, and his iall meant the triumph of the antiecclesiastical party in England (see WOLSEY, THOMAS). Laymen who had resented their exclusion irom power mere now promoted to offices such as those oi lord chancellor and lord privy seal which they had rarely held beiore, and parliament was encouraged to propound lay grievances against the church. Henry relied on the support of the laity to abolish papal jurisdiction and reduce clerical privilege and property in England. and by a close alliance with Francis I he insured himself against the enmity of Charles V. But it was only gradually that the breach with Rome was completed. Henry had defended the papacy against Luther in 1521 and had received in return the title "deiender oi the faith." He never liked Protestantism, and he was prepared ior peace with Rome on his own terms. Those terms were impossible of acceptance by a pope in Clement VII's position, but beiore Clement had made up his mind to reject them, Henry had discovered that the papacy was hardly worth conciliating. His eyes mere opened to the extent of his own power as the exponent of national antipathy to papal jurisdiction and ecclesiastical privilege, and his appetite ior power grew. With Thomas Cromwell's help he secured parliamentary support, and its useiulness led him to extend parliamentary representation to Wales and Calais, to defend the privileges of parliament and to yield rather than forfeit its confidence (see CROMWELL, THOMAS). He had little difficulty in securing the Acts of Annates, Appeals and Supremacy which completed the separation irom Rome, or the dissolution of the monasteries, which, by transferring enormous wealth irom the church to the crown, really, in Cecil's opinion, ensured the reformation (*see* ENGLISH HISTORY).

The abolition of the papal jurisdiction removed all obstacles to the divorce irom Catherine and to the legalization oi Henry's marriage with Anne Boleyn (1533). But the recognition of the royal supremacy could only be enforced at the cost of the heads of Sir Thomas More, Bishop Fisher and a number of monks and others among whom the Carthusians signalized themselves by their devotion (1535–36). Anne Boleyn iared no better than the Catholic martyrs; she failed to produce a male heir to the throne, and her conduct afforded a jury of peers. over which her uncle, the duke of Noriolk, presided, sufficient excuse for condemning her to death on a charge of adultery (1536). Henry then married Jane Seymour, who was obnoxious to no one, pave birth to Edward VI, and then died (1537). The dissolution of the monasteries had meanwhile evoked a popular protest in the north, and it was only by skilful and unscrupulous diplomacy that Henry mas enabled to suppress the Pilgrimage of Grace (Feb. 1537). Foreign intervention was avoided through the renewal of mar between Francis and Charles, and the insurgents were hampered by having no rival candidate for the throne and no means of securing the execution of their program.

Nevertheless their rising warned Henry against further doctrinal charges. He had authorized the English Bible and some approach toward Protestant doctrine in the Ten Articles. He had also considered the possibility oi a political and theological alliance with the Lutheran princes of Germany. But in 1538 he definitely rejected their theological terms, while in 1539–40 they rejected his political proposals. By the Act oi Six Articles (1539) he took his stand on Catholic doctrine; and when the Lutherans had rejected his alliance, and Cromxvell's nominee, Anne of Cleves, had proved both distasteful on personal grounds and unnecessary because Charles and Francis were not really projecting a Catholic crusade against England, Anne mas divorced and Cromwell beheaded (1540). The new queen. Catherine Howard, represented the triumph oi the reactionary party under Gardiner and Noriolk; but there was no idea oi returning to the papal obedience, and even Catholic orthodoxy as represented by the Six Articles was enforced only by spasmodic outbursts of persecution.

The secular importance of Henry's activity has been somewhat obscured by his achievements in the sphere of ecclesiastical politics; but no small part of his energies was devoted to the task of expanding the royal authority at the expense of temporal competitors. Feudalism was not yet dead, and in the north and nest there were mediaeval iranchises in which the royal writ and common law hardly ran at all. Wales and its marches were brought into legal union with the rest of England by the statutes oi Wales (1534–36), and after the Pilgrimage of Grace the council of the north was reorganized to bring into subjection the extensive jurisdictions of the northern earls. Neither they nor the lesser chiefs who flourished on the lack of common law and order could be reduced by ordinary methods, and the councils of Wales and of the north mere given summary powers derived irom the Roman civil law similar to those exercised by the Star Chamber at Westminster and the court oi Castle Chamber at Dublin. Ireland had been leit by Wolsey to wallow in its own disorder; but disorder was

anathema to Henry's mind, and in 1534 Sir William Skeffington was sent to apply English methods and artillery to the government of Ireland. Sir Anthony St. Leger continued his policy irom 1540; Henry, instead of being merely lord of Ireland dependent on the pope, was made by an Irish act of parliament king and supreme head of the Irish church. Conciliation was also tried with some success; plantation schemes were rejected in favour of an attempt to Anglicize the Irish; their chieftains were created earls and endowed with monastic lands, and so peaceiul mas Ireland in 1542 that the lord deputy could send Irish kernes and gallow-glasses to fight against the Scots.

Henry, however, seems to have believed as much in the coercion of Scotland as in the conciliation of Ireland. Margaret Tudor's marriage had not reconciled the realms; and as soon as James V became a possible pawn in the hands of Charles V, Henry bethought himself of his old claims to suzerainty over Scotland. At first he was willing to subordinate them to an attempt to win over Scotland to his antipupal policy, and he made various efforts to bring about an interview with his nephew. But James V was held alooi by Cardinal Beaton and by his two French marriages; and France was alarmed by Henry's growing friendliness with Charles V, who was mollified by his cousin Mary's restoration'to her place in the .succession to the throne. In 1542 James madly sent a Scottish army to ruin at Solway Moss; his death a few weeks later left the Scottish throne to his infant daughter Mary Stuart, and Henry set to work to secure her hand ior his son Edward and the recognition of his own suzerainty. A treaty n-as signed with the Scottish estates, but it was torn up a few months later under the influence of Beaton and the queen dowager Mary of Guise, and the earl of Hertford was sent in 1544 to punish this breach of promise by sacking Edinburgh.

Perhaps to prevent French intervention in Scotland Henry joined Charles V in invading France, and captured Boulogne (Sept. 1544). Rut Charles left his ally in the lurch and concluded the peace of Crêpy that same month, and in 1545 Henry had to face alone a French invasion of the Isle oi Wight. This attack proved abortive, and peace between England and France was made in 1546. Charles V's desertion inclined Henrv to listen to the yroyosals or the threatened Lutheran princes, and the last two years of his reign were marked by a renewed tendency to advance in a Protestant direction. Catherine Howard had been brought to the block (1542) on charges in which there was probably a good deal of truth, and her successor, Catherine Parr, was a patroness of the new learning. An act oi 1545 dissolved chantries, colleges and other religious foundations, and in the autumn of 1546 the Spanish ambassador was expecting further antiecclesiastical measures. Gardiner had almost been sent to the Tower, and Norfolk and Surrey were condemned to death, while Cranmer asserted that it was Henry's intention to convert the mass into a communion service. An opportunist to the last, he would readily have sacrificed any theological convictions he may have had in the interests of national uniformity. He died on Jan. 28, 1547, and was buried in St. George's chapel, Windsor.

The atrocity of many of Henry's acts, the novelty and success of his religious policy, the apparent despotism of his methods, or all combined, have made it difficult to estimate calmly the importance of Henry's, work or the conditions which made it possible. Henry's egotism was proiound, and personal motives underlay his public action. While political and ecclesiastical conditions made the breach with Rome possible—and in the view of most Englishmen desirable—Henry VIII was led to adopt the policy by private considerations. He worked ior the good of the state because he thought his interests were bound up with those of the nation; and it was the real coincidence of this private and public point of view that made it possible for so selfish a man to achieve so much for his country. The royal supremacy over the church and the means by which it was eniorced were harsh and violent expedients, but it was of the highest importance that England should be caved irom religious civil war, and it could be saved only by a despotic government. It mas necessary for the iuture development of England that its governmental system should be centralized and unified, that the authority oi the monarchy should be more firmly extended over Wales and the western and northern borders, and that the still existing ieudal franchises should be crushed; and these objects were worth the price paid in the methods oi the Star Chamber and of the councils of the north and of Wales. Henry's work on the navy requires no apology; without it Elizabeth's victory over the Spanish Armada, the liberation of the Netherlands and thy development of English colonies would have been impossible; and "of all others the year 1545 best marks the birth of the English 'naval power" (Sir J. S. Corbett. *Drake and the Tudor Navy,* vol. i, p. 59). His judgmrnt mas more at fault when he sought by violence to bring Scotland into union with England. Rut at least Henry appreciated the necessity of union within the British Isles, and his work in Ireland relaid the foundations of English rule. No less important mas his development of the parliamentary system. Representation was extended to Wales, Cheshire, Berwick and Calais; and parliamentary authority was enhanced, largely that it might deal with the church, until men began to complain oi this new parliamentary infallibility. The privileges of the two houses mere encouraged and expanded, and parliament mas led to exercise ever wider powers. This policy was not attributable to any beliei on Henry's part in parliamentary government but to opportunism, to the circumstance that parliament was willing to do most of the things which Henry desired, while competing authorities, the church and the old nobility, were not. Nevertheless, to the encouragement given by Henry VIII parliament owed not a little of its iuture growth, and to the aid rendered by parliament Henry owed his success.

He has been described as a "despot under the forms of law"; and it is apparently true that he committed no illegal act. His despotism consists not in any attempt to rule unconstitutionally but in the extraordinary degree to which he was able to use constitutional means in the iurtherance of his own personal ends. His industry, his remarkable political insight, his lack oi scruple and his combined strength of will and subtlety of intellect enabled him to utilize all the forces which tended at that time toward strong government throughout western Europe. The monarchy alone seemed capable of guiding the state through the social and political anarchy which threatened all nations in their transition from mediaeval to modern organization. The king was the emblem, the iocus and the bond oi national unity; and to preserve unity men were ready to put up with vagaries which to other ages seem intolerable. Henry could thus behead ministers and divorce wives with comparative impunity, because the individual appeared to be of little importance compared with the state. This impunity provoked a licence which is responsible for the unlovely ieaturcs of Henry's reign and character. The elevation and the isolation of his position iostered a detachment from ordinary virtues and compassion, and he was a remorseless incarnation of Machiavelli's *Prince.* He had an elastic conscience which was always at the beck and call oi his desire, and he cared little ior principle. But he had a passion for efficiency and for the greatness of England and himself. His mind, in spite of its clinging to the outward forms of the old faith, was intensely secular, and he was as devoid of a moral sense as he was of a genuine religious temperament. His greatness consists in his practical aptitude, in his political perception and in the seli-restraint which enabled him to confine within limits tolerable to his people an insatiable appetite ior power.

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Of the numerous paintings of Henry none is by Holbein, who, however, executed the striking chalk drawing of Henry's head, now at Lugano, and the famous but decaying cartoon at Chatsworth. The well-known three-quarter length at Windsor usually attributed to Holbein is by an inferior artist. Several good portraits are reproduced in the 1902 edition of A. F. Pollard's *Henry VIII.* Henry composed numerous state papers still extant; his only book was his *Assertio septem sacramentorum contra M. Lutherum* (1521), a copy of which, signed by Henry himself, is at Windsor. His songs and ballads were edited (London, 1912) by Lady M. Trefusis for the Roxburghe club. (A. F. Po.; R. B. WM.)

HENRY I (1008–1060), king of France, son of King Robert and his queen, Constance of Aquitaine, and grandson of Hugh Capet, succeeded his father in 1031, although in 1027 he had already been anointed king at Reims and associated in the government with his father. His mother formed a powerful league with her younger son. Robert, against him, and he was forced to take refuge with Robert II, duke of Normandy. In the civil war which resulted. Henry finally defeated his opponents in 1032. Constance died in 1034, and Robert was given the duchy of Burgundy, thus founding that great collateral line which was to rival the kings of France for three centuries. From 1033 to 1043 Henry was involved in a life and death contest with those nobles whose territory adioined the roval domains. especiallv with the house of Blois and the counts of Champagne. Henry's success was largely attributable to the help given him by Robert of Normandy, but upon the accession of Robert's son William (the Conqueror), Normandy itself became the chief danger. From 1047 until his death Henry was almost constantly at war with William. Henry's reign marks the height of feudalism. Normandy, Champagne and Burgundy being only nominally subject to royal authority. Yet Henry maintained the independence of the clergy against the pope Leo IX, and claimed Lorraine from the emperor Henry III. In 1059 he had his eldest son Philip crowned as joint king, and died the following year. Henry married in 1043 Maud, niece of the emperor Henry III, who died childless in 1044. In 1051 Henry married the Rus-

sian princess Anne, daughter of Yaroslav I., grand duke of Kiev. She bore him two sons, Philip, his successor, and Hugh, count of Vermandois.

See the *Historiae* of Rudolph Glaber, edited by M. Prou (Paris, 1886); F. Sochnée, *Catalogue des actes d'Henri Ier* (1907); de Caiz de Saint Aymour, *Anne de Russie, reine de France* (1896); *E.* Lavisse, *Histoire de France,* tome ii. (1901), and the article on Henry I. in *La Grande Encyclopédie* by *M.* Prou.

HENRY II. (1519–1559), king of France, the second son of Francis I. and Claude, succeeded to the throne in 1547. When only seven years old he was sent by his father, with his brother the dauphin Francis, as a hostage to Spain in 1526, whence they returned after the conclusion of the peace of Cambrai in 1530. Henry was perhaps young to have carried away abiding impressions, yet throughout his life his character, dress and bearing were far more Spanish than French. In 1533 his father married him to Catherine de' Medici, and he became dauphin by the death of his elder brother Francis in 1536. From that time he was under the domination of Catherine, of Diane de Poitiers, and also of Duke Anne de Montmorency, his mentor. His younger brother, Charles of Orleans, was his father's favourite; and the rivalry of Diane and the duchesse d'fitampes widened the breach between the king and the dauphin. Henry supported the constable Montmorency when he was disgraced in 1541; protested against the treaty of Crépy in 1544; and at the end of the reign held himself completely aloof. After his accession in 1547 Diane, Montmorency and the Guises were all-powerful, and dismissed Cardinal de Tournon, de Longueval, the duchesse d'fitampes and all the late king's friends and officials. At that time Henry was twenty-eight years old. He was a robust man, and inherited his father's love of violent exercise; but his character was weak and his intelligence mediocre, and he had none of the superficial and brilliant gifts of Francis I. He was cold, haughty, melancholy and dull. He was a bigoted Catholic, and showed to the Protestants even less mercy than his father. During his reign the royal authority became more severe and more absolute than ever. Resistance to the financial extortions of the government was cruelly chastised, and the "Chambre Ardente" was instituted against the Reformers. Abroad, the struggle was continued against Charles V. and Philip II., which ended in the much-discussed treaty of Cateau-Cambrésis. Some weeks afterwards high feast was held on the occasion of the double marriage of the king's daughter Elizabeth with the king of Spain, and of his sister Margaret with the duke of Savoy. On June 30, 1559, when tilting with the count of Montgomery, Henry was wounded in the temple by a lance; he died on July 10. By his wife Catherine de' Medici he had seven children living: Elizabeth, queen of Spain; Claude, duchess of Lorraine; Francis (II.), Charles (IX.) and Henry (III.), all of whom came to the throne; Marguerite, who became queen of Navarre in 1572; and Francis, duke of Alençon and afterwards of Anjou, who died in 1584.

The bulk of the documents for the reign of Henry II. are unpublished, and are in the Bibliothèque Nationale, Paris. Of the published documents, *see* especially the correspondence of Catherine de' Medici (ed. by de la Ferrière, Paris, 1880), of Diane de Poitiers (ed. by Guiffrey, Paris, 1866), of Antoine de Bourbon and Jeanne d'Albret (ed. by Rochambeau, Paris, 1877), of Odet de Selve, ambassador to England (ed. by Lefevre-Pontalis, Paris, 1888) and of Dominique du Gabre, ambassador to Venice (ed. by Vitalis, Paris, 1903); Ribier, *Lettres et mémoires d'estat* (Paris, 1666); *Relations des ambassadeurs vénitiens,* etc. *See* also H. Lemonnier, "La France sous Henri II." (Paris, 1904), in the *Histoire de France,* by *E.* Lavisse, which contains a fuller bibliography of the subject.

HENRY III. (1551–1589), king of France, third son of Henry II. and Catherine de' Medici, was born at Fontainebleau on Sept. 19, 1551. As duke of Anjou, he won, under the direction of Tavannes, the battles of Jarnac and Moncontour over Condé and Coligny in 1569, and he assisted his mother in organizing the massacre (1572) of St. Bartholomew. He was Catherine's favourite son, and she now (1573) secured his election to the throne of Poland. But next year the death of his brother, Charles IX., brought him back post-haste to assume the crown of France. His accession meant a fresh lease of power for Catherine, from whose authority he never emancipated himself. His indolence and his vicious and corrupt life scandalized both the Huguenots and the Catholic party. For the civil conflicts of his reign, see **FRANCE: *History.***

A revolt (May 12, 1588) in Paris, the "day of the barricades," forced Henry to take refuge at Chartres. He then secured the murder of Henry of Guise and his brother, the cardinal, at Blois (Dec. 23, 1588). Early in January, Catherine de' Medici died. "Now I am king," cried Henry. But Paris was in the hands of the partisans of Guise, many of the provinces were in revolt, and Henry was driven into alliance with Henry of Navarre. Together they were investing Paris, when the Leaguers avenged the Guise murders through the instrumentality of a fanatic monk, Jacques Clément, who stabbed the king at an audience on Aug. 1, 1589. Henry died a few hours later, naming Henry of Navarre as his successor. By his wife, Louise de Mercoeur, he left no children, and with him the male line of the house of Valois became extinct.

See Correspondence of Catherine de' Medici and of Henry IV. (in the *Collection de documents inddits),* and of the Venetian ambassadors, etc.; P. Matthieu, *Histoire de France,* vol. i. (1631); Scipion Dupleix, *Histoire* de *Henri III.* (1633); Robiquet, *Paris et la Ligue* (1886); and J. H. Mariéjol, "La Réforme et la Ligue," in the *Histoire de France,* by E. Lavisse (Paris, 1904), which contains a more complete bibliography.

HENRY IV. (1553–1610), king of France, the son of Antoine de Bourbon, duke of Vendôme, head of the younger branch of the Bourbons, descendant of Robert of Clermont, sixth son of St. Louis, and of Jeanne d'Albret, queen of Navarre, was born at Pau (Basses Pyrénées) on Dec. 14, 1553. He was educated as a Protestant, and in 1557 was sent to the court at Amiens. In 1561 he entered the Collège de Navarre at Paris, returning in 1565 to Béarn. During the third war of religion in France (1568–1570) he was taken by his mother to Gaspard de Coligny, leader of the Protestant forces since the death of Louis I., prince of Condé, at Jarnac, and distinguished himself at the battle of Arnay-le-Duc in Burgundy in 1569. On his mother's death in 1572 Henry became king of Navarre and married Margaret de Valois (*q.v.*) sister of Charles IX. of France. He escaped the massacre of St. Bartholomew by a feigned abjuration. On Feb. 2, 1576, after several vain attempts, he escaped from the court, joined the combined forces of Protestants and of opponents of the king, and obtained by the treaty of Beaulieu (1576) the government of Guienne. In 1577 he secured the treaty of Bergerac, which foreshadowed the edict of Nantes. As a result of quarrels with his wife, and the unwelcome intervention of Henry III., he undertook the seventh war of religion, seized Cahors on May 5, 1580, and signed the treaty of Fleix on Nov. 26, 1580. The death (1584) of the duke of Anjou, brother of King Henry III., made Henry of Navarre heir presumptive to the throne of France. Excluded from it by the treaty of Nemours (1585) he began the "war of the three Henrys" by a campaign in Guienne (1586) and defeated Anne, duc de Joyeuse, at Coutras on Oct. 20, 1587. Then Henry III., driven from Paris by the League on account of his murder of the duke of Guise at Blois (1588), sought the aid of the king of Navarre to win back his capital, recognizing him as his heir. The assassination of Henry III. on Aug. 1, 1589 left Henry king of France; but he had to struggle for ten more years against the League and against Spain before he won his kingdom. The main events in that long struggle were the victory of Arques (1589) over Charles, duke of Mayenne; of Ivry (1590); the siege of Paris (1590); of Rouen (1592); the meeting of the Estates of the League (1593), which the *Satire Ménippée* turned to ridicule; and finally the conversion of Henry IV. to Catholicism in July 1593—an act of political wisdom, since it brought about the collapse of all opposition. Paris gave in to him on March 22, 1594 and province by province yielded to arms or negotiations; while the victory of Fontaine-Française (1595) and the capture of Amiens forced Philip II. of Spain to sign the peace of Vervins on May 2, 1598. On April 13 of that year Henry IV. had promulgated the Edict of Nantes.

Then Henry set to work to pacify and restore prosperity to his kingdom. Convinced by the experience of the wars that France needed an energetic central power, he pushed at times his royal prerogatives to excess, raising taxes in spite of the Estates, interfering in the administration of the towns, reforming their consti-

tutions, and holding himself free to reject the advice of the notables if he consulted them. Aided by his faithful friend Maximilien de Béthune, baron de Rosny and duc de Sully (*q.v.*), he reformed the finances, repressed abuses, suppressed useless offices, extinguished the formidable debt and realized a reserve of eighteen millions. To alleviate the distress of the people he undertook to develop both agriculture and industry: planting colonies of Dutch and Flemish settlers to drain the marshes of Saintonge, issuing prohibitive measures against the importation of foreign goods (1597), introducing the silk industry, encouraging the manufacture of cloth, of glass-ware, of tapestries (Gobelins), and under the direction of Sully—named *grand-voyer de France*—improving and increasing the routes for commerce. A complete system of canals was planned, that of Briare partly dug. New capitulations were concluded with the sultan Ahmed I. (1604) and treaties of commerce with England (1606), with Spain and Holland. Attempts were made in 1604 and 1608 to colonize Canada (see CHAMPLAIN, SAMUEL DE). The army was reorganized, its pay raised and assured, a school of cadets formed to supply it with officers, artillery constituted and strongholds on the frontier fortified. While lacking the artistic tastes of the Valois, Henry beautified Paris, building the great gallery of the Louvre, finishing the Tuileries, building the Pont Neuf, the Hôtel-de-Ville and the Place Royale.

The foreign policy of Henry IV. was directed against the Habsburgs. Without declaring war, he did all possible harm to them by alliances and diplomacy. In Italy he gained the grand duke of Tuscany—marrying his niece Marie de' Medici in 1600—the duke of Mantua, the republic of Venice and Pope Paul V. The duke of Savoy, who had held back from the treaty of Vervins in 1598, signed the treaty of Lyons in 1601; in exchange for the marquisate of Saluzzo, France acquired Bresse, Bugey, Valromey and the bailliage of Gex. In the Low Countries, Henry sent subsidies to the Dutch in their struggle against Spain. He concluded alliances with the Protestant princes in Germany, with the duke of Lorraine, the Swiss cantons (treaty of Soleure, 1602) and with Sweden. In 1609, the opening of the question of the succession of John William the Good, duke of Cleves, of Jülich and of Berg, led Henry, in spite of his own hesitations and those of his German allies, to declare war on the emperor Rudolph II. But he was assassinated by Ravaillac (*q.v.*) on May 14, 1610, upon the eve of his great enterprise, leaving his policy to be followed up later by Richelieu. Sully in his *Économies royales* attributes to his master the "great design" of constituting, after having defeated Austria, a vast European confederation of fifteen states—a "Christian Republic"—directed by a general council of sixty deputies reappointed every three years. But this "design" has been attributed rather to the imagination of Sully himself than to the more practical policy of the king.

No figure in France has been more popular than that of "Henry the Great." He was affable, quick-witted, good-hearted and generally indulgent. His courage amounted almost to recklessness. He was a better soldier than strategist. Although at bottom authoritative he surrounded himself with admirable advisers (Sully, Sillery, Villeroy, Jeannin) and profited from their co-operation. His numerous love affairs (of which the most famous are those with Gabrielle d'Estrées and Henriette d'Entragues), did not affect his policy, in which he was guided only by an exalted ideal of his royal office, and by a certain sympathy—perhaps exaggerated in popular tradition—for the common people.

Henry IV. had no children by his first wife, Margaret of Valois. By Marie de' Medici he had Louis, later Louis XIII.; Gaston, duke of Orleans; Elizabeth, who married Philip IV. of Spain; Christine, duchess of Savoy; and Henrietta, wife of Charles I. of England. Among his bastards the most famous were the children of Gabrielle d'Estrées—Caesar, duke of Vendôme, Alexander of Vendôme, and Catherine Henriette, duchess of Elbeuf. Several portraits of Henry are preserved at Paris, in the Bibliothèque Nationale (cf. Bouchot, Portraits au crayon, p. 189), at the Louvre (by Probus, bust by Barthélemy Prieur) at Versailles, Geneva (Henry at the age of fifteen), at Hampton Court, at Munich and at Florence.

For the sources of the history of his reign see the *Recueil des lettres missives de Henri IV.*, published from 1839 to 1853 by B. de Xivrey, in the Collection de documents *inédits relatifs à* l'histoire de France, and the various researches of Galitzin, Bautiot, Halphen, Dussieux and others. Besides their historic interest, the letters written personally by Henry, whether love notes or letters of state, reveal a charming writer. Mention should be made of Auguste Poirson's *Histoire du règne* de Henri *IV.* (2nd ed., 4 vols., Paris, 1862–67) and of J. H. Mariéjol's volume (vi.) in the *Histoire de France*, edited by Ernest Lavisse (Paris, 1905), where main sources and literature are given with each chapter. A Revue Henri IV. has been founded at Paris (1905). Finally, a complete survey of the sources for the period 1494–1610 is given by Henri Hauser in vol. vii. of Sources de l'histoire de France (Paris, 1906), in continuation of A. Molinier's collection of the sources for French history during the middle ages.

HENRY I. (876?–936), surnamed the "Fowler," German king, son of Otto the Illustrious, duke of Saxony, shared in early life in various campaigns for the defence of Saxony. He married Hatburg, a daughter of Irwin, count of Merseburg, but as she had taken the veil on the death of a former husband this union was declared illegal by the church, and in 909 he married Matilda, daughter of a Saxon count named Thiederich, and a reputed descendant of the hero Widukind. On his father's death in 912 he became duke of Saxony, which he defended against the Slavs (see SAXONY). In 918 the German king Conrad I. advised the nobles to make the Saxon duke his successor. The Franks and the Saxons met at Fritzlar in May 919 and chose Henry as German king. The new king refused to allow his election to be sanctioned by the church. His authority, save in Saxony, was merely nominal; but he secured a recognition of his sovereignty from the Bavarians and the Swabians. In 921 Charles III. of France recognized Henry as king of the East Franks, and when in 923 the French king was taken prisoner by Herbert, count of Vermandois, Lorraine came under Henry's authority, and Giselbert, who married his daughter Gerberga, was recognized as duke. Henry reduced various Slavonic tribes in the east to subjection, took Brennibor, the modern Brandenburg, from the Hevelli, and secured both banks of the Elbe for Saxony. In 923 he had bought a truce for ten years with the Hungarians, by a promise of tribute, and on its expiration he gained two great victories over them in 933 at Jechaburg and Riade. The Danes were defeated, and territory as far as the Eider secured for Germany; and the king sought further to extend his influence by entering into relations with the kings of England, France and Burgundy. He died at Memleben on July 2, 936. By his first wife, Hatburg, he left a son, Thankmar, who was excluded from the succession as illegitimate; and by Matilda he left three sons, the eldest of whom, Otto (afterwards the emperor Otto the Great), succeeded him, and two daughters. Henry undertook only such enterprises as he was able to carry through. Laying more stress on his position as duke of Saxony than king of Germany, he conferred great benefits on his duchy. The founder of her town life and the creator of her army, he ruled in harmony with her nobles and secured her frontiers from attack.

See Widukind of Corvei, "Res gestae Saxonicae," ed. G. Waitz in the Monumenta Germaniae historica. *Scriptores*, Band iii. (Hanover and Berlin, 1826 *seq.*); "Die Urkunde des deutschen Konigs Heinrichs I.," edited by T. von Sickel in the Monumenta *Germaniae* historica. *Diplomata* (Hanover, 1879); W. von Giesebrecht, *Geschichte* der *deutschen Kaiserzeit*, Bände i., ii. (Leipzig, 1881); G. Waitz, *Jahrbücher* des deutschen Reichs unter *König Heinrich* I. (Leipzig, 1885); and F. Löher, Die deutsche Politik *König Heinrich* I. (Munich, 1857).

HENRY VII. (1211–1242), German king, son of the emperor Frederick II. and his first wife Constance, daughter of Alphonso II., king of Aragon, was crowned king of Sicily in 1212 and made duke of Swabia in 1216. Pope Innocent III. had favoured his coronation as king of Sicily in the hope that the union of Sicily with the Empire would be dissolved, and had obtained a promise from Frederick to this effect. Nevertheless Henry was chosen king of the Romans, or German king, at Frankfort in April 1220, and crowned at Aix-la-Chapelle on May 8, 1222 by his guardian Engelbert, archbishop of Cologne. He appears to have spent most of his youth in Germany, and in 1225 was married to Margaret (d. 1267), daughter of Leopold VI., duke of Austria. The murder of Engelbert in 1225 was followed by an increase of disorder in Germany, and in 1227 Henry took part in a quarrel which had

arisen on the death of Henry V., the childless count palatine of the Rhine. Relations between Frederick and his son began to be strained. The emperor had favoured the Austrian marriage because Margaret's brother, Duke Frederick II., was childless; but Henry took up a hostile attitude towards his brother-in-law and wished to put away his wife and marry Agnes, daughter of Wenceslaus I., king of Bohemia. In 1231 Henry refused to appear at the diet at Ravenna, and opposed the privileges granted by Frederick to the princes at Worms. In 1232 he submitted to his father, but in 1233 he issued a manifesto to the princes, and in 1234 raised the standard of revolt at Boppard. He succeeded in forming an alliance with the Lombards in December 1234, but his few supporters fell away when the emperor reached Germany in 1235, and, after a vain attack on Worms, Henry submitted and was kept for some time as a prisoner in Germany. His formal deposition as German king was not considered necessary, as he had broken the oath taken in 1232. He was removed to San Felice in Apulia, and afterwards to Martirano in Calabria, where he died, probably by his own hand, on Feb. 12, 1242. His two sons, Frederick and Henry, died in Italy about 1251.

See J. Rohden, *Der Sturz Heinrichs VII.* (Göttingen, 1883); F. W. Schirrmacher, *Die letzten Hohenstaufen* (Gottingen, 1871); E. Winkelmann, *Kaiser Friedrich II.* (Leipzig, 1889); P. Reinhold, *Die Empörung Konig Heinrichs gegen seinen Vater* (1911).

HENRY I (c. 1210–1274), surnamed THE FAT, king of Navarre and count (as Henry III) of Champagne, was the youngest son of Theobald I of Navarre by Margaret of Foix and succeeded his eldest brother, Theobald II, as king of Navarre and count of Champagne in Dec. 1270. His proclamation at Pamplona, however, did not take place till March of the following year, and his coronation was delayed until May 1273. At his death in 1274 the male line of the counts of Champagne and kings of Navarre became extinct. He married in 1269 Blanche, daughter of Robert. count of Artois, and niece of King Louis IX, and was succeeded by his only legitimate child, Joan, by whose marriage to Philip the Fair (afterward king of France) in 1284 the crown of Navarre was united to the French.

HENRY II. (1503–1555), titular king of Navarre, was the eldest son of Jean d'Albret (d. 1516) by his wife Catherine de Foix, sister and heiress of Francis Phoebus, king of Navarre, and was born at Sanquesa in April 1503. When Catherine died in exile in 1517 Henry succeeded her in her claim on Navarre, which was disputed by Ferdinand I. king of Spain; and under the protection of Francis I. of France he assumed the title of king. After ineffectual conferences at Noyon in 1516 and at Montpellier in 1518, an active effort was made in 1521 to establish him in the *de facto* sovereignty; but the French troops which had seized the country were ultimately expelled by the Spaniards. In 1525 Henry was taken prisoner at the battle of Pavia, but he contrived to escape, and in 1526 married Margaret, the sister of Francis I. and widow of Charles, duke of Alençon. By her he was the father of Jeanne d'Albret (d. 1572), and was consequently the grandfather of Henry IV. of France. Henry, who had some sympathy with the Huguenots, died at Pau on May 25, 1555.

HENRY I. (1512–1580), king of Portugal, third son of Emanuel the Fortunate, was born in Lisbon on Jan. 31, 1512. In 1532 he was made archbishop of Braga. In 1542 he received the cardinal's hat, and in 1578 when he was called to succeed his grandnephew Sebastian on the throne, he held the archbishoprics of Lisbon and Coimbra as well as that of Braga, in addition to the wealthy abbacy of Alcobazar. As a sovereign he proved weak, timid and incapable. On his death in 1580, the male line of the royal family which traced its descent from Henry, first count of Portugal (c. 1100), came to an end

HENRY, PRINCE OF BATTENBERG: *see* BATTENBERG and MOUNTBATTEN.

HENRY II. (1489–1568), duke of Brunswick-Wolfenbüttel, son of Duke Henry I., was born on Nov. 10, 1489. He began to reign in 1514, but his brother William objected to the indivisibility of the duchy which had been decreed by the elder Henry, and it was only in 1535, after an imprisonment of 11 years, that William recognized his brother's title. In 1525 he assisted Philip, landgrave of Hesse, to crush the rising of the peasants in north Germany, and in 1528 took help to Charles V. in Italy, where he narrowly escaped capture. He joined the Catholic princes in concerting measures for opposing the Reformation. Henry was attacked by Luther with unmeasured violence in a writing *Wider Hanns Worst*. The duke soon came into collision with the Protestant towns of Goslar and Brunswick, against the former of which a sentence of restitution had been pronounced by the imperial court of justice (*Reichskammergericht*). Charles V. had suspended the execution of this sentence, a proceeding which Henry declared was *ultra vires*. The league of Schmalkalden, led by Philip of Hesse and John Frederick, elector of Saxony, took up arms to defend the towns; and in 1542 Brunswick was overrun and the duke forced to flee. In September 1545 he tried to regain his duchy, but was taken prisoner by Philip, and only released in April 1547. After his return to Brunswick he quarrelled with his subjects on political and religious questions, while his duchy was ravaged by Albert Alcibiades, prince of Bayreuth. Henry joined the league of princes against Albert, and after the death of Maurice, elector of Saxony, at Sievershausen in July 1553, he commanded the allied troops and defeated Albert in two engagements. In his later years he was reconciled with his Protestant subjects. He died at Wolfenbüttel on June 11, 1568. The duke was twice married, firstly in 1515 to Maria (d. 1541), sister of Ulrich of Wiirttemberg, and secondly in 1556 to Sophia (d. 1575) daughter of Sigismund I., king of Poland. He had a romantic attachment to Eva von Trott, whom he represented as dead and afterwards kept concealed at Staufenburg. He was succeeded by his only surviving son, Julius (1528–1589).

See F. Koldewey, *Heinz von Wolfenbüttel* (Halle, 1883); and F. Bruns, *Die Vertreibung Herzog Heinrichs von Braunschweig durch den Schmalkaldischen Bund* (Marburg, 1889).

HENRY (1108?–1139), surnamed the "Proud," duke of Saxony and Bavaria, second son of Henry the Black, duke of Bavaria, and Wulfhild, daughter of Magnus Billung, duke of Saxony, was a member of the Welf family. His father and mother both died in 1126, and as his elder brother Conrad had entered the church, Henry became duke of Bavaria and shared the family possessions in Saxony, Bavaria and Swabia with his younger brother, Welf. In 1127 he married Gertrude, the only child of the German king, Lothair the Saxon, and at once took part in the warfare between the king and the Hohenstaufen brothers, Frederick II., duke of Swabia, and Conrad, afterwards the German king Conrad III. Simultaneously he suppressed a rising in Bavaria, led by Frederick, count of Bogen, during which both duke and Count sought to establish their own candidates in the bishopric of Regensburg. Frederick submitted in 1133, and two years later the Hohenstaufen brothers made their peace with Lothair. In 1136 Henry accompanied Lothair to Italy, and taking command of one division of the German army marched into southern Italy, devastating the land as he went. It was probably about this time that he was invested with the margraviate of Tuscany and the lands of Matilda, the late margravine. After the Italian campaign Henry was appointed by the emperor as his successor in the dukedom of Saxony. When Lothair died in 1137 Henry's wealth and position made him a formidable candidate for the German throne; but his ambition aroused the jealousy of the princes, and prevented his election. The new king, Conrad III., demanded the imperial *insignia* which were in Henry's possession, and the duke in return asked for his investiture with the Saxon duchy. Conrad refused to assent on the pretext that it was unlawful for two duchies to be in one hand. Attempts at a settlement failed, and in July 1138 the duke was placed under the ban, and Saxony was given to Albert the Bear, afterwards margrave of Brandenburg. War broke out in Saxony and Bavaria, but was cut short by Henry's sudden death, whether by poison or not cannot be ascertained, at Quedlinburg on Oct. 20, 1139. Henry was a man of great ability, and his early death alone prevented him from playing an important part in German history.

See S. Riezler, *Geschichte Bayerns*, Band i. (Gotha, 1878); W. Bernhardi, *Lothar von Supplinburg* (Leipzig, 1879); W. von Giesebrecht, *Geschichte der deutschen Kaiserzeit*, Band iv. (Brunswick, 1877); and A. L. Poole in *Cambridge Mediaeval History*, vol. v.

HENRY (1129–1195), surnamed the "Lion," duke of Saxony and Bavaria, only son of Henry the Proud, duke of Saxony and Bavaria, and Gertrude, daughter of the emperor Lothair the Saxon, was born at Ravensburg, and was a member of the family of Welf. In May 1142 Henry was invested as duke of Saxony at Frankfort, and Bavaria was given to Henry II., Jasomirgott, margrave of Austria, who married his mother. In 1147 Henry married Clementia, daughter of Conrad, duke of Zahringen (d. 1152). He made an expedition against the Abotrites, or Obotrites, in 1147, and won much land beyond the Elbe, in which were re-established the bishoprics of Mecklenburg, Oldenburg and Ratzeburg. Henry maintained, against Hartwig archbishop of Bremen, his right to invest these bishops, a privilege afterwards confirmed by the emperor Frederick I. In 1147 he made a formal claim on the duchy of Bavaria, and in 1151 made an unsuccessful attempt to take possession. The situation was changed in his favour when Frederick I. succeeded Conrad as German king in 1152. In 1154 he recognized the claim of Henry, who accompanied him on his first Italian campaign and suppressed a rising at Rome. Henry's formal investiture as duke of Bavaria took place in 1156. Two years later, Adolph II., count of Holstein, was compelled to cede Liibeck to him; campaigns in 1163 and 1164 broke the resistance of the Abotrites; and Saxon garrisons were established in the conquered lands. He had also helped Frederick I. in his expedition of 1157 against the Poles, and in 1159 had gone to his assistance in Italy.

In 1166 a coalition was formed against Henry at Merseburg under the leadership of Albert the Bear, margrave of Brandenburg. and Archbishop Hartwig. After indecisive fighting Frederick intervened, and made peace in 1168. Having obtained a divorce from his first wife in 1162, Henry was married in 1168 to Matilda (1156–89), daughter of Henry II. of England, and mas soon afterwards sent by the emperor Frederick I. on an embassy to England and France. A war with Valdemar of Denmark, caused by a quarrel over the booty from the conquest of Riigen, lasted until 1171, when, in pursuance of a peace treaty Henry's daughter, Gertrude, married the Danish prince, Canute. During his pilgrimage to Jerusalem in 1172, Henry was received with great respect by the eastern emperor Manuel Comnenus at Constantinople.

A variety of reasons were leading to a rupture between Frederick and Henry, who showed little inclination to sacrifice his interests in Germany to help the imperial cause in Italy. He was displeased when his uncle, Welf, bequeathed his Italian and Swabian lands to the emperor, and the crisis came after Frederick's check before Alessandria in 1175. Henry declined to help the emperor in 1176, and though the peace of Venice provided for the restoration of Ulalrich to his see of Halberstadt, Henry refused to give up the lands which he had seized belonging to the bishopric. This provoked a war in which Ulalrich was joined by Philip, archbishop of Cologne. The dispute was to be settled at Worms, but Henry's failure to appear to answer the charges preferred against him, led to his being placed under the imperial ban at Wiirzburg in 1180, and deprived of his lands.

Meanwhile the war with Ulalrich continued, but after his victory at Weissensee Henry's cause began to decline. When Frederick took the field in 1181, Henry sought peace. He was granted the counties of Liineburg and Brunswick, but was banished under oath not to return without the emperor's permission. He went to Normandy, and afterwards to England, returning to Germany with Frederick's permission in 1185. He was soon regarded once more as a menace to peace, and of the three alternatives offered by the emperor in 1188 he rejected the idea of making a formal renunciation of his claim, or of participating in the crusade, and chose exile, going again to England in 1189. A few months later, he returned to Saxony, asserting that his lands had not been defended according to the emperor's promise. He found many allies, won Lubeck, and soon almost the whole of Saxony was in his power. King Henry VI. took the field against him, and in 1190 a peace was arranged at Fulda, by which he retained Brunswick and Liineburg, received half the revenues of Liibeck. and gave two of his sons as hostages. In 1193 he revolted against Henry VI., but the captivity of his brother-in-law Richard I., king of England, led to a reconciliation. Henry passed his later years in intellectual and artistic pursuits at Brunswick, where he died on Aug. 6, 1195. One of his sons was Otto, afterwards the emperor Otto IV., and another was Henry (d. 1227) count palatine of the Rhine.

Henry won his surname of "Lion" by his intrepidity. His influence on the fortunes of Saxony and northern Germany was considerable. He colonized the whole of northern Germany down to the Elbe; he founded numerous towns in Germany and sought to spread Christianity by introducing the Cistercians, founding bishoprics, and building churches and monasteries. Lane Poole, in the *Cambridge Medieval Hzstory* says of him, "He ruled an *imperium in imperio,* but he did not abuse his privileged position; his rule for the 20 years which followed the settlement of Ratisbon was beneficial to Germany, if it was detrimental to the interests of individual princes. Henry threw himself with all his energy into the work of German expansion, the promotion of commercial enterprise, the development of municipal life."

The authorities for the life of Henry the Lion are those dealing with the reign of the emperor Frederick I., and the early years of his son King Henry VI. The chief modern works are G. Prutz, *Heinrich der Löwe* (Leipzig, 1866); M. Philippson, *Geschzchte Heinrichs des Löwen* (Leipzig, 1867, 2nd ed. 1918); and L. Weiland, *Das sächsische Herzogthum unter Lothar und Heinrich dem Löwen* (Greifswald 1866); F. Guterbock, *Der Prozess Heinrichs des Lowen* (1909); A. L. Poole, *Henry the Lzon* (1912) and *E.* Gronen, *Die Machtpolitik H. des Löwen* (1919).

HENRY, JOSEPH (1797–1878), U.S. physicist and scientific administrator, who had a great influence on the development of science in the United States, was born in Albany, N.Y., on Dec. 17, 1797, of Scottish ancestry. Henry attended a country district school to the age of 13; showing little interest in study, he was apprenticed to a watchmaker.

When Henry was 16, a popular book on natural history awakened his ambition, so that he resumed his education, attending Albany academy, teaching in country schools and tutoring to pay his way. Completing the prescribed course, he continued his studies in chemistry, anatomy and physiology with a view to practising medicine. An unexpected appointment in 1825 to survey a route for a state road from the Hudson river to Lake Erie changed his goal to engineering, and it was with some reluctance that in 1826 he accepted an appointment to teach mathematics and natural philosophy in the Albany academy.

But his decision proved a most happy one. Beginning experiments in electromagnetism, Henry was the first to insulate wire for the magnetic coil; he invented the "spool" or "bobbin" winding; he discovered the necessary law of proportion between the electromotive force in the battery and the resistance of the magnet. He thus worked out for the first time the differing functions of two entirely different kinds of electromagnets; the one surrounded by numerous coils of no great length revolutionized the feeble electromagnet of William Sturgeon. The other surrounded by a continuous coil of great length made possible for the first time the transmission of a current over a great distance with little loss. Every electrical dynamo or motor uses the electromagnet in practically the form in which it was left by Henry in 1829. The principles involved in the "intensity" magnet constitute the indispensable basis of every form of the electromagnetic telegraph since invented, and Henry himself invented and demonstrated what appears to have been the first practical electromagnetic telegraph in 1830–31 at Albany. It consisted of a mile of copper bell wire interposed in a circuit between a small Cruickshanks battery and an "intensity" magnet of continuous fine coil. A permanent magnet pivoted to swing horizontally like the compass needle, was arranged so that one end remained in contact with a leg of the soft iron core, while the other end was near an office bell. At each excitation of the electromagnet the suspended magnet was repelled from one leg and attracted by the other, so that its free end tapped the bell. This was the first instance of magnetizing iron at a great distance, or of a suitable combination of magnet and battery being so

arranged as to be capable of such action. Reporting his achievements in *Silliman's Journal* in **1831** Henry pointed out that the way was now clear for the invention of the commercial electromagnetic telegraph. In **1835,** after his transfer to the College of New Jersey (later Princeton university), he added a step in the invention of the "relay" by which a relatively feeble current operated an electromagnet which in turn controlled the local circuit of a more powerful magnet. This invention is extensively used in the field of electrical control, known as distant control. It was also in **1835** that Henry first used the earth as a return conductor. But in **1829** he had devised and constructed the first electromagnetic motor, an oscillating machine with automatic pole changer, publishing a description of it in **1831.** This machine was the forerunner of all electric motors. In the same period he made two other fundamental discoveries. The honour for the discovery of self-induction which he announced in **1832** has been universally conceded to him, and it was chiefly in recognition of this achievement that the International Congress of Electricians in Chicago, Ill., in **1893** gave his name to the standard unit of inductive resistance. The other discovery, that of electromagnetic induction, was made independently and at the same period by both Henry and Michael Faraday, and since the latter published first, the credit is rightfully given to him.

Professorship at Princeton. — After Henry's appointment to fill the chair of natural philosophy at Princeton in **1832** he taught physics and mathematics and lectured in chemistry, mineralogy, geology; later adding astronomy and architecture. Continuing his physical researches, he discovered that a current of low potential could induce a current of high potential by a suitable arrangement of the coils. He elucidated the laws upon which the electrical transformer of modern times is constructed. He found, also, that a second induced current could induce a third; the third a fourth; and so on, indefinitely; and that these currents could be induced at a distance. Some of his experiments in induction involved the transmission of electric force without wires through the floors and walls of buildings, and in one case he magnetized a needle by the transmission from a lightning flash **8** mi. away. This appears to be the earliest record of the action of ether waves of the type employed in radio telegraphy and telephony in modern times. The discovery of the oscillatory character of the electrical discharge came in **1842.** Outside the field of electricity, Henry showed that liquids and solids generally have the same amount of cohesion. He showed, by means of a thermogalvanometer, that sun spots radiate less heat than the general solar surface. He invented a new method for determining the velocity of projectiles. And in **1844** he presented a theoretical paper foreshadowing the principle of the conservation of energy.

Secretaryship at Smithsonian Institution. — In Dec. **1846** the second great period of Henry's life began with his election as first secretary of the newly formed Smithsonian institution. The plan of organization which he drew up for it was so far beyond the average intelligence of his day as to meet with bitter opposition. But scientific men turned to the institution as a rallying and guiding centre. Under his leadership branches of science hitherto unworked in the United States were taken up; activity in all fields was tremendously stirred; scientific exploration was made a beneficiary of the military exploration and commercial exploitation of the west; the government's support of scientific activity was enlisted and given direction.

Creation of **U.S.** Weather Service. — While at Albany he had devoted much attention to meteorology, realizing the need for much more data, and one of his first acts at the Smithsonian was to organize a corps of volunteer observers spread over the continent. He introduced standard instruments from abroad. prepared tables of instructions, and for **30** years maintained the investigations, collecting, reducing and publishing results which now form a considerable portion of the foundation of meteorological science. In this connection he was the first to use the telegraph to transmit weather reports; the first to indicate daily atmospheric conditions on a map; the first to embrace a continent under a single system; the first to make weather forecasts from the data obtained. The success of the Smithsonian meteorological work resulted in the creation of the U.S. weather bureau.

A second main achievement while at the Smithsonian was to supply American science with the first great agency for free publication of results. Of almost equal importance was the system Henry inaugurated of distribution of these publications to libraries and scientific bodies throughout the world. This soon developed into the system of international exchanges by which scientific and later government publications were exchanged between the rest of the world and the United States through the Smithsonian.

Other Scientific Work. — In **1852** Henry became a member of the lighthouse board, serving as chairman from **1871** until his death. This gave him the incentive to make his classical researches on sound in relation to fog signaling which provided his country with the most serviceable system of fog signals known to maritime powers. His researches also enabled the government to change from sperm oil to lard oil and later from lard oil to mineral oil as an illuminant, greatly increasing the efficiency of light beacons. He directed the mobilization of scientific effort during the Civil War and was a prime mover in the organization of the National Academy of Sciences of which he was the second president. He also took a leading part in the organization of the American Association for the Advancement of Science and of the Philosophical Society of Washington.

Henry was by general consent the foremost of U.S. physicists of his day; his influence upon the development of scientific work in the United States and upon its character cannot be overestimated. He was a man of varied culture, of large breadth and liberality of views, of generous impulses, of great gentleness and courtesy of manner, combined with equal firmness of purpose and energy of action, He died in Washington. D.C., on May **13, 1878.**

BIBLIOGRAPHY. — **A** *Memorial of Joseph Henry,* published by order of Congress (Washington, 1880), included also in *Smithsonian Misc. Colls.,* vol. xxi (1881); J. **G.** Crowther, *Famous American Men of Science* (New York, 1937); Thomas Coulson, *Joseph Henry, His Life and Work* (Princeton, 1950). (C. G. A.)

HENRY, MATTHEW (1662–1714), English Nonconformist divine, was born on the confines of Flintshire and Shropshire. on Oct. **8, 1662.** He was the son of Philip Henry. who had, two months earlier, been ejected by the Act of Cniformity. In **1687** Matthew Henry became minister of a Presbyterian congregation at Chester, removing in 1712 to Mare street. Hackney. He died suddenly on June 22, 1714, at Nantwich. Henry's well-known *Exposition of the Old and New Testaments* (1708–10) is a commentary of a practical and devotional rather than of a critical kind.

HENRY, O. (WILLIAM SIDNEY PORTER) (1862–1910), U.S. short-story writer, romanticized the commonplace and expressed the effect of coincidence on character through humour, grim or ironic; despite contrived plots and occasional clowning, his stories are significant social documents, artistically told. Born in Greensboro, N.C., Sept. 11, **1862,** he was christened William Sidney Porter. (In **1898** he dropped the first name and changed his middle name to Sydney.) He attended a school taught by his aunt, then clerked in his uncle's drugstore. In **1882** he went from a gloomy home to Texas with friends. On a ranch managed by Lee Hall, famous Texas ranger, Porter absorbed the robust life of La Salle county, but served only as a sheepherder or mail carrier. Within two years he was in Austin, working in the general land office and later as teller in the First National bank. He began writing free-lance sketches at about the time of his marriage to Athol Estes in **1887,** and in **1894** he started a humorous weekly, The *Rolling Stone.* When this venture failed, Porter joined the *Houston Post* as reporter, columnist and occasional cartoonist.

On Feb. 10, **1896,** he was indicted for embezzlement of bank funds. Friends aided his flight to New Orleans, where he worked as a reporter and felt the spell of the old French quarter before reaching safety in Honduras. Soon news of his wife's fatal illness brought him back to Austin, but lenient authorities did not press the case until after her death. When convicted, Porter received the lightest sentence possible and was allowed to appeal his case. In April **1898** he entered the penitentiary at Columbus, O.; his sentence was shortened to three years and three months

for good behaviour. As night druggist in the prison hospital he could write to earn money for support of his daughter Margaret His stories of adventure in the southwest and Central America were immediately popular with magazine readers. and nhen he emerged from prison W. S. Porter had become O. Henry.

In 1902 O. Henry arrived in New York—his "Bagdad on the Subway"—to begin a career as brief as it was brilliant. From Dec. 1903 to Jan. 1906 he produced a story a week for the *New York World,* writing also for syndicated magazines. His first book. *Cabbages and Kings* (1904), depicted fantastic characters against exotic Honduran backgrounds. *The Four Million* (1906) revealed the lives of the multitude of New York in their daily routines and searchings for romance and adventure. *The Trimmed Lamp* (1907) also explored metropolitan life, and *Heart of the West* (1907) presented accurate and fascinating tales of the Texas range. Then in rapid succession came *The Voice of the City* (1908), *The Gentle Grafter* (1908), *Roads of Destiny* (1909), *Options* (1909), *Strictlv Business* (1910) and *Whirligigs* (1910).

Despite his popularity, O. Henry's final years were marred by ill health, a desperate financial struggle and addiction to alcohol A second marriage in 1907 was unhappy. After his death on June j, 1910, three more collected volumes appeared: *Sixes and Sevens* (1911), *Rolling Stones* (1912) and *Waifs and Strays* (1917). Later seven fugitive stories and poems, *O. Henryana* (1920), *Letters to Lithopolis* (1922) and two collections of his early work on the *Houston Post, Postscripts* (1923) and *O Henry Encore* (1939), were published. Foreign translations and adaptations for other art forms attest his universal applicaticn and appeal (E. H. LG.)

O. Henry's varied life is reflected in his stories. The genial magic of his fine imagination. humour and brilliant narrative skill triumph over the occasional journalism of his method, and he remains endlessly and enchantingly rereadable. His New York stories are the most famous. but it is probable that some of the southern and western tales, in which there is less strain for glittering effect, are of more lasting value. The tragedy of his own life taught him a chivalrous tenderness for the unlucky. Some of the greatest native endowments a writer can have were undeniably his; of him, as much as of any modern writer, it can be said that he had "no talent. only genius." (C. M.)

BIBLIOGRAPHY.—*The Complete Works of O Henry,* 2 vol., introduction by Harry Hansen (1953) *See* C. Alphonso Smith, *O. Henry Biography* (1916); *R* H Davis and A B Maurice, *The Caliph of Bagdad (1931);* E Hudson Long, *O. Henry* (1949); and Gerald Langford, *Alias* O. *Henry* (1957) (E H LG.)

HENRY, PATRICK (1736–1799), American politician and orator, was born at Studley, Hanover county, Va., on May 29, 1736. He was the son of John Henry, a well-educated Scotsman, who served in Virginia as county surveyor, colonel and judge of a county court. His mother was one of a family named Winston of Welsh descent, noted for conversational and musical talent. A mediocre student in the country school and under his father's tutorship, Patrick proved equally unsuccessful in business. In seven years he failed twice as a storekeeper and once as a farmer. In the meantime he acquired a taste for reading history and decided to study law. After a brief period of preparation he was admitted to the bar at the age of 24 and rapidly acquired a considerable practice. Then in 1763 was delivered his speech in "The Parson's Cause," a suit brought about by the custom of paying the clergy in money or tobacco according to the state of the market, which made Henry the idol of the common people of Virginia and procured for him an enormous clientele. In 1765 he was elected a member of the Virginia legislature, where he became in the same year the author of the "Virginia Resolutions," which, being no less than a declaration of resistance to the Stamp Act and an assertion of the right of the colonies to legislate for themselves independently of the control of the British parliament, gave a most powerful impetus to the movement resulting in the American Revolution. In a speech urging their adoption appear the often-quoted words, said to have been uttered in tones of thrilling solemnity, "Caesar had his Brutus, Charles the First his Cromwell, and George the Third (here he was interrupted by cries of 'Treason') and George the Third may profit by their example! If this be treason, make the most of it."

In the House of Burgesses he was prominent as a radical in all measures in opposition to the British Government, and was a member of the first Virginia committee of correspondence. In 1774 and 1775 he was a delegate to the continental congress. In 1775, in the second revolutionary convention of Virginia, Henry, regarding war as inevitable, presented resolutions for arming the Virginia militia, supporting them in a speech with the dramatic peroration, "I know not what course others may take, but as for me, give me liberty or give me death!" The resolutions were passed and their author was made chairman of the committee for which they provided. The chief command of the forces of Virginia was also given to him, but he was so checked by the Committee of Public Safety, that he resigned on Feb. 28, 1776. In the Virginia convention of 1776 he favoured the postponement of a declaration of independence until a firm union of the colonies and the friendship of France and Spain had been secured. In the same convention he served on the committee which drafted the first constitution for Virginia, and was elected governor of the State, being re-elected in 1777 and 1778, thus serving as long as the new constitution allowed any man to serve continuously. As governor he gave Washington able support and sent out the expedition under George Rogers Clark (*q.v.*) into the Illinois country.

In 1778 he was chosen a delegate to Congress, but declined to serve. From 1780 to 1784 and from 1787 to 1790 he was again a member of his State legislature; and from 1784 to 1786 was again governor. Until 1786 he was a leading advocate of a stronger central government, hut when chosen a delegate to the Philadelphia constitutional convention of 1787, he declined to serve and he led the opposition to ratification in Virginia, contending that the proposed Federal Constitution was dangerous to the liberties of the country. This change of attitude is thought to have been due chiefly to his suspicion of the North aroused by John Jay's proposal to surrender to Spain for 25 or 30 years the navigation of the Mississippi. From 1794 until his death he declined in succession the following offices: U.S. senator (1794), secretary of State in Washington's cabinet (1795), chief justice of the U.S. Supreme Court (1795), governor of Virginia (1796), to which office he had been elected by the assembly, and envoy to France (1799). In 1799, however, he consented to serve again in his State legislature, where he wished to combat the Virginia Resolutions; he never took his seat, since he died, on his Red Hill estate, on June 6 of that year. Henry was twice married, first to Sarah Shelton and second to Dorothea Dandridge.

HENRY, VICTOR (1850–1907), French philologist, was born at Colmar in Alsace on Aug. 17, 1850. Having held appointments at Douai and Lille, he was appointed professor of Sanskrit and comparative grammar in the University of Paris. A prolific and versatile writer, he is probably best known by the English translations of his *Pre'cis de Grammaire comparée de l'anglais et de l'allemand* and *Prkcis . . . du Grec et du Latin.* Important works by him on India and Indian languages are. *Manuel pour étudier le Sanscrit vkdique* (with A. Bergaigne, 1890); *Eldments de Sanscrit classique* (1902); *Pre'cis de grammaire Pâlie* (1904); *Les Litte'ratures de l'Inde: Sanscrit, Pâli, Prâcrit* (1904); *La Magie dans l'Inde antique* (1904); *Le Parsisme* (190j); *L'Agnistoma* (1906). Obscure languages (such as Innok, Quichua, Greenland) and local dialects (*Lexique étymologique du Brdton moderne; Le Dialecte Alaman de Colmar)* also claimed his attention. *Le Langage Martien* is a curious book. It contains a discussion of some 40 phrases (amounting to about 300 words), which a certain Mademoiselle Hélène Smith (a spiritualist medium of Geneva, Switz.) was said to have learned while on a hypnotic visit to the planet Mars.

HENRY, WILLIAM (1775–1836), English physician and chemist, author of "Henry's law" that the amount of gas absorbed by a liquid is proportional to the pressure of the gas upon the liquid, was the son of Thomas Henry (1734–1816), apothecary, translator of Lavoisier's *Opuscules* and writer on chemistry. William Henry was born at Manchester on Dec. 12, 1775, and was educated at Edinburgh (M.D., 1807). He devoted himself to

industry and scientific studies. One of his best known papers *(Philosophical Transactions of the Royal Society,* 1803) describes experiments on the quantity of gases absorbed by water under different pressures; the conclusion he reached being that "water takes up of gas condensed by one, two or more additional atmospheres. a quantity which, ordinarily compressed, would be equal to twice, thrice, etc., the volume absorbed under the common pressure of the atmosphere." His *Elements of Experimental Chemistry* went through 11 editions. In a fit of melancholia, he committed suicide at Pendlebury, Sept. 2, 1836. (R. E. O.)

HENRY FITZ HENRY (1155–1183), second son of Henry II., king of England, by Eleanor of Aquitaine, became heir to the throne on the death of his brother William (1156), and at the age of five was married to Marguerite, the infant daughter of Louis VII. In 1170 he was crowned at Westminster by Roger of York. The protests of Becket against this usurpation of the rights of Canterbury were the ultimate cause of the primate's murder. The young king soon quarrelled with his father, who allowed him no power and a wholly inadequate revenue, and headed the great baronial revolt of 1173. He was assisted by his father-in-law, to whose court he had repaired; but, failing to shake the old king's power either in Normandy or England, made peace in 1174. Despite the generous terms which he received, he continued to intrigue with Louis VII., and was in consequence jealously watched by his father. In 1182 he and his younger brother Geoffrey took up arms, on the side of the Poitevin rebels, against Richard Coeur de Lion, apparently from resentment at the favour which Henry II. had shown to Richard in giving him the government of Poitou while they were virtually landless. Henry II. took the field in aid of Richard; but the young king and Geoffrey continued to aid the Aquitanian rising until the young king died (June 11, 1183). His death was bitterly regretted by his father.

HENRY OF ALMAIN (1235–1271), so called from his father's German connections, was the son of Richard, earl of Cornwall and king of the Romans. As a nephew of both Henry III. and Simon de Montfort he wavered between the two at the beginning of the Barons' War, but finally took the royalist side and was among the prisoners taken by Montfort at Lewes (1264). In 1268 he took the cross with his cousin Edward, who, however, sent him back from Sicily to pacify the unruly province of Gascony. Henry took the land route with the kings of France and Sicily. While attending mass at Viterbo (March 13, 1271) he was attacked by Guy and Simon de Montfort, sons of Earl Simon, and foully murdered. This revenge was the more outrageous since Henry had personally exerted himself on behalf of the Montforts after Evesham. The deed is mentioned by Dante, who put Guy de Montfort in the seventh circle of hell.

HENRY OF BLOIS, bishop of Winchester (1101–1171), was the son of Stephen, count of Blois, by Adela, daughter of William I., and brother of King Stephen. Educated at Cluny, he was brought to England by Henry I. and made abbot of Glastonbury. In 1129 he was given the bishopric of Winchester and allowed to hold his abbey in conjunction with it. His hopes of the see of Canterbury were disappointed, but he obtained in 1139 a legatine commission which gave him a higher rank than the primate. Indeed, one of the ecclesiastical councils over which he presided formally declared that the election of the king in England was the special privilege of the clergy. Stephen owed his crown to Henry (1135), but they quarrelled when Stephen refused to give Henry the primacy; and the bishop took up the cause of Roger of Salisbury (1139). After the battle of Lincoln (1141) Henry declared for Matilda; but finding his advice treated with contempt, rejoined his brother's side, and his successful defence of Winchester against the empress (Aug.–Sept. 1141) was the turning-point of the civil war. The expiration of his legatine commission in 1144 deprived him of much of his power. At the accession of Henry II. (1154) he retired from the world. He died in 1171.

HENRY OF GHENT (HENRICUS DE GANDAVO) (d. 1293), scholastic philosopher, known as "Doctor Solemnis," was born in Ghent, where he studied before going to Cologne. In 1267 he was a canon of Tournai and in 1276 archdeacon of Bruges. By 1277 he was a master of theology at Paris, where he strongly opposed the mendicants.

Henry's philosophy, with its strong Augustinian colouring of peripatetic elements, closely resembles that of the early Franciscans. Thus, like them, he maintains that matter has its own actuality and by the Divine power could exist apart from form, that there is no real distinction between essence and existence or between the soul and its faculties, that a *forma corporeitatis* in man must be assumed if the independent natures of body and soul are to be ensured, that divine illumination is necessary for true knowledge, and that an eternal creation is impossible. Duns Scotus, whose formal distinction and voluntaristic leanings Henry anticipates, attacks his more original contributions, including his theory of negation as the principle of individuation, his rejection of the *species intelligibiles* in cognition, his stress on the activity of the intellect, his philosophy of conscience, and his theories that the Divine essence under a *relatio rationis* to *a* creature is the form in which God knows things and that creatures existed *secundum esse essentiae* in the Divine mind from all eternity.

BIBLIOGRAPHY.—Henry's *Quodlibeta* was published at Paris (1518) and at Venice (1608 and 1613), and his *Summa theologzae* at Paris (1520) and at Ferrara (1646). His *Comm. on the Physics,* his *Quaestiones on the Metaphysics* and a logical treatise are still in manuscript. The *De Scriptoribus ecclesiasticis* is probably not by him. *See* F. Ehrle, "Beitr. zu den Biographien beriihmter Scholastiker" in *Auchiv. fur Lit. u. Kirchengeschichte des Mittelalters* (1885); *H.* Delehaye, *Nouvelles Recherches sur Henri de Gand* (1886); *C.* Werner, *Heinrich von Gent als Reprasentant des christlichen Platonismus* (Vienna, 1878); De Wulf, *Hist. de la phil. scholastique dans les Pays-Bas* (1895); *G.* Hagemann, *De Henrici Gandavensis quem vocant ontologismo* (1898); *J.* Lichterfeld, *Die Ethik Heinrichs v. Gent* (1906); R. Braun, *Die Erkenntnislehre Heinrichs v. Gent* (1916).

HENRY OF HUNTINGDON *(c.* 1080/90–*c.* 1155), English chronicler whose *Historia Anglorum,* from 55 B.C. to A.D. 1154, is interesting historically for the light it throws on the *Anglo-Saxon Chronicle,* on which the earlier part is based. Born sometime between 1080 and 1090, probably in Lincolnshire, Henry entered the household of Robert Bloet, bishop of Lincoln, at an early age. and in 1110 was appointed by him archdeacon of Hertford and Huntingdon. He was on familiar terms with his patron and also, apparently, with Bloet's successor. Alexander of Blois, who encouraged him to undertake the writing of his history. The first text, dealing with the period to 1129, appeared in 1130; four subsequent recensions brought it down to the accession of Henry II in 1154, made the occasion of a verse panegyric showing all the writer's loftiness of style. Henry must have died soon after, for a new archdeacon was appointed in 1155. The only recorded event of his later life is that in 1139 he accompanied Theobald, archbishop of Canterbury, to Rome.

The *Historia Anglorum,* formerly much esteemed, is now regarded as being of little independent value for the period before 1126, being largely a compilation or translation of such sources as Bede and the *Chronicle,* interspersed with passages of rhetoric. The later part, disappointingly. does little to illuminate contemporary events. More interesting for its sidelights on famous personalities of the day is the minor moralizing tract *Epistola ad Walterum de contemptu mundi,* written probably about 1135. Henry also wrote *De Miraculis,* a book of extracts from Bede, and two other Latin epistles, appended to later recensions of the *Historia.* He is known to have composed eight books of Latin epigrams, of which two books survive in a manuscript copy of the *Historia* (Lambeth manuscript, no. 118).

BIBLIOGRAPHY.—The *Historia Anglorum* was first printed in Sir Henry Savile's *Rerum Anglicarum scriptores post Bedam* (1596) The standard edition is by T. Arnold in the Rolls Series (1879), with appendix containing the *Epistola ad Walterum.* There is a translation by T. Forester in Bohn's *Antiquarian Library* (1853).... *See* also *F.* Liebermann, *Forschungen zur deutschen Geschichte,* XVIII (1878); R. R. Darlington, *Anglo-Norman Historians* (1947).

HENRY OF LAUSANNE (variously known as OF BRUYS, OF CLUNY, OF TOULOUSE, and as THE DEACON), French heresiarch of the first half of the 12th century. Practically nothing is known of his origin or early life, but if St. Bernard's reproach (*Ep.* 241) be true, Henry was an apostate monk.

In 1134 Henry appeared before Innocent II at the council

of Pisa, where he was compelled to abjure his errors and was imprisoned. Towards 1139, Peter the Venerable, abbot of Cluny, wrote his *Epistola seu tractatus adversus Petrobrusianos* (Migne, *Patr. Lat.* 189) against the disciples of Peter of Bruys and Henry of Lausanne, whom he calls Henry of Bruys, and whom, at the moment of writing, he accuses of preaching heresy in the south of France. In 1145, at the instance of the legate Alberic, St. Bernard set out for the heretical towns of Bergerac, Périgueux, Sarlat, Cahors and Toulouse. At his approach Henry quitted Toulouse, leaving Bernard by his eloquence and miracles to make many converts and to restore Toulouse and Albi to orthodoxy. After inviting Henry to a disputation, which he refused to attend, St. Bernard returned to Clairvaux. Soon afterwards the heresiarch was arrested, brought before the bishop of Toulouse, and probably imprisoned for life.

See E. Vacandard, "Les Origines de l'hérésie albigeoise," *Revue des questions historiques* (1894), and *Vie de S. Bernard* (vol. ii., 1895).

HENRY OF PORTUGAL, surnamed the "Navigator" (1394–1460), duke of Viseu, governor of the Algarve, was born at Oporto on March 4, 1394. He was the third surviving son of John (João) I., the founder of the Aviz dynasty, under whom Portugal, victorious against Castile and against the Moors of Morocco, began to take a prominent place among European nations; his mother was Philippa, daughter of John of Gaunt. When Ceuta, the "African Gibraltar," was taken in 1415, Prince Henry performed the most distinguished service of any Portuguese leader, and received knighthood; he was now created duke of Viseu and lord of Covilham, and about the same time began his explorations, which, however, limited in their original conception, certainly developed into a search for a better knowledge of the western ocean and for a sea-gay along the unknown coast of Africa to the supposed western Nile (our Senegal), to the rich negro lands beyond the Sahara desert, to the half-true, half-fabled realm of Prester John, and so ultimately to the Indies.

In 1415, the year of Ceuta, the prince sent out one John de Trasto on a voyage which brought the Portuguese to Grand Canary. There was no discovery here, for the whole Canarian archipelago was now well known to French and Spanish mariners. But in 1418 Zarco rediscovered Porto Santo, and in 1420 Madeira, which had originally been discovered in the 14th century. In 1424–25 Prince Henry attempted to purchase the Canaries, and began the colonization of the Madeira group, both in Madeira itself and in Porto Santo, for which he obtained charters (1430 and 1433) from the Portuguese Crown. In 1427, again, with his father King John, he sent out the pilot Diogo de Sevill, followed in 1431 by Gonçalo Velho Cabral, to explore the Azores. This rediscovery of the far western archipelago suggests that Henry had in mind the possibility of such a western route to Asia as Columbus attempted in 1492. Meantime, in 1418, Henry had gone in person to relieve Ceuta from an attack of Morocco and Granada Mussulmans; had accomplished his task, and had planned, though he did not carry out, a seizure of Gibraltar. At this time, it is probable that he was gathering information from the Moors with regard to the coast of "Guinea" and the interior of Africa. In 1419, after his return to Portugal, he was created governor of the "kingdom" of Algarve, the southernmost province of Portugal; and his connection now began with what afterwards became known as the "Infante's Town" (*Villa* do *Iffante*) at Sagres, close to Cape St. Vincent; where, before 1438, a *Tercena Nabal* or naval arsenal grew up and where, from 1438, after the Tangier expedition, the prince often resided.

In 1433 King John died; exhorting his son not to abandon his schemes; and in 1434 one of Henry's ships, commanded by Gil Eannes, at length doubled Cape Bojador. In 1435 Baldaya, the prince's cup-bearer, passed 50 leagues beyond; and by 1436 the Portuguese had almost reached Cape Blanco. Plans of further conquest in Morocco, resulting in 1437 in the disastrous attack upon Tangier, and followed in 1438 by the death of King Edward (Duarte) and the domestic troubles of the minority of Affonso V., now interrupted Atlantic and African exploration down to 1441, except in the Azores, where rediscovery and colonization progressed, as is shown by the royal licence of July 2, 1439, to people "the seven islands" of the group then known. In 1441 exploration began again in earnest with the venture of Antam Gonçalvez, who brought to Portugal the first slaves and gold-dust from the Guinea coasts beyond Bojador; while Nuno Tristam in the same year pushed on to Cape Blanco. These successes produced a great effect; the cause of discovery became popular; and many volunteers, especially merchants and seamen from Lisbon and Lagos, came forward. In 1442 Nuno Tristam reached the Bay or Bight of Arguim, where the infante erected a fort in 1448, and where for years the Portuguese carried on vigorous slave-raiding. Meantime the prince, who was now a knight of the Garter of England, proceeded with his Sagres buildings, which formed the nucleus of the "Infante's Town," and which had been begun about 1437.

In 1444–46 there was a burst of maritime and exploring activity; more than 30 ships sailed with Henry's licence to Guinea; and several of their commanders achieved notable success. Thus Diniz Diaz, Nuno Tristam, and others reached the Senegal in 1445; Diaz rounded Cape Verde in the same year; and in 1446 Alvaro Fernandez pushed on almost to our Sierra Leone, to a point 110 leagues beyond Cape Verde. This was perhaps the most distant point reached before 1461. In 1444, moreover, the island of St. Michael in the Azores was sighted (May 8), and in 1445 its colonization was begun. During this latter year also Juan Fernandez (*q.v.*) spent seven months among the natives of the Arguim coast, and brought back the first trustworthy first-hand European account of the Sahara hinterland. Slave-raiding continued ceaselessly; by 1446 the Portuguese had carried off nearly a thousand captives from the newly surveyed coasts; but between this time and the voyages of Cadamosto (*q.v.*) in 1455–1456, the prince altered his policy, forbade the kidnapping of the natives and endeavoured to promote their peaceful intercourse with his men. In 1445–46, again, Dom Henry renewed his earlier attempts to purchase or seize the Canaries, which brought Portugal to the verge of war with Castile; but the home Government refused to support him, and the project was again abandoned. Azurara's narrative ceases in 1448; one of the latest expeditions noticed by him is that of a foreigner in the prince's service, "Vallarte the Dane," which ended in destruction near the Gambia, after passing Cape Verde in 1448. After this the chief matters in Dom Henry's life are, first, the progress of discovery and colonization in the Azores; secondly, the rapid progress of civilization in Madeira, evidenced by its timber, sugar, corn and honey, and above all by its wine; and thirdly, the explorations of Cadamosto and Diogo Gomes (*q.v.*).

Cadamosto in 1455 and 1456, explored part of the courses of the Senegal and the Gambia, discovered the Cape Verde islands (1456), named and mapped more carefully than before a considerable section of the coast beyond Cape Verde, and gave much new information on the trade-routes of north-west Africa and on the native races; while Gomes, in his first important venture (after 1448 and before 1458), though not accomplishing the full Indian purpose of his voyage (he took a native interpreter with him for use "in the event of reaching India"), explored and observed in the Gambia valley and along the adjacent coasts with fully as much care and profit. As a result of these expeditions the infante seems to have sent out in 1458 a mission to convert the Gambia negroes. Gomes' second voyage, resulting in another "discovery" of the Cape Verde islands, was probably in 1462, after the death of Prince Henry; it is likely that among the infante's last occupations were the necessary measures for the equipment and despatch of this venture, as well as of Pedro de Sintra's important expedition of 1461.

The infante's share in home politics was considerable, especially in the years of Affonso V.'s minority (1438, etc.) while his elder brother Pedro was regent. When Dom Pedro rose in revolt (1447), Henry stood by the king and allowed his brother to be crushed. In the Morocco campaigns of his last years, especially at the capture of Alcazar the Little (1458), he restored his military fame which brought him invitations from the pope, the emperor and the kings of Castile and England, to take command of their armies. The prince was also grand master of the Order of Christ, the

successor of the Templars in Portugal; and most of his Atlantic and African expeditions sailed under the flag of his order, whose revenues were at the service of his explorations, in whose name he asked and obtained the official recognition of Pope Eugenius IV. for his work, and on which he bestowed privileges in the new lands. As "protector of Portuguese studies," Dom Henry founded a professorship of theology, and perhaps also chairs of mathematics and medicine, in Lisbon. To instruct his captains, pilots and other pioneers more fully in the art of navigation and the making of maps and instruments he procured the aid of one Master Jacome from Majorca, together with that of certain Arab and Jewish mathematicians. One Master Peter also inscribed and illuminated maps for the infante; the mathematician Pedro Nunes declares that the prince's mariners were well taught and provided with instruments and rules of astronomy and geometry "which all map-makers should know"; Cadamosto says that the Portuguese caravels in his day were the best sailing ships afloat; while, from several matters recorded by Henry's biographers, it is clear that he devoted great attention to the study of earlier charts and of any available information he could gain upon the trade routes of northwest Africa. Even if there were never a formal "geographical school" at Sagres, or elsewhere in Portugal, founded by Prince Henry, it appears certain that his court was the centre of active and useful geographical study, as well as the source of the best practical exploration of the time.

The prince died on Nov. 13, 1460, and was buried in the church of St. Mary in Lagos, but a year later his body was removed to the monastery of Batalha.

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HENRY RASPE (1202?–1247), German king and landgrave of Thuringia, was the second surviving son of Hermann I, landgrave of Thuringia. When his brother, the landgrave Louis IV, died in Italy in 1227, Henry seized the government of Thuringia and expelled his brother's widow St. Elizabeth of Hungary and her son Hermann. Henry made good his position, although his nephew Hermann II was nominally the landgrave until his death in 1242. In 1236 Henry accompanied the emperor Frederick II on a campaign against Frederick II, duke of Austria, and took part in the election of his son Conrad as German king at Vienna in 1237. But he did not appear at the diet of Verona in 1238; possibly he disliked the betrothal of his nephew Hermann to the emperor's daughter Margaret. At all events, when the projected marriage had been broken off the landgrave supported the emperor in 1239 in opposition to a plan formed by various princes to elect an anti-king. In 1241 Henry's loyalty again wavered, and he was himself mentioned as a possible antiking. Frederick's visit to Germany in 1242 prevented this step for a time. In April 1246 Pope Innocent IV wrote to the German princes advising them to choose Henry as their king in place of Frederick, who had just been declared deposed. Henry was elected at Veitshochheim on May 22, 1246, and became known as the *Pfaffenkönig,* or parsons' king. He defeated King Conrad near Frankfort on Aug. j, 1246, and, after holding a diet at Niirnberg, undertook the siege of Ulm. He died at the Wartburg on Feb. 17, 1247.

HENRYSON, ROBERT (fl. 1475), one of the foremost of the Scottish Chaucerians. He is described on some early title pages as schoolmaster of Dunfermline—probably at the Benedictine abbey school—and he appears among the *morts* in William Dunbar's *Timor mortis conturbat me,* which was printed about 1508. Otherwise, the only detail known of his life is a circumstantial account of his deathbed wit in Sir Francis Kynaston's manuscript translation of Chaucer's *Troilus* into Latin (1635).

Henryson's longest work is *The Morall Fabillis of Esope the Phrygian, Compylit in Eloquent & Ornate Scottis,* a version of 13 fables based mainly on John Lydgate and William Caxton and running to over 400 seven-lined stanzas. The collection, made "be requeist and precept of ane Lord," has a prologue; and each tale is adorned with a *moralitas.* Some of the tales may have been written with some oblique political intention but their virtue lies in the freshness of the narrative, the sly humour and sympathy of Henryson's animal characterization and in his miniatures of the Scottish countryside. Not all the fables are written, as he modestly says, in "hamelie language and in termes rude," for he rises easily into an aureate style for comic effect or instruction; but his fundamental style is excellently colloquial.

In *The Testament of Cresseid,* a narrative and "complaint" in 86 stanzas, Henryson completes the story of Chaucer's Criseyde. He describes how he settled down on a winter night with *Troilus and Criseyde* and, questioning "gif all that Chauceir wrait was trew," turned to another version of the tale. From this he describes Criseyde's rejection by Diomede, her decline into prostitution, her rebuke to the gods, her punishment in leprosy and her death. The "uthir quair" is usually explained as a conventional fiction; but it may have been *The Spectakle of Luf,* a Latin work containing a hint of Criseyde's fate among a series of *exempla,* which was translated at St. Andrems in 1492 *(see* J. Kinsley in the *Times Literary Supplement,* Nov. 14, 1952). The *Testament* is more than a splendid piece of rhetorical craftsmanship; blended with Henryson's unwavering concern for justice are an aesthetic attraction to the repulsive and grotesque, and a refined sense of the "variance" of human love.

Among the shorter poems ascribed to Henryson are the lovely *Orpheus and Eurydice,* based on Boethius and akin to the *Testament* in mood and style; the "pastourelle" *Robene and Makyne,* in which a traditional French *genre* assimilates the speech and humour of the Scottish peasantry; and a number of fine moral narratives and meditations. Henryson is a slighter and less volatile figure than Dunbar; but in a narrower range he is as exquisite an artist.

BIBLIOGRAPHY.—*Manuscripts: The Morall Fabillis* is contained in four manuscripts: (1) the Asloan ms. (early 16th century), now in the possession of the Talbot de Malahide family in Dublin (ed. by W. A. Craigie for the Scottish Text society, 2 vol., 1923–5); (2) the Bannatyne ms. (1568), in the National Library of Scotland (ed. by W. T. Ritchie ior the Scottish Text society, 4 vol., 1928–34); (3) British museum Harleian ms. 3865 (1571; the most complete ms. version); and (4) the Makculloch ms., in the Edinburgh university library (one fable only). Early printed editions are dated 1570 (published by H. Charteris, Edinburgh, and surviving in a unique copy), 1571 (published by Bassandyne, Edinburgh, and surviving in a unique copy) and 1577 (London). There are no early manuscripts of *The Testameizt of Cressezd.* The earliest printed text is included in W. Thynne's *Chaucer* (1532). Later surviving editions are dated 1593 and 1663; at least two other 17th-century editions are lost. *Orpheus and Eurydice* was printed at Edinburgh by W. Chepman and A. Myllar c. 1508, and survives in a unique but incomplete copy. It is also included in the Asloan and Bannatyne mss. The shorter poems are preserved in the Bannatyne and other early mss.

Editioits: The standard collected edition is by G. Gregory Smith, for the Scottish Text society, 3 vol. (1906–14). There is a useful students' edition by H. Harvey Wood, 2nd ed. (1958).

See also M. *W.* Stearns, *Robert Henryson* (1949), a iull but uneven discussion of the poems and their background; E. M. W. Tillyard, in *Five Poenzs, 1470–1870* (1948); *A.* K. Moore, "Robene and Makyne," in *Modern Language Review,* vol. xliii (1948); E. Muir in *Essays on Literature and Society* (1949); J. Kinsley in *Scottish Poetry: a Critical Survey* (19jj); C. Elliott, on the *Testament,* in *The Journal of English and Germanic Philology,* vol. liv (1955). (J. KY.)

HENSCMEL, SIR GEORGE (ISIDOR GEORG) (1850–1934), English musician (naturalized 1890), of German family, was born at Breslau, and educated as a pianist, making his first public appearance in Berlin in 1862. He subsequently, however, took up singing, having developed a fine baritone voice. In 1577 he began a successful career in England and in 1881 he married the American soprano, Lillian Bailey (d. 1901), who was associated with

him in a number of vocal recitals. He was also prominent as a conductor, started the London symphony concerts in 1886 and both in England and America (where he was the first conductor of the Boston symphony concerts, 1881) he did admirable work in this way, giving programs always of the highest type. In 1907 he married as his second wife Amy Louis, also a musician, of New York. He continued singing and teaching until long past his 70th year. Among his compositions may be mentioned a fine *Stabat Mater* (Birmingham Festival. 1894), an opera *Nubia* (Dresden, 1899) and many admirable songs.

HENSELT, ADOLF VON (1814–1889), German pianist. a follower of Liszt. Born at Schwabach. Bavaria. May 12. 1814. he studied the piano under J. N. Hummel at Weimar and composition under Simon Sechter in Vienna. He toured Germany as a pianist in 1836, and in 1838 settled in St. Petersburg, where he acquired a great position as teacher and performer and received a title. His manner of playing was similar to that of Liszt, except that. whereas Liszt relied on the pedals for maintaining sonorify, Henselt developed an exceptionally large stretch of the hand, which enabled him to hold down widely spaced notes. His method is illustrated in his *Études*, his *Exercices préparatoires* and his edition of the studies of J. B. Cramer for which he provided a second piano part. He also edited the piano works of Weber and made piano transcriptions of his overtures. His compositions include a piano concerto (Op. 16), some smaller piano pieces, a duo for piano and horn, a piano trio and two sets of choral pieces. *Maienzeit* and *Morgenständchen*. He died at Warmbrunn, Silesia, Ocr. 10, 1889.

See W. von Lenz, *Die grossen Pianoforte-Virtuosen unserer Zeit* (1872).

HENSLOW, JOHN STEVENS (1796–1861), English clergyman. botanist and geologist who popularized botany at the University of Cambridge and largely inspired Charles Darwin's taste for natural history. was born at Rochester, Kent. on Feb. 6, 1796. He graduated in mathematics at St. John's college, Cambridge, in 1818 and then turned to natural history. making geological expeditions to the Isle of Wight and the Isle of Man with Adam Sedgwick. They founded the Cambridge Philosophical society in 1821. In 1822 Henslow became professor of mineralogy at Cambridge, and was ordained in 1824. In 1827 he was made professor of botany, and enlivened its teaching, especially through excursions. He obtained for Darwin, his pupil and friend, the position of naturalist to H.M.S. "Beagle" (1831–36), and. in Darwin's own words. "took charge of the collections I sent home, and by his correspondence directed my endeavours." In 1837 Henslow was made rector of Hitcham, Suffolk, living there from 1839. Despite opposition. he fostered among his parishioners an interest in the economic and practical aspects of botany. greatly to the improvement of local farming practice. Henslow died at Hitcham on May 16. 1861. He formed many collections. and helped Sir W. J. Hooker with the botanical museums at Kew. His publications include *A Catalogue of British Plants* (1829; 2nd ed.. 1835); *Principles of Descriptive and Physiological Botany* (1835). He contributed to E. Skepper's *Flora of Suffolk* (1860).

HENSLOWE, PHILIP (d. 1616). English theatre proprietor and manager, the most important of the Elizabethan age. was born in Lindfield. Sussex. and apparently settled in Southwark. London. before 1577. He married the widow of Viscount Montague's bailiff, in whose service he had been; and with her money became an owner of much Southwark property. including inns and lodging houses. At various times he had interests in dyeing. starch-making and wood selling, as well as pawnbroking. moneylending and theatrical enterprises. He was a churchwarden and held some minor court offices. becoming a Groom of the Chamber. In 1587 Henslowe and a partner built the Rose playhouse on the Bankside near Southwark bridge. and under Henslowe's financial management various companies acted there from 1592 to 1603. He had an interest in the suburban Newington Butts theatre in 1594 and later in the Swan playhouse in Paris garden, at the western end of the Bankside. With the actor Edward Alleyn, who had married Henslowe's stepdaughter. he presented bearbaiting and bullbaiting in an old arena near the Swan. In 1610 Henslowe built a new theatre, the Hope. designed for plays as well as bearbaiting, on this site. The most sumptuous of Henslowe's theatres was the Fortune, built just north of London for the Admiral's Men in 1600.

Henslowe's theatres saw the first production of many important Elizabethan dramas; he was associated in one way or another with most of the famous playwrights for a quarter of a century, and his Admiral's Men were the chief rivals of Shakespeare's company. Henslowe was a shrewd. crotchety man of business who kept a tight hand on his theatrical companies. his players and his playwrights. "Should these fellowes come out of my debt I should have no rule over them." In the year before his death his players brought an indictment of "oppression" against him. The famous "Henslowe's diary" is really a manuscript book of miscellaneous accounts and memoranda. playhouse receipts, payments to playwrights, loans or advances to players, payments for ,materials, costumes! etc. It is one of the most important sources for the theatrical history of the time. For example! fully two-thirds of the plays mentioned in the diary are now otherwise lost. This book and other important theatrical papers were left by Edward Alleyn as part of his benefaction to Dulwich college. J. P. Collier edited the diary for the Shakespeare society in 1845, but unfortunately inserted a number of forged interpolations.

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(FK. C. B.)

HENSON, HERBERT HENSLEY (1863–1947), English priest. was born in London on Nov. 8, 1863. As an unattached student at Oxford he graduated in 1884 and was elected a fellow of All Souls college. He was ordained in 1887; and. after being head of Oxford house at Bethnal Green for a year, he was given the living of Barking. Essex. He was incumbent of St. Mary's hospital, Ilford, 1895–1900, canon of Westminster and rector of St. Margaret's. 1900–12, and dean of Durham, 1912–18, when he was promoted to the bishopric of Hereford in succession to Percival. Because of his pronounced liberal opinions in theology, and his insistence on the validity of Nonconformist orders. his appointment aroused some controversy. From 1920 to 1939 he was bishop of Durham. He died on Sept. 27, 1947, at his home near Ipswich.

HENTY, GEORGE ALFRED (1832–1902), English war correspondent and author, was born at Trumpington, near Cambridge, and educated at Westminster school and Caius college, Cambridge. He served in the Crimea in the purveyor's department, and after the peace filled various posts in the department in England and Ireland, but drifted into journalism for the *London Standard*. He volunteered as special correspondent for the Austro-Italian War of 1866, accompanied Garibaldi in his Tirolese campaign, followed Lord Napier through the mountain gorges to Magdala, and Lord Wolseley across bush and swamp to Kumasi. Eext he reported the Franco-German War, starved in Paris through the siege of the Commune and then turned south to rough it in the Pyrenees during the Carlist insurrection. He was in Asiatic Russia at the time of the Khiva expedition, and later saw the desperate hand-to-hand fighting of the Turks in the Serbian war. In middle life he began to write excellent books of adventure for boys, many of which had a good historical background. His first boys' book *Out on the Pampas* dates from 1868; the last two, posthumously published, were *With Kitchener to the Sudan* (1903), and *With the Allies to Pekin* (1904). There are some 80 of these stories. Henty died on Nov. 16, 1902.

HENZADA, a town and district of Lower Burma, formerly in the Pegu. but now in the Irrawaddy division. Area, 2.782 sq.mi. Pop. (1941) 693.271. The district lies to the west of the Irrawaddy and stretches to the crest of the Arakan Yomas which form the boundary between Henzada and the Sandoway district of Arakan. The district thus comprises a tract of hilly, forested country on the west and a portion of the plain of the Irrawaddy on the east. The town of Henzada itself is usually regarded as lying at the southern end of the Irrawaddy valley proper and at the head of the delta. The low-lying eastern portions of the district are protected from inundation by immense embankments, so

that almost the whole is suitable for rice cultivation. Tobacco is also an important crop. The hills in the western part are forested. The chief town of the district is Henzada, which had in 1953 a population of 61,972. Other towns in the district are Myan-aung, with a population of 11,155; and Kyangin with a population of 6.073 according to the 1953 census. The river towns are served by the steamers of the Irrawaddy Flotilla company and a branch of the Burma railway runs from Kyangin to Henzada and from Henzada to Bassein.

The district was once a portion of the Talaing kingdom of Pegu, afterward annexed to the Burmese empire in 1753, and has no history of its own.

HEPATICA (Hepatica americana), a North American plant of the buttercup family (Ranunculaceae), called also liverleaf, liverwort and squirrel cup, native in woods from Nova Scotia to Manitoba and south to Florida and Missouri. It is a low, almost stemless perennial. about 3 in. high, often growing in tufts, with thick, evergreen, three-lobed basal leaves on very hairy stalks, and delicate blue, purple or white flowers. about $\frac{7}{8}$ in. broad, composed of 6 to 12 sepals, and borne singly on hairy stalks. Immediately beneath the flower are three leaflets (involucre) simulating a calyx. The very similar sharp-lobed hepatica (H. acutiloba), with pointed instead of rounded leaf lobes, found from Quebec to Minnesota and south in the Alleghanies to Georgia and in the interior to Missouri, is rare or absent near the Atlantic coast.

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OLD WORLD HEPATICA (H. TRILOBA)

The hepaticas are among the earliest and best-known woodland wild flowers of eastern North America, the two species occurring together in many localities. The leaves that last over winter are deep olive green or bronzy above and reddish-purple or liver-coloured beneath. According to some botanical authorities the genus Hepatica is included in the genus Anemone. The Old World hepatica or liverleaf (Hepatica triloba or Anemone Hepatica), widely distributed in Asia and Europe, and often cultivated, is not found native in the British Isles. (See ANEMONE; RANUNCULACEAE.)

HEPATITIS, CANINE VIRAL, is an acute viral infection, common in young dogs. affecting the liver and inner lining of blood vessels. It is usually characterized by fever, lack of appetite, vomiting, intense thirst, abdominal tenderness and hemorrhages. This disease has long been confused with canine distemper, next to which it is the most important disease of dogs in the United States. It also infects foxes, timber wolves, coyotes and bears.

In 1930 Richard Green of the United States published information indicating that the cause of infectious canine hepatitis in foxes was a virus. The disease as produced experimentally in dogs was first described by Green in 1934. In 1947 Sven Rubarth of Sweden published a comprehensive paper on the disease as it occurred both naturally and experimentally. Rubarth suggested that the virus producing infectious canine hepatitis was the same as Green's virus, and his theory was tested further by William Carlson and Harold Siedentopf, who confirmed it.

Symptoms and Treatment. — This disease is usually seen in young dogs; it does occur in older dogs. Puppies seem most susceptible, and in this group the mortality rate is highest. The infection may occur at any time during the year. The severity of the illness varies from an unnoticeable disease to a fatal infection. Usually, a susceptible dog becomes ill six to nine days after exposure to a dog discharging the virus. The first sign of infectious hepatitis is an elevation of the dog's temperature, the fever lasting from one to six days. A fever of short duration is sometimes the only sign of canine infectious hepatitis, but if the fever persists for more than two days, other symptoms become apparent.

In addition to the general signs of distress, the primary indication of infectious hepatitis is an attitude of apathy, followed by a partial or complete loss of appetite, combined with intense thirst. A watery exudate is occasionally discharged from the eyes. Fiery redness of the mouth lining is considered an important sign. Complications, such as tonsillitis, are sometimes noticed, but the degree of severity varies. Abdominal tenderness is frequently observed, and pain is evidenced by pressure on the abdomen in the region of the liver and gall bladder. Vomiting is occasionally seen. Swellings, causing disfigurement, are sometimes found in the region around the neck, head and trunk. Skin hemorrhages may result from a bodily injury: and these bleed profusely from the site of the wound; control of hemorrhage is difficult because of the prolonged blood clotting time. Sometimes jaundice is reported. Nervous disorders in dogs have been observed in a few natural cases. but never in experimentally infected dogs.

Approximately 25% of the dogs that recover from infectious hepatitis develop temporary bluish-white discolorations of one or both corneas. These may develop between seven and ten days after disappearance of acute illness.

Treatment of symptoms by a veterinarian is desirable to prevent the complications that may occur as a result of secondary bacterial infection. Careful nursing also is needed. Unfortunately there is no therapeutic substance that affects the disease course resulting from direct virus action, once symptoms are observed.

Lesions.--In fatal cases the primary destruction occurs in the blood vessels and in the liver cells. Multiple hemorrhages and excessive fluid in tissues and body cavities occur as a result of blood vessel damage. The liver is slightly enlarged and is usually tan-coloured with darker mottled streaks. A characteristic change is the thickened gall bladder wall. A definite diagnostic aid is the presence of intranuclear inclusion bodies in liver cells and the cells of the inner lining of blood vessels.

Transmission and Immunization. — In 1951 George Poppensiek and James Baker reported a finding that explains the transmission and survival of the canine infectious hepatitis virus. It persists for months in the urine of most dogs that recover from the infection and serves therefore as a constant source of infection to susceptible dogs. Thus prevention becomes the most important aspect in protecting the dog population from this highly contagious infection, and vaccination is the practical solution.

Various vaccines are available to immunize dogs against canine hepatitis. One, an inactivated virus vaccine, is extremely safe since the virus is treated chemically to inhibit its disease-producing properties. However, protection by this method is of limited duration. By contrast, a live virus vaccine produces a dependable immunity of longer duration. The live virus vaccine is desirable since it elicits no unfavourable reaction in the dog, having been modified by laboratory procedure through transfer in tissue-cultured dog kidney cells and then in tissue-cultured pig kidney cells.

In 1952 James Gillespie, James Robinson and Baker found that dogs could be infected simultaneously with canine infectious hepatitis and another important disease of dogs, canine distemper. After recovery, the dogs were immune to both diseases. Later in the same year, Poppensiek and Baker proved that immunity against both diseases can be produced in dogs by the administration of distemper virus modified by culture in hen's eggs in combination with canine hepatitis virus derived from infected dogs. When given simultaneously with antiserum, no clinical signs of illness resulted from the vaccination procedure. By use of canine hepatitis virus modified by tissue culture transfer, serum is no longer necessary to immunize dogs against canine distemper and infectious canine hepatitis. The dual vaccine has proved to be a safe and effective method for immunization of dogs.

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HEPHAESTION, a Macedonian general, celebrated as the friend of Alexander the Great, who called Hephaestion his Patro-

clus. In the later campaigns in Bactria and India, he superintended the founding of cities and colonies and built the fleet intended to sail down the Indus. He was rewarded with a golden crown and the hand of Drypetis, the sister of Alexander's wife Stateira (324 B.C.).

In the same year he died suddenly at Ecbatana. Mourning was ordered throughout Asia; at Babylon a funeral pile was erected and temples were built in his honour (see ALEXANDER III, THE GREAT).

HEPHAESTION (?2nd century A.D.), Greek metrist of Alexandria. author of a work on metre in 48 books which was reduced to form a manual (Gr. enchiridion) by successive abridgments. The manual became a popular schoolbook and it alone survives. It is the only complete ancient work on metrics extant (see PROSODY. CLASSICAL). Appendixes dealing with poetic structure and with metrical notations may not be by Hephaestion. Important scholia have independent value.

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HEPHAESTUS (Gr. *Hēphaistos*), in Greek mythology, the god of fire. As the distribution of his shrines testifies, he was originally a deity of that Anatolian population known to the Greeks as Carians. The home of his worship seems to have been the Lycian Olympus, where a quantity of natural gas still escapes from the soil. This was in antiquity "at once the sanctuary and the image" of the god (Max. Tyr. Dissert. ii., 8). Hence the cuit spread to other places in Asia Minor and to some islands, especially Lemnos and Moschylus, which it reached very early. Hephaestus became the god of fire in general, and consequently the divine smith and patron of craftsmen. His cult reached Athens not later than about 600 B.C., and was carried at an early but unknown date to the volcanic Liparaean Islands off Sicily, whence it spread sporadically to Sicily and Campania. Crete it never reached, and Greece proper, with the exception of Attica, hardly at all. Natural fires, volcanic or gaseous, were often considered to be the workshops of Hephaestus.

In Homer the fire-god was the son of Zeus and Hera, cast out from heaven, either by Zeus, when he fell on Lemnos, or by Hera, who threw him down immediately after his birth in disgust at his lameness, when he was received by the sea-goddesses Eurynome and Thetis (Iliad, i. 590; xviii. 395).

The subsequent return of Hephaestus to Olympus is a favourite theme in early art. His wife was Charis, (in the Iliad) or Aphrodite (in the Odyssey). The connexion of the rough Hephaestus with these goddesses is curious; it may be due to the beautiful works (χαριέντα ἔργα) of the smith-god, but it is possibly derived from the supposed fertilizing and productive power of fire, in which case Hephaestus is a natural mate of Charis, a goddess of spring, and Aphrodite, the goddess of love. In Homer, the skill of Hephaestus in metallurgy is often mentioned; his forge was on Olympus, where he was served by images of golden handmaids that he had animated. Similar myths are found in relation to the Finnish smith-god Ilmarinen and the Teutonic Wieland; a belief in the magical power of metal-workers is a common survival from an age in which their art was new and mysterious., In epic poetry Hephaestus is rather a comic figure, and his limping gait provokes "Homeric laughter" among the gods. It has been suggested that in an early stage of society the trade of a smith would be suitable for the lame; Hephaestus and the lame Wieland would thus conform to the type of their human counterparts.

At Athens, with its large industrial population, Hephaestus was an important god. He finds a place in the local myths (see ERECHTHEUS). His temple has been identified, not improbably, with the so-called "Theseum." It contained a statue of Athena, and the two deities are often associated, in literature and cult, as the joint givers of civilization to the Athenians. The class of artisans was under their special protection; and the joint festival of the two divinities — the Chalceia — commemorated the invention of bronze-working by Hephaestus. In the *Hephaisteia* (the particular festival of the god) there was a torch race, a ceremonial not indeed confined to fire-gods like Hephaestus and Prometheus, but probably in its origin connected with them, whether its object was to purify and quicken the land, or (according to another theory) to transmit a new fire with all possible speed to places where the fire was polluted. The relation between Hephaestus and Prometheus is in some respects close, though the distinction between these gods is clearly marked. The fire, as an element, belongs to the Olympian Hephaestus; the Titan Prometheus, a more human character, steals it for the use of man. Prometheus resembles the Polynesian Maui, who went down to fetch fire from the volcano of Mahuika, the fire-god. Hephaestus is a culture-god mainly in his secondary aspect as the craftsman, whereas Prometheus originates all civilization with the gift of fire. But Prometheus despite his Greek name, in actual cult, was largely superseded by Hephaestus.

In archaic art Hephaestus is generally represented as bearded, though occasionally a younger beardless type is found, as on a vase (in the British Museum), on which he appears as a young man assisting Athena in the creation of Pandora. At a later time the bearded type prevails. The god is usually clothed in a short sleeveless tunic and wears a round close-fitting cap. His face is that of a middle-aged man, with unkempt hair. He is in fact represented as an idealized Greek craftsman, with the hammer, and sometimes the pincers. In art no attempt was made, as a rule, to indicate the lameness of Hephaestus; but one sculptor (Alcamenes) is said to have suggested the deformity without spoiling the statue.

HEPHTHALITES (EPHTHALITES). This many-named and enigmatic tribe was of considerable importance in the history of India and Persia in the 5th and 6th centuries and was known to the Byzantine writers. who call them Ephthalitoi, Euthalitoi. Nephthalitoi or Abdeloi. The last of these resembles the name Haital used by Arab chroniclers. They were also called Leukoi Hounnoi or Chounoi. White (that is. fair-skinned) Huns. The earliest information about the Hephthalites comes from the Chinese chronicles. in which it is stated that they were originally a tribe of the great Yue-Chi (*q.v.*), living to the north of the Great Wall and in subjection to the Jwen-Jwen, as were also the Turks at one time. Their original name was Hoa or Hoa-tun.

Before the 5th century A.D. they began to move westward, for about 420 they were in Transoxiana and for the next 130 years they were a menace to Persia. which they continually and successfully invaded. though they never held it as a conquest. The Sassanid king Bahram V fought several campaigns with them and succeeded in keeping them at bay, but they defeated and killed Firuz, A.D. 484. The Persians were not quit of the Hephthalites until 557. when Khosrau I Xnushirvan destroyed their power with the assistance of the Turks.

The Huns who invaded India appear to have belonged to the same stock as those who molested Persia. The headquarters of the horde were at Bamian and at Balkh. and from these points they raided to the southeast and southwest. Skandagupta repelled an invasion in 455, but the defeat of the Persians in 484 probably stimulated their activity. and at the end of the 5th century their chief Toramana penetrated to Malwa in central India and succeeded in holding it for some time. His son Mihiragula (*c.* 510–540) made Sakala in the Punjab his Indian capital, but the cruelty of his rule provoked the Indian princes to form a confederation and revolt against him *c.* 528. He took refuge in Kashmir. where after a few years he seized the throne. He died (*c.* 540). and shortly afterward the Hephthalites collapsed under the attacks of the Turks. They were probably gradually absorbed in the surrounding populations.

Another theory concerning the racial origin of the Hephthalites is that they were one branch of the Chionites (also known as Hunas or White Huns). This branch is said to have settled in Bactria (*q.v.*) whence they invaded Persia. while a second branch, the Zavula. moved south and settled round Kabul and Ghazni. It was the Zavula. according to this theory. who invaded India.

The accounts of the Hephthalites. especially those of the Indian Hunas, dwell on their ferocity and cruelty. Their invasions shook

Indian society and institutions to the foundations but, unlike the earlier Kushans, the Hephthalites do not seem to have introduced new ideas into India nor to have acted as other than a destructive force. Many of Mihiragula's coins bear the Nandi bull (Siva's emblem); and the king's name is preceded by the title *sahi* (shah). which had previously been used by the Kushan dynasty. Toramana's coins are found plentifully in Kashmir, which, therefore, probably formed part of the Huna dominions before Mihiragula's time.

Greek writers give a more flattering account of the Hephthalites; Procopius says they were far more civilized than the Huns of Attila. The Chinese writers say their customs were like those of the Turks: that they had no cities, lived in felt tents, were ignorant of writing and practised polyandry. Nothing whatever is known of their language, but some scholars explain the names Toramana and Jauvla as Turkish.

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HEPPLEWHITE, GEORGE (d. 1786), English cabinet-maker and furniture designer whose name is famous for a graceful style rather than for the work of his own hand. Little is known of his life except that he was apprenticed to Robert Gillow of Lancaster, went to London and opened a shop in Redcross street. St. Giles, Cripplegate. He died in 1786, and administration of his estate was granted to his widow, Alice, who carried on the business. The *Cabinet-Maker and Upholsterer's Guide* was published in 1788, with nearly 300 designs "from drawings by A. Hepplewhite and Co. Cabinet-makers." A second edition, almost unchanged, appeared in 1789, and a third edition was published in 1794, the section on chairs being brought up to date, notably by the inclusion of chairs with square backs. The plates in the *Guide* are unsigned, but ten designs signed "Hepplewhite" or "Heppelwhite" are included in the *Cabinet-Makers' London Book of Prices* (1788).

Pieces of furniture based on designs in the *Guide* are rare, and no piece can be definitely attributed to Hepplewhite's firm. Nor can Hepplewhite's personal responsibility for the designs in the *Guide* be established. In a note on a chair design incorporating the three feathers, it is claimed that it "has been executed with good effect for the prince of Wales," but the firm is not mentioned in the royal accounts, nor is there any other evidence to show that Hepplewhite's was a fashionable firm. The achievement of the *Guide* was to translate into simple yet elegant terms the more extravagant furniture of the neoclassical style as seen in the designs of Robert Adam. This purpose is expressed in the preface, "to unite elegance and utility, and blend the useful with the agreeable."

That the designs are not an original creation but rather the expression of the best in current taste is again confirmed in the preface, "we designedly followed the latest or most prevailing fashion only. purposely omitting such articles, whose recommendation mas mere novelty, and perhaps a violation of all established rule."

Simplicity, elegance and utility are characteristic of all the designs in the *Guide*. Many of them were intended to be made in inlaid satinwood, others in mahogany or with japanned decoration. Chairs. with straight tapered legs, have shield-, heart- and oval-shaped backs, incorporating urns. festoons, cornhusk chains and other typical motifs of the neoclassical style. Upholstered settees of serpentine form, window seats with scrolled arms small square- and circular-topped inlaid tables, bookcases with delicate tracery in the glazed doors and serpentine fronted chests of drawers are all characteristic of the graceful style to which Hepplewhite has given his name.

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HEPTARCHY, a word used by historians to designate the period between the setting up of Anglo-Saxon kingdoms in England toward the end of the 5th century and the destruction of most of them by the Danes in the second half of the 9th century. It is derived from the Greek words for "seven" and "rule" and appears first to have been used by William Lambarde in 1576. The seven kingdoms were Northumbria, Mercia, East Anglia, Essex, Kent, Sussex and Wessex. The term is inaccurate, however, for in sqme periods Northumbria consisted of the two kingdoms of Deira and Bernicia, and Lindsey also had a royal line of its own. while Sussex ceased to be a separate kingdom in the late 8th century.

(D. WK.)

HERA, in Greek mythology a daughter of the Titans Cronus and Rhea, sister-wife of Zeus and queen of the Olympian gods. The Romans identified her with their Juno (*q.v.*). The derivation of Hera's name is obscure, but it probably means simply "lady"; it is likely that she was a pre-Hellenic deity. Hera plays an important part in literature from the time of Homer and Hesiod, appearing most frequently as the jealous and rancorous wife of Zeus and pursuing with vindictive hatred the heroines, such as Alcmene, Leto and Semele. who were beloved by Zeus, as also their children. In cult, however, her dignity and power are naturally more emphasized.

Hera was worshiped throughout the Greek world, and especially in the ancient centres of Argos, Mycenae and Sparta, which she claims in the *Iliad* as her three dearest cities—although her Spartan cult subsequently somewhat declined. She was particularly honoured on the island of Samos, off the coast of Asia Minor, and worshiped also extensively in Magna Graecia, as witness her temple at Crotona on the south Italian coast.

Hera was held to be the sole lawful wife of Zeus from an early time; she soon supersedes Dione, who shares with him his ancient oracle shrine at Dodona in Epirus. He and Hera therefore often share altars and sacrifices, and also a dramatic representation of their sacred marriage. For instance, at Plataea in Boeotia, an effigy of Hera was made from an oak tree, dressed in bridal attire and carried in procession on a cart.

This conveyed a story to the effect that Hera had left Zeus in anger; that Zeus, to win her back through jealousy, announced that he was about to marry and dressed up a puppet to imitate a bride; and that Hera, meeting the wedding procession and tearing off the "bride's" veil, discovered the ruse and was reconciled to her husband. Every sixth year this mime was performed with numerous images, which were then burned on the top of Mt. Cithaeron together with animals and the sacrificial altar The rite thus appears to be a charm designed to quicken the growth of vegetation; the marriage of Zeus and Hera would, in this case, represent the union of the king and queen of May. Legends also often mention how the pair had anticipated marriage.

But Hera and Zeus need not for all that have had anything originally to do with the earth or with vegetation. The ceremony of the solemn concealment and discovery of Hera's image on the seashore at Samos suggests a marriage neither of heaven and earth nor of two vegetation spirits but rather a reflection of certain local marriage customs. It is to be noted that Hera had little to do with agriculture except at Argos, and that she was not closely associated with such earth and vegetation deities as Cybele, Demeter. Persephone and Dionysus.

In general Hera was worshiped in two main capacities: as consort of Zeus and queen of heaven; and as goddess of marriage and of the life of women. This latter sphere naturally made her the protectress of women in childbed. and she bore the title of Eileithyia (q v.), the birth-goddess, at Argos and Athens. In Homer and Hesiod she is the mother of Eileithyia. Her cult title of "maiden," "wife," "widow" or "divorced" express her worshipers' different conditions of life.

At Argos and Samos, however, Hera was more even than queen of heaven and marriage-goddess. She was patron of those cities, which gave her a position corresponding to that of Athena at Athens. Her Argive ritual was markedly agricultural; the first plow oxen were hers as "lady of the yoke," and the sprouting ears of corn were "the flowers of Hera." Girls called "flower-bearers" served in her temple, and a spring flower festival was celebrated by Peloponnesian women. She also had a celebration called the

Shield, and there was an armed procession in her honour at Samos. All this resulted from the breadth of functions attributed to the patron deity of a Greek state: a city-goddess must be chief in peace and war alike, and her interests reflect those of her people.

The animal especially sacred to Hera was the cow. The Homeric epithet *boopis* may have meant "cow-faced" to her earliest worshipers—the heifer-goddess Io (*q.v.*) was her first Argive priestess — although it was later understood as "large-eyed" (like a cow). Oxen drew her car in processions, and cows were sacrificed to her Her sacred bird was first the cuckoo. under whose form Zeus wooed her. and later.the peacock.

Hera's first primitive cult images consisted of a log, a plank or a pillar. Later came statues. of nhich the most celebrated was the work of gold and ivory made by the elder Polyclitus for the Heraion at Argos soon after 423 B.C. He seems to have fixed her type as the majestic, rather severe but youthful matron that she subsequently appears. *See* also references under "Hera" in the Index volume

See M. P. Nilsson, *Geschichte* der *griechischen Religion,* 2nd ed., vol. i, pp. 427–433 (1955).

HERACLEIA or, in the Latin form. HERACLEA. the name of a large number of ancient cities founded by the Greeks.

1. HERACLEA, an ancient city of Lucania. near the modern Policoro. Italy; 3 mi. from the coast of the Gulf of Tarentum, between the Aciris (Xgri) and Siris (Sinni) rivers about 13 mi. S.S.W. of Metapontum. It was a Greek colony founded by the Tarentines who had been deieated by the Thurians in 433 B.C. There Pyrrhus, king of Epirus, defeated the consul Laevinus in 280 B.C., after he had crossed the Siris river. In 278 B.C., probably in order to detach it from Tarentum, the Romans made a special treaty with Heraclea, on such favourable terms that in 89 B.C. the Roman citizenship given to the inhabitants by the Lex Plautia Papiria was only accepted after considerable hesitation. Having accepted Roman citizenship, it became a municipium; part of a copy on bronze of the Lex Iulia Municipalis of 46 B.C., found between Heraclea and Metapontum, is of the highest importance for knowledge of that law. It was still of importance under the empire; a branch road from Venusia joined the coast road there. Its medieval representative was Anglona, once a bishopric.

There was another Heraclea to which Herodotus refers. near Mt. Eryx. founded by Dorieus not. long after 500 B.C. and soon destroyed by the Carthaginians and Egesteans.

2. HERACLEA MINOA. an ancient town on the south coast of Sicily, at the mouth of the Halycus river (modern Platani) about 20 mi. W.N.W. of Girgenti. It was founded by Selinus and was always a border town between Carthaginian and Greek territory. It was taken by the Lacedaemonian colonists under Euryleon shortly before 500 but must have iallen into Carthaginian hands before Acragas (406). They lost it temporarily to Agathocles and Pyrrhus. but used it as a base in the first Punic War.

3. HERACLEA PONTICA (mod. Eregli), an ancient city on the coast of Bithynia in Asia Minor, at the mouth of the Kilijsu. It was founded by a Megarian colony. which soon subjugated the native Mariandynians and extended its power over a considerable territory. The prosperity of the city was utterly destroyed in the Mithridatic War. It was the birthplace of Heracleides Ponticus. The modern town is known for its coal mines.

4. HERACLEA SINTICA, a town in Thracian Macedonia, to the south of the Strymon, the site of which was sought by Leake at the village of Zervokhori, and identified by the discovery of local coins. while other authorities place it farther north.

5. HERACLEA, a tom-n on the borders of Caria and Ionia. near Mt. Latmus. A temple and a rock-cut theatre were once visible. In its neighbourhood was the burial cave of Endymion.

6. HERACLEA-CYBISTRA (mod. Eregli in the vilayet of Konia), under the name Cybistra, had some importance in Hellenistic times owing to its position near the point where the road to the Cilician Gates enters the hills. It lay in the way of armies and was more than once sacked by the Arab invaders of Asia Minor (A.D. 805 and 832) It becàme Turkish (Seljuk) in the 11th century.. Modern Eregli grew from a large village to a town after the railway reached it from Konia and Karaman in 1904. South, at Ivriz. is a Hittite rock relief: representing a king adoring a god. This was the first Hittite monument discovered in modern times (early 18th century, by an emissary of Louis XIV).

7. HERACLEA LYNCESTIS (mod. Monastir) was a town in Macedonia. on the Via Egnatia.

For Heraclea Trachinia *see* TRACHIS, and for Heraclea Perinthus *see* PERINTHUS.

HERACLEA was also the name of one of the Cyclades, between Kaxos and Ios, which is still called Iraklia, and bears traces of a Greek township with temples to Tyche and Zeus Lophites.

HERACLEIDES PONTICUS (d. after 322 B.C.). Greek philosopher. an eminent member of the Greek Academy (see ACADEMY, GREEK). was born at Heracleia in Pontus. Some authorities count him among the Peripatetics; but he was certainly a pupil of Plato. who left the Academy temporarily in his charge; and he was nearly elected to succeed Speusippus as the head of the Academy. His writings are lost except for a few fragments. We know that he taught the axial rotation of the earth, that he anticipated either the geoheliocentric or the geocentric hypothesis (Copernicus expressed his indebtedness to him, but the interpretation of the details of Heracleides' astronomic theories is controversial) and that he taught some kind of (teleologicalj atomism. Several works of his were devoted to literary criticism, musicology, etc. Besides these (more scientific) interests, he dealt with occult phenomena (trances. cosmological visions. prophecies, portents) and cataclysms, proving or illustrating by them the existence of gods, divine retribution, reincarnation, etc.. thus exemplifying the supranaturalistic tendencies of Platonism and foreshadowing some aspects of Neoplatonism.

See F. Wehrli (ed.). *Herakleides Pontikos* (Basel, 1953); P. Duhem, *Le Système du monde,* i, iii (Paris, 1913, 1915). (PP. M.)

HERACLEON, a Gnostic who flourished *c.* A.D. 125, probably in the south of Italy. He appears to have regarded the divine nature as a vast abyss in whose *pleroma* were aeons of different orders — emanations from the source of being. Midway between the supreme God and the material world was the Demiurgus, who created the latter, and under whose jurisdiction the animal soul of man proceeded after death. while his celestial soul returned to its origin. Origen. who treats Heracleon as a notabie exegete, has preserved fragments of his commentary on the fourth Gospel (brought together by Grabe in vol. ii of his *Spicilegium*), while Clement of Alexandria quotes what appears to be a passage from a commentary on Luke. These writings are intensely mystical and allegorical.

HERACLEONAS, East Roman emperor (Feb.–Sept. 641), was the son of Heraclius (*q.v.*) and Martina. At the end of Heraclius' reign he obtained through his mother's influence the title of Xugustus (638), and after his father's death was proclaimed joint emperor with his half-brother Constantine III. The premature death of Constantine. in May 641, left him sole ruler. But suspicion that he and Martina had murdered Constantine led to a revolt and to the mutilation and banishment of the supposed offenders. Nothing is known of him after 641.

HERACLIDAE, the general name for the numerous descendants of Heracles (Hercules); the name is especially used in antiquity for Hyllus and his descendants, the leaders of the Dorian invasion of the Peloponnese. The Dorian invasion and the collapse of the Heroic civilization is represented in Greek tradition as the "return of the Heraclids," seeking their father's inheritance. primarily Argos, oi which he had been defrauded by Eurystheus. The legend appears to have been reduced to order by Ephorus. and the date fixed at 1104 B.C.

The two main traditions may be summarized thus — chiefly from Herodotus and Pindar. The first centres round Echemus, king of Arcadia. who defeated the Heraclidae at the Isthmus before the Trojan War. They covenanted to stay away for three generations. At the end of this period the three sons of Xristomachus returned to Peloponnesus. captured it and divided the territory. Temenus taking .Argus. the sons of Xristodemus Sparta and Cresphontes Messene. The second. implicit in Herodotus' account of the coming of the Dorians, tells of the adoption by Xegimius, the Thessalian ancestor of the Dorians, of Hyllus as coheir with his own

sons (hence the Dorian tribes, Hylleis, Pamphyloi and Dymanes); and of the subsequent conquest of Peloponnesus by the three and their followers. It is difficult to reconcile these traditions, and, considered separately, each presents problems. It is probable that Messene was never Dorian until its conquest by Sparta.

There are further complications in addition to the confusion introduced by later writers; for instance, there is a Heraclid called Aletes ("the wanderer") who appears in Peloponnesus in one of the stories; he may have come from Rhodes. And Herodotus has a story of a Heraclid dynasty in Lydia. which ruled for the 505 years before the Mermnadae dynasty (685), the last being Candaules, who was killed by Gyges the founder of the Mermnad house.

(See DORIANS.)

The main ancient authorities in addition to Herodotus *(passim* and esp. i, 56; ix, 26) are Pindar, *Pyth,* ix, *Olymp.* vii.

HERACLITUS (c. 540–*c.* 480 B.C.), Greek philosopher, of Ephesus, was descended from the earlier kings of the city but surrendered his family privileges to his brother. He was a violent critic of his fellow citizens, of other thinkers and of mankind in general. Most of the stories about his life and death (*e.g.,* that he buried himself in dung to cure dropsy) are malicious embroideries on some of his well-known sayings, by Hellenistic biographers writing in the 3rd century B.C. and later. More than 100 short fragments survive as quotations in later writers; his style, vivid, gnomic and often cryptic, rapidly earned Heraclitus the name "the obscure."

According to Heraclitus the most important thing for men was the understanding of the logos, the universal formula of things in accordance with which all natural events occur and which all men should be able to assimilate. The majority, he complained, ignored the logos, even when he himself explained it, and relied like dreamers on a private and therefore false view of the world. An important manifestation of the logos was the underlying connections betueen opposites. This was illustrated by Heraclitus with many concrete examples; *e.g.,* sea water is both harmful (for men) and beneficial (for fishes). The connection between opposites—apparently the most divergent of all things—meant that the world was not just an indeterminate agglomeration of essentially distinct components, but a coherent and discoverable system in which changes in one direction are ultimately balanced by corresponding ones in the other; there is a hidden attunement or connection between things which means that what is apparently "tending apart" is actually "being brought together." The apprehension of the formal unity of the world of experience, rather than the genetic unity sought in the theogonic and Milesian tradition, together with the conviction that man's first task is to understand the principles that control both himself and his environment, was perhaps Heraclitus' main philosophical contribution.

The world order is eternal, an "ever-living fire kindling in measures and being extinguished in measures." (It was a Stoic interpretation, perhaps following Theophrastus, that assigned to Heraclitus the idea of a periodic universal conflagration.) Fire is in one respect a concrete manifestation of the logos, since its own changes are proportionate and "measured" in terms of fuel, flame and smoke. Pure fire fills the sky, as ether or the shining upper air. Parts of it "turn to" sea (presumably as rain), while parts of sea turn to earth. Simultaneously equivalent masses of earth and sea throughout the world as a whole are reverting to sea and fire; thus a continuous world order is preserved. Heraclitus illustrated this kind of persistence of unity through change by the analogy of the river: "Upon those who step into the same rivers different and ever different waters flow down." Plato, who may have been thinking in terms of the exaggerated version of Heraclitus' doctrine propagated by Cratylus, took this to mean that all things absolutely are in constant flux, though this often escapes the senses. But Heraclitus, who said "The things of which there is seeing, hearing, understanding, are those that I prefer," is unlikely to have favoured an explanation of change which contradicted the senses unnecessarily. He was acutely aware of the "strife" of things, without which, indeed, the reaction between opposites, and thus their essential connection, would cease; but not all parts of the cosmic battlefield need be in strife at the same time: rocks and mountains, for example, can be temporarily stable, though they too will eventually change.

God was identified by Heraclitus with the opposites, persisting through their changes and thus able perfectly to comprehend their unity. Thus God knows "how all things are steered through all" and is completely wise. The rites of conventional religion were ridiculed by Heraclitus, unless by accident they symbolized the true relation of opposites.

The soul is made of fire and is bound up in the same cycle of changes as individual parts of the world as a whole. Death involves the total extinction of soul; sleep, drunkenness, or stupidity, its partial moistening. It seems that particularly fiery and virtuous souls (notably of those who died suddenly and bravely in battle, unmoistened by sickness) might survive for a time as beneficent daemons, before returning to ethereal fire.

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HERACLIUS (Ἡρακλεῖος) (c. 575–641), East Roman emperor, was born in Cappadocia. His father held high military command under the emperor Maurice, and as governor of Africa maintained his independence against the usurper Phocas (*q.v.*). When invited to head a rebellion against the latter, he sent his son with a fleet which reached Constantinople unopposed. and precipitated the dethronement of Phocas. Proclaimed emperor (610), Heraclius set himself to reorganize the utterly disordered administration At first he found himself helpless before the Persian armies (see PERSIA: *History;* and KHOSRAU) of Khosrau, which conquered Syria and Egypt and since 616 had encamped opposite Constantinople; in 618 he even proposed to abandon his capital and seek a refuge in Carthage, but at the entreaty of the patriarch he took courage. By securing a loan from the church and suspending the corn-distribution at Constantinople, he raised sufficient funds for war, and after making a treaty with the Avars. who had nearly surprised the capital during an incursion in 619, he was at last able to take the field against Persia. During his first expedition (622) he failed to secure a footing in Armenia, whence he had hoped to take the Persians in flank, but by his unwearied energy he restored the discipline and efficiency of the army. In his second campaign (624–26) he penetrated into Armenia and Albania, and beat the enemy in the open field. After a short stay at Constantinople, which his son Constantine had successfully defended against renewed incursions by the Avars. Heraclius resumed his attacks upon the Persians (627). Though deserted by the Khazars, with whom he had made an alliance upon entering into Pontus, he gained a decisive advantage by a brilliant march across the Armenian highlands into the Tigris plain, and a hard-fought victory over Khosrau's general, Shahrbaraz, in which Heraclius distinguished himself by his personal bravery. A subsequent revolution at the Persian court led to the dethronement of Khosrau in favour of his son Kavadh II (*q.v.*); the new king promptly made peace with the emperor, whose troops were already advancing upon the Persian capital Ctesiphon (528). Having secured his eastern frontier, Heraclius returned to Constantinople with the true cross, which in 629 he brought back in person to Jerusalem. On the northern frontier of the empire he kept the Avars in check by inducing the Serbs to migrate from the Carpathians to the Balkan lands so as to divert the attention of the Avars.

The triumphs which Heraclius had won did not bring him lasting popularity. In his civil administration he followed out his own ideas without deferring to the nobles or the Church, and the opposition which he encountered from these quarters went far to paralyze his attempts at reform. Worn out by continuous fighting and weakened by dropsy, Heraclius failed to show sufficient energy against the new peril that menaced his eastern provinces

towards the end of his reign. In 629 the Saracens made their first incursion into Syria (see CALIPHATE: *The* First Four Caliphs); in 636 they won a victory on the Yermuk (Hieromax), and in the following years conquered all Syria, Palestine and Egypt. Heraclius made no attempt to retrieve the misfortunes of his generals, but evacuated his possessions in sullen despair. The remaining years of his life he devoted to theological speculation and ecclesiastical reforms. His religious enthusiasm led him to oppress his Jewish subjects; on the other hand he sought to reconcile the Christian sects, and to this effect propounded in his *Ecthesis* a conciliatory doctrine of monothelism. Heraclius died of dropsy in 642. He had been twice married; his second union, with his niece Martina, was frequently made a matter of reproach to him. In spite of his partial failures, Heraclius must be regarded as one of the greatest of Byzantine emperors, and his early campaigns were the means of saving the realm from almost certain destruction.

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HERALD; for the mediaeval and modern functions of a herald, see HERALDRY.

Greek Heralds, So-called.—The word "herald" is commonly used to translate Gr. κῆρυξ, which has various meanings. (1) In Homer, a κῆρυξ is mostly a trusted attendant or retainer of a chieftain, one might almost say a gentleman of the bedchamber. We several times hear of them attending and waiting on their lords, performing confidential Services for them, and so forth. But they also have official and public functions; they proclaim and execute the king's will—in which capacity it would seem that their persons are inviolable—and summon and keep order at the folk-moot. (2) These functions continue at later times, and we find heralds acting as inviolable messengers between states, even in time of war, proclaiming meetings of a senate, popular assembly, or court of law, reciting the formulae of prayer, etc., thereat, and summoning persons to attend. Hermes, himself the herald of the gods, is their patron and carries' a herald's staff (caduceus, κηρύκειον; see HERMES). (3) Besides these paid functionaries of the State, there was a clan of kerykes at Eleusis, who had certain duties in connection with the mysteries. (4) The word, however, often means no more than a crier, whether at the Olympian or other games or simply at a sale or the like.

Latin "Heralds."—Setting aside the misuse of "herald" to translate praeco (crier, auctioneer), or *apparitor* (summoner, attendant on a magistrate), we may notice the real equivalent of the Greek κῆρυξ in his capacity as an inviolable messenger, the *fetialis*. A college of jetiales existed from very early times; such an institution was by no means confined to Rome, and parallels to it are found among quite low savages, giving us the right to suppose that it had long been recognized in Italy before our earliest historical documents. At Rome, if a breach of international law by a neighbouring state was alleged, two fetiales at least were appointed, the *pater* patratus, who was the senior member of the deputation, and the Verbenarius, or carrier of the sacred herbs (verbenae, sagmina), which apparently represented the Roman territory. These went to the State in question and thrice solemnly demanded redress (clarigeratio); if this was not obtained within 30 days, they reported the matter at Rome; when war was voted they returned to the frontier, and flung a javelin, made of cornel-wood and having either an iron point or one end sharpened and hardened by fire (this clearly is the older form), into the hostile territory, calling on the gods to witness the justice of their cause. In later times, a plot of land in Rome, containing the famous *columna* bellica or pillar of war, was by a legal fiction made to represent hostile territory, and the javelin cast into it, thus avoiding the long journeys overseas to perform the ceremony. They also made treaties of peace, when the terms had been agreed upon and ratified. For this purpose, the deputation carried flint knives, or a flint knife, which was the embodiment of Jupiter, and kept in one of his temples (*Iuppiter* lapis). They met the deputation of the other state; the terms of the treaty were read aloud; a pig was killed with the knife (hence the phrase foedus *ferire*, to smite a treaty-victim, for "to make a treaty," the Greeks said ὅρκια τάμνειν, to cut oath-victims, and had a very similar rite), and Jupiter was invoked to smite Rome in like manner, if Rome were the first wantonly to violate the treaty. The college of fetiales, though little is heard of it after 201 B.C., continued to exist throughout the empire.

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HERALDRY. Although the word heraldry properly belongs to all the business of the herald (*q.v.*), it has long attached itself to that which in earlier times was known as armory, the science of armorial bearings.

History of Armorial Bearings.—In all ages and in all quarters of the world distinguishing symbols have been adopted by tribes or nations, by families or by chieftains. Greek and Roman poets describe the devices borne on the shields of heroes, and many such painted shields are pictured on antique vases. Rabbinical writers have supported the fancy that the standards of the tribes set up in their camps bore figures devised from the prophecy of Jacob, the ravening wolf for Benjamin, the lion's whelp for Judah and the ship of Zebulon. In the East we have such ancient symbols as the five-clawed dragon of the Chinese empire and the chrysanthemum of the emperor of Japan. In Japan, indeed, the systematized badges borne by the noble clans may be regarded as akin to the heraldry of the West, and the circle with the three asarum leaves of the Tokugawa shoguns has been made as familiar to us by Japanese lacquer and porcelain as the red pellets of the Medici by old Italian fabrics. Before the landing of the Spaniards in Mexico the Aztec chiefs carried shields and banners, some of whose devices showed after the fashion of a phonetic writing the names of their bearers; and the eagle on the new banner of Mexico may be traced to the eagle that was once carved over the palace of Montezuma. That mysterious business of totemism, which students of folk-lore have discovered among most primitive peoples, must be regarded as another of the forerunners of true heraldry, the totem of a tribe supplying a badge which was sometimes displayed on the body of the tribesman in paint, scars or tattooing. Totemism so far touches our heraldry that some would trace to its symbols the white horse of Westphalia, the bull's head of the Mecklenburgers and many other ancient armories.

When true heraldry begins in Western Europe nothing is more remarkable than the suddenness of its development, once the idea of hereditary armorial symbols was taken by the nobles and knights. Its earliest examples are probably still to be discovered by research, but certain notes may be made which narrow the dates between which we must seek its origin. The older writers on heraldry, lacking exact archaeology, were wont to carry back the beginnings to the dark ages, even if they lacked the assurance of those who distributed blazons among the angelic host before the Creation. Even in our own times old misconceptions give ground slowly. Georg Ruexner's Thurnier Buch of 1522 is still cited for its evidence of the tournament laws of Henry the Fowler, by which those who would contend in tournaments were forced to show four generations of arms-bearing ancestors. Yet modern criticism has shattered the elaborated fiction of Ruexner. In England many legends survive of arms borne by the Conqueror and his companions. But nothing is more certain than that neither armorial banners nor shields of arms were borne on either side at Hastings. The famous record of the Bayeux tapestry shows shields which in some cases suggest rudely devised armorial bearings, but in no case can a shield be identified as one which is recognized in the generations after the Conquest. So far is the idea of personal arms from the artist, that the same warrior, seen in

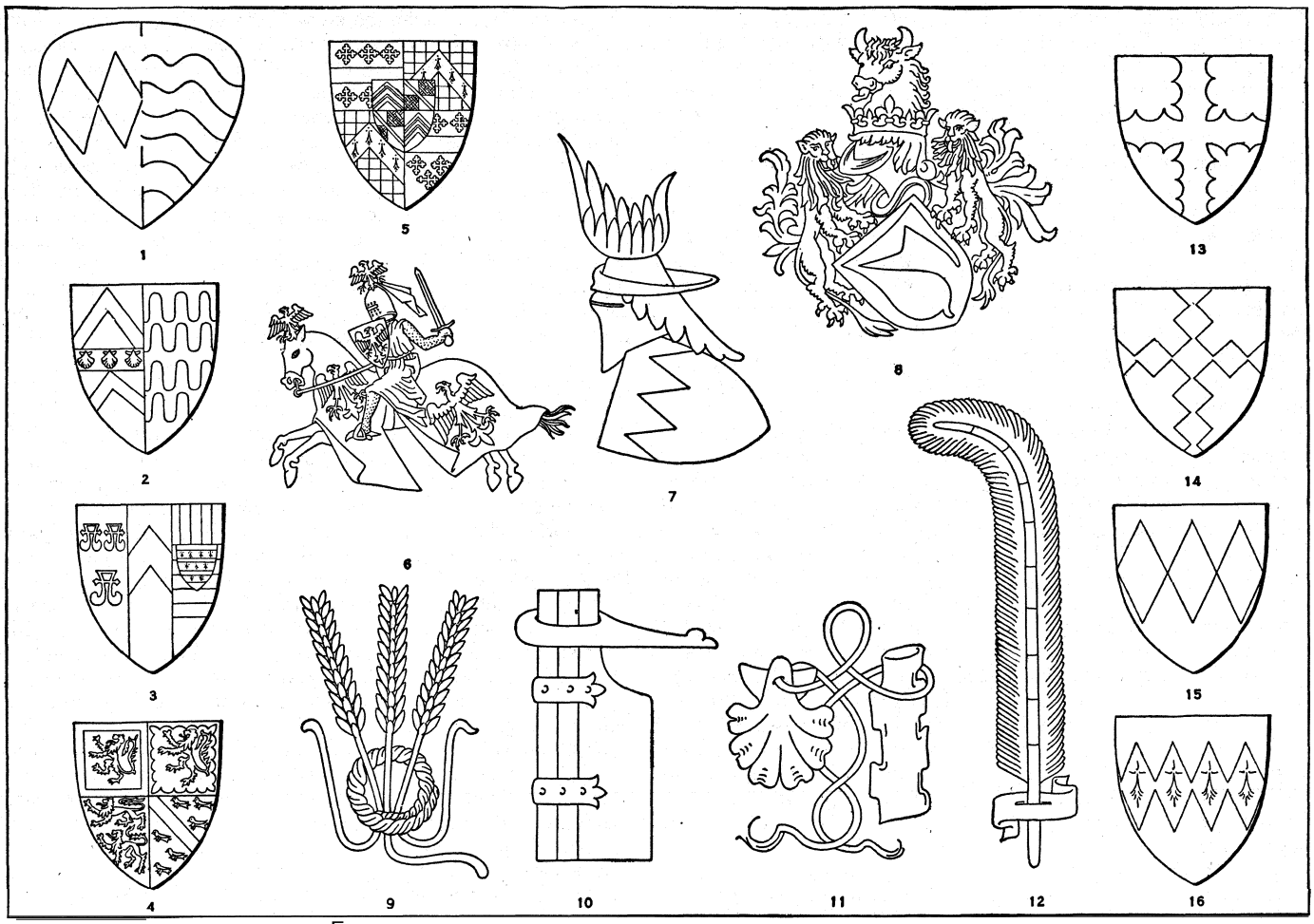

FIG. I.—SHIELDS BEARING ARMS CHARACTERISTIC OF THE MIDDLE AGES

(1) Shield from seal of Robert de Pinkeny, an early example of parted arms. (2) Shield of Joan atte Pole, widow of Robt. Hemenhale, from her seal (1403), showing parted arms. (3) Shield of Beatrice Stafford from her seal (1404), showing her arms of Stafford between those of her husbands—Thomas, Lord Roos, and Sir Richard Burley. (4) Shield of John Taibot, first Earl of Shrewsbury (d. 1453), showing four coats quartered. (5) Shield of Richard Beauchamp, Earl of Warwick, from his garter stall-plate (after 1423). The arms are Beauchamp quartering Newburgh with a scocheon of Clare quartering Despenser. (6) Ralph de Monhermer (1301) showing shield of arms, helm with crest and mantle, horse-crest and armorial trappings. (7) Shield and crested helm with hat and mantle of Thomas Hengrave (1401). (8) Arms of William, Lord Hastings, from his seal (1477), showing shield, crowned and crested helm with mantle and supporters. (9) Badge of John of Wethamstede, abbot of St. Albans (d. 1465), from his tomb in the abbey church. (10) Rudder badge of Wilioughby. (11) Badge of Dacre of Gilsland and Dacre of the North. (12) Ostrich feather badge of Beaufort, from a garter stall-plate of 1440. The silver feather has a quill of gobony silver and azure. (13 and 14) Mohun. (15) Montagu. (16) Dynham

different parts of the tapestry's history, has his shield with differing devices. A generation later, Anna Comnena, the daughter of the Byzantine emperor, describing the shields of the French knights who came to Constantinople, tells us that their polished faces were plain.

Of all men, kings and princes might be the first to be found bearing arms. Yet the first English sovereign who appears on his great seal with arms on his shield is Richard I. His seal of 1189 shows his shield charged with a lion ramping towards the sinister side. Since one half only is seen of the rounded face of the shield, English antiquaries have perhaps too hastily suggested that the whole bearing was two lions face to face. But the mounted figure of Philip of Alsace, count of Flanders, on his seal of 1164 bears a like shield charged with a like lion, and in this case another shield on the counterseal makes it clear that this is the single lion of Flanders. Therefore we may take it that, in 1189, King Richard bore arms of a lion rampant, while, nine years later, another seal shows him with a shield of the familiar bearings which have been borne as the arms of England by each one of his successors.

That seal of Philip of Alsace is the earliest known example of the arms of the great counts of Flanders. The ancient arms of the kings of France, the blue shield powdered with golden fleurs-de-lys, appear even later. Louis le Jeune, on the crowning of his son Philip Augustus, ordered that the young prince should be clad in a blue dalmatic and blue shoes, sewn with golden fleurs-de-lys, a flower whose name, as "Fleur de Loys," played upon that of his own, and possibly upon his epithet name of Florus. A seal of the same king has the device of a single lily. But the first French royal seal with the shield of the lilies is that of Louis VIII. (1223–1226). The eagle of the emperors may well be as ancient a bearing as any in Europe, seeing that Charlemagne is said, as the successor of the Caesars, to have used the eagle as his badge. The emperor Henry III. (1039–1056) has the sceptre on his seal surmounted by an eagle; in the 12th century the eagle was embroidered upon the imperial gloves. At Molsen in 1080 the emperor's banner is said by William of Tyre to have borne the eagle, and with the beginning of regular heraldry this imperial badge would soon be displayed on a shield. The double-headed eagle is not seen on an imperial seal until after 1414, when the bird becomes the recognized arms of the king of the Romans.

There are, however, earlier examples of shields of arms than any of these. A document of the first importance is the description by John of Marmoustier of the marriage of Geoffrey of Anjou with Maude the empress, daughter of Henry I., when the king is said to have hung round the neck of his son-in-law a shield with golden "lioncels." Afterwards the monk speaks of Geoffrey in fight, "pictos leones preferens in clypeo." Two notes may be added to this account. The first is that the enamelled plate now in the museum at Le Mans, which is said to have been placed over the tomb of Geoffrey after his death in 1151, shows him bearing a

long shield of azure with six golden lioncels, thus confirming the monk's story. The second is the well-known fact that Geoffrey's bastard grandson, William with the Long Sword, undoubtedly bore these same arms of the six lions of gold in a blue field, even as they are still to be seen upon his tomb at Salisbury. Some ten years before Richard I. seals with the three leopards, his brother John, count of Mortain, is found using a seal upon which he bears two leopards, arms which later tradition assigns to the ancient dukes of Normandy and to their descendants the kings of England before Henry II., who is said to have added the third leopard in right of his wife, a legend of no value. Mr. Round has pointed out that Gilbert of Clare, earl of Hertford, who died in 1152, bears on his seal to a document sealed after 1138 and not later than 1146, the three cheverons afterwards so well known in England as the bearings of his successors. An old drawing of the seal of his uncle Gilbert, earl of Pembroke (*Lansdowne* MS. 203), shows a cheveronny shield used between 1138 and 1148. At some date between 1144 and 1150, Waleran, count of Meulan, shows on his seal a pennon and saddle-cloth with a checkered pattern: the house of Warenne, sprung from his mother's son, bore shields checky of gold and azure. In the inventory of Norman seals made by M. Demay, there is among the archives of the Manche a grant by Eudes, seigneur du Pont, sealed with a seal and counterseal of arms, to which M. Demay gives a date as early as 1128; but this is an error; the date should be 1218. Another type of seal common in this 12th century shows the personal device which had not yet developed into an armorial charge. A good example is that of Enguerrand de Candavène, count of St. Pol, where, although the shield of the horseman is uncharged, sheaves of oats, playing on his name, are strewn at the foot of the seal. Five of these sheaves were the arms of Candavène when the house came to display arms. In the same fashion three different members of the family of Armenteres in England show one, two or three swords upon their seals, but there is no evidence of a coat of arms derived from these devices.

From the beginning of the 13th century arms upon shields increase in number. Soon the most of the great houses of the west display them with pride. Leaders in the field, whether of a royal army or of a dozen spears, saw the military advantage of a custom which made shield and banner things that might be recognized in the press. Although it is probable that armorial bearings have their first place upon the shield, the charges of the shield are found displayed on the knight's long surcoat, his "coat of arms," on his banner or pennon, on the trapper of his horse and even upon the peaks of his saddle. An attempt has been made to connect the rise of armory with the adoption of the barrel-shaped close helm; but even when wearing the earlier Norman helmet with its long nasal the knight's face was not to be recognized. The Conqueror, as we know, had to bare his head before he could persuade his men at Hastings that he still lived. Armory satisfied a need which had long been felt. When fully armed, one galloping knight was like another; but friend and foe soon learned that the gold and blue checkers meant that Warenne was in the field and that the gold and red vair was for Ferrers. Earl Simon at Evesham sent up his barber to a spying place and, as the barber named in turn the banners which had come up against him, he knew that his last fight was at hand. In spite of these things the growth of the custom of sealing deeds and charters had at least as much influence in the development of armory as any military need. By this way, women and clerks, citizens and men of peace, corporations and colleges, came to share with the fighting man in the use of armorial bearings. Arms in stone, wood and brass decorated the tombs of the dead and the houses of the living; they were broidered in bed-curtains, coverlets and copes, painted on the sails of ships and enamelled upon all manner of goldsmiths' and silversmiths' work. And, even by warriors, the full splendour of armory was at all times displayed more fully in the fantastic magnificence of the tournament than in the rougher business of war.

There can be little doubt that ancient armorial bearings were chosen at will by the man who bore them, many reasons guiding his choice. Crosses in plenty were taken. Old writers have asserted that these crosses commemorate the badge of the crusaders, yet the fact that the cross is the symbol of the faith was reason enough. No symbolism can be found in such charges as bends and fesses; they are on the shield because a broad band, aslant or athwart, is a charge easily recognized. Mediaeval wisdom gave every noble and magnanimous quality to the lion, and therefore this beast is chosen by hundreds of knights as their bearing. We have already seen how the arms of a Candavène play upon his name. In ancient shields almost all beasts and birds other than the lion and the eagle play upon the bearer's name. No object is so humble that it is unwelcome to the knight seeking a pun for his shield. Trivet has a three-legged trivet. The legends which assert that certain arms were "won in the Holy Land" or granted by ancient kings for heroic deeds in the field are for the most part worthless fancies.

Tenants or neighbours of the great feudal lords were wont to make their arms by differencing the lord's shield or by bringing some charge of it into their own bearings. Thus a group of Kentish shields borrow lions from that of Leyborne, which is azure with six lions of silver. Shirland of Minster bore the same arms differenced with an ermine quarter. Detling had the silver lions in a sable field. The Vipont ring or annelet is in several shields of Westmorland knights, and the cheverons of Clare, the cinquefoil badge of Beaumont and the sheaves of Chester can be traced in the coats of many of the followers of those houses. Sometimes the lord himself set forth such arms in a formal grant, as when the baron of Greystock grants to Adam of Blencowe a shield in which his own three chaplets are charges. The Whitgreave family of Staffordshire still show a shield granted to their ancestor in 1442 by the earl of Stafford, in which the Stafford red cheveron on a golden field is four times repeated.

Differences.—By the custom of the middle ages the "whole coat," which is the undifferenced arms, belonged to one man only and was inherited whole only by his heirs. Younger branches differenced in many ways, following no rule. In modern armory the label is reckoned a difference proper only to an eldest son. But in older times, although the label was very commonly used by the son and heir apparent, he often chose another distinction during his father's lifetime, while the label is sometimes found upon the shields of younger sons. Changing the colours or varying the number of charges, drawing a bend or baston over the shield or adding a border are common differences of cadet lines. Beauchamp, earl of Warwick, bore "Gules with a fesse and six crosslets gold." His cousins are seen changing the crosslets for martlets or for billets. Bastards difference their father's arms, as a rule, in no more striking manner than the legitimate cadets. Towards the end of the 14th century we have the beginning of the custom whereby certain bastards of princely houses differenced the paternal arms by charging them upon a bend, a fesse or a chief, a cheveron or a quarter. Before his legitimation the eldest son of John of Gaunt by Katharine Swinford is said to have borne a shield party silver and azure with the arms of Lancaster on a bend. After his legitimation in 1397 he changed his bearings to the royal arms of France and England within a border gobony of silver and azure. Warren of Poynton, descended from the last earl Warenne and his concubine, Maude of Neirford, bore the checkered shield of Warenne with a quarter charged with the ermine lion of Neirford. By the end of the middle ages the baston under continental influence tended to become a bastard's difference in England and the jingle of the two words may have helped to support the custom. About the same time the border gobony began to acquire a like character. The "bar sinister" of the novelists is probably the baston sinister, with the ends couped, which has since the time of Charles II. been familiar on the arms of certain descendants of the royal house. But it has rarely been seen in England over other shields; and, although the border gobony surrounds the arms granted to a peer of Victorian creation, the modern heralds have fallen into the habit of assigning, in nineteen cases out of twenty, a wavy border as the standard difference for illegitimacy.

Although no general register of arms was maintained it is remarkable that there was little conflict between persons who had chanced to assume the same arms. The famous suit in which Scrope, Grosvenor and Carminow all claimed the blue shield with

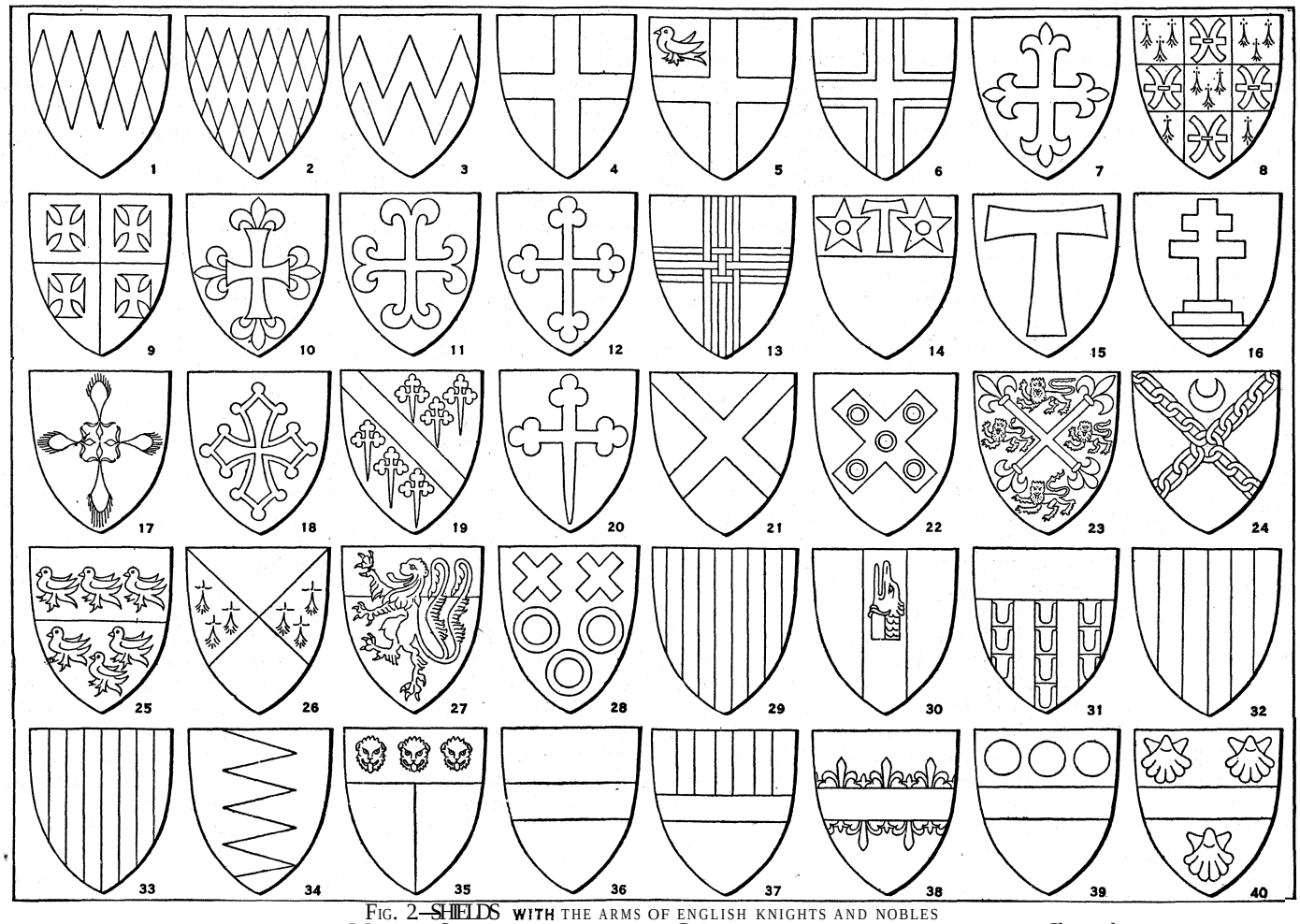

FIG. 2.—SHIELDS WITH THE ARMS OF ENGLISH KNIGHTS AND NOBLES

(1) Percy. (2) Fauconberg. (3) West. (4) St. George. (5) Harcla. (6) Creveauer. (7) Latimer. (8) Mill-rinds. (9) Chetwode. (10) Swynnerton. (11) Willoughby. (12) Brerelegh. (13) Skirlaw. (14) Drury. (15) St. Anthony's Cross. (16) Brytton. (17) Hurlestone. (18) Melton. (19) Howard. (20) Upton. (21) Nevill. (22) Upton. (23) Aynho. (24) Elwett. (25) Fenwick. (26) Restwolde. (27) Hastang. (28) Hilton. (29) Provence. (30) Gascoigne. (31) Ferlington. (32) Strelley. (33) Rothinge. (34) Bermingham. (35) Caldecote. (36) Colevile. (37) Fauconberg. (38) Cayvile. (39) Dovereux. (40) Chamberlayne

the golden bend is well known, and there are a few cases in the 14th century of like disputes which were never carried to the courts. But the men of the middle ages would seem to have had marvellous memories for blazonry; and we know that rolls of arms for reference, some of them the records of tournaments, existed in great numbers. A few examples of these remain to us, with painted shields or descriptions in French blazon, some of them containing many hundreds of names and arms.

To women were assigned, as a rule, the undifferenced arms of their fathers. In the early days of armory married women—well-born spinsters of full age were all but unknown outside the walls of religious houses—have seals on which appear the shield of the husband or the father or both shields side by side. But we have some instances of the shield in which two coats of arms are parted or, to use the modern phrase, "impaled." Early in the reign of King John, Robert de Pinkeny seals with a parted shield. On the right or dexter side—the right hand of a shield is at the right hand of the person covered by it—are two fusils of an indented fesse: on the left or sinister side are three waves. The arms of Pinkeny being an indented fesse, we may see in this shield the parted arms of husband and wife—the latter being probably a Basset. In many of the earliest examples, as in this, the dexter half of the husband's shield was united with the sinister half of that of the wife, both coats being, as modern antiquaries have it, dimidiated. This "dimidiation," however, had its inconvenience. With some coats it was impossible. If the wife bore arms with a quarter for the only charge, her half of the shield would be blank. Therefore the practice was early abandoned by the majority of bearers of parted shields although there is a survival of it in the fact that borders and tressures continue to be "dimidiated" in order that the charges within them shall not be cramped. Parted shields came into common use from the reign of Edward II., and the rule is established that the husband's arms should take the dexter side. There are, however, several instances of the contrary practice. On the seal (1310) of Maude, wife of John Boutetort of Halstead, the engrailed saltire of the Boutetorts takes the sinister place. A twice-married woman would sometimes show a shield charged with her paternal arms between those of both of her husbands, as did Beatrice Stafford in 1404, while in 1412 Elizabeth, Lady of Clinton, seals with a shield paled with five coats—her arms of la Plaunche between those of four husbands. In most cases the parted shield is found on the wife's seal alone. Even in our own time it is recognized that the wife's arms should not appear upon the husband's official seal, upon his banner or surcoat or upon his shield when it is surrounded by the collar of an order. Parted arms, it may he noted, do not always represent a husband and wife. Richard II. parted with his quartered arms of France and England those ascribed to Edward the Confessor, and parting is often used on the continent where quartering would serve in England. In 1497 the seal of Giles Daubeney and Reynold Bray, fellow justices in eyre, shows their arms parted in one shield. English bishops, by a custom begun late in the 14th century, part the see's arms with their own. By modern English custom a husband and wife, where the wife is not an heir, use the parted coat on a shield, a widow bearing the same upon the lozenge on which, when a spinster, she displayed her father's coat alone. When the wife is an heir, her arms are now borne in a little scocheon above those of her husband. If the husband's arms be in

an unquartered shield the central charge is often hidden away by this scocheon.

The practice of marshalling arms by quartering spread in England by reason of the example given by Eleanor, wife of Edward I., who displayed the castle of Castile quartered with the lion of Leon. Isabel of France, wife of Edward II., seals with a shield in whose four quarters are the arms of England, France, Navarre and Champagne. Early in the 14th century Simon de Montagu, an ancestor of the earls of Salisbury, quartered with his own arms a coat of azure with a golden griffon. In 1340 we have Laurence Hastings, earl of Pembroke, quartering with the Hastings arms the arms of Valence, as heir of his great-uncle Aymery, earl of Pembroke. In the preceding year the king had already asserted his claim to another kingdom by quartering France with England, and, after this, quartered shields became common in the great houses whose sons were carefully matched with heirs female. When the wife was an heir the husband would quarter her arms with his own, displaying, as a rule, the more important coat in the first quarter. Marshalling becomes more elaborate with shields showing both quarterings and partings, as in the seal (1368) of Sibil Arundel, where Arundel (Fitzalan) is quartered with Warenne and parted with the arms of Montagu. In all, save one, of these examples the quartering is in its simplest form, with one coat repeated in the first and fourth quarters of the shield and another in the second and third. But to a charter of 1434 Sir Henry Bromflete sets a seal upon which Bromflete quarters Vesci in the second quarter, Aton in the third and St. John in the fourth, after the fashion of the much earlier seal of Edward II.'s queen. Another development is that of what armorists style the "grand quarter," a quarter which is itself quartered, as in the shield of Reynold Grey of Ruthyn, which bears Grey in the first and fourth quarters and Hastings quartered with Valence in the third and fourth. Humphrey Bourchier, Lord Cromwell, in 1469, bears one grand quarter quartered with another, the first having Bourchier and Lovaine, the second Tatershall and Cromwell.

The last detail to be noted in mediaeval marshalling is the introduction into the shield of another surmounting shield called by old armorists the "innerscocheon" and by modern blazoners the "inescutcheon." John the Fearless, count of Flanders, marshalled his arms in 1409 as a quartered shield of the new and old coats of Burgundy. Above these coats a little scocheon, borne over the crossing of the quartering lines, had the black lion of Flanders, the arms of his mother. Richard Beauchamp, the adventurous earl of Warwick, who had seen most European courts during his wanderings, may have had this shield in mind when, over his arms of Beauchamp quartering Newburgh, he set a scocheon of Clare quartering Despenser, the arms of his wife Isabel Despenser, co-heir of the earls of Gloucester. The seal of his son-in-law, the King-Maker, shows four quarters — Beauchamp quartering Clare, Montagu quartering Monthermer, Nevill alone, and Newburgh quartering Despenser. An interesting use of the scocheon *en surtout* is that made by Richard Wydvile, Lord Rivers, whose garter stall-plate has a grand quarter of Wydvile and Prouz, quartering Beauchamp of Hache, the whole surmounted by a scocheon with the arms of Reviers or Rivers, the house from which he took the title of his barony. On the continent the common use of the scocheon is to bear the paternal arms of a sovereign or noble, surmounting the quarterings of his kingdoms, principalities, fiefs or seigniories. The prince of Wales bore the arms of Saxony above those of the United Kingdom differenced with his silver label. Marshalling takes its most elaborate form, the most removed from the graceful simplicity of the middle ages, in such shields as the "Great Arms" of the Austrian empire, wherein are nine grand quarters each marshalling in various fashions from three to eleven coats, six of the grand-quarters bearing scocheons ***en*** *surtout,* each scocheon ensigned with a different crown.

Crests. — The most important accessory of the arms is the crested helm. Like the arms it has its pre-heraldic history in the crests of the Greek helmets, the wings, the wild boar's and bull's heads of Viking headpieces. A little roundel of the arms of a Japanese house was often borne as a crest in the Japanese helmet, stepped in a socket above the middle of the brim. The 12th-century seal of Philip of Alsace, count of Flanders, shows a demi-lion painted or beaten on the side of the upper part of his helm, and upon his seal of 1198 King Richard Coeur de Lion's barrel-helm has a leopard upon the semicircular comb-ridge, the edge of which is set off with feathers arranged as two wings. Crests, however, came slowly into use in England, although before 1250 Roger de Quincy, earl of Winchester, is seen on his seal with a wyver upon his helm. Of the long roll of earls and barons sealing the famous letter to the pope in 1301 only five show true crests on their seals. Two of them are the earl of Lancaster and his brother, each with a wyver crest like that of Quincy. One, and the most remarkable, is John St. John of Halnaker, whose crest is a leopard standing between two upright palm branches. Ralph de Monhermer has an eagle crest, while Walter de Moncy's helm is surmounted by a fox-like beast. In three of these instances the crest is borne, as was often the case, by the horse as well as the rider. Others of these seals to the barons' letter have the fan-shaped crest without any decoration upon it. But as the furniture of tournaments grew more magnificent the crest gave a new field for display, and many strange shapes appear in painted and gilded wood, metal, leather or parchment above the helms of the jousters. The Berkeleys, great patrons of abbeys, bore a mitre as their crest painted with their arms, like crests being sometimes seen on the continent where the wearer was *advocatus* of a bishopric or abbey. The whole or half figures or the heads and necks of beasts and birds were employed by other families. Saracens' heads topped many helms, that of the great Chandos among them. Astley bore for his crest a silver harpy standing in marsh-sedge, a golden chain fastened to a crown about her neck. Dymoke played pleasantly on his name with a long-eared moke's scalp. Stanley took the eagle's nest in which the eagle is lighting down with a swaddled babe in his claws. Many early helms, as that of Sir John Loterel, painted in the Loterel psalter, repeat the arms on the sides of a fan-crest. Howard bore for a crest his arms painted on a pair of wings, while simple "bushes" of feathers are seen in great plenty. The crest of a cadet is often differenced like the arms, and thus a wyver or a leopard will have a label about its neck. The Montagu griffon on the helm of John, marquess of Montagu, holds in its beak the gimel ring with which he differenced his father's shield. His brother, the King-Maker, following a custom commoner abroad than at home, shows two crested helms on his seal, one for Montagu and one for Beauchamp—none for his father's house of Nevill. It is often stated that a man, unless by some special grace or allowance, can have but one crest. This, however, is contrary to the spirit of mediaeval armory in which a man, inheriting the coat of arms of another house than his own, took with it all its belongings, crest, badge and the like. The heraldry books, with more reason, deny crests to women and to the clergy, but examples are not wanting of mediaeval seals in which even this rule is broken. It is perhaps unfair to cite the case of the bishops of Durham who ride in full harness on their palatinate seals; but Henry Despenser, bishop of Norwich, has a helm on which the winged griffon's head of his house springs from a mitre, while Alexander Nevill, archbishop of York, seals with shield, supporters and crowned and crested helm like those of any lay magnate. A seal cut for the wife of Thomas Chetwode, a Cheshire squire, has a shield of her husband's arms parted with her own and surmounted by a crowned helm with the crest of a demi-lion; and this is not the only example of such bearings by a woman.

Before passing from the crest let us note that in England the juncture of crest and helm was commonly covered, especially after the beginning of the 15th century, by a torse or "wreath" of silk, twisted with one, two or three colours. Coronets or crowns and "hats of estate" often take the place of the wreath as a base for the crest, and there are other curious variants. With the wreath may be considered the mantle, a hanging cloth which, in its earliest form, is seen as two strips of silk or sendal attached to the top of the helm below the crest and streaming like pennants as the rider bent his head and charged. Such strips are often displayed from the conical top of an uncrested helm, and some ancient examples have the air of the two ends of a stole or of

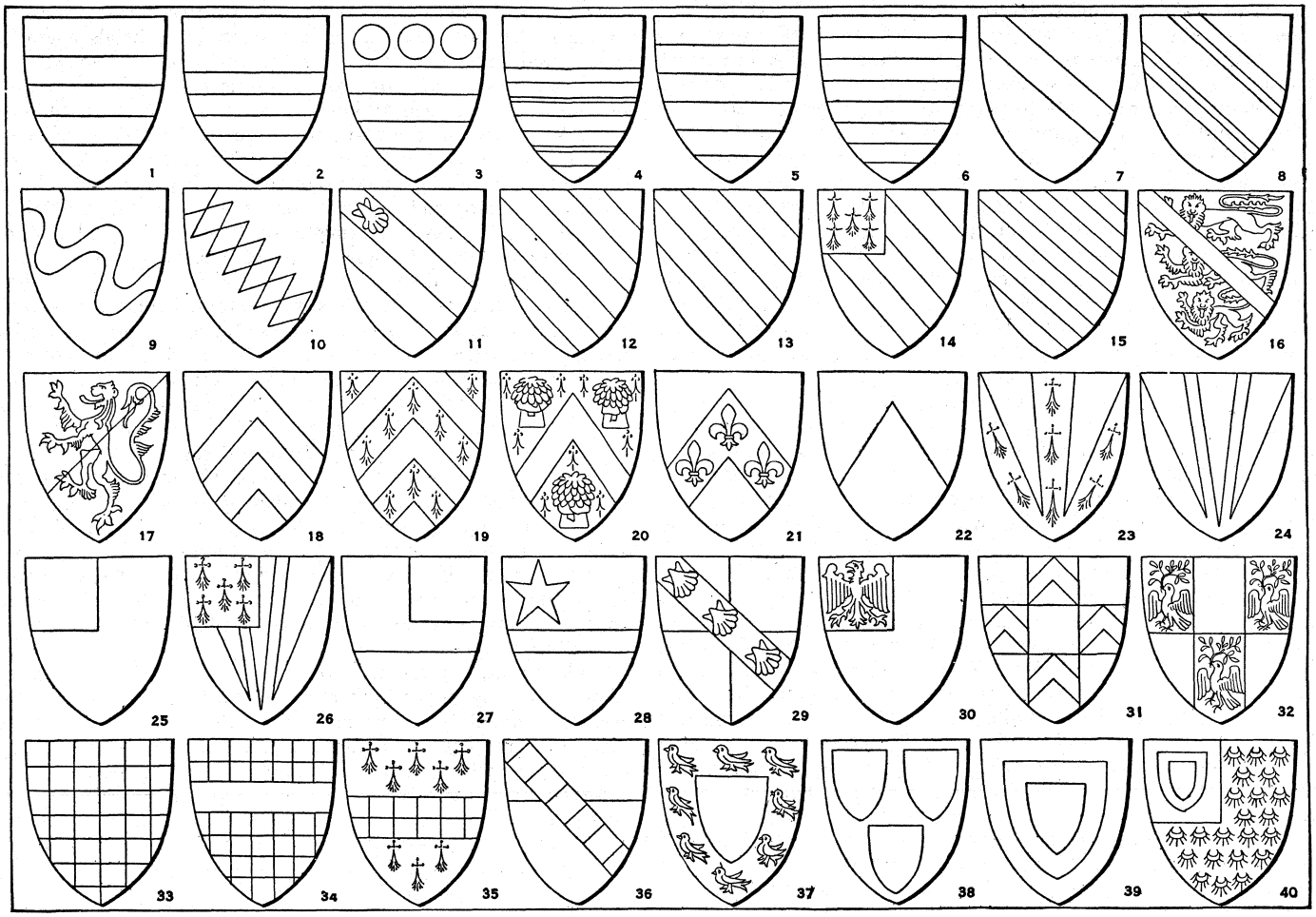

FIG 3.— MEDIAEVAL SHIELDS OF ARMS

(1) Harcourt. (2) Manners. (3) Wake. (4) Melsanby. (5) Grey. (6) Fitzalan of Bedale. (7) Mauley. (8) Harley. (9) Wallop. (10) Ralegh. (11) Tracy. (12) Bodrugan. (13) St. Philibert. (14) Bishopsdon. (15) Montfort. (16) Lancaster. (17) Fraunceys. (18) Chaworth. (19) Peyteoyn. (20) Sheffield. (21) Cobham. (22) Aston. (23) Hollis. (24) Bryene. (25) Blencowe. (26) Basset. (27) Wydvile. (28) Odingseles. (29) Ever. (30) Phelip, Lord Bardolf. (31) Whitgrave. (32) Tallow Chandlers. (33) Warenne. (34) Clifford. (35) Arderne. (36) Cromwell. (37) Erpingham. (38) Davillers. (39) Balliol. (40) Surtees

the *infulae* of a bishop's mitre. The general opinion of antiquaries has been that the mantle originated among the crusaders as a protection for the steel helm from the rays of an Eastern sun; but the fact that mantles take in England their fuller form after our crusading days were over seems against this theory. When the fashion for slittering the edges of clothing came in, the edges of the mantle were slittered like the edge of the sleeve or skirt, and, flourished out on either side of the helm, it became the delight of the painter of armories and the seal engraver. Modern heraldry in England paints the mantle with the principal colour of the shield, lining it with the principal metal; this in cases where no old grant of arms is cited as evidence of another usage. The mantles of the king and of the prince of Wales are, however, of gold lined with ermine and those of other members of the royal house of gold lined with silver. In ancient examples there is great variety and freedom. Where the crest is the head of a griffon or bird the feathering of the neck will be carried on to cover the mantle. Other mantles will be powdered with badges or with charges from the shield, others checkered, barred or paled. More than thirty of the mantles enamelled on the stall-plates of the mediaeval Garter-knights are of red with an ermine lining, tinctures which in most cases have no reference to the shields below them.

Supporters.— Shields of arms, especially upon seals, are sometimes figured as hung round the necks of eagles, lions, swans and griffons, as strapped between the horns of a hart or to the boughs of a tree. Badges may fill in the blank spaces at the sides between the shield and the inscription on the rim, but in the later 13th and early 14th centuries the commonest objects so serving are sprigs of plants, lions, leopards, or, still more frequently, lithe-necked wyvers. John of Segrave in 1301 flanks his shields with two of the sheaves of the older coat of Segrave: William Marshal of Hingham does the like with his two marshal's staves. Henry of Lancaster at the same time shows on his seal a shield and a helm crested with a wyver, with two like wyvers ranged on either side of the shield as "supporters." It is uncertain at what time in the 14th century these various fashions crystallize into the recognized use of beasts, birds, reptiles, men or inanimate objects, definitely chosen as "supporters" of the shield, and not to be taken as the ornaments suggested by the fancy of the seal engraver. That supporters originate in the decoration of the seal there can be little doubt. Some writers, the learned Menêtrier among them, will have it that they were first the fantastically clad fellows who supported and displayed the knight's shield at the opening of the tournament. If the earliest supporters were wild men, angels or Saracens, this theory might be defended; but lions, boars and talbots, dogs and trees are guises into which a man would put himself with difficulty. By the middle of the 14th century we find what are clearly recognizable as supporters. These, as in a lesser degree the crest, are often personal rather than hereditary, being changed generation by generation. The same person is found using more than one pair of them. The kings of France have had angels as supporters of the shield of the fleurs de lys since the 15th century, but the angels have only taken their place as the sole royal supporters since the time of Louis XIV. Sovereigns of England from Henry IV. to Elizabeth changed about between supporters of harts, leopards, antelopes, bulls, greyhounds, boars and dragons. James I. at his accession to the English throne brought the Scottish

unicorn to face the English leopard rampant across his shield, and, ever since, the "lion and unicorn" have been the royal supporters.

An old herald wrote as his opinion that "there is little or nothing in precedent to direct the use of supporters." Modern custom gives them, as a rule, only to peers, to knights of the Garter, the Thistle and St. Patrick, and to knights who are "Grand Crosses" or Grand Commanders of other orders. Royal warrants are sometimes issued for the granting of supporters to baronets, and, in rare cases, they have been assigned to untitled persons. But in spite of the jealousy with which official heraldry hedges about the display of these supporters once assumed so freely, a few old English families still assert their right by hereditary prescription to use these ornaments as their forefathers were wont to use them.

Badges.—The badge may claim a greater antiquity and a wider use than armorial bearings. The "Plantagenet" broom is an early example in England, sprigs of it being figured on the seal of Richard I. In the 14th and 15th centuries every magnate had his badge, which he displayed on his horse-furniture, on the hangings of his bed, his wall and his chair of state, besides giving it as a "livery" to his servants and followers. Such were the knots of Stafford, Bourchier and Wake, the scabbard-crampet of La Warr, the sickle of Hungerford, the swan of Toesni, Bohun and Lancaster, the dun bull of Nevill, the blue boar of Vere and the bear and ragged staff of Beauchamp, Nevill of Warwick and Dudley of Northumberland. So well known of all were these symbols that a political ballad of 1449 sings of the misfortunes of the great lords without naming one of them, all men understanding what signified the Falcon, the Water Bowge and the Cresset and the other badges of the doggerel. More famous still were the White Hart, the Red Rose, the White Rose, the Sun, the Falcon and Fetterlock, the Portcullis and the many other badges of the royal house. The Prince of Wales's feathers are as well known to-day as the royal arms. The Flint and Steel of Burgundy make a collar for the order of the Golden Fleece.

Mottoes.—The motto now accompanies every coat of arms in Great Britain. Few of these Latin aphorisms, these bald assertions of virtue, high courage, patriotism, piety and loyalty have any antiquity. Some few, however, like the "Espérance" of Percy, were the war-cries of remote ancestors. "I mak' sicker" of Kirkpatrick recalls pridefully a bloody deed done on a wounded man, and the "Dieu Ayde," "Agincourt" and "D'Accomplir Agincourt" of the Irish Montmorencys and the English Wodehouses and Dalisons, glorious traditions based upon untrustworthy genealogy. The often-quoted punning mottoes may be illustrated by that of Cust, who says "Qui Cust-odit caveat," a modern example and a fair one. Ancient mottoes, as distinct from the war or gathering cry of a house, are often cryptic sentences whose meaning might be known to the user and perchance to his mistress. Such are the "Plus est en vous" of Louis de Bruges, the Flemish earl of Winchester, and the "So have I cause" and "Till then thus" of two Englishmen. The word motto is of modern use, our forefathers speaking rather of their "word" or of their "reason."

Lines.—Eleven varieties of lines, other than straight lines, which divide the shield, or edge our cheverons, pales, bars and the like, are pictured in the heraldry books and named as engrailed, embattled, indented, invected, wavy or undy, nebuly, dancetty, raguly, potenté, dovetailed and urdy. As in the case of many other such lists of the later armorists these eleven varieties need some pruning and a new explanation. The most commonly found is the line engrailed, which for the student of mediaeval armory must be associated with the line indented. In its earliest form the line which a roll of arms will describe indifferently as indented or engrailed takes almost invariably the form to which the name indented is restricted by modern armorists.

The cross may serve as our first example. A cross, engrailed or indented, the words being used indifferently, is a cross so deeply notched at the edges that it seems made up of so many lozenge-shaped wedges or fusils. About the middle of the 14th century begins a tendency, resisted in practice by many conservative families, to draw the engrailing lines in the fashion to which modern armorists restrict the word "engrailed," making shallower indentures in the form of lines of half circles. Thus the engrailed cross of the Mohuns takes either of the two forms which we illustrate. Bends follow the same fashion, early bends engrailed or indented being some four or more fusils joined bendwise by their blunt sides, bends of less than four fusils being very rare. Thus also the engrailed or indented saltires, pales or cheverons, the exact number of the fusils which go to the making of these being unconsidered. For the fesse there is another law. The fesse indented or engrailed is made up of fusils as is the engrailed bend. But although early rolls of arms sometimes neglect this detail in their blazon, the fusils making a fesse must always be of an ascertained number. Montagu, earl of Salisbury, bore a fesse engrailed or indented of three fusils only, very few shields imitating this. Mediaeval armorists will describe his arms as a fesse indented of three indentures, as a fesse fusilly of three pieces, or as a fesse engrailed of three points or pieces, all of these blazons having the same value. The indented fesse on the red shield of the Dynhams has four such fusils of ermine. Four, however, is almost as rare a number as three, the normal form of a fesse indented being that of five fusils as borne by Percys, Pinkenys, Newmarches and many other ancient houses. Fesses of six fusils are not to be found. Note that bars indented or engrailed are, for a reason which will be evident, never subject to this counting of fusils. Fauconberg, for example, bore "Silver with two bars engrailed, or indented, sable." Displayed on a shield of the flat-iron outline, the lower bar would show fewer fusils than the upper, while on a square banner each bar would have an equal number —usually five or six.

While bends, cheverons, crosses, saltires and pales often follow, especially in the 15th century, the tendency towards the rounded "engrailing," fesses keep, as a rule, rheir bold indentures —neither Percy nor Montagu being ever found with his bearings in aught but their ancient form. Borders take the newer fashion as leaving more room for the charges of the field. But indented chiefs do not change their fashion, although many saw-teeth sometimes take the place of the three or four strong points of early arms, and parti-coloured shields whose parting line is indented never lose the bold zig-zag.

While bearing in mind that the two words have no distinctive force in ancient armory, the student and the herald of modern times may conveniently allow himself to blazon the sharp and saw-toothed line as "indented" and the scalloped line as "engrailed," especially when dealing with the debased armory in which the distinction is held to be a true one and one of the first importance. One error at least he must avoid, and that is the following of the heraldry-book compilers in their use of the word "dancetty." A "dancetty" line, we are told, is a line having fewer and deeper indentures than the line indented. But no dancetty line could make a bolder dash across the shield than do the lines which the old armorists recognized as "indented." In old armory we have fesses dancy—commonly called "dances"—bends dancy, or cheverons dancy; there are no chiefs dancy nor borders dancy, nor are there shields blazoned as parted with a dancy line. Waved lines, battled lines and ragged lines need little explanation that a picture cannot give. The word invecked or invected is sometimes applied by old-fashioned heraldic pedants to engrailed lines; later pedants have given it to a line found in modern grants of arms, an engrailed line reversed. Dovetailed and undy lines are mere modernisms. Of the very rare nebuly or clouded line we can only say that the ancient form, which imitated the conventional cloud-bank of the old painters, is now almost forgotten, while the bold "wavy" lines of early armory have the word "nebuly" misapplied to them.

CHARGES

The Ordinary Charges.—The writers upon armory have given the name of Ordinaries to certain conventional figures commonly charged upon shields. Also they affect to divide these into Honourable Ordinaries and Sub-ordinaries without explaining the reason for the superior honour of the Saltire or for the subordination of the Quarter. Disregarding such distinctions, we may begin with the description of the "Ordinaries" most commonly to be found.

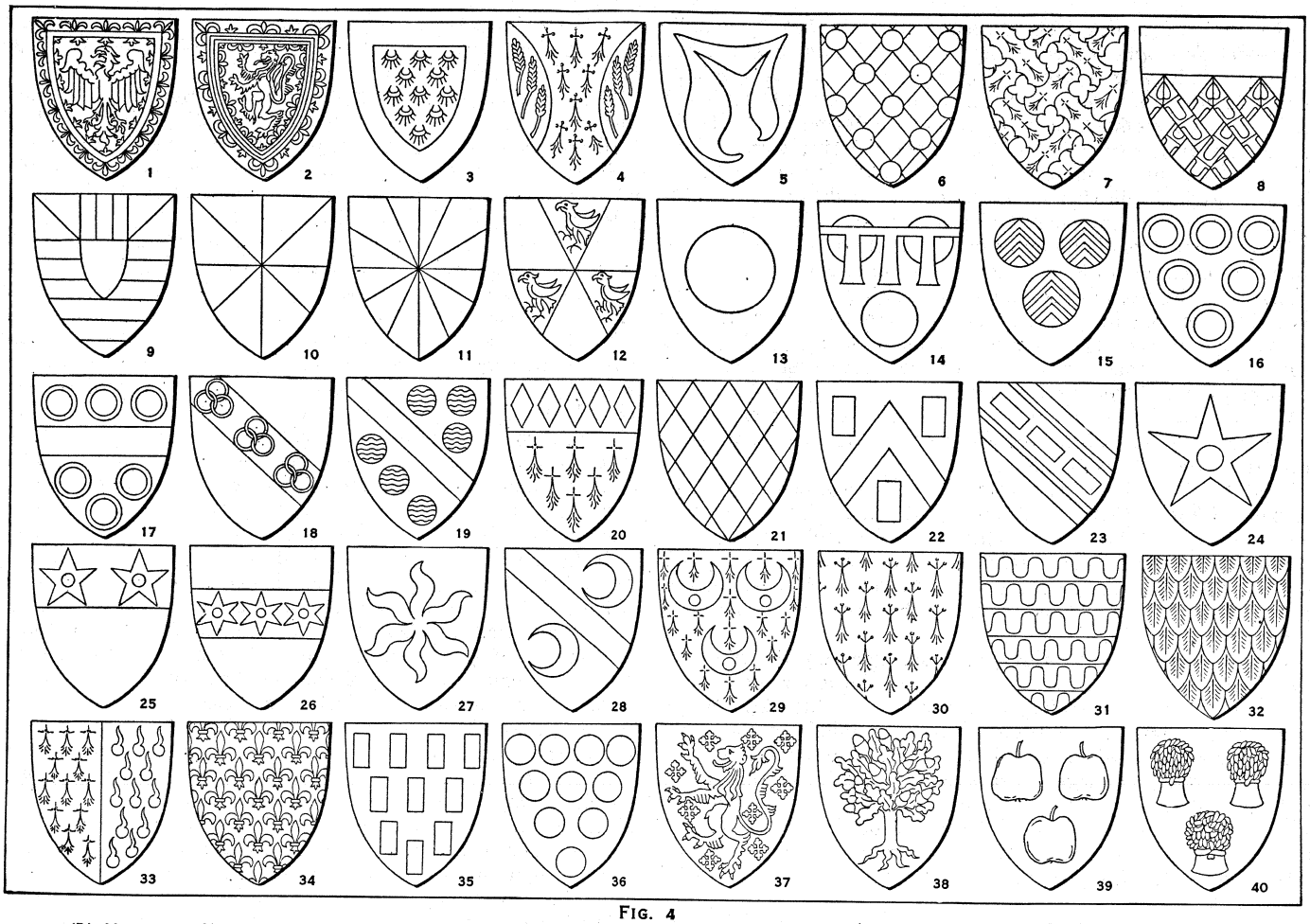

FIG. 4

(1) Vampage. (2) Scotland. (3) Hondescote. (4) Greyby. (5) Hastings. (6) Trussel. (7) Giffard. (8) Wyvile. (9) Mortimer. (10) Campbell. (11) Bassingbourne. (12) Stoker. (13) Burlay. (14) Courtenay. (15) Caraunt. (16) Vipont. (17) Avenel. (18) Hawberk. (19) Stourton. (20) Charles. (21) Fitzwilliam. (22) Mounchensy. (23) Haggerston. (24) Harpeden. (25) Gentil. (26) Grimston. (27) Ingilby. (28) Gobioun. (29) Longchamp. (30) Brittany. (31) Beauchamp. (32) Mydlam. (33) Grayndorge. (34) Mortimer. (35) Cowdray. (36) Zouche. (37) La Warr. (38) Cheyndut. (39) Applegarth. (40) Chester

From the first the Cross was a common bearing on English shields, "Silver a cross gules" being given early to St. George, patron of knights and of England, for his arms; and under St. George's red cross the English were wont to fight. Our armorial crosses took many shapes, but the "crosses innumerabill" of the Book of St. Albans and its successors may be left to the heraldic dictionary makers who have devised them. It is more important to define those forms in use during the middle ages, and to name them accurately after the custom of those who bore them in war, a task which the heraldry books have never as yet attempted with success.

The cross in its simple form needs no definition, but it will be noted that it is sometimes borne "voided" and that in a very few cases it appears as a lesser charge with its ends cut off square, in which case it must be clearly blazoned as "a plain Cross."

Andrew Harcla, the march-warden, whom Edward II. made an earl and executed as a traitor, bore the arms of St. George with a martlet sable in the quarter. Crevequer of Kent bore "Gold, a voided cross gules." Newsom (14th century) bore "Azure, a fesse silver with three plain crosses gules."

Next to the plain Cross may be taken the Cross paty, the *croiz patée* or *paté* of old rolls of arms. It has several forms, according to the taste of the artist and the age. So, in the 13th and early 14th centuries, its limbs curve out broadly, while at a later date the limbs become more slender and of even breadth, the ends somewhat resembling fleurs-de-lys. Each of these forms has been seized by the heraldic writers as the type of a distinct cross for which a name must be found, none of them, as a rule, being recognized as a cross paty, a word which has its misapplication elsewhere. Thus the books have "cross patonce" for the earlier form, while "cross clechée" and "cross fleurie" serve for the others. But the true identification of the various crosses is of the first importance to the antiquary, since without it descriptions of the arms on early seals or monuments must needs be valueless. Many instances of this need might be cited from the British Museum catalogue of seals, where, for example, the cross paty of Latimer is described twice as a "cross flory," six times as a "cross patonce," but not once by its own name, although there is no better known example of this bearing in England. Latimer bore "Gules, a cross paty gold."

The cross formy follows the lines of the cross paty save that its broadening ends are cut off squarely. Chetwode bore "Quarterly silver and gules with four crosses formy countercoloured"—that is to say, the two crosses in the gules are of silver and the two in the silver of gules.

The cross flory or flowered cross, the "cross with the ends flowered"—*od les boutes floretes* as some of the old rolls have it—is, like the cross paty, a mark for the misapprehension of writers on armory, who describe some shapes of the cross paty by its name. Playing upon discovered or fancied variants of the word, they bid us mark the distinctions between crosses "fleur-de-lisée," "fleury" and "fleurettée," although each author has his own version of the value which must be given these precious words. But the facts of the mediaeval practice are clear to those who take their armory from ancient examples and not from phrases plagiarized from the hundredth plagiarist. The flowered cross is one whose limbs end in fleur-de-lys, which spring sometimes from a knop or bud but more frequently issue from the square ends of a cross of the "formy" type. Swynnerton bore "Silver, a flowered cross sable."

The mill-rind, which takes its name from the iron of a mill-stone—fer de *moline*—must be set with the crosses. Some of the old rolls call it *croiz recercelé,* from which armorial writers have leaped to imagine a distinct type. Also they call the mill-rind itself a "cross moline" keeping the word mill-rind for a charge having the same origin but of somewhat differing form. Since this charge became common in Tudor armory it is perhaps better that the original mill-rind should be called for distinction a mill-rind cross. Willoughby bore "Gules, a mill-rind cross silver."

The crosslet, cross botonny or cross crosletted, is a cross whose limbs, of even breadth, end as trefoils or treble buds. It is rarely found in mediaeval examples in the shape—that of a cross with limbs ending in squarely cut plain crosses—which it took during the 16th-century decadence. As the sole charge of a shield it is very rare; otherwise it is one of the commonest of charges. Brerelegh bore ('Silver, a crosslet gules."

Within these modest limits we have brought the greater part of that monstrous host of crosses which cumber the dictionaries. A few rare varieties may be noticed.

Dukinfield bore "Silver, a voided cross with sharpened ends." Skirlaw, bishop of Durham (d. 1406), the son of a basket-weaver, bore "Silver, a cross of three upright wattles sable, crossed and interwoven by three more." Drury bore "Silver, a chief vert with *a* St. Anthony's cross gold between two golden molets, pierced gules." Brytton bore "Gold, a patriarch's cross set upon three degrees or steps of gules."

The crosses paty and formy, and more especially the crosslets, are often borne fitchy, that is to say, with the lower limb somewhat lengthened and ending in a point, for which reason the 15th-century writers call these "crosses fixabill." In the 14th-century rolls the word "potent" is sometimes used for these crosses fitchy, the long foot suggesting a potent or staff. From this source modern English armorists derive many of their "crosses potent," whose four arms have the T heads of old-fashioned walking staves. Howard bore "Silver, a bend between six crosslets fitchy gules." Scott of Congerhurst in Kent bore "Silver, a crosslet fitchy sable."

The Saltire is the cross in the form of that on which St. Andrew suffered. whence it is borne on the banner of Scotland, and by the Andrew family of Northamptonshire. Nevile of Raby bore "Gules, a saltire silver." Nicholas Upton, the 15th-century writer on armory, bore "Silver, a saltire sable with the ends couped and five golden rings thereon." Aynho bore "Sable, a saltire silver, having the ends flowered, between four leopards gold."

The chief is the upper part of the shield and, marked out by a line of division, it is taken as one of the Ordinaries. Shields with a plain chief and no more are rare in England, but Tichborne of Tichborne has borne since the 13th century "Vair, a chief gold." According to the heraldry books the chief should be marked off as a third part of the shield, but its depth varies, being broader when charged with devices and narrower when, itself uncharged, it surmounts a charged field. Fenwick bore "Silver, a chief gules with six martlets countercoloured," and in this case the chief would be the half of the shield. Clinging to the belief that the chief must not fill more than a third of the shield, the heraldry books abandon the word in such cases, blazoning them as "party per fesse."

Hastang bore "Azure, a chief gules and a lion with a forked tail over all." Walter Kingston seals in the 13th century with a shield of "Two rings or annelets in the chief."

With the chief may be named the Foot, the nether part of the shield marked off as an Ordinary. So rare is this charge that we can cite but one example of it, that of the shield of John of Skipton, who in the 14th century bore "Silver with the foot indented purple and a lion purple." The foot, however, is a recognized bearing in France, whose heralds gave it the name of champagne.

The Pale is a broad stripe running the length of the shield. Of a single pale and of three pales there are several old examples. Four red pales in a golden shield were borne by Eleanor of Provence, queen of Henry III.; but the number did not commend itself to English armorists. When the field is divided evenly into six pales it is said to be paly; if into four or eight pales, it is blazoned as paly of that number of pieces. But paly of more or less than six pieces is rarely found.

The Yorkshire house of Gascoigne bore "Silver, a pale sable with a golden conger's head thereon, cut off at the shoulder." Ferlington bore "Gules, three pales vair and a chief gold."

When the shield or charge is divided palewise down the middle into two tinctures it is said to be "party." "Party silver and gules" are the arms of the Waldegraves. Bermingham bore "Party silver and sable indented." Such partings of the field often cut through charges whose colours change about on either side of the parting line. Thus Chaucer the poet bore "Party silver and gules with a bend countercoloured."

The Fesse is a band athwart the shield, filling, according to the rules of the heraldic writers, a third part of it. By ancient use, however, as in the case of the chief and pale, its width varies with the taste of the painter, narrowing when set in a field full of charges and broadening when charges are displayed on itself. When two or three fesses are borne they are commonly called Bars. "Ermine *four* bars gules" is given as the shield of Sir John Sully, a 14th-century Garter knight, on his stall-plate at Windsor; but the plate belongs to a later generation, and should probably have three bars only. Little bars borne in couples are styled Gemels (twins). The field divided into an even number of bars of alternate colours is said to be barry, barry of six pieces being the normal number. If four or eight divisions be found the number of pieces must be named; but with ten or more divisions the number is unreckoned and "burely" is the word.

Colevile of Bitham bore "Gold a fesse gules." West bore "Silver, a dance (or fesse dancy) sable." Fauconberg bore "Gold, a fesse azure with three pales gules in the chief." Cayvile bore "Silver, a fesse gules, flowered on both sides." Devereux bore "Gules, a fesse silver with three roundels silver in the chief" Chamberlayne of Northamptonshire bore "Gules, a fesse and three scallops gold." Harcourt bore "Gules, two bars gold." Manners bore "Gold, two bars azure and a chief gules." Wake bore "Gold, two bars gules with three roundels gules in the chief."

The Bend is a band traversing the shield aslant, arms with one, two or three bends being common during the middle ages in England. Bendy shields follow the rule of shields paly and barry, but as many as ten pieces have been counted in them. The bend is often accompanied by a narrow bend on either side, these companions being called Cotices. A single narrow bend, struck over all other charges, is the Baston, which during the 13th and 14th centuries was a common difference for the shields of the younger branches of a family, coming in later times to suggest itself as a difference for bastards.

The Bend Sinister, the bend drawn from right to left beginning at the "sinister" corner of the shield, is reckoned in the heraldry books as a separate Ordinary, and has a peculiar significance accorded to it by novelists Mediaeval English seals afford a group of examples of Bends Sinister or Bastons Sinister, but there seems no reason for taking them as anything more than cases in which the artist has neglected the common rule.

Mauley bore "Gold, a bend sable." Harley bore "Gold, a bend with two cotices sable" Wallop bore "Silver, a bend wavy sable." Bishopsdon bore "Bendy of six pieces, gold and azure, with a quarter ermine." Montfort of Whitchurch bore "Bendy of ten pieces gold and azure." Henry of Lancaster, second son of Edmund Crouchback, bore the arms of his cousin, the king of England, with the difference of "a baston azure" Adam Fraunceys (14th century) bore "Party gold and sable bendwise with a lion countercoloured" The parting line is here commonly shown as "sinister."

The Cheveron, a word found in mediaeval building accounts for the barge-boards of a gable. is an Ordinary whose form is explained by its name. Perhaps the very earliest of English armorial charges, and familiarized by the shield of the great house of Clare, it became exceedingly popular in England Like the bend and the chief, its width varies in different examples. Likewise its angle varies, being sometimes so acute as to touch the top of the shield, while in post-mediaeval armory the point is often blunted beyond the right angle. One, two or three cheverons occur

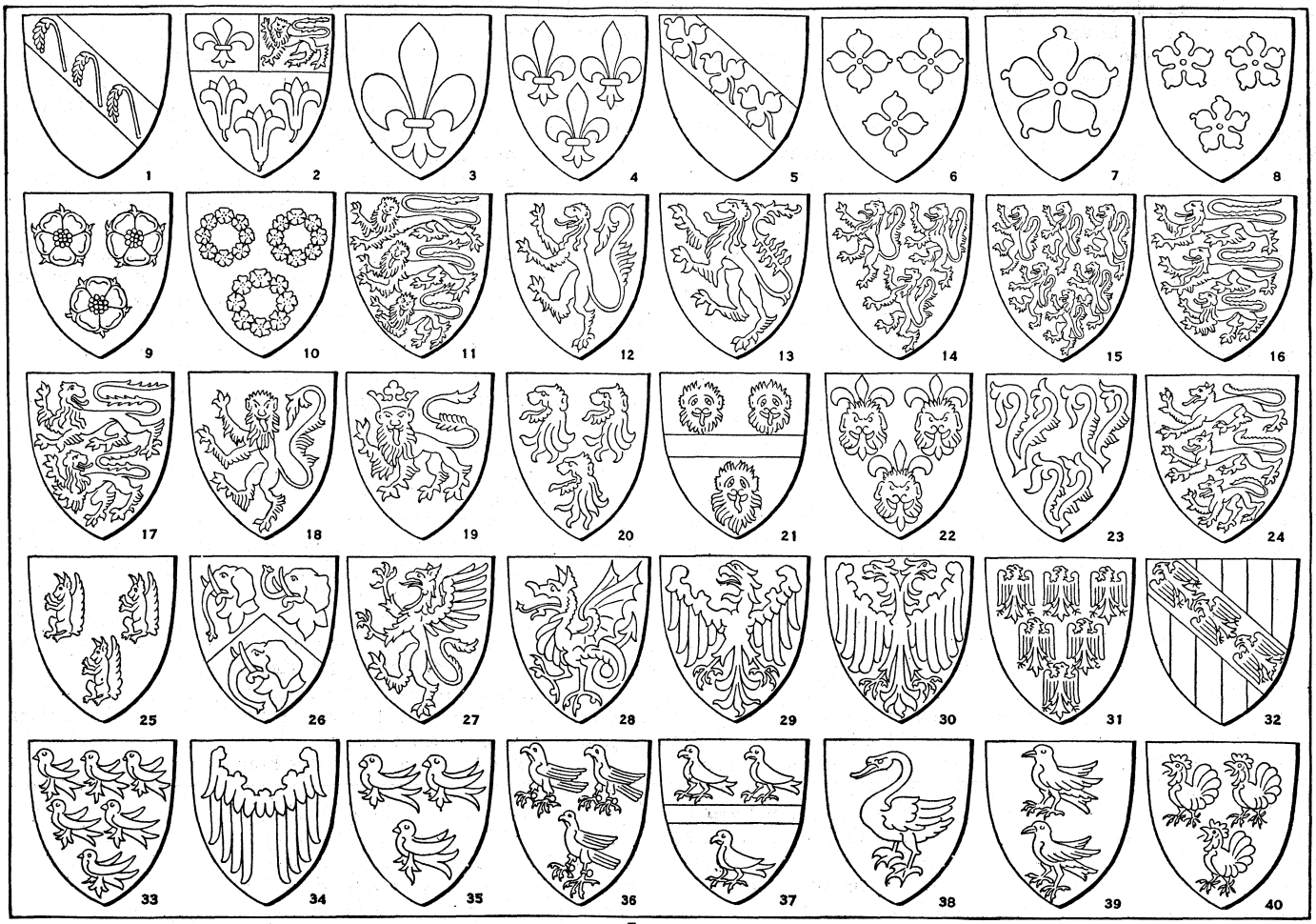

FIG. 5

(1) Rye. (2) Eton College. (3) Aguylon. (4) Peyferer. (5) Hervey. (6) Vincent. (7) Quincy. (8) Bardolf. (9) Cosington. (10) Hilton. (11) England. (12) Fitzalan. (13) Felbrigge. (14) Fiennes. (15) Leyburne. (16) Carew. (17) Fotheringhay. (18) Brocas. (19) Lisle. (20) Kenton. (21) Pole. (22) Cantelou. (23) Pynchebek. (24) Lovett. (25) Talbot. (26) Saunders. (27) Griffin. (28) Drake. (29) Monhermer. (30) Siggeston. (31) Gavaston. (32) Graunson. (33) Arundel. (34) Seymour. (35) Naunton. (36) Fauconer. (37) Twenge. (38) Asdale. (39) Corbet. (40) Cockfield

in numberless shields, and five cheverons have been found. Also there are some examples of the bearing of cheveronny.

The earls of Gloucester of the house of Clare bore "Gold, three cheverons gules" and the Staffords derived from them their shield of "Gold, a cheveron gules." Chaworth bore "Azure, two cheverons gold." Peytevyn bore "Cheveronny of ermine and gules." St. Quintin of Yorkshire bore "Gold, two cheverons gules and a chief vair." Sheffield bore "Ermine, a cheveron gules between three sheaves gold."

Shields parted cheveronwise are common in the 15th century, when they are often blazoned as having chiefs "enty" or grafted. Aston of Cheshire bore "Party sable and silver cheveronwise" or "Silver, a chief enty sable."

The Pile or stake (estache) is a wedge-shaped figure jutting from the chief to the foot of the shield, its name allied to the pile of the bridge-builder. A single pile is found in the notable arms of Chandos, and the black piles in the ermine shield of Hollis are seen as an example of the bearing of two piles. Three piles are more easily found, and when more than one is represented the points are brought together at the foot. In ancient armory piles in a shield are sometimes reckoned as a variety of pales, and a Basset with three piles on his shield is seen with three pales on his square banner. Chandos bore "Gold, a pile gules."

The Quarter is the space of the first quarter of the shield divided crosswise into four parts. As an Ordinary it is an ancient charge and a common one in mediaeval England, although it has all but disappeared from modern heraldry books, the "Canton," an alleged "diminutive," unknown to early armory, taking its place. Like the other Ordinaries, its size is found to vary with the scheme of the shield's charges, and this has persuaded those armorists who must needs call a narrow bend a "bendlet," to the invention of the "Canton," a word which in the sense of a quarter or small quarter appears for the first time in the latter part of the 15th century. Writers of the 14th century sometimes give it the name of the Cantel, but this word is also applied to the void space on the opposite side of the chief, seen above a bend.

Blencowe bore "Gules, a quarter silver." Basset of Drayton bore "Gold, three piles (or pales) gules with a quarter ermine." Wydvile bore "Silver, a fesse and a quarter gules." Odingseles bore "Silver, a fesse gules with a molet gules in the quarter."

Shields or charges divided crosswise with a downward line and a line athwart are said to be quarterly. An ancient coat of this fashion is that of Say who bore (13th century) "Quarterly gold and gules"—the first and fourth quarters being gold and the second and third red. Ever or Eure bore the same with the addition of "a bend sable with three silver scallops thereon."

With the 15th century came a fashion of dividing the shield into more than four squares, six and nine divisions being often found in arms of that age. The heraldry books, eager to work out problems of blazonry, decide that a shield divided into six squares should be described as "Party per fesse with a pale counterchanged," and one divided into nine squares as bearing "a cross quarter-pierced." It seems a simpler business to follow a 15th-century fashion and to blazon such shields as being of six or nine "pieces." Thus John Garther (15th century) bore "Nine pieces erminees and ermine" and Whitgreave of Staffordshire "Nine pieces of azure and of Stafford's arms, which are gold with a cheveron gules." The Tallow Chandlers of London had a grant

in 1456 of "Six pieces azure and silver with three doves in the azure, each with an olive sprig in her beak."

Squared into more than nine squares the shield becomes checky or checkered and the number is not reckoned. Warenne's checker of gold and azure is one of the most ancient coats in England and checkered fields and charges follow in great numbers. Even lions have been borne checkered. Warenne bore "Checky gold and azure." Clifford bore the like with "a fesse gules." Cobham bore "Silver, a lion checky gold and sable." These checkered fesses, bars, bends, borders and the like, will commonly bear but two rows of squares, or three at the most. The heraldry writers are ready to note that when two rows are used "counter-compony" is the word in place of checky, and "compony-counter-compony" in the case of three rows. It is needless to say that these words have neither practical value nor antiquity to commend them. But bends and bastons, labels, borders and the rest are often coloured with a single row of alternating tinctures. In this case the pieces are said to be "gobony." Thus John Cromwell (14th century) bore "Silver, a chief gules with a baston gobony of gold and azure."

The scocheon or shield used as a charge is found among the earliest arms. Itself charged with arms, it served to indicate alliance by blood or by tenure with another house, as in the bearings of St. Owen whose shield of "Gules with a cross silver" has a scocheon of Clare in the quarter. In the latter half of the 15th century it plays an important part in the curious marshalling of the arms of great houses and lordships. Erpingham bore "Vert, a scocheon silver with an orle (or border) of silver martlets." Davillers bore at the battle of Boroughbridge "Silver, three scocheons gules."

The scocheon was often borne voided or pierced, its field cut away to a narrow border. Especially was this the case in the far North, where the Balliols, who bore such a voided scocheon, were powerful. The voided scocheon is wrongly named in all the heraldry books as an orle, a term which belongs to a number of small charges set round a central charge. Thus the martlets in the shield of Erpingham, already described, may be called an orle of martlets or a border of martlets. This misnaming of the voided scocheon has caused a curious misapprehension of its form, even Dr. Woodward, in his *Heraldry, British* and *Foreign,* describing the "orle" as "a narrow border detached from the edge of the shield." Following this definition modern armorial artists will, in the case of quartered arms, draw the "orle" in a first or second quarter of a quartered shield as a rectangular figure and in a third or fourth quarter as a scalene triangle with one arched side. Thereby the original voided scocheon changes into forms without meaning. Balliol bore "Gules, a voided scocheon silver." Surtees bore "Ermine, with a quarter of the arms of Balliol."

The *Tressure* or flowered tressure is a figure which is correctly described by Woodward's incorrect description of the orle as cited above, being a narrow inner border of the shield. It is distinguished, however, by the fleurs-de-lys which decorate it, setting off its edges. The double tressure which surrounds the lion in the royal shield of Scotland, and which is borne by many Scottish houses who have served their kings well or mated with their daughters, is carefully described by Scottish heralds as "flowered and counter-flowered," a blazon which is held to mean that the fleurs-de-lys show head and tail in turn from the outer rim of the outer tressure and from the inner rim of the innermost But this seems to have been no essential matter with mediaeval armorists and a curious 15th-century enamelled roundel of the arms of Vampage shows that in this English case the flowering takes the more convenient form of allowing all the lily heads to sprout from the outer rim. Vampage bore "Azure, an eagle silver within a flowered tressure silver." The king of Scots bore "Gold, a lion within a double tressure flowered and counter-flowered gules."

The Border of the shield when marked out in its own tincture is counted as an Ordinary. Plain or charged, it was commonly used as a difference. As the principal charge of a shield it is very rare, so rare that in most cases where it apparently occurs we may, perhaps, be following mediaeval custom in blazoning the shield as one charged with a scocheon and not with a border. Thus Hondescote bore "Ermine, a border gules" or "Gules, a scocheon ermine." Somerville bore "Burely silver and gules and a border azure with golden martlets."

The Flaunches are the flanks of the shield which, cut off by rounded lines, are borne in pairs as Ordinaries. These charges are found in many coats devised by 15th-century armorists. "Ermine, two flaunches azure with six golden wheat-ears" was borne by John Greyby of Oxfordshire (15th century).

The Label is a narrow fillet across the upper part of the chief, from which hang three, four, five or more pendants, the pendants being, in most old examples, broader than the fillet. Reckoned with the Ordinaries, it was commonly used as a means of differencing a cadet's shield, and in the heraldry books it has become the accepted difference for an eldest son, although the cadets often bore it in the middle ages. John of Hastings bore in 1300 before Carlaverock "Gold, a sleeve (or maunche) gules," while Edmund his brother bore the same arms with a sable label. In modern armory the pendants are all but invariably reduced to three, which, in debased examples, are given a dovetailed form while the ends of the fillet are cut off.

The Fret, drawn as a voided lozenge interlaced by a slender saltire, is counted an Ordinary. A charge in such a shape is extremely rare in mediaeval armory, its ancient form when the field is covered by it being a number of bastons—three being the customary number—interlaced by as many more from the sinister side. Although the whole is described as a fret in certain English blazons of the 15th century, the adjective "fretty" is more commonly used. Trussel's fret is remarkable for its bezants at the joints, which stand, doubtless, for the golden nail-heads of the "trellis" suggested by his name. Curwen, Wyvile and other northern houses bearing a fret and a chief have, owing to their fashion of drawing their frets, often seen them changed by the heraldry books into "three cheverons braced or interlaced."

Huddlestone bore "Gules fretty silver." Trussel bore "Silver fretty gules, the joints bezanty." Hugh Giffard (14th century) bore "Gules with an engrailed fret of ermine."

Another Ordinary is the Giron or Gyron—a word now commonly mispronounced with a hard "g." It may be defined as the lower half of a quarter which has been divided bendwise. No old example of a single giron can be found to match the figure in the heraldry books Gironny, or gyronny, is a manner of dividing the field into sections, by lines radiating from a centre point, of which many instances may be given. Most of the earlier examples have some twelve divisions although later armory gives eight as the normal number, as Campbell bears them.

Bassingbourne bore "Gironny of gold and azure of twelve pieces." William Stoker, who died Lord Mayor of London in 1484, bore "Gironny of six pieces azure and silver with three popinjays in the silver pieces." A pair of girons on either side of a chief were borne in the strange shield of Mortimer, commonly blazoned as "Barry azure and gold of six pieces, the chief azure with two pales and two girons gold, a scocheon silver over all." An early example shows that this shield began as a plain field with a gobony border.

With the Ordinaries we may take the Roundels or Pellets, disks or balls of various colours. Ancient custom gives the name of a bezant to the golden roundel, and the folly of the heraldic writers has found names for all the others, names which may be disregarded together with the belief that, while bezants and silver roundels, as representing coins, must be pictured with a flat surface, roundels of other hues must needs be shaded by the painter to represent rounded balls. Rings or Annelets were common charges in the North, where Lowthers, Musgraves and many more, differenced the six rings of Vipont by bearing them in various colours.

Burlay of Wharfdale bore "Gules, a bezant." Courtenay, earl of Devon, bore "Gold, three roundels gules with a label azure." Caraunt bore "Silver, three roundels azure, each with three cheverons gules." Vipont bore "Gold, six annelets gules." Avenel bore "Silver, a fesse and six annelets (*aunels*) gules." Stourton bore "Sable, a bend gold between six fountains." The fountain is a roundel charged with waves of white and blue.

The Lozenge is linked in the heraldry book with the Fusil. This

Fusil is described as a lengthened and sharper lozenge. But it will be understood that the Fusil, other than as part of an engrailed or indented bend, pale or fesse, is not known to true armory. Also it is one the notable achievements of the English writers on heraldry that they should have allotted to the lozenge, when borne voided, the name of Mascle. This "mascle" is the word of the oldest armorists for the unvoided charge, the voided being sometimes described by them as a lozenge, without further qualifications. Fortunately the difficulty can be solved by following the late 14th-century custom in distinguishing between "lozenges" and "voided lozenges" and by abandoning altogether this misleading word Mascle.

Thomas of Merstone, a clerk, bore on his seal in 1359 "Ermine, a lozenge with a pierced molet thereon." Braybroke bore "Silver, seven voided lozenges gules." Charles bore "Ermine, a chief gules with five golden lozenges thereon."

Billets are oblong figures set upright. Black billets in the arms of Delves of Cheshire stand for "delves" of earth and the gads of steel in the arms of the London Ironmongers' Company took a somewhat similar form. Sir Ralph Mounchensy bore in the 14th century "Silver, a cheveron between three billets sable."

With the Billet, the Ordinaries, uncertain as they are in number, may be said to end. But we may here add certain armorial charges which might well have been counted with them.

First of these is the Molet, a word corrupted in modern heraldry to Mullet, a fish-like change with nothing to commend it. This figure is as a star of five or six points, six points being perhaps the commonest form in old examples, although the sixth point is, as a rule, lost during the later period. Mediaeval armorists are not, it seems, inclined to make any distinction between molets of five and six points, but some families, such as the Harpedens and Asshetons, remained constant to the five-pointed form. It was generally borne pierced with a round hole, and then represents, as its name implies, the rowel of a spur. In ancient rolls of arms the word Rowel is often used, and probably indicated the pierced molet. That the piercing was reckoned an essential difference is shown by a roll of the time of Edward II., in which Sir John of Pabenham bears "Barry azure and silver, with a bend gules and three molets gold thereon," arms which Sir John his son differences by piercing the molets. Beside these names is that of Sir Walter Baa with "Gules a cheveron and three rowels silver," rowels which are shown on seals of this family as pierced molets. Probably an older bearing than the molet, which would be popularized when the rowelled spur began to take the place of the prick-spur, is the Star or Estoile, differing from the molet in that its five or six points are wavy. It is possible that several star bearings of the 13th century were changed in the 14th for molets. The star is not pierced in the fashion of the molet; but, like the molet, it tends to lose its sixth point in armory of the decadence. Suns, sometimes blazoned in old rolls as Sun-rays--rays de *soleil* —are pictured as unpierced molets of many points, which in rare cases are waved.

Harpeden bore "Silver, a pierced molet gules." Gentil bore "Gold, a chief sable with two molets goles pierced gules." Grimston bore "Silver, a fesse sable and thereon three molets silver pierced gules." Ingleby of Yorkshire bore "Sable, a star silver."

The Crescent is a charge which has to answer for many idle tales concerning the crusading ancestors of families who bear it. It is commonly borne with both points uppermost, but when representing the waning or the waxing moon—decrescent or increscent—its horns are turned to the sinister or dexter side of the shield. Peter de Marines (13th century) bore on his seal a shield charged with a crescent in the chief. William Gobioun (14th century) bore "A bend between two waxing moons."

Tinctures.— The tinctures or hues of the shield and its charges are seven in number—gold or yellow, silver or white, red, blue, black, green and purple. Mediaeval custom gave, according to a rule often broken, "gules," "azure" and "sable" as more high-sounding names for the red, blue and black. Green was often named as "vert," and sometimes as "synobill," a word which as "sinople" is used to this day by French armorists. The song of the siege of Carlaverock and other early documents have red, gules or "vermeil," sable or black, azure or blue, but gules, azure, sable and vert came to be recognized as armorists' adjectives, and an early 15th-century romance discards the simple words deliberately, telling us of its hero that

> His shield was black and blue, sanz fable,
> Barred of azure and of sable.

But gold and silver served as the armorists' words for yellows and whites until late in the 16th century, when, gold and silver made way for "or" and "argent," words which those for whom the interest of armory lies in its liveliest days will not be eager to accept. Likewise the colours of "sanguine" and "tenné" brought in by the pedants to bring the tinctures to the mystical number of nine may be disregarded.

A certain armorial chart of the duchy of Brabant, published in 1600, is the earliest example of the practice whereby later engravers have indicated colours in uncoloured plates by the use of lines and dots. Gold is indicated by a powdering of dots; silver is left plain. Azure is shown by horizontal shading lines; gules by upright lines; sable by cross-hatching of upright and horizontal lines. Diagonal lines from sinister to dexter indicate purple; vert is marked with diagonal lines from dexter to sinister. The practice, in spite of a certain convenience, has been disastrous in its cramping effects on armorial art, especially when applied to seals and coins.

Besides the two "metals" and five "colours," fields and charges are varied by the use of the furs ermine and vair. Ermine is shown by a white field flecked with black ermine tails. and vair by a conventional representation of a fur of small skins sewn in rows, white and blue skins alternately. In the 15th century there was a popular variant of ermine, white tails upon a black field. To this fur the books now give the name of "ermines"—a most unfortunate choice, since ermines is a name used in old documents for the original ermine. "Erminees," which has at least a 15th-century authority, will serve for those who are not content to speak of "sable ermined with silver." Vair, although silver and blue be its normal form, may be made up of gold, silver or ermine, with sable or gules or vert, but in these latter cases the colours must be named in the blazon. To the vairs and ermines of old use the heraldry books have added "erminois," which is a gold field with black ermine tails, "pean," which is "erminois" reversed, and "erminites," which is ermine with a single red hair on either side of each black tail. The vairs, mainly by misunderstanding of the various patterns found in old paintings, have been amplified with "countervair," "potent," "counter-potent" and "vair-en-point," no one of which merits description.

No shield of a plain metal or colour has ever been borne by an Englishman, although the knights at Carlaverock and Falkirk saw Amaneu d'Albret with his banner all of red having no charge thereon. Plain ermine was the shield of the duke of Brittany and no Englishman challenged the bearing. But Beauchamp of Match bore simple vair, Ferrers of Derby "Vairy gold and gules," and Ward "Vairy silver and sable."

Only one English example has hitherto been discovered of a field covered not with a fur but with overlapping feathers. A 15th-century book of arms gives "Plumetty of gold and purple" for "Mydlam in Coverdale."

Drops of various colours which variegate certain fields and charges are often mistaken for ermine tails when ancient seals are deciphered. A simple example of such spattering is in the shield of Grayndore, who bore "Party ermine and vert, the vert dropped with gold."

A very common variant of charges and fields is the sowing or "powdering" them with a small charge repeated many times. Mortimer of Norfolk bore "gold powdered with fleurs-de-lys sable" and Edward III. quartered for the old arms of France "Azure powdered with fleurs-de-lys gold," such fields being often described as flowered or flory. Golden billets were scattered in Cowdray's red shield, which is blazoned as "Gules billety gold," and bezants in that of Zouche, which is "Gules bezanty with a quarter ermine." The disposition of such charges varied with the users. Zouche as a rule shows ten bezants placed four, three, two and one on his shield, while the old arms of France in the

royal coat allows the pattern of flowers to run over the edge, the shield border thus showing halves and tops and stalk ends of the fleurs-de-lys. But the commonest of these powderings is that with crosslets, as in the arms of John la Warr "Gules crusily silver with a silver lion."

Trees, Leaves and Flowers.—Sir Stephen Cheyndut, a 13th-century knight, bore an oak tree, the *cheyne* of his first syllable, while for like reasons a Piriton had a pear tree on his shield. Three pears were borne *(temp.* Edward III.) by Nicholas Stivecle of Huntingdonshire, and about the same date is Applegarth's shield of three red apples in a silver field. Leaves of burdock are in the arms (14th century) of Sir John de Lisle and mulberry leaves in those of Sir Hugh de Morieus. Three roots of trees are given to one Richard Rotour in a 14th-century roll. Malherbe (13th century) bore the "evil herb"—a teazle bush. Pineapples are borne here and there, and it will be noted that armorists have not surrendered this, our ancient word for the "fir-cone," to the foreign *ananas.* Out of the cornfield English armory took the sheaf, three sheaves being on the shield of an earl of Chester early in the 13th century and Sheffield bearing sheaves for a play on his name. For a like reason Peverel's sheaves were sheaves of pepper. Rye bore three ears of rye on a bend, and Graindorge had barley-ears. Flowers are few in this field of armory, although lilies with their stalks and leaves are in the grant of arms to Eton College. Ousethorpe has water flowers, and now and again we find some such strange charges as those in the 15th-century shield of Thomas Porthelyne who bore "Sable, a cheveron gules between three 'popyebolles,' or poppy-heads vert."

The fleur-de-lys, a conventional form from the beginnings of armory, might well be taken amongst the "ordinaries." In England as in France it is found in great plenty. Aguylon bore "Gules, a fleur-de-lys silver." Peyferer bore "Silver, three fleur-de-lys sable." *(See* also FLEUR-DE-LIS.)

Trefoils are very rarely seen until the 15th century, although Hervey has them, and Gausill, and a Bosville coat seems to have borne them. They have always their stalk left hanging to them. Vincent, Hattecliffe and Massingberd all bore the quatrefoil, while the Bardolfs, and the Quincys, earls of Winchester, had cinqfoils. The old rolls of arms made much confusion between cinqfoils and sixfoils *(quintefoilles e sisfoilles)* and the rose. It is still uncertain how far that confusion extended amongst the families which bore these charges. The cinqfoil and sixfoil, however, are all but invariably pierced in the middle like the spur rowel, and the rose's blunt-edged petals give it definite shape soon after the decorative movement of the Edwardian age began to carve natural buds and flowers in stone and wood. Hervey bore "Gules, a bend silver with three trefoils vert thereon." Vincent bore "Azure, three quatrefoils silver."

Quincy bore "Gules, a cinqfoil silver." Bardolf of Wormegay bore "Gules, three cinqfoils silver." Cosington bore "Azure, three roses gold."

Beasts and Birds.—The book of natural history as studied in the middle ages lay open at the chapter of the lion, to which royal beast all the noble virtues were set down. What is the oldest armorial seal of a sovereign prince as yet discovered bears the rampant lion of Flanders. In England we know of no royal shield earlier than that first seal of Richard I. which has a like device. A long roll of English earls, barons and knights uore the lion on their coats—Lacy, Marshal, Fitzalan and Montfort. Percy, Mowbray and Talbot. By custom the royal beast is shown as rampant, touching the ground with but one foot and clawing at the air in noble rage. So far is this the normal attitude of a lion that the adjective "rampant" was often dropped, and we have leave and good authority for blazoning the rampant beast simply as "a lion," leave which a writer on armory may take gladly to the saving of much repetition. In France and Germany this licence has always been the rule, and the modern English herald's blazon of "Gules a lion rampant or" for the arms of Fitzalan, becomes in French *de gueules au lion d'or* and in German *in Rot ein goldener Loewe.* Other positions must be named with care and the prowling "lion passant" distinguished from the rampant beast, as well as from such rarer shapes as the couchant lion, the lion sleeping, sitting or leaping. Of these the lion passant is the only one commonly encountered. The lion standing with his forepaws together is not a figure for the shield, but for the crest, where he takes this position for greater stableness upon the helm, and the sitting lion is also found rather upon helms than in shields. For a couchant lion or a dormant lion one must search far afield, although there are some mediaeval instances. The leaping lion is in so few shields that no maker of a heraldry book has, it would appear, discovered an example. In the books this "lion salient" is described as with the hind paws together on the ground and the fore paws together in the air, somewhat after the fashion of a diver's first movement. But examples from seals and monuments of the Felbrigges and the Merks show that the leaping lion differed only from the rampant in that he leans somewhat forward in his eager spring. The compiler of the British Museum catalogue of mediaeval armorial seals, and others equally unfamiliar with mediaeval armory, invariably describe this position as "rampant," seeing no distinction from other rampings. As rare as the leaping lion is the lion who looks backward over his shoulder. This position is called "regardant" by modern armorists. The old French blazon calls it *rere regardant* or *turnaunte le visage arere,* "regardant" alone meaning simply "looking," and therefore we shall describe it more reasonably in plain English as "looking backward" The two-headed lion occurs in a 13th-century coat of Mason, and at the same period a monstrous lion of three bodies and one head is borne, apparently, by a Sharingbury.

The lion's companion is the leopard. What might be the true form of this beast was a dark thing to the old armorist, yet knowing from the report of grave travellers that the leopard was begotten in spouse-breach between the lion and the pard, it was felt that his shape would favour his sire's. But nice distinctions of outline, even were they ascertainable, are not to be marked on the tiny seal, or easily expressed by the broad strokes of the shield painter. The leopard was indeed lesser than the lion, but in armory, as in the Noah's arks launched by the old yards, the bear is no bigger than the badger. Then a happy device came to the armorist. He would paint the leopard like the lion at all points. But as the lion looks forward the leopard should look sidelong, showing his whole face. The matter was arranged, and until the end of the middle ages the distinction held and served. The disregarded writers on armory, Nicholas Upton, and his fellows, protested that a lion did not become a leopard by turning his face sidelong, but none who fought in the field under lion and leopard banners heeded this pedantry from cathedral closes. The English king's beasts were leopards in blazon, in ballad and chronicle, and in the mouths of liegeman and enemy. Henry V.'s herald, named from his master's coat, was Leopard Herald; and Napoleon's gazettes never fail to speak of the English leopards. In our own days, those who deal with armory as antiquaries and students of the past will observe the old custom for convenience sake. Those for whom the interest of heraldry lies in the nonsense-language brewed during post-mediaeval years may correct the mediaeval ignorance at their pleasure The knight who saw the king's banner fly at Falkirk or Crécy tells us that it bore "Gules with three leopards of gold" The modern armorist will shame the uninstructed warrior with "Gules, three lions passant gardant in pale or."

As the lion rampant is the normal lion, so the normal leopard is the leopard passant, the adjective being needless. In a few cases only the leopard rises up to ramp in the lion's fashion, and here he must be blazoned without fail as a leopard rampant.

Parts of the lion and the leopard are common charges. Chief of these are the demi-lion and the demi-leopard, beasts complete above their slender middles, even to the upper parts of their lashing tails. Rampant or passant, they follow the customs of the unmaimed brute. Also the heads of lion and leopard are in many shields, and here the armorist of the modern handbooks stumbles by reason of his refusal to regard clearly marked mediaeval distinctions. The instructed will know a lion's head because it shows but half the face and a leopard's head because it

is seen full-face. But the handbooks of heraldry, knowing naught of leopards, must judge by absence or presence of a mane, speaking uncertainly of leopards' faces and lions' heads and faces. Here again the old path is the straighter. The head of a lion, or indeed of any beast, bird or monster, is generally painted as "razed," or torn away with a ragged edge which is pleasantly conventionalized. Less often it is found "couped" or cut off with a sheer line. But the leopard's head is neither razed nor couped, for no neck is shown below it. Likewise the lion's fore leg or paw—"gamb" is the book word—may be borne, razed or couped. Its normal position is raised upright, although Newdegate seems to have borne "Gules, three lions' legs razed silver, the paws downward." With the strange bearing of the lion's whip-like tail cut off at the rump, we may end the list of these oddments.

Fitzalan, earl of Arundel, bore "Gules, a lion gold." Simon de Montfort bore "Gules, a silver lion with a forked tail." Segrave bore "Sable, a lion silver crowned gold." Havering-bore "Silver, a lion rampant gules with a forked tail, having a collar azure." Felbrigge of Felbrigge bore "Gold, a leaping lion gules." Esturmy bore "Silver, a lion sable (or purple) looking backward." Marmion bore "Gules, a lion vair." Mason bore "Silver, a two-headed lion gules." Lisle bore "Gules, a leopard silver crowned gold." Ludlowe bore "Azure, three leopards silver." Brocas bore "Sable, a leopard rampant gold."

John Hardrys of Kent seals in 1372 with arms of "a sitting leopard." John Northampton, Lord Mayor of London in 1381, bore "Azure, a crowned leopard gold with two bodies rampant against each other." Newenham bore "Azure, three demi-lions silver." A deed delivered at Lapworth in Warwickshire in 1466 is sealed with arms of "a molet between three demi-leopards."

The tiger is rarely named in collections of mediaeval arms. Deep mystery wrapped the shape of him, which was never during the middle ages standardized by artists. A crest upon a 15th-century brass shows him as a lean wolf-like figure, with a dash of the boar, gazing after his vain wont into a looking-glass; and the 16th-century heralds gave him the body of a lion with the head of a wolf, head and body being tufted here and there with thick tufts of hair. But it is noteworthy that the arms of Sir John Norwich, a well-known knight of the 14th century, are blazoned in a roll of that age as "party azure and gules with a tiger rampant ermine." Now this beast in the arms of Norwich has been commonly taken for a lion, and the Norwich family seem in later times to have accepted the lion as their bearing. But a portion of a painted roll of Sir John's day shows on careful examination that his lion has been given two moustache-like tufts to the nose. A copy made about 1600 of another roll gives the same decoration to the Norwich lion, and it is at least possible we have here evidence that the economy of the mediaeval armorist allowed him to make at small cost his lion, his leopard and his tiger out of a single beast form.

Take away the lions and the leopards, and the other beasts upon mediaeval shields are a little herd. In most cases they are here to play upon the names of their bearers. Thus Swinburne of Northumberland has the heads of swine in his coat and Bacon has bacon pigs. Three white bears were borne by Barlingham, and a bear ramping on his hind legs is for Barnard. Lovett of Astwell has three running wolves, Videlou three wolves' heads, Colfox three foxes' heads.

An elephant was brought to England in the days of Henry III., but he had no immediate armorial progeny, although Sanders of Northants may have borne before the end of the middle ages the elephants' heads which speak of Alysander the Great, patron of all Sanderses. Of dogs the greyhound and the talbot, or mastiff, are found most often. Thus Talbot of Cumberland had talbots, and Mauleverer, running greyhounds or "leverers" for his name's sake. The alaund, a big, crop-eared dog, is in the 15th-century shield of John Woode of Kent, and "kenets," or little tracking dogs, in a 13th-century coat of Kenet. The horse is not easily found as an English charge, but Moyle's white mule seems an old coat; horses' heads are in Horsley's shield, and ass heads make crests for more than one noble house. Askew has three asses in his arms. Three bats or flittermice are in the shield of Burninghill and in that of Heyworth of Whethamstede.

As might be looked for in a land where forest and greenwood once linked from sea to sea, the wild deer is a common charge in the shield. Downes of Cheshire bore a hart "lodged" or lying down. Hertford had harts' heads, Malebis, fawns' heads (*testes* de *bis*), Buckingham, heads of bucks. The harts in Rotherham's arms are the roes of his name's first syllable. Reindeer heads were borne by Bowet in the 14th century. Antelopes, fierce beasts with horns that have something of the ibex, show by their great claws, their lion tails and their boar muzzles and tusks that they are midway between the hart and the monster. The yale, eale or gall, is found among fifteenth century supporters, an antelope-like creature sometimes shown with one horn curving behind and the other curving to the front.

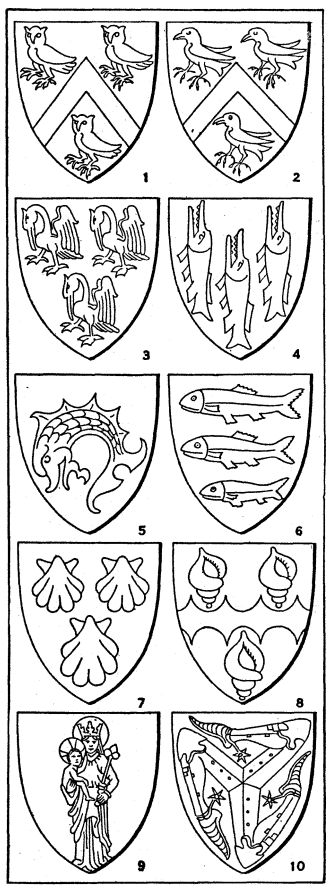

FIG. 6.— BRITISH SHIELDS OF ARMS (1) Burton. (2) Rokeby. (3) Pelham. (4) Lucy. (5) Fishacre. (6) Roche (7) Dacre. (8) Shelley. (9) See of Salisbury. (10) Isle of Man

Of the outlandish monsters the griffon is the oldest and the chief. With the hinder part of a lion, the rest of him is eagle, head and shoulders, wings and fore legs. The long tuft under the beak and his pointed ears mark him out from the eagle when his head alone is borne. At an early date a griffon rampant, his normal position, was borne by the great house of Montagu as a quartering, and another griffon played upon Griffin's name.

The wyver, who becomes wyvern in the 16th century, and takes a new form under the care of inventive heralds, was in the middle ages a lizard-like dragon, generally with small wings. Sir Edmund Mauley in the 14th century is found differencing the black bend of his elder brother by charging it with three wyvers of silver. During the middle ages there seems small distinction between the wyver and the still rarer dragon, which, with the coming of the Tudors, who bore it as their badge, is seen as a four-legged monster with wings and a tail that ends like a broad arrow. The monster in the arms of Drake, blazoned by Tudor heralds as a wyvern, is clearly a fire-drake or dragon in his origin.

The unicorn rampant was borne by Harlyn of Norfolk; unicorn's heads by the Cambridgeshire family of Paris. The mermaid with her comb and looking-glass makes a 14th-century crest for Byron, while "Silver, a bend gules with three silver harpies thereon" is found in the 15th century for Entyrdene.

Concerning beasts and monsters the heraldry books have many adjectives of blazonry which may be disregarded. Even as it was once the pride of the cook pedant to carve each bird on the board with a new word for the act, so it became the delight of the pedant herald to order that the rampant horse should be "forcené," the rampant griffon "segreant," the passant hart "trippant"; while the same hart must needs be "attired" as to its horns and "unguled" as to its hoofs. There is ancient authority for the nice blazonry which sometimes gives a separate colour to the tongue and claws of the lion, but even this may be set aside. Though a black lion in a silver field may be armed with red claws, and a golden leopard in a red field given blue claws and tongue, these trifles are but fancies which follow the taste of the painter, and are never of obligation. The tusks and hoofs of the

boar, and often the horns of the hart, are thus given in some paintings a colour of their own which elsewhere is neglected.

As the lion is among armorial beasts, so is the eagle among the birds. A bold convention of the earliest shield painters displayed him with spread wing and claw, the feat of a few strokes of the brush, and after this fashion he appears on many scores of shields. Like the claws and tongue of the lion, the beak and claws of the eagle are commonly painted of a second colour in all but very small representations. Thus the golden eagle of Lymesey in a red field may have blue beak and claws, and golden beak and claws will be given to Jorce's silver eagle upon red. A lure, or two wings joined and spread like those of an eagle, is a rare charge sometimes found. When fitted with the cord by which a falconer's lure is swung, the cord must be named.

Monhermer bore "Gold, an eagle vert." Siggeston bore "Silver, a two-headed eagle sable." Gavaston, earl of Cornwall, bore "Vert, six eagles gold." Bayforde of Fordingbridge sealed (in 1383) with arms of "An eagle bendwise, with a oorder engrailed and a baston." Graunson bore "Paly silver and azure with a bend gules and three golden eagles thereon."

Commoner than the eagle as a charge is the martlet, a humbler bird which is never found as the sole charge of a shield. In all but a few early representations the feathers of the legs are seen without the legs or claws. The martlet indicates both swallow and martin, and in the arms of the Cornish Arundels the martlets must stand for "hirundels" or swallows.

The falcon or hawk is borne as a rule with close wings, so that he may not be taken for the eagle. In most cases he is there to play on the bearer's name: and this may be said of most of the flight of lesser birds.

Naunton bore "Sable, three martlets silver." Heron bore "Azure, three herons silver." Fauconer bore "Silver, three falcons gules." Hauvile bore "Azure, a dance between three hawks gold." Twenge bore "Silver, a fesse gules between three popinjays (or parrots) vert." Cranesley bore "Silver, a cheveron gules between three cranes azure." Asdale bore "Gules, a swan silver." Dalston bore "Silver, a cheveron engrailed between three daws' heads razed sable." Corbet bore "Gold, two corbies sable." Sumeri (13th century) sealed with arms of "A peacock with his tail spread" John Pyeshale of Suffolk (14th century) sealed with arms of "Three magpies."

Fishes, Reptiles and Insects.—Like the birds, the fishes are borne for the most part to call to mind their bearers' names. Unless their position be otherwise named, they are painted as upright in the shield, as though rising towards the water surface. The dolphin is known by his bowed back, old artists making him a grotesquely decorative figure.

Lucy bore "Gules, three luces (or pike) silver." Heringaud bore "Azure, crusilly gold, with six golden herrings." Fishacre bore "Gules, a dolphin silver." La Roche bore "Three roach swimming" John Samon (14th century) sealed with arms of "Three salmon swimming."

Shell-fish would hardly have place in English armory were it not for the abundance of scallops which have followed their appearance in the banners of Dacre and Scales. The crest of the Yorkshire Scropes, playing upon their name, was a pair of crabs' claws. Dacre bore "Gules, three scallops silver." Shelley bore "Sable, a fesse engrailed between three whelk-shells gold."

Reptiles and insects are barely represented. The lizards in the crest and supporters of the Ironmongers of London belong to the 15th century. Gawdy of Norfolk may have borne the tortoise in his shield in the sarne age. "Silver, three toads sable" was quartered as a second coat for Botreaux of Cornwall in the 16th century—Botereau or Boterel signifying a little toad in the old French tongue—but the arms do not appear on the old Botreaux seals beside their ancient bearing of the griffon. Beston bore "Silver, a bend between six bees sable" and a 15th-century Harbottle seems to have sealed with arms of three bluebottle flies. Three butterflies are in the shield of Presfen of Lancashire in 1411, while the winged insect shown on the seal of John Mayre, a King's Lynn burgess of the age of Edward I., is probably a mayfly.

Human Charges.—Man and the parts of him play but a small part in English shields, and we have nothing to put beside such a coat as that of the German Manessen, on which two armed knights attack each other's hauberks with their teeth. But certain arms of religious houses and the like have the whole figure, the see of Salisbury bearing the Virgin and Child in a blue field. And old crests have demi-Saracens and falchion men, coal-miners, monks and blackamoors. Sowdan bore in his shield a turbaned soldan's head; Eady, three old men's "'eads"! Heads of maidens, the "winsome marrows" of the ballad, are in the arms of Marow. The Stanleys, as kings of Man, quartered the famous three armed legs whirling mill-sail fashion, and Tremayne of the west bore three men's arms in like wise. "Gules, three hands silver" was for Malmeyns as early as the 13th century, and Tynte of Colchester displayed hearts.

Miscellaneous Charges.—Other charges of the shield are less frequent but are found in great variety, the reason for most of them being the desire to play upon the bearer's name.

Weapons and the like are rare, having regard to the military associations of armory. Daubeney bore three helms; Philip Marmion took with his wife. the coheir of Kilpek, the Kilpek shield of a sword (espek). Tuck had a stabbing sword or "tuck." Bent bows were borne by Bowes, an arblast by Arblaster, arrows by Archer, birding-bolts or bosouns by Bosun, the mangonel by Mangnall. The three lances of Amherst is probably a mediaeval coat; Lewestone had battle-axes.

Of horse-furniture we have the stirrups of Scudamore and Giffard, the horse-barnacles of Bernake and the horse-shoes borne by many branches and tenants of the house of Ferrers.

Of musical instruments there are pipes, trumps and harps for Pipe, Trumpington and Harpesfeld. Hunting horns are common among families bearing such names as Forester or Horne. Remarkable charges are the three organs of Grenville, who held of the house of Clare, the lords of Glamorgan.

The most notable of the charges derived from clothing is the hanging sleeve familiar in the arms of Hastings, Conyers and Mansel.

Chess-rooks, hardly to be distinguished from the roc or roquet at the head of a jousting-lance, were borne by Rokewode and by many more. Topcliffe had pegtops in his shield, while Ambesas had a cast of three dice which should each show the point of one, for "to throw ambesace" is an ancient phrase used of those who throw three aces.

Although the British are a sea-going people, there are few ships in British armory, most of these in the arms of sea-ports. Anchors are commoner.

Castles and towers, bridges, portcullises and gates have all examples, and a minster-church was the curious charge borne by the ancient house of Musters of Kirklington.

Letters of the alphabet are very rarely found in ancient armory; but three capital T's, in old English script, were borne by Toft of Cheshire in the 14th century. In the period of decadence whole words or sentences, commonly the names of military or naval victories, are often seen.

Blazonry.—All ill-service has been done to the students of armory by those who have pretended that the phrases in which the shields and their charges are described or blazoned must follow arbitrary laws devised by writers of the period of armorial decadence. One of these laws, and a mischievous one, asserts that no tincture should be named a second time in the blazon of one coat. Thus if gules be the hue of the field any charge of that colour must thereafter be styled "of the first." Obeying this law the blazoner of a shield of arms elaborately charged may find himself sadly involved among "of the first," "of the second" and "of the third." It is needless to say that no such law obtained among armorists of the middle ages. The only rule that demands obedience is that the brief description should convey to the reader a true knowledge of the arms described.

The examples of blazonry given in that part of this article which deals with armorial charges will be more instructive to the student than any elaborated code of directions. It will be observed that the description of the field is first set down, the

blazoner giving its plain tincture or describing it as burely, party, paly or barry, as powdered or sown with roses, crosslets or fleurs-de-lys. Then should follow the main or central charges, the lion or griffon dominating the field, the cheveron or the pale, the fesse, bend or bars, and next the subsidiary charges in the field beside the "ordinary" and those set upon it. Chiefs and quarters are blazoned after the field and its contents, and the border, commonly an added difference, is taken last of all. Where there are charges both upon and beside a bend, fesse or the like, a curious inversion is used by pedantic blazoners. The arms of Mr. Samuel Pepys of the Admiralty Office would have been described in earlier times as "Sable, a bend gold between two horses' heads razed silver, with three fleurs-de-lys sable on the bend." Modern heraldic writers would give the sentence as "Sable, on a bend or between two horses' heads erased argent, three fleurs-de-lys of the first." Nothing is gained by this inversion but the precious advantage of naming the bend but once. On the other side it may be said that, while the newer blazon couches itself in a form that seems to prepare for the naming of the fleurs-de-lys as the important element of the shield, the older form gives the fleur-de-lys as a mere postscript, and rightly, seeing that charges in such a position are very commonly the last additions to a shield by way of difference. In like manner when a crest is described it is better to say "a lion's head out of a crown" than "out of a crown a lion's head." The first and last necessity in blazonry is lucidity, which is cheaply gained at the price of a few syllables repeated.

Modern Heraldry. — With the accession of the Tudors armory began a rapid decadence. Heraldry ceased to play its part in military affairs, the badges and banners under which the mediaeval noble's retinue came into the field were banished, and even the tournament in its later days became a renascence pageant which did not need the painted shield and armorial trappers. Treatises on armory had been rare in the days before the printing press, but even so early a writer as Nicholas Upton had shown himself as it were unconcerned with the heraldry that any man might see in the camp and the street. From the Book of St. Albans onward the treatises on armory are informed with a pedantry which touches the point of crazy mysticism in such volumes as that of Sylvanus Morgan. Thus came into the books those long lists of "diminutions of ordinaries," the closets and escarpes, the endorses and ribands, the many scores of strange crosses, and such wild fancies as the rule, based on an early German pedantry, that the tinctures in peers' shields should be given the names of precious stones and those in the shields of sovereigns the names of planets. Blazon became cumbered with that vocabulary whose French of Stratford atte Bowe has driven serious students from a business which, to use a phrase as true as it is hackneyed, was at last "abandoned to the coachpainter and the undertaker."

With the false genealogy came in the assumption or assigning of shields to which the new bearers had often no better claim than lay in a surname resembling that of the original owner. The ancient system of differencing arms disappeared. Now and again we see a second son obeying the book-rules and putting a crescent in his shield or a third son displaying a molet, but long before our own times the practice was disregarded, and the most remote kinsman of a gentle house displayed the "whole coat" of the head of his family.

The art of armory had no better fate. An absurd rule current for some three hundred years has ordered that the helms of princes and knights should be painted full-faced and those of peers and gentlemen sidelong. Obeying this, the herald painters have displayed the crests of knights and princes as sideways upon a full-faced helm; the torse or wreath, instead of being twisted about the brow of the helm, has become a sausage-shaped bar see-sawing above the helm, and upon this will be balanced a crest which might puzzle the ancient craftsman to mould in his leather or parchment. A ship on a lee-shore with a thunderstorm lowering above its masts may stand as an example of such devices. "Tastes, of course, differ," wrote Dr. Woodward, "but the writer can hardly think that the épergne given to Lieut.-General Smith by his friends at Bombay was a fitting ornament for a helmet." As with the crest, so with the shield. It became crowded with ill-balanced figures devised by those who despised and ignored the ancient examples whose painters had followed instinctively a simple and pleasant convention. Landscapes and seascapes, musical lines, military medals and corrugated boiler-flues have all made their appearance in the shield. Even as on the signs of public houses, written words have taken the place of figures, and the often-cited arms exemplified to the first Earl Nelson marked, it may be hoped, the high watermark of these distressing modernisms. Of late years, indeed, official armory in England has shown a disposition to follow the lessons of the archaeologist, although the recovery of mediaeval use has not yet been as successful as in Germany, where for a long generation a school of vigorous armorial art has flourished.

OFFICERS OF ARMS

Officers of arms, styled kings of arms. heralds and pursuivants, make their appearance at an early period of the history of armory as the messengers both in peace and in war of princes and magnates. It is probable that from the first they bore in some wise their lord's arms as the badge of their office. In the 14th century we have heralds with the arms on a short mantle; witness the figure of the duke of Gelderland's herald painted in the Armorial *de Gelre*. The title of Blue Mantle pursuivant, as old as the reign of Edward III, suggests a like usage in England. When the tight-laced coat of arms went out of fashion among the knighthood the loose tabard of arms with its wide sleeves was at once taken in England as the armorial dress of both herald and cavalier. and the fashion of it has changed but little since those days. Clad in such a coat the herald was the image of his master and, although he himself was rarely chosen from any rank above that of the lesser gentry, his person. as a messenger, acquired an almost priestly sacredness. To injure or to insult him was to affront the coat that he wore.

We hear of kings of arms in the royal household of the 13th century, and we may compare their title with those of such officers as the King of the Ribalds and the King of the Minstrels; but it is noteworthy that, even in modern warrants for heralds' patents, the custom of the reign of Edward III is still cited as giving the necessary precedents for the officers' liveries. Officers of arms took their titles from their provinces or from the titles and badges of their masters. Thus we have Garter, Norroy and Clarenceux, March, Lancaster, Windsor, Leicester, Leopard, Falcon and Blanc Sanglier as officers attached to the royal house; Chandos, the herald of the great Sir John Chandos; Vert Eagle of the Nevill earls of Salisbury, Esperance and Crescent of the Percys of Northumberland. The spirit of Henry VII's legislation was against such usages in baronial houses, and in the age of the Tudors the last of the private heralds disappears.

In England the royal officers of arms were made a corporation by Richard III. Nowadays the members of this corporation, known as the College of Arms or Heralds' College, are Garter Principal King of Arms, Clarenceux King of Arms South of Trent, Norroy Xing of Arms North of Trent. the heralds Windsor, Chester, Richmond, Somerset, York and Lancaster, and the pursuivants Rouge Croix, Bluemantle, Rouge Dragon and Portcullis. Another king of arms, not a member of this corporation, has been attached to the order of the Bath since the reign of George I, and an officer of arms, without a title, attends the order of St. Michael and St. George.

There is no college or corporation of heralds in Scotland or Ireland. In Scotland "Lyon-king-of-arms," "Lyon rex *armorum*," or "Leo *fecialis*," so called from the lion on the royal shield, is the head of the office of arms. When first the dignity was constituted is not known, but Lyon was a prominent figure in the coronation of Robert II in 1371. The office was at first, as in England. attached to the earl marshal, but it has long been conferred by patent under the great seal, and is held direct from the crown. Lyon is also king-of-arms for the national order of the Thistle. He is styled "Lord Lyon," and the office has always been held by men of family, and frequently by a peer who would appoint a

"Lyon depute." He is supreme in all matters of heraldry in Scotland. Following him there are the Scottish heralds, Albany, Ross and Rothesay, with precedence according to date of appointment; and the pursuivants, Carrick, March and Unicorn. Heralds and pursuivants are appointed by Lyon.

In Ireland also there is but one king-of-arms, Ulster. The office was instituted by Edward VI in 1553. The patent is given by Rymer, and refers to certain emoluments as "*praedicto officio . . . ab antiquo spectantibus.*" The allusion is to an Ireland king-of-arms mentioned in the reign of Richard II and superseded by Ulster. Ulster holds office by patent, during pleasure; under him the Irish office of arms consists of two heralds. Cork and Dublin, and a pursuivant, Athlone. Ulster is king-of-arms to the order of St. Patrick. He held visitations in parts of Ireland from 1568 to 1620, and these and other records, including all grants of arms from the institution of the office, are kept in Birmingham tower, Dublin.

The armorial duties of the ancient heralds are not clearly defined. The patent of Edward IV. creating John Wrythe king-of-arms of England and the style of Garter, speaks vaguely of the care of the office of arms and those things which belong to that office. We know that the heralds had their part in the ordering of tournaments. wherein armory played its greatest part, and that their expert knowledge of arms gave them such duties as reckoning the noble slain on a battlefield. But it is not until the 15th century that we find the heralds following a recognized practice of granting or assigning arms, a practice on which John of Guildford comments, saying that such arms given by a herald are not of greater authority than those which a man has taken for himself. The *Book of St. Albans,* put forth in 1486, speaking of arms granted by princes and lords, is careful to add that "armys bi a mannys proper auctorite taken, if an other man have not borne theym afore, be of strength enogh," repeating. as it seems. Nicholas Upton's opinion which, in this matter, does not conflict with the practice of his day. It is probable that the earlier grants of arms by heralds were made by reason of persons uncunning in armorial lore applying for a suitable device to experts in such matters, and that such setting forth of arms may have been practised even in the 14th century.

The earliest-known grants of arms in England by sovereigns or private persons are, as a rule, the conveyance of a right in a coat of arms already existing or of a differenced version of it. Thus in 1391 Thomas Grendale, a squire who had inherited through his grandmother the right in the shield of Beaumeys, granted his right in it to Sir William Moigne, a knight who seems to have acquired the whole or part of the Beaumeys manor in Sawtry. Under Henry VI we have certain rare and curious letters of the crown granting nobility with arms, "*in signum hujusmodi nobilitatis*" to certain individuals, some and perhaps all of whom were foreigners who may have asked for letters which followed a continental usage. After this time we have a regular series of grants by heralds who in later times began to assert that new arms, to be valid, must necessarily be derived from their assignments, although ancient use continued to be recognized.

An account of the genealogical function of the heralds, so closely connected with their armorial duties, will be found in the article GENEALOGY. In spite of the work of such distinguished men as Camden and Dugdale they gradually fell in public estimation until Blackstone could write of them that the marshalling of coat armour had fallen into the hands of certain officers called heralds, who had allowed for lucre such falsity and confusion to creep into their records that even their common seal could no longer be received as evidence in any court of justice. From this low estate they rose again when the new archaeology included heraldry in its interests, and several antiquaries of repute later wore the herald's tabard.

In spite of the vast amount of material which the libraries catalogue under the head of heraldry, the subject has as yet received little attention from antiquaries working in the modern spirit. The old books are as remarkable for their detachment from the facts as for their folly. The work of Nicholas Upton, De *studio militari,* although written in the first half of the 15th century, shows, as has been already remarked, no attempt to reconcile the conceits of the author with the armorial practice which he must have seen about him on every side. Gerard Leigh. Bossewell, Ferne and Morgan carried on this bad tradition, each adding his own extravagances. The *Display* of *Heraldry,* first published in 1610 under the name of John Guillim, is more reasonable if not more learned, and in its various editions gives a valuable view of the decadent heraldry of the 17th century. In the 19th century many important essays on the subject were to be found in such magazines as the *Genealogist,* the *Herald and Genealogist* and the *Ancestor,* while Planché's *Pursuivant of Arms* contained some slight but suggestive work which attempted original inquiry But Woodward's *Treatise on Heraldry, British and Foreign* (1896), in spite of many errors arising from the author's reliance upon unchecked material, must be counted the only scholarly book in English upon a matter which has engaged so many pens. Among foreign volumes may be cited those of Menestrier and Spener, and the vast compilation of the German Siebmacher. Notable ordinaries of arms are those of Papworth and Renesse, companions to the armorials of Burke and Rietstap. The student may be advised to turn his attention to all works dealing with the effigies, brasses and other monuments of the middle ages, to the ancient heraldic seals and to the heraldry of mediaeval architecture and ornament.

(O. B.)

HERAT, city and province, Afghanistan. The city lies in 34° 20′ 30″ N. and 62° 11′ 0″ E., 2,500 ft. above sea level. Estimated pop. about 50,000. It has quite lost its ancient commercial importance. From it lines of communication radiate to Russian, British. Iranian and Afghan territory. The city forms a quadrangle about 1,600 yd. by 1,500 yd.; on the west, south and east, only the gateways project from the line of defense, but on the north there is a double outwork consisting of the Ark, or citadel, and a lower work at its foot, called the Ark-i-nao, or "new citadel," which extends 100 yd. beyond the line of the city wall. That which distinguishes Herat from all other oriental cities is the stupendous earthwork upon which the city wall is built. This earthwork averages 250 ft. in width at the base and about 50 ft. in height, and as it is crowned by a wall 25 ft. high and 14 ft. thick at the base, supported by about 150 semicircular towers, and is further protected by a ditch 45 ft. in width and 16 in depth, it presents an appearance of imposing strength.

Defenses.—When the royal engineers of the Russo-Afghan Boundary commission entered Herat in 1885 they found its buildings in various stages of disrepair and lacking all effective defenses Outside, ancient ruins and mounds impeded all field of fire. To the northwest, beyond the Tal-i-Bangi, the magnificent outlines of the Mosalla filled a wide space with the glorious curves of dome and gateway and the stately grace of tapering minars. The needs of defense, however, called for its destruction, but four minars standing at the corners of the wide plinth still remain to attest to its glory and to exhibit samples of decorative tilework of intricate beauty of design and exquisite taste in the blending of colour. At the same time the ancient graveyards round the city were swept smooth and levelled; obstructions were demolished, outworks constructed and the defenses generally renovated. Whether or not the strength of this bulwark of northwestern Afghanistan should ever be practically tested, the general result of investigations into the value of Herat as a strategic centre was largely to rnodify the once widely accepted view that the key to India lay within it. Abdur Rahman and his successor Habibullah steadfastly refused the offer of British engineers to strengthen its defenses; and though the Afghans themselves occasionally undertook repairs, it is doubtful whether the old walls of Herat were maintained in a state of efficiency.

The **City** Gates.—The city possesses five gates, two on the northern face, the Kutab-chak near the northeast angle of the wall, and the Malik at the re-entering angle of the Ark-i-nao; and three others in the centres of the remaining faces. the Irak gate on the west, the Kandahar gate on the south and the Kushk gate on the east face. The main streets, the *Chahar-súk,* are well built, the principal one having a vaulted roof. Sear the cenlral quadrangle of the city is a vast domed reservoir of water. The only other

public building of any consequence in Herat is the Jamma Musjid or Great Mosque which comprises an area of 800 yd. square, and must have been a most magnificent structure. It was erected towards the close of the 11th century, during the reign of Shah Sultan Hussein of the family of Timur, and is said when perfect to have been 465 ft. long by 275 ft. wide, to have had 408 cupolas, 130 windows, 444 pillars and 6 entrances, and to have been adorned in the most magnificent manner with gilding, carving, precious mosaics and other elaborate and costly embellishments.

Ancient **Ruins.**—Along the slopes of the northern hills there is a space of some 4 m. in length by 3 m. in breadth, the surface of the plain, strewn over its whole extent with pieces of pottery and crumbling bricks, and also broken here and there by earthen mounds and ruined walls, the débris of palatial structures which at one time were the glory and wonder of the East. Of these structures indeed some have survived to the present day in a sufficiently perfect state to bear witness to the grandeur and beauty of the old architecture of Herat. Scarcely inferior to the mosque of the Mosalla though of more moderate dimensions, is the tomb of the saint Abdullah Ansari, in the same neighbourhood. This building, erected by Shah Rukh Mirza, grandson of Timur, over 500 years ago, contains exquisite Oriental sculpture. Adjoining the tomb also are marble sepulchres of princes of the house of Timur; and especially deserving of notice is a royal building tastefully decorated by an Italian artist named Geraldi, in the service of Shah Abbas the Great. It is held in high veneration by all classes, and the famous Dost Mohammed Khan is himself buried at the foot of the tomb of the saint. Two other royal palaces named respectively Bagh-i-Shah and Takht-i-Sefer, are on the same rising ground somewhat farther to the west.

Character of Inhabitants. — The original inhabitants of Ariana were no doubt of the Aryan family, cognate with the Persian race, but they probably intermixed at a very early period with the Sacae and Massagetae, who seem to have held the mountains from Kabul to Herat and to whom must be ascribed — rather than to an infusion of Turco-Tartaric blood introduced by the armies of Jenghiz and Timur — the peculiar broad features and flattish countenance of the inhabitants of Herat, Seistan and the eastern provinces of Persia. Under Herat, however, there are a very large number of tribes, ruled over by separate and semi-independent chiefs, and belonging probably to different nationalities. The principal group of tribes is called the Chahar-Aimak, or "(four races," the constituent parts of which, however, are variously stated by different authorities both as to strength and nomenclature. The Heratis are agricultural and not nearly so warlike as the Pathans from the neighbourhood of Kabul or Kandahar.

Environs of Herat. — The long narrow valley of the Hari Rud, starting from the western slopes of the Koh-i-Baba, extends almost due west for 300 m. before it takes its great northern bend at Kuhsan, and passes northwards through the broken ridges of the Siah Bubuk (the western extremity of the range which we now call Paropamisus) towards Sarakhs. For the greater part of its length it drains the southern slopes only of the Paropamisus and the northern slopes of a parallel range called Safed Koh. The Paropamisus forms the southern face of the Turkistan plateau, which contains the sources of the Murghab river; the northern face of the same plateau is defined by the Band-i-Turkistan. On the south of the plateau we find a similar succession of narrow valleys dividing parallel flexures, or anticlinals, formed under similar geological conditions to those which appear to be universally applicable to the Himalaya, the Hindu Kush, and the Indus frontier mountain systems. From one of these long lateral valleys the Hari Rud receives its principal tributary, which joins the main river below Obeh, 180 m. from its source; and it is this tributary (separated from the Hari Rud by the narrow ridges of the Koh-i-Safed and Band-i-Baian) that offers the high road from Herat to Kabul, and not the Hari Rud itself. From its source to Obeh the Hari Rud is a valley of sandy desolation. Masses of melting snow annually give rise to floods, irequently rendering the river impassable and cutting off the crazy brick bridges at Herat and Tirpul. It is impossible, whilst watching the rolling, seething volume of flood-water which swirls westwards in April, to imagine the waste stretches of dry river-bed which in a few months' time (when every available drop of water is carried off for irrigation) will represent the Hari Rud. The soft shales or clays of the hills bounding the valley render these hills especially subject to the action of denudation, and the result, in rounded slopes and easily accessible crests, determines the nature of the easy tracks and passes which intersect them. At the same time, any excessive local rainfall is productive of difficulty and danger from the floods of liquid mud and loose boulders which sweep like an avalanche down the hill sides. The intense cold which usually accompanies these sudden northern blizzards of Herat and Turkistan is a further source of danger.

Cultivated Area. — From Obeh, 50 m. east of Herat, the cultivated portion of the valley commences, and it extends, with a width which varies from 8 to 16 m., in Kuhsan, 60 m. west of the city, presenting a remarkable scene of luxurious fertility. The system of irrigation by which these agricultural results are attained is most elaborate. The Herati Tajik, adopts the karez (or, Persian, *kanat*) system of underground irrigation and brings every drop of water that he can find to the surface. The valley about Herat includes a flat alluvial plain. Three miles to the south of the city the river flows from east to west, spanned by the Pal-i-Malun. East and west stretches the long vista of the Hari Rud. Due north lie the hills called the Koh-i-Mulla Khwaja about 3 m. distant from the city. This northern line of barren, broken sandstone hills is geographically no part of the Paropamisus range, from which it is separated by a stretch of sandy upland about 20 m. in width, called the Dasht-i-Hamdamao, or Dasht-i-Ardewan, formed by the talus or drift of the higher mountains. Through this stretch of *dasht* the drainage from the main water-divide breaks downwards to the plains of Herat, where it is arrested and utilized for irrigation purposes.

The Korokh Valley. — To the north-east of the city a very considerable valley has been formed between the Paropamisus and the subsidiary Koh-i-Mulla Khwaja range, called Korokh. Here there are one or two important villages and a well-known shrine marked by a group of pine trees which is unique in this part of Afghanistan. The valley leads to a group of passes across the Paropamisus into Turkistan, of which the Zirmast is perhaps the best known. The main water-divide between Herat and the Turkistan Chol (the loess district) has been called Paropamisus for want of any well-recognized general name. To the north of the Korokh valley it exhibits something of the formation of the Hindu Kush (of which it is apparently a geological extension), but as it passes westwards it becomes broken into fragments by processes of denudation, until it is hardly recognizable as a distinct range at all. The direct passes across it from Herat (the Baba and the Ardewan) wind amongst masses of disintegrating sandstone for some miles on each side of the dividing watershed, but farther west the rounded knolls of the rain-washed downs may be crossed almost at any point without difficulty.

HISTORY

The name of Herat first appears in the list of primitive Zoroastrian settlements contained in the *Vendidād Sadē*, where it seems to apply to the river or river-basin, which was the special centre of population. Of the foundation of Herat (or Heri) nothing is known. We can only infer from the colossal character of the earthworks which surround the modern town that, like the similar remains at Bost on the Helmund and at Ulan Robat of Arachosia, they belong to that period of Central-Asian history which preceded the rise of Achaemenian power, and which in Grecian romance is illustrated. by the names of Bacchus, of Hercules. and of Semiramis. To trace in any detail the fortunes of Herat would be to write the modern history of the East, for there has hardly been a revolution, or war, in Central Asia since the time of the prophet in which Herat has not played a conspicuous part. Under the Tahirids of Khorasan, the Saffarids of Seistan, and the Samanids of Bokhara it flourished for some centuries in peace and progressive prosperity; but during the succeeding rule of the Ghaznevid kings its metropolitan character was for a time obscured by the celebrity of the neighbouring capital of Ghazni

(*q.v.*) until finally in the reign of Sultan Sanjar of Merv, about 1157, the city was entirely destroyed by an irruption of the Ghuzz, the predecessors of the modern Turkomans. Herat gradually recovered under the enlightened Ghorid kings, so that at the time of Jenghiz Khan's invasion it equalled or even exceeded in populousness and wealth its sister capitals of Balkh, Merv, and Nishapur, the united strength of the four cities being estimated at three millions of inhabitants. But this Mongol visitation was most calamitous: only 40 persons are said to have survived the general massacre of 1232, and a similar catastrophe overtook the city in 1398 on the fall of the Kurt dynasty (*see* MONGOLS). It is, therefore, astonishing to find that early in the 15th century Herat was again flourishing and populous, and the favoured seat of the art and literature of the East. It was under the princes of the house of Timur that most of the noble buildings were erected, of which the remains still excite our admiration at Herat, while all the great historical works relative to Asia, such as the *Rozet-es-Sefā*, the *Habīb-es-Seir*, *Hafiz Abrū's Tarikh*, the *Matlā a-es-Sa'adin*, etc., date from the same place and the same age. Four times was Herat sacked by Turkomans and Usbegs during the centuries which intervened between the Timuride princes and the rise of the Afghan power, and it has never in modern times attained to anything like its old importance. Afghan tribes, who had originally dwelt far to the east, were first settled at Herat by Nadir Shah, and from that time they have monopolized the government and formed the dominant element in the population. It is needless to trace the revolutions and counter-revolutions which have followed each other in quick succession at Herat since Ahmad Shah Durani founded the Afghan monarchy about the middle of the 18th century; it is enough to say that Herat has been throughout the seat of an Afghan Government, sometimes in subordination to Kabul and sometimes independent. Persia indeed for many years showed a strong disposition to reassert the supremacy over Herat which was exercised by the Safawid kings, but Britain steadily resisted the encroachment; and, indeed, after helping the Heratis to beat off the attack of the Persian army in 1838, the British at length compelled the shah in 1857, at the close of his war with them, to sign a treaty recognizing the further independence of the place, and pledging Persia against any further interference with the Afghans. In 1863 Herat, which for 50 years previously had been independent of Kabul, was incorporated by Dost Mohammed Khan in the Afghan monarchy.

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HÉRAULT, a *de'partement* in the south of' France, formed from Lower Languedoc. Pop. (1954) 471,429. Area, 2,403 sq.mi. It is bounded northeast by Gard, northwest by Aveyron and Tarn, and south by Aude and the Golfe du Lion.

The southern prolongation of the Cévennes mountains, composed of Archaean and Paleozoic rocks, with Mesozoic rocks on the southern edge and in the plateau of Larzac, occupies the northwest of the *dkpartement*, the highest point being about 4,250 ft. above sea level. Southeast of this come hills and plateaus decreasing as they approach the rich coastal plains at the mouth of the Orb and the Hérault river and, farther to the northeast the line of intercommunicating coastal salt lagoons (Etang de Thau, etc.). Northwest the Garrigues, a district of dry Mesozoic limestone plateaus and hills, stretches into the neighbouring *de'partement* of Gard. Southwest of this is the plain of Pliocene rocks with recent eruptive rocks near Agde. The mountains of the northwest form the watershed between the Atlantic and Mediterranean basins. From them flow the Hérault, its tributary the Lergue, and more to the southwest the Livron and the Orb, the main rivers of the *de'partement.*

The climate is colder and more rainy in the mountains than on the plain which has dry summers with occasional storms. Hérault ranks first among French *départements* for area of vineyards; the red wines of St. Georges, Cazouls-lès-Béziers, Picpoul and Maranssan, and the white wines of Frontignan and Lunel are famous. Mulberries. olives and chestnuts flourish. Silkworms are reared. Considerable numbers of sheep are raised, their milk being utilized for the preparation of Roquefort cheeses. There are quarries of marble, limestone, gypsum, etc.; the marshes supply salt. The most important mineral springs are at Lamalou-les-Bains and Balaruc-les-Bains. Woolen and cotton cloth, especially for military use, silk (Ganges), casks, soap and fertilizing stuffs are made. There are also oil works, distilleries (Béziers) and tanneries (Bédarieux).

Fishing is important; Sète and Mèze are the chief ports. Hérault exports salt fish, wine, liqueurs, timber, salt, building material, etc. It imports cattle, skins, wool, cereals, vegetables, coal and other commodities.

The railway lines belong chiefly to the Southern and P.L.M. companies. The Canal du Midi traverses the south of the *département* for 44 mi. and terminates at Siite. The canal des Étangs traverses the *de'partement* for about zo mi., forming part of a line of communication between Sbte and Aigues-Mortes. Montpellier, the capital, is the seat of a bishopric of the province of Avignon, and of a court of appeal and centre of an *acade'mie* (educational division).

The *de'partement* belongs to the 16th military region (Montpellier). It is divided into the *arrondissements* of Montpellier and Béziers, with 36 cantons and 342 communes.

Montpellier, Béziers, Lodève, Bédarieux, Sète, Agde, Pézenas, Lamalou-les-Bains and Clermont-l'Hérault are the more important towns.

Among the other interesting places in the *dkpartement* are St. Pons, with a church of the 12th century, once a cathedral; Villemagne, which has two ruined churches, one of the 13th, the other of the 14th century; Pignan, a medieval town, near uhich is the 13th-century abbey church of Vignogoul in the early Gothic style; and St. Guilhem-le-Désert, which has a church of the 11th and 12th centuries Maguelonne, which in the 6th century became the seat of a bishopric transferred to Montpellier in 1536, has a cathedral of the 12th century.

HÉRAULT DE SÉCHELLES, MARIE JEAN (1759–1794), French politician, was born at Paris on Sept. 20, 1759. He made his debut as a lawyer at the Châtelet, and later was *avocat général* to the parliament of Paris. He devoted himself to literature, and his account of his visit to the comte de Buffon at Montbard has with some justice been called a masterpiece of interviewing, before the day of journalists. Hérault took part in the taking of the Bastille and on Dec. 8, 1789, was appointed a judge in Paris.

On his return from a mission to Alsace (Jan.–April, 1791) he was appointed *commissaire du roi* in the court of cassation. He was elected as a deputy for Paris to the Legislative Assembly, where he gravitated towards the extreme left, and, as a member of the diplomatic committee, presented a famous report demanding that the nation should be declared to be in danger (June 11, 1793). After the revolution of Aug. 10, 1792 (*see* FRENCH REVOLUTION), he co-operated with Danton, and on Sept. 2, was appointed president of the Legislative Assembly.

Hérault was several times president of the Convention, notably on June 2, 1793, the occasion of the attack on the Girondins and on Aug. 10, 1793, when the passing of the new constitution was celebrated. On the rejection of the projected constitution drawn up by the marquis de Condorcet, he was entrusted with the task of preparing a fresh one; his plan became the constitution of 1793, which was passed, but never applied. As a member of the committee of public safety Hérault was employed on a mission in Alsace (Oct.–Dec. 1793) which made him an object of suspicion to the other members of the committee of public safety, and especially to Robespierre. He mas accused of treason, condemned with Danton, and executed on the 16th Germinal in the year II (April 5, 1794).

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HERB, any plant whose stem or stalk dies entirely or down to the ground each year and does not have, as in shrubs or trees, a woody or permanent stem above ground; such plants are also called herbaceous.

The term "herb" is also used of those herbaceous plants which possess certain properties and are used for medicinal purposes. for flavouring or garnishing in cooking, and also for perfumes (see FLAVOURINGS and HORTICULTURE). Some herbs are slightly woody, but have no true bark.

HERBARIUM, a collection of dried and pressed plants preserved and mounted to illustrate as far as possible their characters. A herbarium can be a very useful teaching aid or an absorbing hobby, but far more important is its use as a reference collection for botanical identification of plants and as a body of information for botanical research. Because the same kind of plant may vary greatly according to the environmental conditions, both as a direct response and by genetic adaptation, it is only by gathering together for comparison and study a large series of specimens of each species that the limits of variation within species, and the differences among them, can be satisfactorily determined.

Herbarium specimens of flowering plants ferns and the larger algae are customarily dried between sheets of heavy blotting paper or construction felt under pressure so that the dried specimen is flat Most specimens will dry in about a week. if the blotters are changed several times. The drying can be hastened by interspersing ventilators of corrugated cardboard among the blotters, and by the gentle application of heat.

Although the colours of flowers and leaves eventually fade, herbarium specimens last indefinitely, some being more than 300 years old.

After being dried the specimens are customarily attached to sheets of heavy white paper for permanent storage. Heavy all-rag (linen) paper is preferred because of its lasting qualities. The standard size of a herbarium sheet in the United States is $11\frac{1}{2} \times 16\frac{1}{2}$ in.; in Europe a slightly longer and narrower sheet is more common. One or more plants (depending on the size of the individuals) of the same kind, collected at the same time and place, are mounted on a herbarium sheet. Traditionally the specimens have been attached to the sheet with gummed cloth tape. or glue. or both glue and tape, the coarser parts sometimes also being sewn. During the 1950s many institutional and research herbarium~especially in the United States, began using a plastic containing ethyl cellulose and a proprietary resin in place of glue and tape.

A label is affixed to the lower right hand corner of a herbarium sheet. The label properly bears the name of the plant, the exact locality and habitat in which it was collected. the date of collection, the collector's name and a number. All specimens of the same kind collected at the same time and place are given the same number; these specimens may thereafter be deposited at several different herbariums. The colour of the flowers and any other significant information that may not be permanently shown by the specimen should also be given on the label. Many herbariums also stamp a serial specimen accession number on each sheet.

The mounted specimens are arranged according to the species, genus and family, placed in folders of heavy paper. and filed on shelves in airtight cases, preferably metal. since they lessen the chance of damage by fire or destructive insects. The sequence of species in a genus, and genera in a family, differs in different herbariums.

Some herbariums have a strictly alphabetical order for ease in filing and reference. Others have a systematic sequence according to supposed relationship to facilitate comparison and identification of specimens. In large herbariums the species of a genus are often also segregated geographically, with a separate sequence for each region.

Herbarium specimens of mosses, liverworts and some of the smaller algae are customarily put in small paper packets rather than being mounted, and boxes of these packets are stored in the herbarium cases. Fleshy fungi are usually dried without pressure and filed in small cardboard boxes in the cases.

Herbarium specimens are subject to attack by the larvae of several species of skin beetles (family, Dermestidae) and sometimes by other insects as well. Mildly aromatic plants such as the composites. crucifers and umbellifers are especially favoured, while some other groups such as grasses and ferns are seldom eaten. Newly dried specimens are particularly subject to attack. In some herbariums the specimens are treated with an alcoholic solution of mercuric chloride when mounted. This protects them for usually several years, but eventually the poison flakes off, and there has been some concern about its being a health hazard. Repellents such as paradichlorobenzene and naphthalene may also be placed in the cases, and the specimens may be periodically fumigated.

A herbarium is the most essential tool for research in plant classification. serving as a permanent record of the distribution of each species. its range of variability and the correlation of that variability with the geography and habitat. A botanist writing a flora of a region relies largely on herbarium specimens, which he studies against a background of his own observation on living plants. In more critical studies of smaller groups of species, cultural and breeding experiments, determination of chromosome number and other detailed analyses are also customary. The herbarium, however, remains the essential foundation for the work, because no one individual can expect to see each of even a small group of species in all localities and all habitats in which they occur. and under the varying conditions of different years and seasons.

Although herbariums serve as samples of natural populations of plants, they must be interpreted with caution because they tend to be biased toward the unusual. When a region is first explored. collectors have all they can do to make specimens of the common plants. Thereafter, the less common species and unusual forms of common species are likely to be collected out of proportion to their abundance Thus the usefulness of a specimen may be greatly enhanced by some indication on the label as to the frequency of such specimens in the wild.

In a group which produces occasional hybrids, the hybrids are likely to be over-represented in herbariums, obscuring the relatively clear distinction which can be seen in nature. Thus the usefulness of a specimen is greatly enhanced by some indication on the label as to the abundance of such plants. and especially by a record of any evidence suggesting that it may not be typical of a population.

Herbariums are repositories for type specimens on which names of species are founded. A scientific name. in order to be accepted must be properly published together with a description, but it is the type specimen nhich permanently determines the application of the name. In many herbariums the types are segregated from the rest of the collection in order to minimize the likelihood of damage.

Of the major herbariums, the one at Kew Gardens (*q.v.*), England, has about 6,000,000 specimens and is the largest in the world. The Berlin herbarium, almost as large as the one at Kew. suffered large-scale destruction during World War II. Other herbariums with 3,000,000 or more specimens are at Leningrad. Paris, Geneva, Florence, Washington D.C.. Cambridge, Mass, and New York city. The original herbarium of Linnaeus was purchased from his widow for the Linnean Society of London, which continues to maintain it.

Cultivated plants. not well represented in most institutional herbarium~are strongly emphasized in only one major herbarium in the United States, the Bailey Hortorium in Ithaca, N.Y., with about 300,000 specimens. (A. CT.)

HERBART, JOHANN **FRIEDRICH** (1776–1841), German philosopher, the founder of a system embracing logic, metaphysics and aesthetics but of particular importance for its psychology and for the educational theory stemming from it, was born at Oldenburg on May 4, 1776. After studying under J. G. Fichte at Jena (1794), he worked as a tutor at Interlaken in Snitzerland from 1797 to 1800, during which period he made the acquaintance of J. H. Pestalozzi (*q.v.*). Becoming a licentiate of Gottingen university in 1802, he was appointed extraordinary pro-

fessor there in 1805. At the close of 1808 he went as professor to Konigsberg. There he also conducted a seminary of pedagogy till 1833, when he returned as professor of philosophy to Gottingen. He died at Gottingen on Aug. 14. 1841.

Philosophical System. — Philosophy, in Herbart's view, is the analysis and elaboration of experience. Logic is the clarification of concepts and reasoning. being concerned with the form of thought; metaphysics and aesthetics are concerned with the content of thought. Logical analysis reveals contradictions in the concepts with which thought begins, and much of Herbart's analysis is devoted to the resolution of these contradictions. He develops a philosophical methodology which can be compared with the Hegelian dialectic *(see* HEGEL, GEORG WILHELM FRIEDRICH). In his metaphysics he starts from the scepticism of Hume and Kant (*qq.v.*) and attempts to determine by reflection alone the nature of what is real. The position finally reached is a "pluralistic realism" — the doctrine that there is a multiplicity of things which have absolute existence.

When one and the same thing, *A*, given in experience. combines a number of contradictory characters, it must be concluded that *A* is resolvable into a plurality of things, $A_1+A_2+A_3$, etc. Analysis ends in the conception of a plurality of absolutely simple beings. Such things tend to disturb each other, and each resists the disturbing effect exercised by the others. In so doing it manifests a variety of "self-preservations.': This general metaphysical doctrine has profoundly important implications for Herbart's psychology.

Psychology. — Herbart's position in the history of philosophy is mainly due to his contributions tn the philosophy of mind. These contributions are presented in two works: the *Lehrbuch zur Psychologie* (Königsberg, 1816; Eng. trans., *A Textbook in Psychology,* New York, 1894) and the *Psychologie als Wissenschaft, neu gegründet auf Erfahrung, Metaphysik und Mathematik,* 2 vol. (1824–25). His central thesis was that the facts of experience with which psychology is concerned are to be explained, not by reference to "faculties." but by reference to the laws governing the combination and interaction of those ultimate mental states variously described as sensations, images, ideas or presentations (*Vorstellungen*). This conception mas derived from his general metaphysics. The soul is one and simple, and its separate acts of "self-preservation" must also be simple. Presentations are the simple elements of mind. Though derived by Herbart from a distinctive metaphysical theory, the doctrine itself does not require to be supported by this theory. It is indeed closely similar to that of the associationist school derived from the British empiricists *(see* EMPIRICISM). He differs from the latter in the attempt to develop, in mathematical form, the statics and mechanics of mental processes and, more importantly, in distinguishing, within the interactions of presentations, conflicts or repulsions from combinations or associations.

The soul has no inherent tendency to change from one state to another. Once in a given state there is no reason why it should change unless there is interference from the outside. Hence, the disappearance of any presentation from consciousness constitutes a problem. There is no problem of explaining memory either as persistence of an idea in consciousness or as recall; the problem is to explain the passage from consciousness and to explain forgetting. The explanation is found in the mutual conflict of presentations opposed in quality. Ideas are forces which exercise attractive or repulsive effects on each other. Presentations may be similar, as one sensation of blue is similar to another sensation of blue a moment before; or they may be disparate, as blue is disparate from sweetness; or they may be contrary, as blue is contrary to yellow. Similar presentations fuse into a unity; disparate presentations combine to form complex presentations; contrary presentations are mutually exclusive. The fundamental laws of the interaction of presentations describe the processes of fusion, of compounding and of arrest. Arrest, or the expulsion of a presentation from consciousness, does not involve its annihilation. The excluded idea continues to exist in an unconscious form and tends, on the removal of obstacles, to return spontaneously to consciousness. The process varies in degree. Arrest may involve not complete repression but only obscuration. When arresting forces are adequate, and no more than adequate, to obscure a presentation, it is said to be "on" the threshold of consciousness. When the forces are greater, it is said to be "below" the threshold. If it is in consciousness at all. it is "above" the threshold. If it is above, on or below the threshold when the conditions require it to be so it is said to be above, on or below the "statical" threshold. If it is above, on or below the threshold when conditions require that it should not be so, it is said to be above. on or below the "dynamical" threshold. Presentations below the statical threshold have no influence on conscious processes, but those below the dynamical threshold may profoundly influence the course of events in consciousness.

All this part of Herbart's doctrine shows striking resemblances to doctrines prominent in 20th-century psychology and might seem to anticipate the laboratory findings which were to establish the influence upon consciousness of certain forms of subliminal stimuli. Especially notable are the similarities between the Herbartian doctrine of conflict and the theories of conflict and repression in Freudian theory. The Herbartian doctrine, however, was "intellectualist," attributing the conflict to the ideas themselves conceived as "forces," whereas in modern theories conflicts between ideas are taken to reflect and derive from conflicts betneen affective or instinctual forces. It is likely, however, that the Herbartian doctrine was influential in determining the earlier form of Freudian theory, in which the concept of a "complex" had much in common with the Herbartian concept of an "apperception mass."

Herbart's doctrine of "apperception" is likewise of interest by reason of its influence upon general theories of motivation and, especially, upon the course of educational psychology.

Presentative activity is exhibited not only in conflicts and repulsions but also in the combination and attraction of ideas. Presentations attract other presentations so as to form complex systems. Presentation masses are formed corresponding to the many "interests" of the individual (*e.g.,* his home and his hobbies) and to larger or smaller systems of concepts such as a philosophy or a body of religious doctrines. "Apperception" is the process by which a presentation mass assimilates new material or works smaller into larger systems. In the course of mental development certain constellations of ideas acquire a permanent dominance which exercises a powerful selective facilitating influence upon the ideas struggling to enter or re-enter consciousness. One most important constellation is the ego itself. This is a mass which enters into every activity which is described as an activity of oneself; *e.g.,* I remember, I think. I feel, etc.

"Feeling." "desire," "volition" are all concepts which in Herbart's psychology are defined and described in terms of the interaction of presentations and presentation masses, the rise and fall of sensations and ideas into consciousness under facilitating conditions and against resistances. As in many earlier accounts, "agreeable feelings" are said to arise under conditions of facilitation; disagreeable feelings under conditions of inhibition and resistance.

Desire exists when a presentation rises by help of another in spite of resistance by a third. This involves feeling, pleasant or painful. generally both. When a presentation reaches a certain stage of distinctness, action follows, if action is possible. A characteristic feature of desire is the state of tension persisting when action is not immediately possible. The disposition of the psychological mechanism which results from desire and issues in action when opportunity occurs is called "volition."

Theory of Education. — As Herbart's metaphysical system lay behind and supported his psychology, so his psychology lay behind and supported his pedagogic theory. It was in having a general theory that he was distinguished from educational reformers such as Friedrich Froebel (*q.v.*) and Pestalozzi, with whose practice he was in general sympathy. The essential principles are set out in two works: the *Aesthetische Darstellung der Welt* (Gottingen, 1804), which, though complete in itself, was published as part of the second edition of his *Pestalozzi's Idee eines A B C der Anschauung* (1st ed., 1802); and the *Allgemeine Padagogik* (Göt-

tingen, 1806), which put forward ideas that had been formed and expressed while Herbart was tutoring at Interlaken several years earlier. In rejecting the traditional doctrines of faculties and the doctrine of innate ideas Herbart was in the line of development of the educational theory which derived from Locke (*q.v.*) and other philosophical empiricists, but in his dynamical treatment of presentational activity he introduced something in advance of the associationist psychology with which empiricism had been generally combined. In the importance that he attached to observation *(Anschauung)* he was following Pestalozzi, but in his psychological analysis of the mental processes involved he provided a theoretical basis for Pestalozzi's practice. In his systematic account of the nature of education, Herbart conceives the process as beginning with the presentation masses which the child has previously acquired from experience and from social intercourse. The teacher, through an "educating instruction," creates knowledge from the former and "sympathy" from the latter. The ultimate objective is the formation of character by the development of an enlightened will, capable of making judgments on right and wrong. Moral judgments are absolute, springing from contemplation, incapable of proof and not requiring proof. They are like the judgments passed on harmonies and discords in music.

Ethics is thus, in the Herbartian system, a branch of aesthetics. It is concerned nith "relations among volitions which unconditionally please or displease." Five such relations are distinguished, corresponding to five comprehensive concepts: (1) inner freedom; (2) perfection; (3) benevolence; (4) right; (5) equity or retribution. The application of ethics to social affairs, with a view to the realization of a well-ordered social life, can be described as a moral technology, comprising politics and pedagogy.

Herbart's educational theories thus form part of a comprehensive and closely knit philosophy. But, though presented as "deduced" from general principles, they are also the expression of his personal cast of mind. His own talents and interests were such that the "educating instruction" which he imparted to his pupils combined science and the humanities in a balanced way seldom achieved in systems of education. The conflict between the demand for specialization and the demand for a general education was resolved by him in the formula "Every man must have a love for all activities, each must be a virtuoso in one." Similarly, his resolution of the conflict between the demand for freedom and self-expression and the demand for discipline had its theoretical basis in his treatment of the subject of "individuality."

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For biography *see* T. Fritzsch, *J. F. Herbarts Leben und Lehre* (Leipzig, 1921); Georg Weiss, *J. F. Herbart: Grundriss seines Lebens* (Langensalza, 1926). The best introduction to Herbart's philosophical psychology in English is G. F. Stout's essay (1888), republished in *Studies in Philosophy and Psychology* (London, New York, 1930). *See* also Christian Ufer, *Introduction to the Pedagogy of Herbart*, Eng. trans. (Boston, 1895); H. M. and E. Felkin, *An Introduction to Herbart's Science and Practice of Education* (London, 1895); Charles de Garmo, *Herbart and the Herbartians* (London, New York, 1895); J. Adams, *The Herbartian Psychology Applied to Eduration* (London, 1897); W. Kinkel, *J. F. Herbart* (Giessen, 1903); A. Darroch, *Herbart and the Herbartian Theory of Education: a Criticism* (London, 1903); C. I. Dodd, *Introduction to the Herbartian Principles of Teaching* (London, 1904); J. Davidson, *A New Interpretation of Herbart's Psychology* (Edinburgh, London, 1906); F. H. Hayward, *The Meaning of Education as Interpreted by Herbart* (London, 1907); R. D. Chalke, *A Synthesis of Froebel and Herbart* (London, 1912); G. Weiss, *Herbart und seine Schule* (Munich, 1928); D. McMurry, *Herbartian Contributions to History Instruction in American Elementary Schools* (New York, 1946).] (C. A. MA.)

HERBELOT DE MOLAINVILLE. BARTHELEMY D' (1625–1695), French orientalist, was bdrn on Dec. 14, 1625, in Paris. He was educated at the University of Paris, and devoted himself to the study of oriental languages, going to Italy to perfect himself in them by converse with the orientals who frequented its sea-ports. There he also made the acquaintance of Holstenius, the Dutch humanist (1596–1661), and Leo Allatius, the Greek scholar (1586–1669). On his return to France after a year and a half, he was received into the house of Fouquet, superintendent of finance, who gave him a pension of 1,500 livres. On Fouquet's disgrace in 1661, he was appointed secretary and interpreter of Eastern languages to the king. On a second visit to Italy the grand-duke Ferdinand II. of Tuscany presented him with a large number of valuable oriental mss., and tried to attach him to his court. Herbelot, however, was recalled to France by Colbert, and in 1692 he succeeded D'Auvergne in the chair of Syriac, in the Collège de France. He died in Paris on Dec. 8, 1695. His great work is the *Bibliothkque orientale, ou dictionnaire universel contenant tout ce qui regarde la connoissance des peuples de l'Orient,* based mainly on the Arabic dictionary of Hadji Khalfa, which occupied him nearly all his life, and was completed in 1697 by A. Galland.

The *Bibliothèque* was reprinted at Maestricht (1776), and at The Hague (4 vols., 1777–99). The latter edition is enriched with the contributions of the Dutch orientalist Schultens, Johann Jakob Reiske (1716–74), and by a supplement provided by Visdelow and Galland.

HERBERAY DES ESSARTS, NICOLAS DE (d. about 1557), French translator, was born in Picardy. He served in the artillery, and at the expressed desire of Francis I he translated into French the first eight books of *Amadis de Gaul* (1540–48). His other translations from the Spanish include *L'Amant maltraité de sa mye* (1539); *Le Premier Livre de la chronique de dom Florès de Grèce* (1552); and *L'Horloge des Princes* (1555) from Guevara. The *Amadis de Gaul* was translated into English by Anthony Munday in 1619.

HERBERT (FAMILY). Earlier generations of a pedigree which carries the origin of the Herberts to Herbert the Chamberlain. a Domesday tenant, being disregarded, their patriarch may be taken to be one Jenkin ap Adam (temp. Edward 111), who had a small Monmouthshire estate at Llanvapley and the office of master sergeant of the lordship of Abergavenny, a place which gave him precedence after the steward of that lordship.

Sir William Herbert, called by the Welsh Gwilim Ddu or Black William, was a baron in 1461 and a Knight of the Garter in the following year. With many manors and castles on the Marches he had the castle, town and lordship of Pembroke, and after the attainder of Jasper Tudor in 1468 was created earl of Pembroke. When in July 1469 he was taken by Sir John Conyers and the northern Lancastrians on Hedgecote, he was beheaded with his brother Sir Richard Herbert of Coldbrook. The second earl while still a minor exchanged at the king's desire in 1479 his earldom of Pembroke for that of Huntingdon. In 1484 this son of one whom Hall not unjustly describes as born "a mean gentleman" contracted to marry Katharine the daughter of King Richard III, but her death annulled the contract and the earl married Mary, daughter of the Earl Rivers, by whom he had a daughter Elizabeth, whose descendants, the Somersets, lived in the Herbert's castle of Raglan until the cannon of the parliament broke it in ruins. With the second earl's death in 1491 the first Herbert earldom became extinct. The ancestor of the present earls of Pembroke and Carnarvon and of the Herbert who was created marquess of Powis was a natural son of the first earl, one Richard Herbert, whom the restored inscription on his tomb at Abergavenny incorrectly describes as a knight. He was constable and porter of Abergavenny Castle, and his son William, "a mad fighting fellow" in his youth, married a sister of Catherine Parr and thus in 1543 became nearly allied to the king, who made him one of the executors of his will. The earldom of Pembroke was revived for him in 1551.

The honours and titles of this clan of marchmen make a long list. They include the marquessate of Powis, two earldoms with the title of Pembroke, two with that of Powis, and the earldoms

of Kuntingdon and Montgomery, Torrington and Carnarvon, the viscountcies of Montgomery and Ludlow, fourteen baronies and seven baronetcies. Seven Herberts have worn the Garter. The knights and squires must be sought among the Raglans. Morgans, Parrys, Vaughans, Prqgers, Hugheses, Thomases. Philips, Powels, Gwyns, Evanses and Joneses, as well as Herberts.

HERBERT, EDMOND (1812–1890), French geologist, was born at Villefargau, Yonne, on June 12, 1812. He was educated at the Collège de Meaux, Auxerre, and at the École Normale in Paris. After holding various appointments he was appointed in 1857 professor of geology at the Sorbonne. To him we owe the first definite arrangement of the Chalk into palaeontological zones *(see* Table in *Geol. Mag.*, 1869, p. 200). During his later years he was regarded as the leading geologist in France. He was a member of the Institute, and was three times president of the Geological Society of France in the course of his life. He died in Paris on April 4, 1890.

HERBERT, GEORGE (1593–1633), English poet, was born at Montgomery castle, on April 3, 1593, the fifth son of Sir Richard Herbert and a brother of Lord Herbert of Cherbury. His mother, Lady Magdalen Herbert, a woman of great good sense and sweetness of character, and a friend of John Donne, exercised great influence over her son. Educated privately until 1605, he was then sent to Westminster and in 1609 he became a scholar of Trinity college, Cambridge, where he was made major fellow in 1616. In 1616 he became reader in rhetoric and in 1619 orator for the university. In this capacity he spent most of his time at court, and was not often at Cambridge except when the king was there. He hoped, indeed, that the post would lead for him, as it had for his predecessors, to political advancement; but the death of James I in 1625 put an end to these hopes and he accepted an appointment as prebendary of Layton Ecclesia (Leighton Bromswold), Huntingdon, where he rebuilt the church. In his Cambridge days he had already written some Latin satiric verses in defence of the universities and the English Church in reply to Andrew Melville's *Anti-Jami-Cami-Categoria.* His friends at this period included Dr. Donne, Sir Henry Wotton, Izaak Walton, Bishop Andrewes and Francis Bacon, who dedicated to him his translation of the Psalms. At Leighton he was within two miles of Little Gidding, and came under the influence of Nicholas Ferrar. There is little doubt that the close friendship with Ferrar had a large share in Herbert's definite adoption of the religious life. We have Herbert's own authority for saying that this period and some space of time after was for him a time of intense religious conflict, out of which eventually came the serenity mirrored in his verse.

In 1630 Charles I, at the instance of the earl of Pembroke, whose kinsman Herbert was, presented him to the living of Fuggle-stone with Bemerton, near Salisbury, and he was ordained priest in September. A year before, after three days' acquaintance, he had married Jane Danvers, whose father had been set on the marriage for a long time. The story of the poet's life at Bemerton, as told by Walton, is one of the most exquisite pictures in literary biography. He devoted much time to explaining the meaning of various parts of the prayer-book, and held services twice every day, at which many of the parishioners attended, and some "let their plough rest when Mr. Herbert's saints-bell rung to prayers, that they might also offer their devotions to God with him."

Next to Christianity itself he loved the English Church. He was passionately fond of music, and his own hymns were written to the accompaniment of his lute or viol. He usually walked once or twice a week to attend the cathedral at Salisbury and before returning home, would "sing and play his part" at a meeting of music lovers. Walton illustrates his kindness to the poor by many touching anecdotes, but he had not been three years at Bemerton when he succumbed to consumption. He was buried beneath the altar of his own church on March 3, 1633.

None of Herbert's English poems was published during his lifetime. On his death-bed he gave to Nicholas Ferrar a manuscript with the title *The Temple; Sacred Poems and Private Ejaculations,* published at Cambridge, apparently for private circulation, almost immediately after Herbert's death. *The Temple* is a collection of religious poems connected by unity of sentiment and inspiration. There is apparent throughout great neatness of execution, particularly in the conclusion, which often comes as a surprise. Herbert was thoroughly imbued with the "metaphysical" tendencies of the age. He was a notable amateur of the "conceit," which, like Donne, he "transplanted" to religious uses. Nothing in his own church at Bemerton was too commonplace to serve as a starting-point for the epigrammatic expression of his piety. The church key reminds him that "it is my sin that locks his handes," and the stones of the floor are patience and humility, while the cement that binds them together is love and charity. The same use is made of illustrations from everyday life. and the curious store of medical and chemical information beloved of the time.

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HERBERT, SIR THOMAS (1606–1682), English traveller and author, born at York in 1606, became a commoner of Jesus college. Oxford. in 1621, but afterward removed to Cambridge. In 1627 he joined the suite of Sir Dodmore Cotton. then starting as ambassador for Persia with Sir Robert Shirley. En route they visited the Cape, Madagascar, Goa and Surat and reached Persia in 1628. After both Cotton and Shirley died at Kazvin. Herbert travelled throughout Persia. On the return voyage he visited Ceylon, the Coromandel coast. Mauritius and St. Helena. He reached England in 1629, travelled in Europe in 1630–31, married in 1632 and retired from court in 1634. During the Great Rebellion he sided with parliament till his appointment to attend on the king in 1646. He was rewarded with a baronetcy at the Restoration (1660). He died at Petergate house, York, on March 1, 1682.

Herbert's chief work is the *Description of the Persian Monarchy* (1634); reissued with additions. etc., in 1638; a third edition followed in 1664 and a fourth in 1677.

HERBERT, VICTOR (1859–1924), U.S. musical composer, was born in Dublin, Ire.. Feb. 1, 1859. He received thorough musical training in Germany where he became active as a composer and violoncello virtuoso (studying with Max Seifritz and Bernhard Cossmann respectively). In 1886 he went to the United States with his wife (Therese Forster), a prima donna in the Metropolitan Opera, played in the Metropolitan orchestra and under Anton Seidl and Theodore Thomas. His earlier compositions, romantic and melodious, were performed by the New York Philharmonic society; he himself was soloist in his two cello concertos.

In America Herbert won fame as composer of brilliant operettas, also as a conductor. In 1893 he assumed leadership of the celebrated 22nd regiment band (formerly Gilmore's); from 1898 to 1904 he conducted the Pittsburgh Symphony orchestra; in the latter year he organized his own concert orchestra which was immensely popular throughout the country.. He energetically led the fight for favourable copyright legislation, passed in 1909, and he benefited all American composers by founding ASCAP (American Society of Composers, Authors and Publishers) in 1914.

Herbert's first operetta was *Prince Ananias* (1894). It was followed by more than 40 others, many of them of the greatest importance in operetta literature. Among the best are *The Serenade* (1897), *The Fortune Teller* (1898), *Babes in Toyland* (1903), *Mlle. Modiste* (1905), *The Red Mill* (1906), *Naughty Marietta* (1910), *Sweethearts* (1913), *The Only Girl* (1914), *Eileen* (1917). His operetta music was superbly orchestrated. He also wrote two grand operas, *Natoma* (1911) and *Madeleine* (1914), and the music for the motion picture, *The Fall of a Nation* (1916). The last-named work was probably the first original symphonic score composed for a feature film. thus a landmark in music and cinema history. Late in life he wrote for revues, notably the *Ziegfeld Follies.* He died in New York city May 26. 1924. (E. N. W.)

HERBERT OF CHERBURY, EDWARD HERBERT, BARON (1583–1648), English soldier, diplomatist, historian and religious philosopher! was born at Eyton-on-Severn on March 3, 1583, and educated at University college, Oxford. On the accession of James I he presented himself at court and was created a knight of the Bath in 1603. In 1610 he served as a volunteer in the Low Countries under the prince of Orange, whose intimate friend he became. and distinguished himself at the capture of Juliers from the emperor. He then traveled in Italy, and two years after his return to England in 1617, Buckingham made him ambassador at Paris, but a quarrel with De Luynes occasioned his recall in 1621. After the death of De Luynes, Herbert resumed his post in Feb. 1622, and tried to 'accomplish the union between Charles and Henrietta Maria and secure the assistance of Louis XIII for the unfortunate elector palatine. On being dismissed in April 1624, he received the Irish peerage of Castle Island in 1624 and the English barony of Cherbury, or Chirbury, in 1629. In 1632 he was appointed a member of the council of war. He attended the king at York in 1639, and in May 1642 was imprisoned by the parliament for urging the addition of the words "without cause" to the resolution that the king violated his oath by making war on parliament. He retired to Montgomery castle, and declined the king's summons. On Sept. 5, 1644, he surrendered the castle to the parliamentary forces. He died in London on Aug. 20, 1648. Lord Herbert's most important work is the De *veritate prout distinguitur a revelatione, a verisimile, a possibile et a falso* (1624), which combines a theory of knowledge with a partial psychology, a methodology for the investigation of truth and a scheme of natural religion. His other writings include the *De religione gentilium* (1663). a natural history of religion; *Expeditio Buckinghami ducis* (1656); *Life and Raigne of Henry VIII* (1649), based on authentic papers; a volume of poems (1665); and an autobiography, first published by Horace Walpole in 1764, and edited by Sidney Lee (1886; 2nd ed., 1907). His English and Latin poems were edited by G. C. Moore Smith (Oxford, 1923).

See Lee's article in *Dictionary of National Biography; C.* de Rémusat, *Lord Herbert de Cherbury* (1874); *C.* Güttler, *Eduard, Lord Herbert von Cherbury* (1897).

HERBERT OF LEA, SIDNEY HERBERT, 1ST BARON (1810–1861), English statesman notable for his association with Florence Nightingale to improve sanitary conditions in the British army during the Crimean War, was born at Richmond, Surrey, on Sept. 16, 1810. He was educated at Harrow and Oriel college, Oxford, where he was a member of that group of brilliant young men, including his close friend W. E. Gladstone, who first attained prominence as admirers of Sir Robert Peel.

Sitting for Wiltshire from 1832 onward. Herbert served under Peel as secretary of the board of control in 1834–35, and as secretary to the admiralty between 1841 and 1845, when he joined the cabinet as secretary at war. The ministry resigned in 1846 after the repeal of the corn laws, and Herbert soon emerged as a leading Peelite. From 1852 he was again secretary at war until Lord Aberdeen's coalition fell in 185j, when he briefly became colonial secretary under Lord Palmerston. During the Crimean War, which revealed grave weaknesses in military administration, Herbert strove for improvement, and the Sebastopol committee on the conduct of the war reported favourably on his efforts. Thereafter, in conjunction with Florence Nightingale, his personal friend, whom he had first sent out to Scutari. Turkey, Herbert promoted successive inquiries, notably the royal commission of 1856, with a view to extensive reform. His opportunity came when he entered Palmerston's ministry of 1859 as secretary for war; but under protracted strain his health broke down. Herbert was raised to the peerage in 1860. and died at Wilton, near Salisbury, on Aug. 2, 1861, shortly after his resignation.

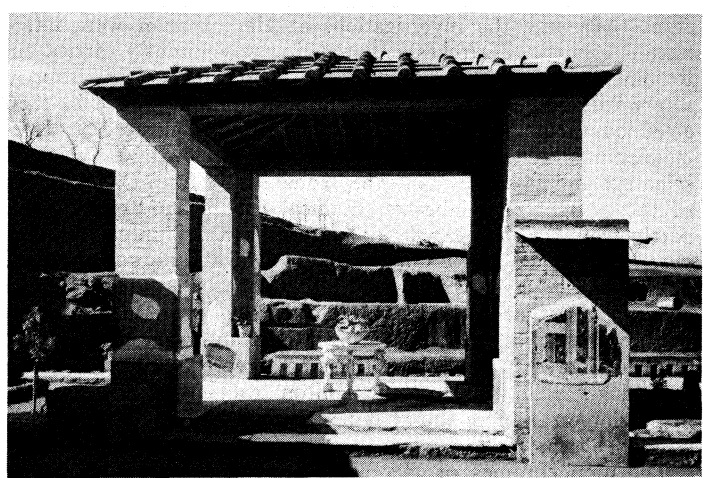
Highly regarded and much loved by his contemporaries. Herbert was a charming, talented man, who failed to fulfill his early promise and is best remembered for his collaboration with Florence Nightingale. Frail and sensitive, with a keen sense of personal responsibility, he could not survive the physical and psychological stresses of the Crimean War and its aftermath; but he succeeded in initiating important reforms at the war office. (A. F. T.)

HERBERTON, a small mining town of Cardwell county, Queensland, Austr., 55 mi. S.W. of Cairns. Pop. (1954) 1,101. Herberton is about 3,000 ft. above sea level. The rainfall is 44 in. The town is one of the main educational centres of north Queensland, with three secondary schools. It is the centre of administration of Herbertonshire. The principal industries are tin and wolfram mining and sawmilling.

HERBIG, GUSTAV (1868–1925), German scholar in Etruscan. was born on June 3, 1868, at Kaiserslautern (Pfalz) and educated at the universities of Munich and Leipzig. He came much in contact with Carl Pauli. the university librarian at Munich, who was also editor of the *Corpus Inscriptionum Etruscarum* (begun in 1893, still incoinplete), the foundation of all modern scientific study of Etruscan. His successive appointments as Pauli's successor, as professor at Rostock (1913), where he served as rector in its quinquecentennial celebrations (founded 1419j, at Breslau (1921) and finally at Munich again (1922) gave him enough leisure to pursue his study of Etruscan. Besides his editorial work. he contributed many articles directed at the solution of its problems on the combinatorial method. He died in Munich on Oct. 1. 1925. (J. WH.)

HERCEGOVINA: *see* BOSNIA AND HERCEGOVISA.

HERCULANEUM, an ancient city of Italy, about two-thirds of a mile from the Portici station of the railway from Naples to Pompeii. The small part of the city, which was investigated at the spot called *Gli scavi nuovi* (the new excavations), was discovered in the 19th century. But the more important works



BY COURTESY OF ITALIAN STATE TOURIST OFFICE

VIEW OF AN EXCAVATED ARBOUR OF A HOUSE AT HERCULANEUM

were executed in the 18th century; of the buildings then explored at a great depth, by means of tunnels, none is visible except the theatre, the orchestra of which lies 85 ft. below the surface.

Herculaneum was a small city of Campania between Neapolis and Pompeii, situated between two streams at the foot of Vesuvius on a hill overlooking the sea, with a safe harbour. It fell under the power of Rome during the Samnite wars. It remained faithful to Rome for a long time. but it joined the Italian allies in the Social War. Having submitted anew in June of the year 665 (88 B.C.), it appears to have been less severely treated than Pompeii. It enjoyed great prosperity toward the close of the republic and in the earlier times of the empire, since many splendid villas were built there, one belonging to the imperial house, another to the family of Calpurnius Piso. By means of the Via Campana it had easy communication northwestward with Neapolis, Puteoli and Capua, and thence by the Via Appia with Rome; and southward with Pompeii and Nuceria, and thence with Lucania and the Bruttii. In the year A.D. 63 it suffered terribly from an earthquake; and hardly had it completed the restoration of some of its principal buildings when it fell beneath the great eruption of the year 79, described by Pliny the younger (*Ep.*, vi. 16, 20), in which Pompeii also was destroyed, with other cities of

Campania. On August 23 Pliny the elder, who had command of the Roman fleet at Misenum, set out to render assistance to Rectina and others dwelling on that coast, but, as there was no escape by sea, the harbour having been filled up, he was obliged to abandon those who had managed to flee from their houses, overwhelmed in a moment by the material poured forth by Vesuvius. Thus, while many made their escape from Pompeii (which was overwhelmed by the fall of the small stones and afterwards by the rains of ashes), comparatively few could manage to escape from Herculaneum, and these found shelter in Neapolis, where they inhabited a quarter called after the buried city. The name of Herculaneum, which for some time remained attached to the site of the disaster, is mentioned in the later itineraries.

In 1719, while Prince Elbeuf was seeking crushed marble, he learned from the peasants that there were in the vicinity some pits from which they had extracted many statues. In 1738, excavations were begun on the spot. At first it was believed that a temple was being explored, but afterwards the inscriptions proved that the building was a theatre, and many scholars hastened to Naples to see the marvellous statues of the Balbi and the paintings on the malls. Bernardo Tanucci, secretary of state in 1755, founded the Accademia Ercolanese, which published the principal works on Herculaneum (*Le Pitture ed i bronzi d' Ercolano,* 8 vols., 1757–1792; *Dissertationis isagogicae ad Herculanensium voluminum explanationem pars prima,* 1797). The excavations, which continued for more than forty years (1738–1780), were executed at first under Xlcubierre (1738–1741), and then with the assistance of the engineers Rorro and Bardet (1 741–1745), Carl Weber (17jo-I764), and Francesco La Vega. After the death of Alcubierre (1780) the last-named was appointed director-in-chief, but from that time the investigations at Herculaneum were intermitted, and the researches at Pompeii were vigorously carried on. Resumed in **1827,** the excavations at Herculaneum were shortly afterwards suspended, nor were the new attempts made in **1866** attended with any success. The antiquities excavated at Herculaneum in the 18th century form a collection of the highest scientific and artistic value. They come partly from the buildings of the ancient city (theatre, basilica, houses and forum), and partly from the private villa of a great Roman family (*cf.* Comparetti and de Petra, *La Villa Ercolanese dei Pisoni,* Turin, 1883). From the city come, among many other marble statues, the two equestrian statues of the Balbi, and the great imperial and municipal bronze statues. Mural paintings of extraordinary beauty were also discovered here, such as those that represent Theseus after the slaughter of the Minotaur, Chiron teaching Achilles the art of playing on the lyre and Hercules finding Telephus who is being suckled by the hind.

The monochromes of Herculaneum remain among the finest specimens of the exquisite taste and consummate skill displayed by the ancient artists. Among the best preserved is Leto and Niobe. The Villa Suburbana has given up a good number of marble busts, and the so-called statue of Aristides, but above all that splendid collection of bronze statues and busts (mostly reproductions of famous Greek works) now to be found in the Naples Museum, the reposing Hermes, the drunken Silenus, the sleeping Faunus, the dancing girls, the bust called Plato, that wrongly believed to be Seneca, the two quoit-throwers or discoboli, and other masterpieces. But a still further discovery made in the Villa Suburbana contributed to magnify the greatness of Herculaneum; within its walls was found the famous library, of which, counting both entire and fragmentary volumes, **1,803** papyri are preserved. Among the nations which took the greatest interest in the discovery of the Herculaneum library, the most honourable rank belongs to England, which sent Hayter and other scholars to Naples to hasten the publication of the volumes. Of the 341 papyri which have been unrolled, **195** have been published (*Herculanensium voluminum quae supersunt* [Naples, 1793–1809]; *Collectio altera,* 1862–1876). They contain works by Epicurus, Demetrius, Polystratus, Colotes, Chrysippus, Carniscus and Philodemus. The names of the authors are in themselves sufficient to show that the library belonged to a person whose principal study was the Epicurean philosophy. But of the great master of this school only a few works have been found. Of his treatise Περὶ φύσεως, divided into **37** books, it is known that there were three copies in the library. Even the other authors above mentioned are but poorly represented, with the exception of Philodemus, of whom **26** different treatises have been recognized. But all these philosophic discussions, belonging for the most part to an author less than secondary among the Epicureans, fall short of the high expectations excited by the first discovery of the library. Among the many volumes unrolled only a few are of historical importance—that which treats of the philosophers of the Academy and that which deals with the Stoics. There are in the library some volumes written in Latin, all so damaged that hardly any of them can be deciphered. One with verses relating to the battle of Actium is believed to belong to a poem of Rabirius. The plan of the villa is the only satisfactory document for the topography of Herculaneum.

HERCULANO DE CARVALHO E ARAÚJO, ALEXANDRE (1810–1877), Portuguese historian, novelist and poet, who with Almeida Garrett introduced romanticism into Portugal. He was born in Lisbon on March 28, 1810. After taking part in the revolt against the absolute power of Dom Miguel, he fled to England and France, returning in 1832 with the army that established the liberal regime in Portugal. His first important works are *A Voz do Profeta,* a lampoon against the popular revolution of 1836, and *A Harpa do Crente* (1838), poems referring mostly to the civil war between **1832** and **1834.** From **1837** to **1839** he was editor of O *Panorama,* a review influenced by the English *Penny Magazine,* in which he first published the historical novels issued later in book form (*Lendas e narrativas,* 2 vol., 1851) and also essays propagating the new European literary tendencies. He was inspired by the conviction that an important cultural reform should complete the reform of political institutions. Elected to the *cortes* in **1840,** he campaigned for a democratic reform of education.

In 1841 António Bernardo da Costa Cabral established an authoritarian regime and Herculano withdrew from politics. As librarian from 1839 of the Royal Library of Ajuda he was able to devote all his time to the composition of the *História de Portugal.* This work was preceded by some preparatory essays (*Cartas sobre a história de Portugal,* 1842; *Apontamentos para a história dos bens da Coroa e dos forais,* 1843–44); and by historical novels, all showing the influence of Sir Walter Scott and Victor Hugo, which introduced this literary genre into Portugal: *Eurico o presbítero* (1844), a narrative in poetical prose of the Arab invasion of the peninsula; O *Bobo* (1843), dealing with the origins of the Portuguese monarchy; and *O Monge de Cister* (1848), set in the reign of John I.

In 1846 appeared the first volume of *Histdria de Portugal.* One of the finest achievements of romantic historiography, this work covers the political and social history of Portugal to 1279 and resembles Jacques Thierry's *Histoire du Tiers État* (1853) in stressing the origin and rise of a middle class. To his contemporaries its most striking characteristic was its exposure of many traditional legends, such as the appearance of Christ to the first king of Portugal in the battle of Ourique. Attacked by the clergy, Herculano answered by denouncing their ignorance and fanaticism.

In **1851** the Costa Cabral regime was overthrown by the movement of the "*Regeneração,*" in which Herculano took part. To support the new regime and to combat the right-wing elements which were undermining it, he helped to found two newspapers, *O País* (1 851) and O *Portuguez* (**18***j*3), in which he wrote against political centralism and the increase in clerical influence. To this period belongs *Da origem e estabelecimento da Inquisição em Portugal* (1854–59; Eng. trans. **1926**). Based on hitherto unknown documents, it attempted to demonstrate that royal absolutism and clerical power were allies in the confiscation of the property of the "New Christians" (converted Jews) through the Inquisition. Herculano was a Roman Catholic of strong opinions and during his early literary career he tried to reconcile Catholicism and liberalism (*Pároco da Aldeia,* 1844), but his quarrel with the clergy and the revival of clerical influence made him consider Ultramontanism the main enemy of liberal institutions. He protested

against the Concordat of 1857, led the campaign against the restoration of the monastic orders and advocated civil marriage. His book on this subject, *Estudos sobre o casamento civil* (1866), was immediately placed on the Roman Index. From 1871 he was openly critical of the new dogmas of the Immaculate Conception and papal infallibility.

The fourth and last volume of the *História de Portugal* was issued in 1853. Grieved by the appointment of a personal enemy as director of the national archives in 1856, Herculano then ceased to write and turned to farming in Vale de Lobos, near Santarém. However, he continued to direct the compilation of the *Portugaliae Monumenta Historica* (vol. 1, 1856) and began to collect his essays and polemical writings in *Opusculos*, 6 vol. (1873–84), which contains some of his best work: vigorous polemic, forceful in expression and terse and elegant in style. He died at Santarém on Sept. 13. 1877.

Herculano impressed his contemporaries deeply not only by his works but by his austere and adamant character. He refused all official honours but enjoyed a national prestige equalled only by that of Victor Hugo in France. His collected works were edited in 33 vol. by Livraria Bertrand.

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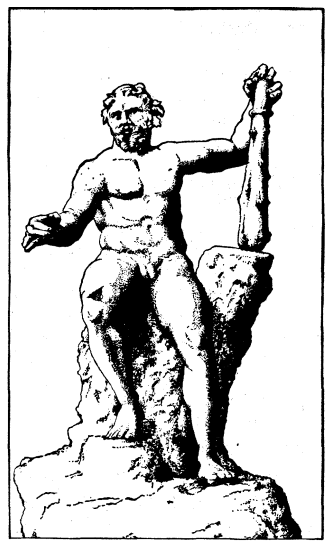
HERCULES, the latinized form of the Greek HERACLES, the most famous Greek hero. His name (Gr. Ἡρακλῆς, probably "glorious gift of Hera," cf. Diocles) shows that he cannot be originally a god, since no Greek god ever has a name compounded of that of another deity. Probably a real man, a chieftain of Tiryns in Mycenaean times and vassal to Argos, lies behind the very complicated mythology of Heracles. As told in later ages, the story in its main outline runs as follows:

Zeus loved Alcmene, wife of Amphitryon of Tiryns, who at the time was living in exile at Thebes. Taking the shape of Amphitryon, he begat a son who he intended should be lord of the Argolid; but by a trick of Hera that position was won for Eurystheus, who was born shortly before Heracles. Hera pursued Heracles with her hatred. In his cradle she sent serpents to kill him, which, however, he despatched. In young manhood, after his first adventure (the killing of the lion of Mt. Cithaeron), Heracles won for his wife Megara, daughter of Creon, king of Thebes, but again Hera interfered, and in a fit of madness sent by her he murdered Megara and her children. For this or for some other reason he became the servant of Eurystheus, son of Sthenelus and king of Argos. The numerous tasks imposed by his master were arranged at some unknown but not early date in antiquity into a cycle of 12 (the 12 Labours or *Dodekatklos)*, usually in the following order: 1, capture of the lion of Nemea; 2, the Hydra of Lerna; 3, capture of the hind (or stag) of Arcadia; 4, capture of the boar of Erymanthus; 5, cleansing of Augeias' stables in Elis; 6, shooting the birds of Stymphalus (so far we have Peloponnesian advenrures only, and these are probably the oldest); 7, capture of the Cretan bull: 8, capture of the mares of Diomedes in Thrace; 9, taking the girdle of Hippolyte, queen of the Amazons: 10, seizing the cattle of Geryon; 11, bringing the apples of the Hesperides; 12, fetching up Cerberus from the lower world. It will be seen that the last two take place in the other world; there is little doubt that they represent a forcible seizure of immortality, and are parallel to the adventure mentioned by Homer *(Iliad,* v., 395) in which he fights and wounds Hades.

Subsidiary to the *Dodekathlos* is a series of minor adventures called *Parerga.* For example, during the 4th labour. he met and fought the Centaurs; during the 11th. he wrestled with the giant Antaeus. A further series of enterprises, undertaken after he was freed from the service of Eurystheus, are known as πράξεις. These include the campaigns against Troy, Elis and Pylos. Other notable incidents are his struggle with Apollo for the sacred tripod at Delphi, stopped by Zeus throwing a thunderbolt between the combatants, and his share in various famous exploits, such as the battle of the gods and giants, and the Argonautic expedition. His last series of adventures was as follows:

His second wife was Deianeira, daughter of Oeneus king of Calydon, for whom he wrestled with her other suitor, the river Achelous. As he was taking her home, the centaur Nessus tried to violate her, and was shot by Heracles with an arrow dipped in the venom of the Hydra. Dying, the centaur bade Deianeira take the blood from his wound and keep it safe, for anyone wearing a garment rubbed with it would love her for ever. Years after, when Hyllus and several other children had been born to them, Heracles fell madly in love with Iole, daughter of Eurytus king of Oechalia. He was repulsed by Eurytus when .he demanded her, and the matter was further complicated by his killing Eurytus' son, for which he had to go into exile for a year, as slave to the Lydian queen Omphale, who set him to do women's work. According to some accounts, Heracles loved her and served her to gain her favours. Returning, he captured Oechalia and took Iole prisoner. Deianeira realized that she was a dangerous rival, and sent Heracles a garment smeared with the blood of Nessus. This was a powerful poison. and Heracles was seized with terrible agonies. At last he had himself brought up to the top of Mt. Oeta where a huge pyre was built. On this he was put and induced a shepherd, Poeas, with the gift of his bow and arrows, to' light it. His mortal part was burned, but his divine part ascended to heaven. was reconciled to Hera, and wedded Hebe. The story of the burning is connected with a very ancient ceremony on Oeta at which victims and also puppets in human shape were burned; *see* Nilsson in *Journ. Hell. Studies,* xliii. (1923) p. 144. This is the latest form of the persistent theme of the winning of immortality.



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

HERCULES RESTING. FROM A CAST MODELLED AFTER A ROMAN BRONZE STATUE IN THE NAPLES MUSEUM

Even this short sketch shows how complex the saga is. The Peloponnesian adventures may well be in origin an exaggerated account of the exploits of a real man, a great tighter and hunter; many of the others may have been originally accredited to some local hero, afterwards absorbed by Heracles. The incident of Omphale sounds like the tale of some Oriental mother-goddess and her male consort. There are several other traces of Heracles being identified with foreign gods; *e.g.,* he is equated with the Phoenician Melqart.

In cult, he is sometimes a hero, sometimes a god; Athens claimed to have been the first to give him divine honours. His titles are numerous, among the most characteristic being ἀλεξίκακος (averter of evil, also a title of Apollo) and καλλίνικος (nobly victorious). In art and literature, he is represented as an enormously strong man, of moderate height, a huge eater and drinker, very amorous, generally kindly but with occasional outbursts of brutal rage. He generally ears the skin of the Nemean lion; his characteristic weapon is the bow, frequently also the club (whether this is original 'or not, is doubtful). Numerous representations of him survive; of statues the most notorious is the hideous muscle-bound figure, now at Naples, known as the Farnese Hercules.

There is another Heracles. one of the Idaean Dactyli, who has only the name in common with the son of Alcmene.

In Italy, his name is corrupted in various ways, the most familiar being the Latin Hercules. He is worshipped as a god only, hero-cult not being Italian, and is principally a god of merchants and traders, although others also pray to him for his characteristic gifts of good luck or rescue from danger. Tithes of commercial profits, etc., were often presented to him, and feasts held in his honour. His best-known cult was at the Ara

Maxima: in the Forum Boarium at Rome. Though very early, this cult is probably not to be identified with that of any native deity. Late and artificial legends represented him as returning from the raid on Geryon's cattle by way of Italy. visiting the future site of Rome and there introducing more humane rites in place of human sacrifices and teaching Evander's people to worship himself, having earned their gratitude by killing the monster Cacus (really an ancient fire god).

For Heracles *see* Preller-Robert, *Griechische Mythologie;* L. R. Farnell, *Hero-Cults.* For Hercules, *see* Preller-Jordan. *Römische Mythologie;* Wissowa, *Religion und Kultus.* (H. J. R.)

Hercules was a favourite figure in French mediaeval literature. In the *Romance of Alexander* the tent oi the hero is decorated with incidents from his adventures. In the prose romance *Les Prouesses et vaillances du preux Hercule* (Paris, 1500), the hero's labours are represented as having been performed in honour of a Boeotian princess; Pluto is a king dwelling in a dismal castle; the Fates are duennas matching Proserpine; the entrance to Pluto's castle is watched by the giant Cerberus. Hercules conquers Spain and takes Merida from Geryon. The book is translated into English as *Hevcules of Greece* (n.d.). Fragments oi a French poem on the subject will be found in the *Bulletin de la soc. des anciens textes français* (1877). Don Enrique de Villena took from *Les Prouesses* his prose *Los Doze Trabajos de Hercules* (Zamora, *1483* and 1499), and Fernandez de Heredia wrote *Trabajos y afanes de Hercules* (Madrid, 1682), which belies its title, being a collection of adages and allegories. *Le Fatiche d'Ercole* (1475) is a romance in poetic prose by Pietro Bassi, and the *Dodeci Travagli di Ercole* (1544), a poem by J. Perillos.

HERCULES, in astronomy, a constellation of the northern hemisphere. Represented by a man kneeling. this constellation was first known as "the man on his knees," and was afterward designated Cetheus, Thescus and Hercules by the ancient Greeks. Hercules contains a famous globular star cluster (Messier 13) which is the finest example in the northern hemisphere. The sun's motion through space is directed toward a point in this constellation. The light of the third magnitude star α Hercules varies irregularly.

HERCYNITE: *see* SPINEL.

HERCZEG, FERENC (1863–1954), Hungarian novelist and playwright, a leading conservative-nationalist writer of the early 20th century, who also played an active part in politics. was born at Versecz, Sept. 22, 1863. He published his first novel in 1890. In 1895 he founded *Új Idők,* which remained for half .a century the literary magazine of the right-wing upper and middle classes. His many novels contained just enough irony and social criticism to cause a harmless shock to the conservative public for whom they were mitten. and brought him great popularity. The main interest of even the best of them, such as *Gyzcrkovics lányok* (1893), which describes the foibles of the gentry. is in the insight they give into the tastes of Herczeg's public. His social comedies. such as *A három testőr* (1895) and *Kék rdka* (1917), are amusing and skilful. *Bizánc* (1904) and *A hid* (1925) are the best oi many historical dramas: the former is set in 15th-century Constantinople, the latter deals with the conflict between the 19th-century statesmen Louis Kossuth and Istvan Széchényi. Herczeg died in Budapest, Feb. 24, 1954. (Ds. SR.)

HERDER, JOHANN GOTTFRIED VON (1744–1803), German critic, philosopher, preacher and educator, was born at Mohrungen, East Prussia, on Xug. 25, 1744, of humble parents. An imaginative and precocious child, he grew up to be one of the most fertile and suggestive thinkers Germany has produced, and not only inspired the literary revolution known as the *Sturm und Drang* but also exercised a profound influence upon German philosophical and political thought and upon the development of the nationalities of eastern Europe. He studied theology and philosophy at Konigsberg from 1762 to 1764, supporting himself by teaching at the Collegium Friedericianum in that city. Some small literary efforts! occasional poems and reviews. belong to those years. At the university he heard the lectures of Iminanuel Kant, from whom he acquired an enthusiasm for geography and anthropology and an interest in critical inquiry that never left him. He formed a close friendship with J. G. Hamann, the "Magus im Norden," who turned his attention to poetry and criticism and emphasized the value of emotion in the production and appreciation of literature. Hamann directed him to the primitive beginnings of literature in the Old Testament, since he considered poetry, religion and revelation to be one and the same thing. Any elements of system that Kant might have taught Herder were destroyed by the influence pf this incoherent but stimulating writer.

Late in 1764 Herder went to Riga as assistant master at thé cathedral school. He stayed in that city until 1769. where he became an important preacher and educator. His first major work, *Fragmente über die neuere deutsche Literatur,* published in 1767, placed him in a leading position in literary criticism. However, his restless imagination and unorthodox views: as well as personal *maladresse* and social dissatisfaction. caused him to decide to leave Riga. His idea was to travel in order to acquire the experience of the world which he had missed hitherto, and upon his return, as headmaster of the Livonian *Lyzeum* in Riga, to initiate important educational reforms. He sailed to Nantes, on the way reflecting upon the course of his life and outlining tremendous plans for the future in the fields of education, philosophy, literature and religion. It became clear to him that his mission in life was to study the whole history of mankind from its primitive beginnings onward and in all its manifestations, in order to show the direction which human society should take in the future. He visited Paris, and while there he received an offer to become travelling companion to the son of the prince-bishop of Lubeck. On the way back to Germany he was shipwrecked off the Dutch coast, but was saved. With his charge, Herder visited Darmstadt. where he met his future wife. Caroline Flachsland, and Strasbourg. where he became acquainted with Goethe. To Goethe he transmitted all his bold ideas on the origins of poetry and introduced him to the fnlk song. the poems of Ossian, Shakespeare, the *Edda* and the Old Testament, presenting them all as the unrepressed utterances of human creative genius and recommending that German literature base itself upon unspoiled native folk-song foundations *(see* GOETHE, JOHANN WOLFGANG VON). He thus initiated the revival in German literature called the *Sturm und Drang.* In 1771 he became court preacher to the count of Schaumburg-Lippe at Bückeburg, continuing to inspire the new literary movement and writing a number of polemical religious and philosophical works. He married in 1773 and in 1776 accepted an invitation! secured for him through Goethe's influence, to become general superintendent and court preacher at Weimar. Excessive sensitivity on his part, jealousy, a strong censorious tendency, ill health and financial difficulties all made his life at Weimar, where he stayed until his death. a story of dreary dissatisfaction. Yet he enjoyed the close friendship of Goethe in the years 1783–93 (although they were alienated from one another at the end), and the poet has testified to the virtual identity of their philosophical ideas; there is no doubt of the strong mutual influence. C. M. Wieland was also among his chief friends. He had a great attraction for men of the younger generation, many of whom visited him and imbibed his instruction; among these were Novalis (Friedrich von Hardenberg) and, more especially. Jean Paul (Johann Paul Friedrich Richter). His greatest works belong to the Weimar years—his *Volkslieder* (1778–79) and his *Ideen* (1784–91), which attempted to realize the dreams of his sea journey, and many others. He died on Dec. 11, 1803.

His Works.—Herder's main works were as follows: *Fragmente über die neuere dezitsche Literatur* (1767), *Kritische Wälder* (1769), which supplemented Lessing's *Literaturbriefe* and *Laokoon; Journal meiner Reise im Jahre 1769,* not published in his lifetime; *Über den Ursprung der Sprache* (1772), a prize essay; fragments on Ossian and Shakespeare in *Von dezctscher Art und Kunst* (1773), the manifesto of the *Sturm und Drang; Die Älteste Urkunde des Menschengeschlechts* (1774–76), a mystical study of Hebrew archaeology; *Auch eine Philosophie der Geschichte zur Bildung der Menschheit* (1774), an attack upon rationalism; *Plastik* (1778), *Von Erkennen und Empfinden der menschlichen Seele* (1778), on human psychology and aesthetic appreciation; *Volkslieder* (1778–79), translations of folk songs of many lands; *Vom Geiste der Ebraischen Poesie* (1782–83), an epoch-making study of the Old Testament as Hebrew national literature; *Ideen zur Philosophie der Geschichte der Menschheit* (1784–91), an un-

finished study of human origins and history; *Zerstreute Blatter* (1785–97), essays and poems teaching the moral conclusions arrived at in the *Ideen; Gott* (1787), stating the religious background of the *Ideen; Briefe zu Beforderung der Humanität* (1793–97), the projection of the conclusions of the *Ideen* into social and political life; *Christliche Schriften* (1794–98). interpreting the ideals of Christianity in accordance with his historical studies; *Metakritik zur Kritik der reinen Vernunft* (1799), *Kalligone* (1800), attempts to refute the Kantian philosophy; *Adrastea* (1801–04), a periodical containing his famous *Cid;* and many other poems, essays, lyric dramas, cantatas, addresses, sermons, fragments and translations from classical and modern languages.

The feature which all Herder's works have in common is the genetic or historical idea, which he originated and developed from many converging currents of thought in Germany and other countries. He applied his idea, with novel and far-reaching results, to all fields of thought. He began by studying the evolution of poetry and from that proceeded to concern himself with the whole process of the history of man and man's self-expression.

Herder believed that great poetry could not come into being without a poetic language, and he claimed, by a study of the phonetic and syntactical qualities of German, that that language, though prematurely aged by rationalism, possessed riches that were still untapped, in the speech of the popular song. those native sources unspoiled by foreign infiltration. He thought that the powerful literary development of the middle ages had been interrupted in Germany by the Renaissance and wars of religion and by the vast external influences that had made themselves felt, and that only by going back across the chasm of time could lost strength be regained. Just as Elizabethan literature in England was the logical outcome of the folk literature of earlier times; so he believed that adherence to the folk-song tradition would bring about a revival of German literature. It was his conviction that all poetry was originally folk song, the spontaneous expression of nature in poetic form. This led him to an awkward enthusiasm for the poems of Ossian; to regard the book of Genesis as the result of the combination of numerous primitive ballads; to anticipate F. A. Wolf's theory of the lyrical origins of Homer; to consider Shakespeare as having dramatized folk-song material; and to collect and publish folk songs from all the world, in order to encourage in his countrymen a larger interest in this basic and instinctive form of poetry. Thomas Percy's *Reliques* had a great influence upon him in this matter. In the folk song he found the direct expression of emotion, and this he regarded as the main factor in all literature. His collection included specimens from as far afield as Greenland and Peru. He desired to prove that poetry was a gift belonging to the whole human race, and in this way to destroy the current belief that the Greeks and Romans and French should hold a monopoly in literature. Literary nationalism followed as a matter of course; poetry, that universal possession, being held to change its character according to place, time, climate, national temperament, etc. He saw, in consequence, that poetry was a valuable source of information concerning the working of the human mind in all countries, and it thus became the indispensable handmaiden of his historical studies.

In a hundred fields Herder's evolutionary ideas caused him to reject the contemporary view that language either was directly communicated by God to man or mas a ready-made product of some early philosophical mind, and he argued instead that speech grew from elementary emotional articulations and was conditioned by the power of reflection which he considered to be a specifically human gift. He thus approached the modern standpoint, but did not agree that the primitive sounds common to man and the higher animals constitute speech. The development of language, therefore, reflects and conditions the development of human thought, and the study of language is a necessary approach to the study of human history or human psychology. Herder thus prepared the way for the science of comparative philology.

Language. literature, tnythology and religion all went hand in hand in Herder's view, and he regarded them as mutually illustrative. He looked back to their early beginnings. He did not agree with David Hume that religion grew from primitive man's fears; he considered that it was man's first attempt to explain the universal phenomena of creation and that it grew to be the primary educative and moral force in man's development. Herder's own religious belief placed the concept of a personal transcendental God within the outer framework of pantheism. Pantheism. as a creed by itself, he regarded as an error. "God is not the world," he said, "and the world is not God." But the world is the expression of God's greatness, which is at once in and above all things; it is always changing, growing and developing, since creation is inexhaustible, and an even balance presides over its operations. Man's highest duty, he felt. was to apprehend this and to follow out its teachings reverently in his own life. For man is himself part of nature and governed by its laws. He believed in the inherent goodness of man, not in original sin. "Idleness," he said, "is the original sin of mankind." In addition, he rejected sectarian dogmatism. Herder's appreciation of the Bible as literature has already been noticed. He brought to its study such sciences as history, philology and psychology, and laid the foundations of the modern study of comparative religion.

Herder's philosophy of history, contained in the *Ideen,* was dominated by these religious views. He explained human life by reference to its origins and its physical environment. This involved a study of geography, astronomy; zoology, botany, physics, etc. Herder was an evolutionist. after the manner of G. W. Leibniz, not of Charles Darwin, although he came near to the latter's view. He regarded man as a special creation and as the topmost rung in nature's scale of being. From the physical factors determining man's growth, he proceeded to human factors. such as speech, religion and nationality, and speculated, in a manner that profoundly affected Goethe, on the matter of the immortality of the soul, postulating the continuance of personality, provided the personality has already been developed in this life. His survey of world history, which included a classic section on the Greeks, only reached the late middle ages. Herder is rightly regarded as the fountainhead of German nationalism. But his view of national self-development was emphatically nonaggressive.

Herder's later works were concerned with his attempt to apply these views to the conduct of contemporary life. He looked forward to a rejuvenation of human culture, once the fullness .of human development. which his compendious ideal of *Humanität* implied, could be realized, the whole of man's emotional. intellectual and spiritual faculties co-operating harmoniously. Such was his answer to the question posed by the French Revolution. He himself was democratically inclined and believed in the nation-state (in so far as he can be said to have believed in the state at all), but the violence of the Revolution (which he at first welcomed) antagonized him, and he pinned his faith more and more to cultural and moral values rather than to political forces. Developing ideas of Benjamin Franklin, he wrote of a "league of humanity" in which all nations and epochs of history might find a place. He stressed the moral value of literature, attacked Kantianism for its threat to religion and its view that man is "radically evil," as well as for its analytic separation of the mental processes. He demanded a close connection between the beautiful and the good and believed that art should represent human life and effort in its completeness. In the last decade of his life he opposed the work of Goethe and Schiller because he believed they exalted form over moral content, and spent his last years vainly striving to produce literature in which the moral content should be in the forefront.

Herder's influence has been incalculable. His meeting with Goethe set German literature on new lines; the doctrines of spontaneity and naturalness, the Faustian idea of striving, the cult of genius, patriotism, the interest in the folk song, the substitution of emotion for reason: which mark the *Sturm und* Drang, derive in the main from him. Similarly, the teaching of the *Ideen* and his other mature works—his idea of Humanitat—affected Goethe's Classical doctrines. At the end of his life the Romantic writers, many of whom sought his society, were profoundly affected by his ideas. They absorbed his philosophy of history, his mediaevalism, his orientalism, his interest in language, his study of comparative literature, his vitalistic conception of nature, his stress upon the

instinctive, his view of poetry as a great educative agent, his cult of the folk song and his critical method. Holderlin, Jean Paul, Novalis. the brothers 4. W. and F. von Schlegel. Schelling, Hegel, F. D. E. Schleiermacher. W. and A. von Humboldt, among others, are all in his debt. Indeed the very concept of "romantic" as signifying "modern" in opposition to "classic" or "ancient" is Herderian in origin. A. W. von Schlegel's lectures, the folk-song collection called *Des Knaben Wunderhorn,* Grimm's *Märchen,* to mention only three works, follow upon lines which Herder indicated. His *Ideen* were translated into English in 1800 by T. O. Churchill and into French in 1827 by Edgar Quinet. Among his English admirers were William Taylor of Norwich. Henry Crabb Robinson and De Quincey; Coleridge disliked him, while in France not only Quinet but Benjamin Constant, Victor Cousin, Jules Michelet and Ernest Renan were eminent students of his works. He appealed to Mazzini. but his greatest effect was in eastern Europe, where his favourable account of the Slavs in the *Ideen* caused him to be regarded as the father of the Slav national Renaissance — Czechoslovak and Yugoslav nationalism, in particular; and he found a major disciple in modern times in Thomas Masaryk, whose political idealism had a great deal in common with Herder's *Humanitätsideal.* He has had influence also in Finland. Argentina: Scandinavia, Poland and Russia, in the literary and political thought of those countries.

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HÉRÉDIA, JOSÉ MARIA DE (1842–1905), French poet, the modern master of the French sonnet, was born at Fortuna Cafeyere. near Santiago de Cuba, being in blood part Spanish Creole and part French. At the age of eight he went from the West Indies to France, and received his classical education with the priests of St. Vincent at Senlis. After a visit to Havana he returned to study at the École des Chartes at Paris. In the later '60s, with F. Coppée, Sully-Prudhomme, P. Verlaine and others less distinguished, he made one of the band of poets who gathered round Leconte de Lisle, and received the name of Parnassians. To this new school, form — the technical side of their art — was of supreme importance, and, in reaction against the influence of Musset. they rigorously repressed in their work the expression of personal feeling and emotion. "True poetry," said Hérédia in his discourse on entering the academy, "dwells in nature and in humanity, which are eternal, and not in the heart of the creature of a day, however great." Hérédia's place in the movement was soon assured. He was the *élève bienaimé* of the master. He wrote very little, and published even less, but his sonnets circulated in manuscript, and gave him a reputation before they appeared in 1893, together with a few longer poems, as a volume, under the title of *Les Trophies.* He was elected to the academy on Feb. 22, 1894, in the place of L. de Mazade-Percin, the publicist. Few purely literary men can have entered the academy with credentials so small in quantity: a small volume of verse, a translation. with introduction, of Diaz del Castillo's *History of the Conquest of New Spain* (1878–81), a translation of the life of the nun Alferez (1894), De Quincey's *Spanish Military Nun* and one or two short pieces of occasional verse and an introduction or so. But the sonnets are of their kind among the most superb in modern literature. "A *Le'gende des siècles* in sonnets," F. Coppée called them. Each presents a picture, striking, brilliant, drawn with unfaltering hand, the picture of some characteristic scene in man's long history. Each line is flawless. Hérédia was one of the most skillful craftsmen who ever practised the art of verse. In 1901 he became librarian of the Bibliothèque de l'Arsénal at Paris. He died at the Château de Bourdonné (Seine-et-Oise) on Oct. 3, 1905, having completed his critical edition of A. Chénier's works;

HEREDIA Y CAMPUZANO, JOSÉ MARLA DE (1803–1839), Cuban poet, whose compositions are characterized by a pervading melancholy and a deep awareness of nature, was born in Santiago on Dec. 31, 1803. His father was a diplomat of liberal principles, in Venezuela (1812–17) and in Mexico (1819–21). The son studied law in Mexico and wrote his famous ode "En el Teocalli de Cholula" in 1820. After his father's death he returned to Cuba. completed his education and practised law. In 1823 he participated in a conspiracy to free Cuba and was exiled, taking refuge in the U.S. After visiting Niagara falls (June 1824), he wrote his celebrated ode "Al Niagara," included in his volume of poems published in New York city in 1825. At the invitation of Pres. Guadalupe Victoria, Heredia went to Mexico in 1825, where he married and, except for a short visit to Cuba, spent the rest of his life. A revised edition of his poems appeared in 1832. He died in Mexico City on May 7, 1839.

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HEREDITAMENT, in law, every kind of property that can be inherited. Hereditaments are divided into corporeal and incorporeal; corporeal hereditaments are "such as affect the senses, and may be seen and handled by the body; incorporeal are not the subject of sensation, can neither be seen nor handled, are creatures of the mind, and exist only in contemplation" (Blackstone, *Commentaries).* An example of a corporeal hereditament is land held in freehold, of incorporeal hereditaments, tithes, advowsons, pensions, annuities, rents, franchises, etc. *(See* FREEHOLD.)

HEREDITARY PENSIONS: *see* PENSIONS: *Perpetual or Hereditary.*

HEREDITY may be defined as the study of all those aspects of living organisms which are specifically governed by certain determining elements derived from the parents but not from the

external environment. As a consequence of the activity of these determinants of hereditary characters, which are called *genes*, an individual plant, animal or microbe resembles its parents in a great many ways, characteristic of its race and species. Sometimes an individual is like its grandparents or other more remote relations in characters not evident in the parents: because genes may be present in an organism without necessarily having an effect on its appearance.

It is convenient to divide all factors controlling the appearance of organisms into two categories: (1) heredity and (2) environment. or, in the words of Francis Galton. "nature" and '.nurture." Resemblances between parents and offspring may be attributable to either of these two things, and usually the classification of a given factor as "hereditary" or "environmental" is unambiguous. Some confusion may arise in connection with certain infectious diseases, such as syphilis, where the causative agent is transmitted from one individual to another in conjunction with, but not inside, the reproductive cells of the host. In this example the infectious agent is clearly a foreign organism and would be classified as an "environmental" factor. Occasionally, however, it becomes difficult to distinguish between infection and heredity, as will be discussed below, under *Cytoplasmic Heredity* and *Heredity in Bacteria and Viruses*.

The decision as to whether a given trait can be ascribed to hereditary or environmental determinants can be made only after examination of the parents. offspring or other close relatives of the individual exhibiting the trait. For example. with poor nutrition, animals may attain an adult weight much below the average. but such an etiect is not hereditary; *i.e.,* it is not reproduced in the animal's descendants, provided adequate food is given to the latter. Many animals, however. exhibit dwarf races. and members of these, no matter how much food they are given. never reach the weight of the normal races. Dwarfs. and many other variations. may be produced by two entirely different factors. hy nature or by nurture, and only breeding experiments, conducted under standard environmental conditions, can establish with certainty the underlying cause of a given variation.

The interactions of environmental and hereditary determinants are often so complex that controversies about which is the more important may be meaningless. Every part of an organism is subject to the control of both kinds of factor. All animals require a favourable environment (*e.g.*, adequate air, food, water, warmth, etc.) for their development. Equally, all animals must start with a favourable array of genes. In certain instances it is possible to make up for some hereditary deficiency by adding a particular substance to the food (see *Heredity of Biochemical Characters* below); or in a more general way, an exceptionally favourable environment may permit the survival of weaker individuals which could not withstand severe competition. But the possibilities of alleviating hereditary defects in this way are limited by the mode of action of the genes concerned. Furthermore, certain traits seem to be controlled solely by hereditary factors; *e.g.,* the blood group antigens in man and other mammals. No amount of environmental treatment is at present known which will modify a person's blood group. On the other hand, certain less specific traits, such as weight. as mentioned above. are rather easily modified environmentally, and the same may be true of the more intangible mental and emotional qualities; but exact data on these matters are not available.

Having agreed that the final form of an organism is related to the environment in which the organism has lived from the start of growth and development (*i.e.*, from the moment of fertilization of the egg), it is necessary next to consider the extent to which the environment *of parents* affects the development of their offspring. In mammals the development of a foetus may be favoured or disturbed by the state of health of the mother and this may be modified by the environment. But maternal effects of this kind do not affect the hereditary constitution of the young: *i.e.,* are not transmitted to further generations. In rare instances (*e.g.,* the direction of coiling of snails) a given trait may be governed by materials which are fully formed in the cytoplasm of the unfertilized egg, but here again the maternal influence extends only to the immediate progeny. The genes are on the whole remarkably uninfluenced by environmental changes, though very drastic agents, such as X-rays (see *Mutation* below), do in fact change the genes specifically.

This statement is not to be taken as implying that the environment is without any influence on the hereditary constitution of a *population* of organisms. As is discussed in detail elsewhere (*see* GENETICS OF POPULATIONS; LAMARCKISM), populations change and evolution occurs through the operation of natural selection. Here it is sufficient to note that changes in genes do not as a rule result in the production of an organism more favourably adjusted to the particular environment under which the change occurred. As will be described below, mutations are essentially random events, and the concept of "inheritance of acquired characters" is not accepted by biologists concerned with the study of heredity, except by T. D. Lysenko and his followers in the U.S.S.R. (see *Societ Genetics* below).

Precise experiments on the inheritance of environmentally induced variations were first carried out by W. Johannsen (1857–1927), with negative results. He self-fertilized bean plants for several generations, and obtained a number of pure lines. The average weights of beans from different pure lines were sometimes different, and such differences were consistent from generation to generation; *i.e.,* they were hereditary. Within a given pure line; variation in bean weight also occurred, but this variation was not inherited. for the heaviest and the lightest classes of beans from the same pure line gave progeny not significantly differing from one another in the average weight of beans produced.

These considerations do not apply with the same force to characters of individual cells, whether the latter be independent organisms such as bacteria. yeasts, protozoa. etc., or constituent parts of a multicellular organism. Some cells can be rather easily modified by the environment. and the induced modifications may persist in daughter cells for prolonged periods of time. Examples will be given below (under *Heredity and Variation of Individual Cells).* However, such cellular modifications are not comparable with true gene changes or mutations and are thought to be concerned with cellular elements less permanent than the genes. In any case it is not true to state that genes are totally unaffected by any environmental stimuli and proceed along a course determined exclusively by themselves. On the contrary. certain agents, such as ionizing radiation. ultra-violet rays and certain chemical substances, are known to cause gene mutations, as will be described below (under *Mutation).* Moreover the activity of the genes is much influenced by the nature of the materials surrounding them in the cell. There is no support for the view that heredity is some mysterious force which cannot be modified or counteracted in any way by human agencies.

In considering heredity it is constantly necessary to bear in mind that the various parts of an organism are not received intact from the parents but developed out of comparatively simple structures present in the egg. There is no real analogy between heredity and the legal notion of inheritance of property. One speaks loosely of a given hereditary character being "transmitted" from parent to offspring. but obviously this is impossible since the only materials which can be thus transmitted are those contained in the uniting sex cells, the eggs and spermatozoa in higher animals. An individual receives from his parents not a set of fully formed characters but a set of determinants or genes. as a consequence of whose activities the hereditary characters are developed. This concept of hereditary determinants is fundamental for an understanding of the nature of heredity. We therefore begin with a few general remarks about the gene.

GENES, CHROMOSOMES AND LIFE CYCLES

According to the theory of genetics, the basis of heredity in all organisms is a unit named by Johannsen in 1909 the "gene." As knowledge has accumulated, the conception of the gene has undergone changes, and some biologists have even wanted to deny its existence altogether. But for the present it can be said that genes are discrete units, probably made up of an extremely complex chemical substance, desoxyriborenucleic acid. bound to a protein.

There is some evidence that the hereditary specificity resides in the nucleic acid part of this substance (denoted as DNA), but this is by no means certain.

Genes are arranged in a very precise way in the cells of an organism. They are arranged linearly in threadlike structures known as chromosomes, of which every organism has a characteristic set. When an egg is fertilized by a spermatozoon, a set of chromosomes from the mother is mixed together with a similar set from the father. In man the unfertilized egg and sperm nuclei each contain a set of 23 chromosomes, which is known as the haploid number. In the fertilized egg there are 46 chromosomes, consisting of 23 pairs in females and 22 pairs and two odd chromosomes in males. Forty-six is the diploid chromosome number in man, and as a result of a very precise duplication of the chromosomes at every cell division, by mitosis, sets of chromosomes are distributed to all the cells of the organism. Thus every part of the body is permeated with hereditary materials like those derived from the two parents. In higher organisms, the actively dividing cells contain diploid sets of chromosomes, while the unfertilized eggs and the sperm cells, or gametes, contain the haploid number. These haploid cells arise from diploid ones by a complex process known as meiosis. It should be mentioned that the chromosomes of paternal and maternal origin are distributed at random in the gametes; *i.e.*, all the "paternal" chromosomes are not found in one gamete. and all the "maternal" chromosomes in another, except by chance. Fusion of the male and female gametes restores the diploid number of chromosomes. In general the cell in which this occurs is called a zygote. (See CYTOLOGY; SEX.)

The life of every organism showing sexual reproduction is differentiated into two phases, the haploid and diploid phases. In higher animals the haploid phase is very brief, consisting only of the gametes themselves. In flowering plants also there are very few haploid cells—just a few nuclei in the pollen tubes and embryo sac. But among lower organisms the situation is quite different. In mosses, haploid and diploid phases are roughly of equal duration. while in some fungi (*e.g.*, the mould *Neurospora*, with which much work on heredity has been done) there is only a single diploid nucleus, namely the zygote itself, all other nuclei being haploid. These variations in life cycles have important consequences which affect the behaviour of hereditary characters in the different groups of organisms.

The fact that the genes are located on the chromosomes. and the precise behaviour of the latter, aids the regular distribution of the genes to the various cells of an organism, and through the gametes to the zygote and the cells of the next generation of organisms. However this is not a passive transport of inert material, but essentially involves the synthesis of new genes at every cell division. In fact the genes are duplicated with extraordinary exactness for enormous numbers of cell cycles. Very rarely indeed there may be a mutation or change of a gene from one form, or allele, to another; and this is recognized by the sudden appearance of a new hereditary character in some part of the organism or in its progeny. The new, mutant gene then continues to be replicated in the same regular manner as the one from which it arose by mutation.

Genes are hypothetical entities in the sense that they cannot be individually seen under the microscope. But their existence is inferred from a series of rigorous experiments, starting with those first performed by G. Mendel (1822–84). Just as in physiology we study the effects of varying environmental factors on the course of development of an organism, so in the study of heredity, or genetics, we study the effects of varying the internal factors, the genes. Experiments of this kind inevitably involve exploitation of the sexual processes, since only with their aid is it possible to effect the desired replacements and recombinations of genes.

MENDEL'S LAWS OF HEREDITY

Mendel studied inheritance in garden peas (*Pisum sativum*) which were cultivated in the monastery garden at Briinn (Brno). Moravia (see also MENDEL, GREGOR JOHANN). His most important results were published in 1866 and 1869 but received practically no notice from the biologists of the time; it was not till 1900, after Mendel's death, that the value of his work was recognized. In that year H. de Vries. C. Correns and E. von Tschermak simultaneously rediscovered and confirmed Mendel's results. Thereafter a great many workers. notably W. Bateson (*q.v.*; 1861–1926), performed similar experiments on many different kinds of animals and plants, and it soon became clear that Mendel's conclusions were valid for the most diverse organisms, from protozoa to man. A few examples from different groups are considered here.

Inheritance in Diploids, Without Dominance.— If a yellow guinea pig is mated with a pink-eyed white, the offspring are cream. Both yellows and whites breed true. but if two creams are mated together, the offspring are yellow, cream or white. and the proportions of the three classes are approximately in the ratio 1:21 Further, if creams are mated to yellows, equal numbers of creams and yellows are obtained; if creams are mated to whites, equal numbers of cream and white. If the genes in animals possessing ability to form the yellow pigment are represented as YY, and animals lacking this ability as yy, and the genes in their gametes as Y and y, respectively, then the product of their fusion —*Yy*—is a cream, producing *Y* and y gametes in equal numbers. In Table I are shown the results of the nine possible matings. Of

TABLE I.—*Inheritance of Coat Colours in Guinea Pigs*
(*YY*=yellow; *Yy*=cream; *yy*=white)

			Mother			
	Colour	Gametes	Yellow *Y*	Cream ½*Y* ½*y*	White *y*	Colour Gametes
Father	*White*	*y*	*Yy*	½*Yy* ½*yy*	*yy*	
	Cream	½*y* ½*Y*	½*YY* ½*Yy*	¼*YY* ¼*Yy* ¼*yy*	½*Yy* ½*yy*	
	Yellow	*Y*	*YY*	½*YY* ½*Yy*	*Yy*	
			Offspring			

course the theoretically expected ratios are not generally obtained unless large numbers of animals are counted. any more than the numbers of red and black cards in a hand taken at random from a pack are in general equal. It is to be noted that the results of all these matings are the same whichever type of animal is used as male and which as female parent.

A zygote (and the animal or plant into which it develops) possessing two identical genes (*e.g.*, YY or yy in the above example) is called a *homozygote;* one possessing two unlike genes—Yy—is a heterozygote The generation produced by crossing two individuals is denoted by F_1, their offspring when self-fertilized or mated among themselves by F_2.

Dominance.— Usually the course of events is slightly obscured by the phenomenon of dominance. If pure-breeding black and blue rabbits are mated, the young are all black, but if these hybrid blacks are mated to blues they give equal numbers of blacks and blues, and if mated among themselves the hybrid blacks give blacks and blues in the ratio 3:1. If the pure-bred blacks are denoted **II**, the blues ii (I symbolizes a gene intensifying blue to black. *i* its absence) the hybrid (F_1) blacks are *Ii*, giving equal numbers of I and i gametes. The situation is essentially the same as in the previous example of the guinea pigs, except that the rabbit heterozygote **Ii** is not intermediate in appearance between the two homozygotes *II* and *ii*, but is indistinguishable from **II**. Black is said to be dominant to blue; blue is *recessive* to black.

Examples of this type show how it is possible for a given animal or plant to contain a particular gene without exhibiting any outward sign of its presence. Proof that recessive genes are present in heterozygotes can be obtained only by examination of the progeny or by knowledge of the parents.

Inheritance in Haploids.——In the haploid cells of higher organisms, and in the entire vegetative tissue of a fungus such as *Neurospora*, each nucleus contains only a single gene of each kind. Thus in maize the pollen grains normally contain a carbohydrate (starch) which stains blue with iodine, but there is a strain known as "waxy," bearing pollen which contains another carbohydrate,

staining red with iodine. If waxy plants are crossed with normal. a heterozygous plant (denoted *Wx/wx*) is obtained, but the pollen produced by such a heterozygote gives exactly half waxy (wx) and half normal (Wx) grains. A similar pollen character is known in rice. Similarly. in *Neurospora crassa* there are two mating types denoted "plus" and "minus." Successful fusion of gametes occurs only between strains of opposite mating type. In *Neurospora* there is only a single diploid cell. the zygote itself. The latter produces haploid cells (the ascospores), of which exactly half are plus and half minus mating types. Similar results are obtained with many other characters in *Neurospora; e.g.,* those concerned with the colour of the mycelium, with the biochemical capabilities and so on.

These examples illustrate the first "law" of Mendel. which states that there are factors (now called genes) which affect development; that these factors retain their individuality from generation to generation and do not become contaminated when they are mixed in a hybrid: and further, that the factors become sorted out from one another when the gametes are formed.

Lethal Genes.—Sometimes the expected Mendelian ratios are not seen to appear because certain types have a much lower viability than others. In fowls there is a breed known as "Creepers," with shortened wings and legs. When Creepers are crossed to normal, the result is an equal proportion of Creepers and normals; when Creepers are crossed together, Creepers and normals are found in the offspring in the ratio 2:1. More careful examination of the results of the last cross shows that there is a third class of progeny which die in the shell at about the fourth day of incubation. Creepers are in fact heterozygotes (*Cc*), and on intercrossing them we really obtain normals (*cc*), heterozygous Creepers (Cc) and the lethal homozygous type (*CC*) in a ratio 1:2:1.

Completely recessive lethal genes are also found very commonly. For example. in maize the most frequent of all genic variations results in a failure to develop chlorophyll. and such plants die because they cannot achieve photosynthesis. Again, in some breeds of cattle. a proportion of the animals are heterozygous for a lethal gene, and when two such animals happen to be mated together, one quarter of the progeny die at an early age. (If death occurs very early, in the uterus. it may not be noticed.) The only way to eliminate these recessive lethal genes from a population is by determining which animals are heterozygotes and which homozygotes by preliminary matinps and examination of the progeny. The proved homozygotes should then be used for further breeding even though the heterozygotes may appear to be more desirable in their appearance. However, such a procedure is slow and expensive with cattle.

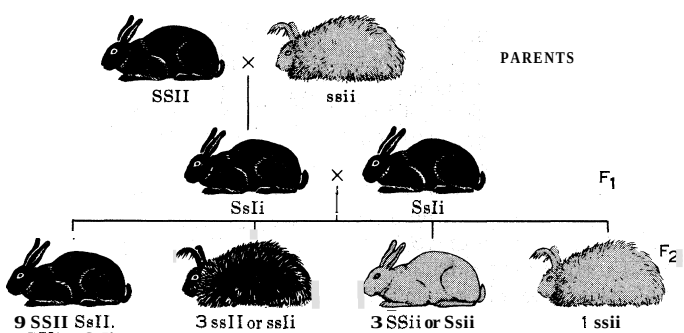


FIG. I.—INHERITANCE OF HAIR LENGTH AND COLOUR IN RABBITS

Inheritance **of** Several Genes.—Mendel also studied the inheritance of two pairs of differentiating characters simultaneously. Another example may be taken from rabbits. Shortness of hair is dominant over length, and due to a gene which may be called S. If a homozygous short-haired black (SSII) is mated with a long-haired (so-called "Angora") blue. having the genes ssii (see Fig. 1), the offspring (F_1's) are double heterozygotes (SsIi) and in appearance short-haired blacks. Half their gametes carry I and half i, and the same is true for S and *s*. The significant finding here is that the four possible classes of gametes *SI, sI,* Si and *si* are formed in equal numbers, and it can be easily shown that random fusion of two lots of such gametes (one from the male F_1 and one from the female F,) will produce in the F_2 generation four classes of rabbit; namely short-haired blacks (SSII, *SsII, SSIi,* SsIi). long-haired blacks (*ssII, ssIi*), short-haired blues (*SSii,* Ssii) and long-haired blues (iiss), in a ratio of 9:3:3:1. Thus in the F_2 not only the two "parental" types of rabbit are obtained, but also two new "recombination" types in which characters from two different individuals have been combined in a single individual. The genetical behaviour of double heterozygotes is precisely the same whether they .are made by the mating *SSII* × *ssii* as above, or from *ssII* × SSii (long-haired black × short-haired blue).

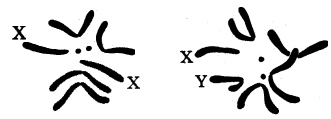


FIG. 2.—CHROMOSOMES IN THE SOMATIC CELLS OF DROSOPHILA MELANOGASTER

Experiments of this kind illustrate the second "law" of Mendel, which states that each pair of factors (genes) behaves independently of every other pair. Further work, to be described below, will show the limitations of this lam of independent assortment. That there are such limitations was shown as early as 1906 by Bateson and R. C. Punnett working with sweet peas (*Lathyrus odoratus*). Crossing together two varieties, the one bearing purple flowers and long pollen. the other red flowers and round pollen, they obtained an F_1 and in the F_2 derived from the latter the following numbers of plants: purple flowers and long pollen, 1,528; purple flowers and round pollen, 106; red flowers and long pollen, 117; red flowers and round pollen, 381. Clearly these figures do not conform with a 9:3:3:1 ratio. There is a surplus of the parental classes and a deficit of the recombination classes of F_2 offspring. The reason for these discrepancies will be made clear below, under Linkage and Crossing Over.

Alleles **and** Multiple Alleles.—Bateson introduced the word "allelomorphic" to describe the characters which segregate from each other in the progeny of hybrids; *e.g.,* the black and blue alternative colours of rabbits are allelomorphic characters. Subsequently the word was applied to the genes rather than to the characters determined by the genes, and is often abbreviated to the form "allelic." Genes which are alternative, in the sense that only one of a given kind can be present in a single gamete (or other haploid cell), are called alleles. As will become clear after presentation of the chromosome theory (see below), in a haploid cell there is only a single chromosomal site—called the locus—at which allelic genes can be placed. In diploid cells, however, there are two such sites, one in each member of a pair of homologous chromosomes. Both members of a pair of alleles may be present in the same cell, as in heterozygotes, or, alternatively, each cell may contain two identical alleles, as in homozygotes. Alleles are usually denoted with the same letter of the alphabet.

Although the cells of an individual diploid organism can contain at the most two different allelic genes, there map be many more than two alleles in a population of many individuals. For example, in rabbits there is a series of four coat-colour variations: full-coloured. chinchilla (silver gray), Himalayan (coloured extremities) and white. The rules of inheritance here are as follows: F_1 hybrids between any two of these types yield F_2 offspring consisting of the same two types (and sometimes intermediates) but no other types. For example, if chinchilla is mated with white there is obtained in the F_2 chinchilla and white but not full-coloured or Himalayan. Here there is a series of four so-called multiple alleles—C, c^{ch}, c^{H}, c—in order of dominance and decreasing pigmentation.

Sometimes the number of allelic forms of a given gene is very large. In a number of plants there is a system of S alleles controlling .self-incompatibility; *e.g.,* in *Nicotiana, Antirrhinum,* some clovers, sweet cherries, etc. Pollen containing, say, the alleles S_1 or S_2 cannot fertilize the ovules borne on a plant having the constitution S_1S_2, but pollen containing the alleles S,, S_3 or any one of possibly 100 other alleles is completely successful. This explains why a cherry orchard containing trees of only a single variety may fail to set any fruit, but will do so abundantly when

a few trees of another variety are mixed in.

The concept of allelism is complex, as will be discussed below (see Position *Effects* and *Pseudoalleles*).

CHROMOSOME THEORY OF HEREDITY

Although cytologists such as E. Strasburger (1844–1912), O. Hertwig (q *v.;* 1849–1922) and others, as well as A. Weismann (*q.v.;* 1834–1914), having observed the very precise behaviour of the chromosomes at mitosis. meiosis, fertilization, etc., believed that the chromosomes were the seat of hereditary factors as early as the 1880s. definite proof of the chromosome theory of heredity could be established only after the rediscovery of Mendel's work in 1900. Thereafter cytologists and geneticists showed. in ever-increasing detail, the exact conformance between the behaviour of the chromosomes seen under the microscope, and the hypothetical genes. whose existence had only been inferred from breeding experiments of the Mendelian type.

The first character shown to be clearly correlated with the presence of a particular chromosome was sex (*q.v.;* see also CYTOLOGY). In higher animals the commonest arrangement is that in which females have two sets of autosomes (chromosomes not specifically concerned with sex) and two identical sex chromosomes (XX). while the males have the same two sets of autosomes but an odd pair of sex chromosomes (XY). In a few groups, such as the birds and Lepidoptera. the situation is reversed, males having two identical X chromosomes and females an X and a Y. In some organisms. notably the fruit fly *Drosophila* melanogaster, the X and Y chromosomes can be seen to be distinct from each other and the autosomes (see fig. 2). Elsewhere, where the X and Y chromosomes look alike, their existence may be inferred from a number of genetic phenomena, of which sex linkage (see below) is the most important. The correspondence between the sex chromosomes and the outward manifestations of the sexual characters is especially clear in gynandromorphs, animals which have half male and half female tissues. Such abnormalities are known in *Drosophila,* one side being male and the other female. On the female side the cells contain the usual two X chromosomes, while on the male side there is only a single X, the other one having been lost at an early stage in development.

Sex Linkage. — Many traits are known to be determined by genes situated on the X chromosome. Such are called sex-linked traits, but this does not mean that they are necessarily limited to one sex, as will be shown. In cats, yellow colour (as distinct from the normal black) is due to a sex-linked gene which may be called b. Dominance is incomplete, and the following are the three possible types: black (BB). tortoise-shell (Bb) and yellow (bb). Among males, however, tortoise-shells are not found, since males have only a single X chromosome and the Y chromosome is practically devoid of genes. In Table II the six possible matings and the progeny obtained are set out. The difference between reciprocal matings of black and yellow is striking. Basically the same situation is found when dominance is complete, as in human colour-blindness or haemophilia, which are due to sex-linked recessive

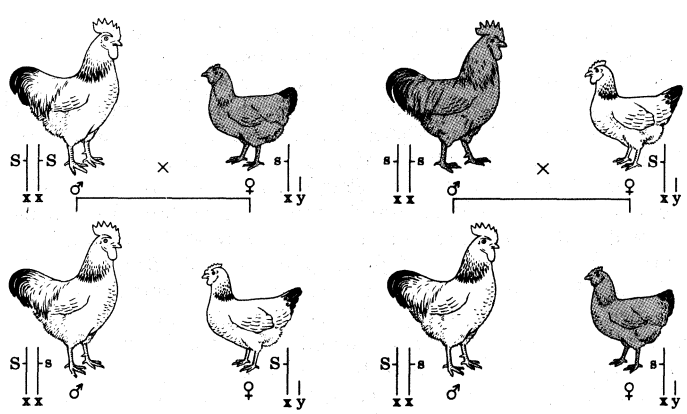


FIG. 3. — SEX LINKAGE IN POULTRY

genes. In interpreting cases of sex linkage generally two facts should be remembered: (1) in most groups of animals, males derive their X chromosome from their mother, their Y chromosome from their father, while females derive one X chromosome from each parent; and (2) sex-linked genes are borne on the X chromosome. The Y chromosome bears very few genes.

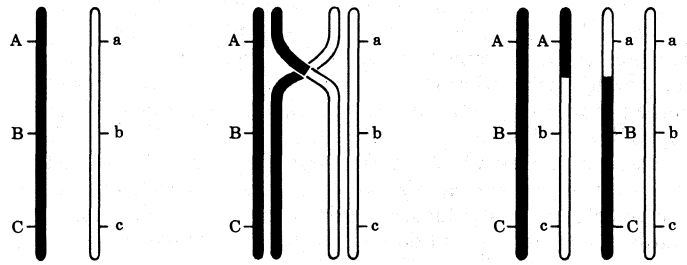
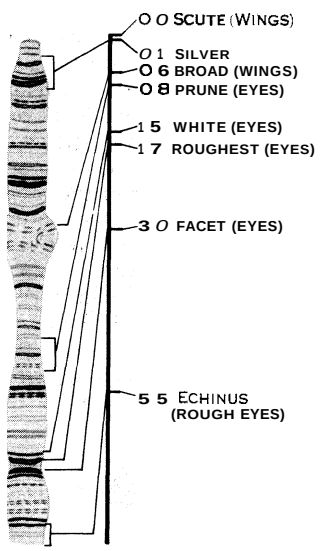


FIG. 4. — DIAGRAM OF CROSSING OVER. SHOWING FORMATION OF TWO CROSS-OVER AND TWO NONCROSSOVER CHROMOSOMES

The following example shows the inheritance of a sex-linked trait in birds, which are exceptional. Here it is the female which is XY and the male XX. The Light Sussex breed of fowls carries a dominant gene (*S*) inhibiting pigment. Rhode Island Reds carry the recessive allele s. The results of reciprocally crossing birds of these two breeds are shown in fig. 3. It should be rioted that matings of Light Sussex hens with Rhode Island cocks yield red pullets and white cockerels, and this has been made use of in the determination of sex in very young chicks.

Linkage and Crossing **Over.** —In 1909 T. H. Morgan (*q.v.;* 1866–1945) put forward his hypothesis of crossing over (suggested by F. A. Janssens' interpretation of the crosslike structures known as chiasmata which hold the pairing chromosomes together at meiosis). Morgan proposed that if t o genes A and B are located at different points of the same chromosome, they would usually be linked together in one chromosome in the cells of the descendants, but sometimes, through breakage and rejoining of the chromosome threads, the two genes could be separated, so that *A* would be borne on one chromosome and B on another. Thus, if an organism were heterozygous for two linked genes (*AB/ab*), most of the gametes would be AB or ab, but a proportion would be "crossover" types Ab or *aB,* and these if used in the production of the offspring would be recognized by the new combinations of characters produced.



FROM C. B. BRIDGES "JOURNAL OF HEREDITY," VOL. 26 (1935) BY COURTESY OF THE AMERICAN GENETIC ASSOCIATION

FIG. 5 — SECTION OF A CHROMOSOME MAP OF DROSOPHILA MELANOGASTER.

The location of eight genes, as determined by crossing over, is shown, with corresponding sections of a salivary gland chromosome

Such a mechanism accounts for the figures given earlier in the sweet pea experiments of Bateson and Punnett.

Morgan also proposed that the farther apart two linked genes were, the more likely would they be to cross over, and thus the distance apart of two genes on the same chromosome could be estimated, in a relative manner, by the frequency of crossing over between them. (Crossover values are expressed numerically as the proportion of crossover gametes to the total.) Furthermore, considering three linked genes, crossing over between the two most extreme ones would be approximately the sum of the crossing over between each of the other two. All these possibilities have been verified. For example, C. B. Bridges (*q.v.;* 1889–1938) studied

the simultaneous inheritance of the following three genes in the fruit fly *Drosophila melanogaster:* ruby eye (*rb*), cut wing (*ct*)

TABLE 11.—*Inheritance of Yellow Colour, Due to a Sex-Linked Gene* (b), *in the Cat*

It will be noticed that the figure of 29.4 is slightly less than the sum of 16.7 + 14.5 = 31.2. This discrepancy is ascribable to the occasional double crossovers (*i.e.,* simultaneous crossing over in the two regions), leading to a restitution of the original combination of genes at the extreme ends.

A vast amount of work has been done on *linkage* (as the association of genes on the same chromosome is called) in *Drosophila* by Morgan, Bridges. A. H. Sturtevant. H. J. Muller and others. There are three large linkage groups (one of them sex-linked) and a fourth very small linkage group. These four groups correspond to the four pairs of chromosomes known in *Drosophila melanogaster (see* fig. 2). The details of crossing over are complex, and the mechanism is not fully understood. The phenomenon is most satisfactorily studied in those organisms in which all four nuclear products of meiosis in a given diploid cell can be recovered and studied in the progeny, by a procedure known as tetrad analysis. This is easily done with certain micro-organisms such as the mould *Neurospora,* the alga *Chlamydomonas,* yeasts and also with some bryophytes. By tetrad analysis. it is shown that crossing over at a given point on the chromosomes involves only two out of the four strands present in the paired chromosome "bivalents" *(see* CYTOLOGY), for of the four cells in a tetrad, two contain crossover and two noncrossover chromosomes *(see* fig. 4).

Detailed chromosome maps have been constructed for a number of organisms, the most elaborate being those of *Drosophila melanogaster.* Here the presence of the giant chromosomes in the salivary glands has enabled cytogeneticists to establish the positions of the genes with great precision. In maize also much chromosome mapping has been done. In this plant there are ten linkage groups and ten pairs of chromosomes. In both maize and *Drosophila* this work has been much aided by the fact that chromosomes can be broken and variously rearranged by treatment with X-rays (see *Mutation* below). A small sample of one of the chromosome maps of *Drosophila* is shown in fig. 5.

In man, very few linked genes are known, apart from the sex-linked group. Where the number of chromosomes is large, linkage studies are very laborious, and in man they are particularly so because of the impossibility of deliberately breeding together individuals containing certain rare genes suspected of being linked.

The conformance between the linkage groups inferred from breeding experiments and the chromosomes observed directly under the microscope is good evidence for the chromosome theory of heredity. More exact proofs of the latter are furnished by certain structural modifications of the chromosomes and the consequential altered behaviour of the genes located on them. Among these modifications are deficiencies, inversions, duplications and translocations of chromosome segments, all of which occur in nature. Their frequency becomes much higher, however. when plants or animals are exposed to ionizing radiation (see *Mutation*).

Polyploidy.—Many cultivated plants contain multiple sets of chromosomes. Plants containing in their somatic cells three times the haploid number of chromosomes are called triploids. those with four times. tetraploids, and so on. Among wheats are found. for example *Triticum monococcum,* diploid with 14 chromosomes; *T. durum* (macaroni wheat), tetraploid with 28 chromosomes; and *T vulgare* (bread wheat), hexaploid with 42 chromosomes. Other polyploid plants are to be found among varieties of oats. apples, pears, plums, cherries, strawberries, raspberries. roses, dahlias, etc. Moreover, among wild plants the different species of a genus often contain series of chromosomes which are all simple multiples of a basic number Evidently polyploidy has played a role in the evolution of such species. In animals the condition is much less common in nature. and when artifically induced may lead to serious disturbances. Among amphibia (*e g.,* some newts) triploids occur occasionally in nature and may be produced artificially by exposing the eggs to unusually low or high temperatures. Triploid and tetraploid newts are sometimes able to complete metamorphosis, but they are all sterile. In some parthenogenetic animals (*i.e.,* those able to bring forth young without fertilization of the ova), polyploidy is known to occur in nature; *e.g.,* among certain weevils, earthworms, etc.

In both animals and plants, cells which have ceased division (especially differentiated cells) may contain highly polyploid numbers of chromosomes. In plants, a certain part of the seed known as the endosperm consists entirely of triploid cells, formed by the fusion of two haploid nuclei from the embryo sac and one haploid nucleus from the pollen tube. These quantitative variations do not in any way contradict the concept of a regular distribution of chromosomes to cells in all parts of the body, a concept which led the early cytologists to foresee the chromosome theory of heredity. Regularly dividing somatic tissues, and especially those of the germ line, show a remarkable constancy in number of chromosomes per cell, characteristic for the species.

Polyploidy in plants has two effects: (1) it may result in an increase in size; and (2) a certain degree of sterility usually follows. The increase in size is by no means universal, though polyploid cells are usually larger than diploid ones. As for the sterility, this could be an advantage or a disadvantage. according to the nature of the crop and the method of propagation. Edible fruits may be better without seeds; *e.g.,* the banana. of which the common varieties are triploid. Again, among ornamental plants, failure to set seed may lead to a prolongation of flowering. On the other hand, with grain crops it is obvious that no reduction in seed setting could be tolerated.

Two kinds of polyploids are distinguished, allopolyploids and autopolyploids. *Primula kewensis* is an example of the former. If P. *floribunda* and *P. verticillata* (both having nine pairs of chromosomes) are crossed, the hybrids (also containing 18 chromosomes) are completely sterile. Such plants have occasionally produced a tetraploid branch (with 36 chromosomes per cell). The latter is self-fertile and the seeds from it gave the new species P. *kewensis.* In this the nine pairs of chromosomes from each parent are able to pair with each other, so that the gametes receive one haploid set of chromosomes from each parent species, and the hybrids breed true. Some other species are thought to have arisen as allopolyploids; *e.g., Galiopsis tetrahit* (from *G. pubescens* × *G. speciosn), Spartina townsendii* (from *S. stricta* × *S. alternifolia)* and some of the cultivated wheats. In autotetraploids there are four similar representatives of each chromosome per cell, and these at meiosis form complex structures which may lead to the development of unbalanced sets of chromosomes in the gametes. Polyploids may be produced artificially by a number of treatments, such as by wounding. by heat shocks or by application of certain chemicals. For example, if tomato plants are cut down, about 2% of the regenerating shoots are tetraploid. Branches of (diploid) apple trees. bearing young flower buds, if subjected to a heat shock of 45° C. for one to two hours, produce a small proportion of unreduced (*i.e.,* diploid) pollen grains. which can be used for fertilization and the production of triploids. Of the chemicals used. the most effective is colchicine, a potent drug extracted from the plant *Colchicum autumnale* and having a destructive action on the mitotic spindles *(see* CYTOLOGY; PLANT BREEDING). With the aid of col-

chicine, tetraploid races of certain cultivated plants, such as clover, have been developed, notably in Sweden. Such races on first development are often sterile. but it is possible to eliminate this disadvantage by prolonged programs of selection and breeding. .

Mendelian heredity is complicated in polyploids by the existence of multiple sets of genes at each locus and by the occurrence of complex chromosomal configurations at meiosis. Simple genic segregation is therefore not usually found.

HEREDITY OF QUANTITATIVE CHARACTERS

Mendel's laws and the chromosome theory of heredity were developed from experiments on easily distinguishahle characters. For example. in Mendel's own experiments there was never any difficulty in assigning a given plant to one of the two classes—tall or dwarf—for the differences were so striking that variations in height resulting from environment did not obscure the segregation. However. much hereditary variation is not of this kind. For example, the height of men varies from about 60 in. to about 78 in., with a mean of about 68 in. (these figures vary. of course, for different nations). No Mendelian segregation appears to occur for such quantitative variation. Commonly it is found that hybrids between two individuals differing markedly in such a character are intermediate between the two parents. and in the F_2 a range of types is obtained, extending continuously between those of the two parents and sometimes beyond them.

Francis Galton (*q.v.*, 1822–1911), who was the first to study this matter statistically, formulated the regression law. according to which parents which deviate from the average type of the "race" in a negative or positive direction beget progeny which on the average deviate in the same direction, but to a lesser extent; the children's type shows regression to the personal type of the parents. At first it was thought that quantitative characters did not obey the Mendelian rules. and a violent controversy arose in England in the early years of the 20th century between two schools known as the biometricians. led by K. Pearson (*q.v.;* 1857–1936), and the Mendelians. led by Bateson. The issue nas confused by the failure of those concerned to distinguish between the hereditary characters of an organism and the underlying determining factors, or genes. Johannsen (as a result of his experiments with beans, already referred to) clarified the situation by formulating the concepts of genotype and phenotype. The latter was defined as the appearance of the adult animal or plant—a measurable reality—resulting from the action both of genetic elements inside the organism and of the environment. The genotype—somewhat more hypothetical—referred to the constitution of the two gametes which unite to form the zygote and the new individual; the genotype is the total of all the genes in an organism.

The conflict between the biometricians and the Mendelians was resolved when it was realized that quantitative characters were governed by Mendelian factors, but that there were many such factors. each individually having only a small effect on the phenotype, all together acting cumulatively. Such views were put forward by H. Nilsson-Ehle (1908) and E. M. East (1910), and later developed mathematically by R. A. Fisher (1918). Consider two plants differing in respect of three pairs of alleles, *A-a,* B-b, C-c, concerned with a metric character such as height. Imagine that each of the three genes written with capital letters makes a small contribution to the height. Thus tall plants (AABBCC) mould contain six effective genes, and small plants (aabbcc) none. The F_1 derived by crossing these two plants (*AaBbCc*) would contain three height-producing genes and would be intermediate between the two parents, assuming no dominance. In the F_2, as many as 27 genotypes are possible, and this would result in the production of a large assortment of plants of different height, ranging between the two parents. If small environmental changes also occur, then a practically continuous range of gradations would be easily understood. If one of the parents had been *aabbCC* and the other *AABBcc,* one could get in the F_2 the two types AABBCC and aabbcc, which would both be more extreme than either parent.

Such a hypothesis of multiple factors, sometimes called polymeric factors or polygenes, satisfactorily accounts for the facts of quantitative inheritance and is consistent with Mendelian theory. but direct proof is difficult to obtain. One piece of supporting evidence is the fact that when two inbred lines (*e.g.,* of maize) are crossed together and F, and F_2 generations produced, the variance in F_2 is usually greater than in F_1. Again, in *Drosophila* it is possible to assess the effects of genes on given chromosomes on a particular metric character. Difficulties arise, however, when one has to consider nonadditive "interactions" of the effects of different alleles at one locus or of genes at different loci. That such interactions must occur is evident from the widespread occurrence of heterosis (or hybrid vigour), a phenomenon having very great economic value in the maize-growing industry (see PLANT BREEDING).

In maize. and also in many other plants and animals. hybrids between individuals of two different inbred lines are often strikingly more vigorous than either parent. This may be due to two causes: (1) heterozygotes for genes at certain loci are more vigorous than either homozygote; *i.e.,* there is an "overdominance" of the heterozygote; and (2) there may be a complementary interaction between dominant genes at different loci.

Another feature of hybrids, which may be allied to heterosis, is their greater stability, under varying environments. as compared with the inbred parents. This is of some importance when using laboratory animals such as mice for assaying drugs, nutritional factors, e t ~ .In testing a given drug, it is desirable that the reaction of the animal be as consistent as possible. If unselected mice obtained from a dealer are used, different mice differ in their genotypes, and may respond differently to the drug. If a single strain of mice is inbred, genotypic variation is reduced, but the reactions of such animals to slightly varying environments may be erratic. If two different inbred lines are hybridized, the result should be mice which are the most uniform of all.

MUTATION

Genes are ordinarily said to be very "stable"; *i.e.,* they are reproduced with great constancy for very long periods. Very rarely, sudden mutations occur, and the new or *mutant* allele is then reproduced in the same regular manner as the original; reverse mutations from a mutant to a wild-type allele also occur. In diploid organisms mutations involve only one of the two genes present in each cell at homologous loci, thus showing that the cause of the mutation process must be localized in very small volumes, possibly limited to the gene itself.

Gene mutations can be recognized only by the appearance of an organism of altered phenotype—a mutant—and this may not be seen till long after the actual genic event. The length of this time lag in manifestation of mutations varies according to the class of mutant gene produced, whether dominant or recessive. autosomal or sex-linked. Mutations to alleles which are partially or fully dominant to the original allele are manifest in the progeny of the individual in whose germ cells the mutation occurred. Several human pedigrees are on record in which a dominant abnormality, such as brachydactyly or neurofibromatosis, arose by mutation. Mutations of sex-linked genes (*i.e.,* those in the X chromosome) to recessive alleles appear according to the following rules (assuming the male to be XY and the female XX, as in man). If the mutation occurs in a female, some of the sons but none of the daughters will show a mutant phenotype. If the mutation occurs in .the germ cells of a male, none of the immediate progeny will appear mutant, but some of the daughters will be heterozygotes and consequently half their sons will be mutants. Finally when a mutation to an autosomal recessive allele occurs, no phenotypic effect need be shown for many generations, in the absence of inbreeding. All the mutant alleles will be present at first in heterozygotes, and if the mutant is rare in the population, the chance occurrence of mating between two heterozygous individuals is unlikely. Inbreeding, as in the marriage of cousins or other close relatives, would, of course, result in a much more rapid manifestation of autosomal recessive mutations. In haploid organisms, such as fungi, algae, some protozoa and bacteria, and in the haploid phase of flowering plants, the long lag periods described above do not occur.

The frequency with which mutations occur in nature is very

difficult to estimate, because of their extreme rarity. It is clear, however, from the work of H. J. Muller and N. W. Timofeev-Ressovsky, that mutations having different effects occur with different frequencies. In Drosophila the rarest mutations are those having an obvious visible effect. "Lethal" mutations, which kill the animal at an early stage, are about eight times as common as "visibles." "Viability" mutations, which slightly lower the viahility, are much commoner even than "lethals."

As for the actual rates, it has been estimated that in the gametes of Drosophila melanogaster one X chromosome in 600 contains a spontaneous lethal mutation somewhere along the chromosome. In *Drosophila* and maize, mutant alleles of individual genes have been found to arise about once in 100,000 or once in 1,000,000 gametes. In man, mutation rates of about 1/100,000 per gene per generation have been estimated; *e.g.*, for haemophilia (a sex-linked recessive), for retinoblastoma (an autosomal dominant) and for albinism (an autosomal recessive). However, these calculations, especially those for man, involve a number of uncertain assumptions. It is known. moreover, that mutation rates vary considerably under different conditions. Increasing temperature has been found to raise the mutation rate in Drosophila. It is believed that mutations occur more commonly in actively dividing cells than in resting cells, but even in the latter (for example, in stored sperm of *Drosophila*) some mutations are found. Genetic factors are also known to modify the mutation rate considerably, for in some races a given gene may be much more mutable than in others. If different organisms are compared (on the basis of admittedly very scanty data) it is found that the rate of mutation per gene per generation is very roughly the same in man as in *Drosophila,* but as the life cycle of man is 10,000 times as long as that of Drosophila, the mutation rate per unit of time must be very much lower in man than in Drosophila; if it were not so, every man would be a repository of large numbers of harmful genes, and could not survive.

Mutagenic Agents: Ionizing Radiation. — In 1927 hluller proved that treatment of *Drosophila* with X-rays leads to the production of mutations in quantities much above those occurring in untreated populations (see NATURALIZATION OF PLANTS AND ANIMALS). Shortly afterward L. J. Stadler reported similar results with maize, and it later became certain that all ionizing radiations induce the production of mutations in all organisms, ranging from bacteria to man. The mutants thus produced (in Drosophilo at least) resemble those previously found in unirradiated material. Moreover, not only gene mutations but also structural alterations of the chromosomes, such as deficiencies, inversions, translocations, etc.. are produced in .quantities by X-irradiation.

The relationship between the dose of X-rays delivered to the cells and the number of mutations produced is strictly linear. In *Drosophila* about 3% of X chromosomes subjected to 1.000 roentgen units develop lethal mutants, and the effects of smaller or larger doses are in proportion. A given dose of 2,000 r may be given in a short period of very intense exposure (eight minutes), or, alternatively, spread out over 30 days from a radium source emitting y-rays. In both cases Muller found that about 6% sex-linked lethal mutations were produced in the gametes of irradiated males.

Even if the exposure is broken up into separate periods. with intervals of rest between. the final result is the same and proportional to the dose. As far as genetic effects of X-irradiation are concerned, there is no "recovery." These considerations do not. however, apply to certain radiation effects on gross chromosomal rearrangements.

The above-mentioned facts have obvious significance in connection with exposure of human beings to ionizing radiation, which is much used in industry, medical diagnosis and therapy, etc.. and which is an inevitable product of atomic energy establishments and atomic explosions. Very small doses, when continued over prolonged periods, or when delivered to very large populations of millions of individuals, may produce as many mutations as the exposure of a few individuals to a massive dose. To the population as a whole. the result may be equally serious, or more so.

The magnitude of the effect depends greatly on the kind of cell irradiated. In Drosophila, a given dose of X-rays produces only one-third as many mutations in spermatogonia (*i.e.*, the cells of the gonad which divide repeatedly to give finally the spermatozoa) as in spermatozoa. while spermatids (cells which transform without division directly into spermatozoa) are even more sensitive than spermatozoa. In maize, a 15-fold increase in mutations produced by X-rays has been reported from the time of minimum sensitivity (just before meiosis) to the maximum (one week before shedding of the pollen). In maize, again, growing tissues have produced eight times the number of X-ray-induced mutations as have resting cells.

As to the relative sensitivity of different organisms, no exact data are available. It is thought likely, however, that mice are more sensitive to the mutation-producing effect of X-rays than Drosophila, and it is reasonable to believe that in this respect man resembles mice more closely than Drosophila. In *Drosophila* the dose of X-rays necessary to double the spontaneous rate is estimated at about 100 r. Just as with spontaneous mutations. X-ray-induced mutations are usually deleterious or lethal. However, with barley, Å. Gustafsson in 1937 succeeded in obtaining, after X-ray treatment, some mutants showing qualities which are desirable from the point of view of man (*e.g.*, giving an increased yield of grain and straw), but such mutants occur at a very low frequency, possibly 1/1,000 of all mutations produced. Again. strains of the mould *Penicillium* giving a much-increased yield of penicillin have been obtained after X-ray treatment. But "improvements" of this kind can be obtained only when it is possible to reject the overwhelming majority of individuals and select the very few having the desired characteristics.

Ultra-Violet Radiation. — Gene mutations (though probably not gross chromosomal rearrangements. such as large deficiencies or translocations) are induced by ultra-violet rays of wave lengths between 2,300 and 3,100 Å, the maximum effect being produced in the range .2,650–2,800 A. This corresponds with the optimum absorption (2.600 Å) of ultra-violet rays by deoxyribosenucleic acid. Because of the fact that ultra-violet rays are rapidly absorbed by living tissues, mutations are induced only when the treated nuclei are near to the surface; *e.g.,* in pollen grains or sperm. or in micro-organisms.

It is believed that the mutagenic action of ultra-violet radiation is indirect. Thus. W. S. Stone and others showed that a small proportion of mutations were induced in bacteria and in *Neurospora* when the latter were grown on a nutrient medium which had been irradiated with ultra-violet rays shortly before the organisms were inoculated. Presumably the irradiation of the food forms a chemical substance which subsequently acts as a mutagen. Exposure of organisms to visible light during or shortly after treatment with ultra-violet rays reduces the number of mutations which finally appear. a phenomenon known as "photorecovery." Lastly, if a pollen grain is irradiated and then used for pollination, the new plant produced may be a "mosaic" consisting of half mutant and half nonmutant cells. This is taken to mean that irradiation initially changes the gene or the surrounding cytoplasm into a condition such as will favour the occurrence of a mutation some time later.

Chemical *Mutagens.*—A great many chemical substances are known to produce gene mutations. In 1941 C. Xuerbach and J. M. Robson, after noticing that mustard gas had an effect on living tissues resembling X-ray burns, placed some individuals of *Drosophila* melanogaster in the vapour of this substance and found that a large number of sex-linked lethal mutations were produced. Later the substance was shown to be mutagenic to a large variety of other organisms. Like X-irradiation, mustard gas induces the occurrence of many kinds of lethal and visible mutations, and also certain chromosome rearrangements. Among many other chemical mutagens may be mentioned the following: nitrogen mustard, phenol, urethane. formaldehyde, caffeine. In general these substances do not have any chemical affinity with one another.

Some mutagens (*e.g.,* urethane and nitrogen mustard, as well as X-rays) are also carcinogens, but there is no general correlation between ability to induce mutations and ability to induce cancer. No chemical mutagen is known which will induce specifically the

mutation of a particular gene, though certain loci may be more susceptible to the action of one kind of mutagen, other loci to others.

Conclusion. — The mode of action of the various mutagenic agents and the detailed nature of the changes produced in the genes and chromosomes are not understood. According to some specialists — though others disagree — X-rays do not produce "genuine" mutations from one allele to another. but act destructively to produce small deficiencies and other chromosoinal changes which may have phenotypic effects indistinguishable from recessive mutations at the locus affected.

The role of these mutagenic agents in producing mutations in nature is probably a minor one. It is true that some known chemical mutagens (*e.g.,* formaldehyde, caffeine, mustard oil) occur in plants, but only at low concentrations. Ionizing radiation (cosmic rays, radioactivity from the earth) occurs naturally, but the intensity would be insufficient to account for the known rate of mutation in Drosophila; though in a slow-breeding organism like man natural radiation may well account for an appreciable proportion of the "spontaneous" mutations. Ultra-violet radiation would not penetrate to the germ cells of higher animals, but might induce some mutations in pollen grains or micro-organisms blown through the air. It is concluded that the cause of "spontaneous" mutations (or the majority of them) is to be sought in the structure and behaviour of the gene itself, which may be naturally unstable, but the whole subject is obscure, especially in view of the phenomena of position effect and pseudoallelism, to be described in the next section.

POSITION EFFECTS AND PSEUDOALLELES

It has been a basic principle of genetics, stemming originally from the work of Mendel himself, that the primary functioning of a given gene is independent of that of other genes in the same cell. It is now known. however, that the behaviour of a given gene may be markedly affected by the presence of neighbouring chromosomal materials. Several different types of this position effect are known. For example, if the wild-type allele of the gene white eye in *Drosophila melanogaster* is translocated to a position near to heterochromatin (*i.e.,* regions of the chromosomes having special staining properties) a variegated eye is produced, consisting of a mosaic of white and wild-type facets. Similar variegation connected with five other genes in the immediate vicinity of white eye is found, and it is thought that such variegation is due to an irregular inhibition of the normal functioning of the wild-type alleles. (It is known that very small deficiencies may produce phenotypic effects indistinguishable from those of recessive mutants at the same loci.) Conversely, genes which are in normal circumstances close to heterochromatin may change their behaviour when moved far away from it. Position effects of this general type are also known in maize and *Oenothera blandina.* Sometimes the inhibition is complete, producing a wholly "mutant" phenotype. A given gene is not irreversibly altered by the change in position, for on returning the gene to its original place the position effect disappears. However if a gene is kept permanently in the "new" position, then an effect very like mutation is produced, and some workers have even suggested that all mutation may be of this type.

A second type of position effect is found when the effect of two closely linked genes is compared side by side on the same chromosome with the effect of the same two genes on opposite, homologous, chromosomes. Before considering this it is necessary to introduce the concept of *pseudoalleles.*

Studies of chromosome maps show that genes are not ordered in the chromosomes in any way obviously connected with phenotypic effect. A given segment of a chromosome may contain genes affecting the most varied characters. However, when a segment is studied in minute detail, clusters of tightly linked genes are often found having similar or even identical phenotypic eifects. For example, in 1953, working with the mould *Aspergillus nidulans,* G. Pontecorvo and J. A. Roper produced a number of biochemical mutants (see Heredity *of Biochemical* Characters below) and made a series of crosses between pairs of apparently identical mutants. Thus a series of adenine-requiring mutants may be taken and crossed in pairs. It is then found that recombinant strains of the fungus. able to grow without added adenine, are formed at very low frequencies, ranging from 1/1,000 to 1/1,000,000. These results are interpreted to mean that mutation at any one of a number of closely adjacent sites on the chromosomes can produce a similar phenotypic effect, but that if sufficiently large numbers are taken. crossing over between pseudoallelic genes at these sites can be demonstrated.

Returning now to the second type of position effect, the "lozenge" locus in Drosophila may be taken as an example. Here it is found that two pseudoalleles when arranged on different chromosomes produce a characteristic roughening effect on the eye. but when combined in the same chromosome they produce the wild type.

These facts render the concept of allelism and of the gene itself less clear than when these terms were first defined. Indeed, some geneticists, such as R. Goldschmidt, have proposed that the notion of discrete genes arranged along the chromosomes like strings of beads must be abandoned altogether, and that the chromosome should be considered as a continuum, containing vaguely defined regions concerned with various synthetic processes. Most geneticists do not take this extreme view and continue to believe in the existence of discrete, separable chromosomal factors. The functioning of adjacent members of a cluster of genes cannot be considered in isolation, however.

HEREDITY OF BIOCHEMICAL CHARACTERS

A great deal of research has been done on problems concerned with the biochemical processes which are initiated by the genes and which finally result in the formation of some product by which the phenotype is recognized. Attention was first directed to such problems by A. E. Garrod (1857–1936), who in 1902 described the rare and harmless human condition alkaptonuria as "an inborn error of metabolism." Alkaptonuric persons excrete homogentisic acid into the urine, which consequently stains black on exposure to the air. The essential peculiarity of the persons concerned is their inability to break down in metabolism the benzene rings of the aromatic amino acids. Studies of pedigrees show that alkaptonuria is usually due to an autosomal recessive gene. Hence it may be inferred that normal persons contain a wild-type gene specifically concerned with some step in the metabolism of these aromatic amino acids.

Many examples of similar phenomena are known. and in some the consequences may be serious or fatal. In galactosuria (also probably due to a recessive gene), persons are unable to metabolize galactose. If milk is given in the diet to affected children, they excrete galactose in the urine and become very ill. They may die if the milk is not replaced by a synthetic mixture containing some sugar other than galactose. In other inherited abnormalities there may be a large excretion in the urine of some metabolite, not because of a block in intermediary metabolism, but because of some specific peculiarity of kidney function. For example. in renal glycosuria (a harmless condition caused by an autosomal dominant gene) the renal tubules have an impairment in capacity to absorb glucose from the glomerular filtrate. Utilization of glucose by the tissues is, however, normal. In cystinuria (probably caused by one or more recessive genes) there is an impairment of renal absorption of the amino acids cystine, lysine and arginine. which consequently appear in the urine and may cause stone formation in the renal pelvis.

A number of inherited disorders of the red blood cells of man are known One of the most important is sickle-cell anaemia, which is nidespread among Negroes in Africa and the United States. It is controlled by a gene which in the homozygous condition produces a severe haemolytic anaemia. Heterozygous persons appear to be perfectly healthy, but if their blood is examined the red cells are seen to exhibit the sickling trait. L. Pauling and others discovered that the red cells of patients suffering from sickle-cell anaemia contain a haemoglobin having a different isoelectric point from the haemoglobin in normal persons. No chemical differences between the two kinds of haemoglobin could be identified, though it is known that the difference resides in the

globin fraction. It is concluded that the wild-type allele controls some step in the synthesis of normal haemoglobin, and the sickle-cell gene is unable to control this step in the same way. A further point is that persons whose blood contains the sickle cells have a diminished susceptibility to malaria. In areas where malaria is common, heterozygotes for sickle-cell anaemia are therefore at an advantage over the normal, and this doubtless explains why so harmful a gene persists at a high frequency in malarial regions.

In micro-organisms, many studies have been made on inherited biochemical variations. following a principle established in 1941 by G. W. Beadle and E. L. Tatum working with the mould *Neurospora crassa.* This fungus will grow on a minimal medium consisting of water. inorganic salts including sulphate and nitrate. glucose and a trace of biotin. Growth is somewhat better on a complete medium containing, in addition to the minimal medium: yeast extract, malt extract and vitamins. A large number of mutants will grow on the complete medium but not on the minimal medium, since they are unable to synthesize substances present in the former but absent in the latter. By adding to the minimal medium a series of substances it is often possible to discover what synthetic process the mutant is unable to carry out.

For example, mutants may require various amino acids. vitamins or nucleic acid constituents (purines and pyrimidines) to be added to the medium, or they may require reduced sulphur or nitrogen.

Differentorganisms may produce different arrays of auxotrophic (as they are called) mutants; *e.g.,* inositol-requiring mutants are common in some fungi, but have not been found in *Neurospora.* But many organisms produce similar auxotrophic mutants; *e.g.,* arginine-requiring mutants occur in the fungi *Neurospora, Penicillium, Aspergillus* and also in the bacterium *Escherichia coli.*

Examination of a large number of independently arisen auxotrophic mutants in a given organism permits inferences to be drawn regarding certain biochemical steps in intermediary metabolism. For example. in *Neurospora* there are three kinds of mutant which are unable to grow unless the amino acid arginine is added to the medium. In class 1 are mutants which can utilize only arginine; in class 2 are mutants which can utilize not only arginine but also, as an alternative, citrulline; in class 3 are mutants which will grow when any one of the three substances arginine, citrulline or ornithine is added to the medium. It may thus be assumed that the synthetic sequence in the wild-type fungus is ornithine → citrulline → arginine. Mutants of class 1 are unable to achieve the step citrulline → arginine; those of class 2 are unable to achieve the step ornithine → citrulline; and class 3 mutants cannot form ornithine from some precursor.

Such conclusions are open to various objections, however. Blocks in metabolism are often partial, so that growth is not completely stopped but merely slowed down; and it is to be expected that organisms have a number of alternative pathways by which a given end-product may be synthesized.

Another approach to the biochemistry of gene action was made by B. Ephrussi and G. W. Beadle in their eye transplantation experiments with *Drosophila melanogaster.* Two eye-colour mutants, vermilion and cinnabar, differ from the wild type in hating brighter red eyes as a result of the absence of a brown pigment which is present in mild-type eyes. If eyes from a cinnabar or vermilion fly are implanted into the body cavity of a wild-type fly, the eyes containing these mutant genes develop the normal deep red colour of the wild type (with the brown pigment present), because substances synthesized by the wild-type flies diffuse into the mutant eyes. Eyes containing the gene vermilion. when implanted into cinnabar flies. also develop the wild-type pigment; but eyes containing the gene cinnabar, when implanted into vermilion flies, fail to form the wild-type pigment. and develop the cinnabar colour. Biochemical studies have shown that the following synthetic sequence is involved: tryptophan → kynurenine → hydroxykynurenine → brown pigment (with some steps omitted). Vermilion flies are unable to carry out the transformation from tryptophan to kynurenine, while cinnabar flies are unable to carry out the transformation from kynurenine to hydroxykynurenine.

It should be added that *Drosophila* is not able to synthesize tryptophan, which must be added to the food, or no brown pigment will be formed.

Hereditary flower-colour variations were investigated biochemically by M. W. Onslow, R. Scott-Moncrieff and others. For example, in the sweet pea, purple flowers contain an anthocyanin pigment based on delphinidin, red flowers contain an anthocyanin based on cyanidin, and salmon flowers contain pelargonidin. Red sweet peas differ from purples genetically by a single recessive gene, and chemically by having pigments with one fewer hydroxyl group; salmon flowers differ further from reds by another recessive gene and by another hydroxyl group. Similar rules are found to be followed in many other plants. Flower colour variation can be brought about, however. by a number of other biochemical mechanisms. such as variations in copigments, *p*H and so on.

To sum up, genes may act, in biochemical terms. in the following ways: (1) by enabling the organism to carry out a particular synthetic step or a step in the breaking down of a compound derived from the food; (2) by altering the ability of some or all cells to absorb particular substances from the surrounding medium; and (3) by diverting synthesis from one path to another. All these effects may be considered to be brought about through the mediation of enzymes (*q.v.*) formed by the genes. Many of the effects of genes are known to be carried out by enzymes, and sometimes the absence of a particular enzyme in a mutant can be demonstrated. The specificities of enzymes and other macromolecules are thought to be determined by direct gene action in which the genes participate by serving as moulds or templates. Though plausible, however, such a view is not supported by any direct evidence.

HEREDITY AND VARIATION OF INDIVIDUAL CELLS

In higher animals and plants a single individual contains a great variety of cells. It is assumed that the same sets of genes are present in all, and that cellular differentiation is due to variation in some other component, most likely in the cytoplasm. In unicellular organisms also, cells may change their character to a marked degree, and there it can be proved that genic changes need not always be responsible; *e.g.,* in the antigen sysiem of the ciliate protozoon *Paramecium aurelia.* The surface antigens *(see* BACTERIOLOGY) of *Paramecium* vary in different strains and under different conditions. Such antigenic variation is subjected to a dual control of genic and cytoplasmic factors. Thus in every *Paramecium* there are several genes (at different loci) which govern antigenic specificity, but normally only genes at a single locus are able to exert their effect on the phenotype at a given moment

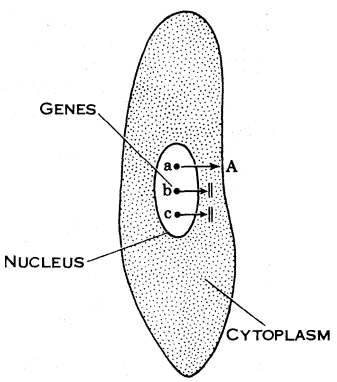


FIG 6 — DIAGRAM OF A PARAMECIUM SHOWING THREE GENES AND THEIR INTERACTION WITH THE CYTOPLASM A IS AN ANTIGEN PRODUCED FROM GENE a

Which gene is thus expressed and which genes are inhibited depend upon the cytoplasm. since the latter can switch from one state to another (and back again), under the influence of various environmental factors such as temperature, salinity of the water and so on. The system is represented diagrammatically in fig. 6. Thus a group of cells, all containing the same array of genes. may nevertheless vary and this *Paramecium* system throws some light on the difficult problem of cellular differentiation in multicellular organisms. The nature of the cytoplasmic components involved is however, unknown.

Another kind of cellular variation is that concerned with adaptation to drugs which has become an important medical problem since the discovery and widespread use of the sulfonamide drugs and antibiotics such as penicillin. It is sometimes found that after an initial period of success in the treatment of a particular bac-

terial infection with a given drug, there may be a relapse, resulting from the development of drug-resistant forms of bacteria. *Gonococci* which are resistant to sulfonamide, *Staphylococci* which are resistant to penicillin and tubercle bacilli which are resistant to streptomycin are particularly common, especially in the vicinity of hospital wards. Drug-resistant strains of bacteria may arise in two ways: (1) by the chance occurrence of a tiny minority of spontaneous mutants, which are selected out in the presence of the drug; and (2) by direct adaptation to the drug, by some process not involving gene mutation. There is controversy as to which mechanism is the more important. It is known. however, that the "mutation and selection" mechanism operates to produce strains of E. *coli* and of *Salmonella typhimurium* resistant to streptomycin and of *Pneumococci* resistant to penicillin. Most commonly, a high degree of drug resistance is reached only after a series of mutations (*e.g.*, with resistance to penicillin), though occasionally full resistance is gained in a single step, as with streptomycin resistance in E. *coli*.

Direct adaptation has been demonstrated in cultures of *Bacillus cereus* initially sensitive to penicillin. If treated with minute amounts of the drug for a short period, such cultures will subsequently produce cells containing the enzyme penicillinase which inactivates penicillin. Growth is then possible in the presence of penicillin. In general, induced adaptations are found in those situations where the cells possess the necessary genes to synthesize certain enzymes. but do not in fact form the enzymes unless stimulated to do so by specific inducing substances in the medium. Such enzyme adaptation or induced enzyme synthesis is commonly met with in bacteria and yeasts, especially in connection with the fermentation of various sugars.

These phenomena illustrate a fundamental property oi cells, namely that of being able to exist in a number of alternative forms, with different enzymatic, antigenic or drug-resistant properties. Since the varied forms may contain identical sets of genes, there is no need to abandon the basic genetic principle of the stability of the genotype under varying environments. When a direct effect of the environment is iound, it may be assumed to operate on some comparatively unstable component of the cytoplasm and not on the genes.

CYTOPLASMIC HEREDITY

Mendel found that hybrids, and their progeny in later generations, did not vary according to which of the original strains of peas had been used as female and which as male parent. Reciprocal crosses yielded essentially the same results, and this has been iound to be so generally, except for sex-linked characters. It is therefore concluded that there is usually no appreciable transmission of hereditary determinants through the cytoplasm, since female gametes contain a large amount of cytoplasm and male gamates very little. Moreover, in species such as *Drosophila melanogaster, Zea mais* and *Neurospora crassa,* where extensive chromosome mapping has been done, the great majority of hereditary characters have been shown to be under the control of genes situated in particular linkage groups.

Nevertheless, the literature contains a considerable number of references to traits which do not coniorm with the above rule. Reciprocal crosses yield divergent progeny when certain species or wild races oi various plants (*e.g., Epilobium*) are crossed. Commonly the viability of the pollen is affected differentially. By the method oi repeated backcrossing it is possible to obtain a plant containing eubstantially all its genes from one race and cytoplasm irom another. Such plants may differ from the original paternal parent and give evidence that some.cytoplasmic factors have been autonomously reproduced in the cytoplasm for generation after generation. In animals behaviour of this kind is rarer, but in the mosquito *Culex pipiens* H. Laven found that the eggs of some geographical races, when fertilized by sperm of certain other races, produced inviable offspring, though the reciprocal matings were quite successful. Even after *14* generations of backcrossing the cytoplasm of the race used as female parent retained its characteristic properties. The precise nature of the cytoplasmic iactors concerned in the above-described examples is obscure.

Characters connected with the green chloroplasts in plants may or may not be determined by hereditary factors in the plastids or in the cytoplasm. In maize and other plants many mutations result in a failure to synthesize chlorophyll, but in most of these mutants the deficient plastids are under strict genic control. In *Mirabilis jalapa,* the seed borne by white parts of variegated plants gives rise to nothing but white-leaveti (and therefore inviable) seedlings, no matter what plant supplies the pollen. In other variegated plants, such as *Pelargonium* and *Oenothera,* a few deficient plastids may be transmitted through the pollen, but not so many as through the embryo sac. Hence there may be some autonomous determinants within the plastids.

Hereditary conditions controlled by cytoplasmic factors are also known in yeasts, *Neurospora, Chlamydomonas* and other organisms. *Paramecium,* because of its possession of the process of conjugation, by which there is a mutual exchange of nuclei between two individuals, usually without any passage of cytoplasm, is especially suitable for the study of the role of the cytoplasm in heredity. In 1938 T. M. Sonneborn discovered the "killer" races of *Paramecium,* which excrete into the water a toxic substance lethal to other races: The "killers" are distinguished from the normal by their content of several hundreds of *kappa* particles in the cytoplasm. The kappa particles are about the size of a small bacterium (1.5–2.5μ in length), contain DNA and vary in a number of ways. Factors external to the kappa particles, such as the conditions in the external medium, or certain genes in the nuclei of the *Paramecia,* may determine whether kappa particles can be maintained in the *Paramecia* and the number of particles which can be maintained; but the hereditary qualities of the kappa particles are due to iactors within the particles themselves. Moreover, kappa particles are produced in a *Paramecium* only if at least one particle is already present or is introduced from outside by cytoplasmic transfer or iniection via the medium. When they were first described, it was thought that the kappa particles were to be considered as cytoplasmically located hereditary determinants, or *plasmagenes;* but later results made it seem more reasonable to consider the kappa particles as separate organisms (though of unknown affinities) living parasitically in the cytoplasm of *Paramecium*.

A rather similar condition is known in *Drosophila nzelanogaster,* certain strains of which are sensitive to killing by carbon dioxide, and contain a cytoplasmic factor called *sigma*.

The two factors—kappa in *Paramecium* and sigma in *Drosophila*—may be considered as borderline units, resembling both hereditary determinants or genes on the one hand and parasitic or symbiotic organisms on the other.

HEREDITY IN BACTERIA AND VIRUSES

Bacteria were at one time considered to be simple types of cells not exhibiting any forms of sexual phenomena and even lacking nuclei. More recent grnetic work has shown without doubt that some at least of these organisms possess a complex hereditary apparatus, consisting of at least one group of linked genes, and that recombination of genes irom different strains and species may be achieved by a number of remarkable processes, some of which resemble the sexual iusions of gametes in higher organisms, while others involve a transfer of genelike material irom cell to cell via the exterior: a process which has not yet been successiully accomplished in any higher organism.

In 1946 J. Lederberg and E. L. Tatum demonstrated a recombination of hereditary factors in *Escherichin coli,* utilizing a number oi biochemical mutants. If very large numbers of bacteria of two different kinds, the one unable to grow in the absence of one substance, the second unable to grow in the absence of a different substance, are mixed together in a liquid medium, and the mixture plated out on agar containing only the minimal medium, a very small proportion of recombinant types of cell is iormed. These are "prototrophs" (*i.e.,* able to grow on the minimal medium) and are selected out. since neither of the parental types could grow there. Further work established the existence of many genes in *E. coli* concerned with various biochemical, antigenic and morphological characters, arranged linearly in a single linkage group. Recombination involves some process analogous to crossing over, but the details are not understood. Nor have cytological studies revealed the chromosome in microscopic preparations. The nature of the sexual process in E. *coli* is not clear, but there is some evidence of a one-way transfer of genetic material, and actual contact of donor and recipient cells of the required type is necessary.

Transfer of genetic material from cell to cell via the exterior has been accomplished by two methods. In the first, nonliving extracts of *Pneumococci* are prepared, and may be purified till they consist almost entirely of DNA. These extracts (containing the so-called transforming principles) are then applied, under certain special conditions, to a different strain of *Pneumococcus*. If a selective technique is available whereby all non-recombinant bacteria are eliminated, and recombinants grow, a small proportion of bacteria can be obtained having certain characters from both strains oi *Pneumococcus* used. Many different hereditary traits can be transferred in this way; *e.g.,* antigenic characters, resistance to drugs and ability to synthesize particular enzymes. Usually only a single factor is transierred at a time, but double characters (*e.g.,* capacity to ferment the sugar mannitol and resistance to streptomycin), due to pairs of closely linked genes, can occasionally be transferred simultaneously. Transformations oi this kind have been demonstrated in bacteria other than *Pneumococcus;* for example, in *Hemophilus influenzae* and *Meningococcus*.

The second method is known as *transduction* and was first used by N. D. Zinder and J. Lederberg. It is similar to that used in the *Pneumococcus* transformations described above, except that in place of the chemical extract a phage lysate is used (*see* below). The method has been demonstrated with *Salmonella typhimurium, E. coli* and *Shigella dysenteriae*. It is believed that when lysis of a bacterium occurs as a result of phage activity, small fragments of the bacterial chromosomes may he incorporated in the phage particles, and when the latter infect a new bacterium the fragments become incorporated in the chromosomes of the newly infected bacterium. If the latter is not lysed, it may develop characters derived from the donor bacterium, though

many details are obscure. As with "transformations" of the *Pneumococcus* type, phage-induced transduction involves single bacterial genes, but occasionally pairs of linked genes are simultaneously transduced.

Exchange of genetic material has been demonstrated even in viruses. Most of this work has been done with the T series of bacteriophages, which are intracellular parasites of the bacterium *Escherichia coli*. When outside the bacteria, phage consists of minute particles containing a core of D A and a coat of protein. Under appropriate conditions the DNA part enters a bacterium leaving the protein outside, and after a short period the bacterium bursts, liberating possibly several hundred phage particles. If two types of phage (*e.g.*, differing in host range and in size of plaques formed by lysis of bacteria on solid media) enter a single bacterium, the resulting lysate may contain not only the two parental types of phage but also the two recombinant types. It is even possible to infect a bacterium with three different phages and to obtain phage particles with characters derived from all three, apparently as the result of two successive matings inside the bacterium. Linkage has been demonstrated in phage genetics, but the exact mechanism by which recombination occurs is unknown. Similar recombination studies have been made with other viruses, including those causing influenza. Hybridization of viruses may be extremely important in giving rise to virulent strains, such as that causing the pandemic of 1918.

Some viruses do not normally destroy their host bacteria but establish a stable symbiotic relationship with them. These viruses are called "temperate" as opposed to "lytic." When a temperate phage enters a bacterium it may give rise to a particle called by A. Lwoff "prophage," which is situated at a particular locus on the bacterial chromosome and is regularly duplicated in the same manner as the bacterial genes. The system may be disturbed by ultra-violet irradiation or other stimulus, active phage is produced, and lysis then occurs. In this system the phage appears to be behaving at one stage as a distinct infectious organism, at another as a bacterial gene. On the other hand, the DNA of phage is chemically distinct from that of bacteria or any other organism, in certain respects.

HETEROCARYOSIS AND SOMATIC CROSSING OVER IN FUNGI

In earlier sections, the various mechanisms concerned with recombination of genetic factors have been described. In higher organisms, the recombination of genes located on different chromosomes takes place as a consequence of the independent assortment of the paternal and maternal homologous chromosomes at meiosis, while recombination of genes in the same linkage group is a consequence of crossing over. In bacteria, recombination may sometimes take place in other ways, such as by transduction. In asexual iungi, still other mechanisms for bringing about recombination are known.

In many iungi the hyphae may contain two or more different kinds of nuclei, and such cultures are known as *heterocaryons*. They arise from fusions of hyphae from different strains, not followed by fusions of nuclei. Just as in diploid organisms heterozygotes are often more vigorous than homozygotes, so in fungi heterocaryons may be more vigorous than the hoinocaryons from which the two kinds of nuclei are derived. For example, one mutant strain of *Neurospora* may be unable to grow on a medium lacking adenine, another may be unable to grow on a medium lacking tryptophan. But a heterocaryon derived from the two strains can grow on a medium lacking both substances. Heterocaryons can give rise to homocaryons by spore formation, since some spores contain only a single nucleus. Thus a kind of rough segregation may occur, but this is a segregation of whole genotypes and not of individual genes. Heterocaryons are very common in nature.

G. Pontecorvo and colleagues produced from heterocaryons diploid strains of some sexual species of fungi (normally only haploid), and with the aid of certain selective techniques were able to show in these diploid strains a low rate of genic recombination due to crossing over in the somatic cells. In sexually reproducing fungi, such as *Aspergillus nidulans,* linkage maps constructed with the aid of somatic crossing over showed the same order of genes as maps made in the usual way, though the numerical values varied.

Somatic crossing over is a valuable technique for obtaining gene recombination—and hence for breeding improved strains—in organisms which cannot be mated in the usual way; *e.g.,* in a number of fungi used in industry, such as *Penicillium chrysogenum*.

SOVIET GENETICS

The theory of heredity as set out in this article is not accepted by T. D. Lysenko and his school. In the years 1935–48 there was a violent controversy in the Soviet Union between adherents of western genetics (called by the Soviet scientists "Mendelism-Weismannism-Morganism") and the Lysenko group, who based their conception of heredity on the writings of the Russian horticulturalist I. V Michurin (1855–1935). This controversy culminated in complete victory for Lysenko in 1948, when he was able to announce that his views had been approved by the Soviet government and the Communist party.

The basis of the antagonism between Soviet and western geneticists mas partly theoretical, partly practical. (The political aspect will be ignored here.) The theoretical objections were concerned with the concept of the gene as an autonomous unit governing the hereditary characters but not modified specifically by the environment. This was considered to be inconsistent with Communist materialist philosophy, which required that every material must be formed in response to the conditions in the surrounding medium. The gene was an "idealist," "metaphysical" concept, according to Lysenko. In place of the gene, Lysenko supposed that heredity is somehow diffused throughout the entire organism and is susceptible to every kind of environmental influence. The Soviet objections on practical grounds were concerned with the fact that western geneticists are unable to change, deliberately, the heredity of an organism in a desired direction, hut must make use of such mutations as may occur by chance. Practical application of Mendelism to breeding is therefore slow, while Lysenko himself claimed the ability to change heredity predictably.

The methods used by the Soviet, or "Michurinist," workers for changing heredity were three: (1) by the effect of the environment; (2) by grafting, or vegetative hybridization; and (3) by sexual hybridization, especially of remotely related forms. By sexual hybridization, however, is here understood something more than a union of two gamete nuclei, for the Soviet workers believe that beneficial results accrue from the fertilization of an egg by not one but a large assortment of spermatozoa; and again, that the heredity of the embryo is controlled not only by the uniting gametes but also by the surrounding maternal tissues.

In 1952 Lysenko proposed a new theory of evolution, based on sudden changes from one species to another due to the action of certain environmental conditions unfavourable to the first species. Thus it was claimed that wheat suddenly produced grains of rye. But this conception, and the evidence on which it was based, was attacked even in the Soviet Union itself.

None of the Lysenkoist views is taken seriously by western geneticists. A few attempts at repeating some of the Soviet experiments were made in western countries (*e.g.,* on the alleged hereditary changes following grafting of plants), but only negative results were obtained.

After 1952 the influence of Lysenko began to wane, and in 1956 it was announced that he had been dismissed from his principal position. This did not, however, at once lead to a revival of Mendelian genetics in the U.S.S.R.

HUMAN HEREDITY

Man is an exceptionally variable species. His hereditary variations may he arbitrarily classified in the following manner: (1) the blood groups; (2) sharply distinct but rare defects showing Mendelian heredity; (3) quantitative variations in stature, degree of pigmentation, etc.; (4) hereditary resistance to disease; and (5) mental and emotional characters. Because of the impossibility of conducting deliberate breeding experiments, resort must be had to the examination of pedigrees, and special mathematical methods have to be adopted. The value of twins in evaluating the relative importance of heredity and environment in human traits may be noted. Identical (or monozygous) twins have identical genotypes, and hence any differences which may exist between pairs must be due to the environment, either postnatally or *in utero*. Pairs of fraternal (or dizygous) twins, on the other hand, differ genetically but in some respects are subjected to an unusually uniform environment, and may therefore show the existence of environmental effects not otherwise noticeable. Proof that a given pair of twins is monozygous or dizygous is most certain if the blood groups are determined.

The blood group antigens are controlled in a very straightforward manner by certain genes, and blood group variations occur in practically all human populations. These traits make it possible to settle most cases of disputed parentage, and they can also be of the greatest value in other fields, such as anthropology and medicine. There are at least 12 different blood group systems in man, of which three only—the ABO, MN and Rh systems—will be considered here.

In the ABO system, which is very important in blood transfusion, there are four classes of individual, O, A, B and AB, the grouping being based on certain agglutination reactions (*see* BACTERIOLOGY; BLOOD TRANSFUSION). The genetic basis consists of a series of three allelic genes—I^O, I^A and I^B—as shown in Table III.

TABLE 111.—Heredity of ABO System of Blood Groups

Blood group	Genotype	Blood group	Genotype
O	I^OI^O	B	I^BI^O or I^BI^B
A	I^AI^O or I^AI^A	AB	I^AI^B

In England, the proportions of the four groups in the population are as follows: O 47%, A 43%, B 7% and AB 3%; and the proportions of the three alleles are estimated as I^O 68%, I^A 26% and I^B 6%. Moving from west to east Europe and into Asia, the frequency of the allele I^B gradually rises. Most human populations contain an assortment of all three alleles, though in characteristic proportions. American Indians have a very high content of the gene I^O.

In the MN system, individuals are distinguished according to the reaction of their red blood cells to certain antisera obtained by injecting human blood into rabbits. The population is classified into three groups, M, MN and N, according to the reaction of the blood to two kinds of antibody, anti-M and anti-N. Individuals of types M and N differ in respect of a single pair of alleles, MN being the

heterozygote. Work in the 1950s indicated the existence of other antigens (called S and s) associated with this locus.

In the Rh system, which is important in connection with haemolytic disease of the newborn, individuals are classified as Rh+ and Rh—. In Great Britain and in the white population of the United States about 85% of the people are Rh+ and 15% Rh—. Rh— persons contain a recessive gene and may be denoted *dd*, while Rh+ persons are DD or *Dd*. Haemolytic disease may arise when an Rh— mother bears an Rh+ child, as a result of formation of anti-D antibodies in the mother's serum, and their action on the child's blood. Hence the condition is likely to arise, though it does not inevitably do so, following a mating between an Rh+ man and an Rh— woman. Fortunately, it is usually only during later pregnancies that a mother develops enough antibody to cause trouble to the child, and the frequency of infant deaths irom haemolytic disease is therefore lower than would be expected on a basis of random combination of Rh+ and Rh— persons.

The genetic situation is complicated by the existence of a number of other genes, which are considered by some workers to form a single series of multiple *(Rh)* alleles and by others as clusters of tightly linked genes (denoted *CDE*). Some of these alleles are rare, and in any case the pair referred to above as *Dd* is the most important from the clinical point of view.

A number of examples of rare human defects controlled by specific genes were mentioned above in the section *Heredity of Biochenzical Characters.* Many other such defects are known. Here may be added a note about the concept of *penetrance.* Study of human pedigrees shows that traits inherited as if due to dominant genes may occasionally fail to appear in a person who, judged by his offspring, is carrying such a gene. An example is polydactyly. It is assumed that the variable penetrance of genes of this type is due to environmental and genetic modifying factors which may vary from individual to individual. Again, it may happen that a hereditary .defect may not make its appearance until comparatively late in life, as is the case for example with Huntington's chorea, caused by a dominant autosomal gene, or with some forms of diabetes. Persons bearing genes for these conditions may have children and die before reaching an age at which the diseases would appear. These facts sometimes confuse the interpretation of pedigrees.

Turning now to human characters showing continuous variation, it may be recalled that stature was one of the first traits to be studied statistically in man, notably by F. Galton and K. Pearson. The range oi variation is readily explained as being due to the cumulative action of a number of genes, together with some effect of the environment. Pearson and A. Lee in 1903 collected data on the heights of 1,078 fathers and their sons, and found a correlation coefficient of 0.51, indicating a high degree of heritability. Moreover, studies of twins reared apart show that the correlation is not significantly different from that of twins kept together. But it must not be forgotten that the environment may be similar for relatives because of cultural and economic reasons, and thus be responsible for some of the correlation found. The degree of pigmentation is also controlled by several genes, acting cumulatively. Studies by C. B. Davenport on Negro-white crosses in the West Indies showed that in the F_1's the pigmentation was intermediate between that of the two parents, and in the F_2 families a more or less continuous range of gradations between Negro and white was found. (Albinism, however, is a totally different phenomenon, controlled by a single autosomal recessive gene.) The inheritance of pigmentation in the eye is not fully understood, though there is some evidence for a dominant gene in brown-eyed and a recessive allele in blue-eyed persons in western Europe; but other genes are also concerned.

Twinning itself has a hereditary basis, as is evident from the fact that twin births are clustered in certain families, but it is not due to a single gene. Moreover, environment plays an important part in the determination of twinning, since the frequency of identical twins increases steadily with maternal age, and for young mothers of a given age, often increases with birth order. Twins have been used to show the existence of a hereditary factor in disease resistance. It is found, for example, that identical twins are more frequently alike in their susceptibility to various diseases than are fraternal twins. This applies to the common infectious diseases of childhood and also to poliomyelitis, leprosy and tuberculosis. A hereditary factor concerning a tendency to develop particular forms of cancer is also evident from studies of twins, as well as from studies on close relatives of patients suffering from cancer. It should be stressed however that there is rarely a direct hereditary determination of any of these diseases, but merely a slight alteration in susceptibility to them.

Finally, regarding the ill-defined quality of intelligence, twin studies show the great importance of the environment. H. H. Newman and colleagues did intelligence tests on pairs of identical twins, some of which had been reared apart and others together. They found pronounced differences; *e.g.,* for identical twins reared apart the correlation coefficient was 0.67, for those reared together it was 0.88. Nevertheless, there is undoubtedly a genetic component as well; *e.g.,* the above-mentioned workers found that none of the identical twins differed by more than 24 points as measured by the tests, whereas 17% of siblings differ by this amount. *(See* also EUGENICS.)

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HEREFORD, a city, municipal borough and county town in the Hereford parliamentary division of Herefordshire. Eng., on the Wye, 28 mi. N.W. of Gloucester by road. Pop. (1951) 32,501. Area 7.9 sq.mi. Hereford was founded, after the crossing of the Severn by the West Saxons early in the 7th century, as a settlement near the Welsh march. Probably founded by Earl Harold, afterward Harold II, the castle was taken by Stephen and was the prison of Prince Edward during the Barons' Wars. The pacification of Wales deprived Hereford of military significance until the Civil War, when it changed hands several times between the parliamentarians and the king and the Scots. In 1086 the town included fees of the bishop, the dean and chapter and the Knights Hospitallers, but was otherwise royal demesne. Incorporation dates from 1189, when Richard I sold the town to the citizens at a fee farm rent. The charter was confirmed several times. Hereford, the site of a provincial mint in 1086, later had a grant of an exclusive merchant guilt in 1215–16. The wool trade was important in 1202, but declined in the 16th century.

The Cathedral. — The Cathedral Church of the Blessed Virgin Mary and St. Ethelbert exemplifies all styles from Norman to Perpendicular. The see was detached from Lichfield in 676, Putta being its first bishop. The removal of murdered Aethelbert's body from Marden to Hereford led to the foundation of a superior church, reconstructed by Bishop Athelstane between 1012 and 1052 and burned by the Welsh in 1053. Begun again in 1079 by Bishop Robert de Losinga, it was carried on by Bishop Reynelm (or Reinhelm) and completed in 1148 by Bishop R. de Betun. In 1786 the western tower fell and carried with it the west front and the first bay of the nave. The west front of modern times was completed in 1904–08. The total length of the cathedral outside is 342 ft. and inside 327 ft. 3 in. The principal features are the central tower (165 ft.), of Decorated work, and the north porch, rich Perpendicular with parvis. The Bishop's cloister: of which only two walks remain, is Perpendicular, of curious design, with heavy tracery

in the bays. Within, the nave has Norman arcades, and there is a Late Norman font. The south transept is Norman and Perpendicular; the north transept was rebuilt about 1260 and contains the beautiful Early English shrine of Bishop St. Thomas de Cantilupe where many miracles were reported. The dark choir is Norman in the arcades and the stage above, with Early English clerestory and vaulting. At the east end is a Norman arch. blocked until 1841 by a Grecian screen erected in 1717. The choir stalls are largely Decorated. The organ contains original work by Renatus Harris and was presented by Charles II. The Lady or "Ladye" chapel, dated about 1220, shows elaborate Early English work, and on its south side opens the little Perpendicular chantry of Bishop Audley (1492–1502). In the north choir aisle is the fan-vaulted chantry of Bishop Stanbury (*c.* 1470), and on the wall is the 13th-century *Mappa Mundi,* a vellum world map by a Lincolnshire monk, Richard of Haldingham. The crypt is Early English. There is a large "chained library" and the cathedral has a collection of rare manuscripts, early printed books and relics.

Other Buildings. — From the southeast transept of the cathedral a cloister leads to the quadrangular college of the Vicars Choral, a Perpendicular building. On this side of the cathedral, too, the bishop's palace, originally a Norman hall, lies near the Castle green, the site of the historic castle, now utterly effaced. The church of All Saints with its tall twisted spire is Early English and Decorated and has a chained library. One only of the six gates and a few fragments of the old walls survived in modem times. On the Brecon road, the White cross. erected in 1347, commemorates the departure of the Black Death. The "Old Guild house," a half-timbered building in the wide commercial street called High Town, dates from 1621 and was made a Jacobean museum. In Widemarsh is the Coningsby hospital (almshouses), built in 1614. whose gardens are the 12th-century chapel of the Knights Hospitallers and the ruins of the 14th-century Blackfriars monastery. Old-established schools are the Cathedral school (1384) and the Blue Coat school (1710). Hereford has an art gallery and a museum and was the birthplace of David Garrick and the home of the Kembles.

The Three Choirs festival of Hereford, Gloucester and Worcester is held annually in rotation at these cities. Trade is chiefly agricultural, with sales of Hereford cattle and the making of cider and jam, fruit canning and brewing. There are industries making furniture, glass, leather, nickel alloys, bricks, etc.

HEREFORDSHIRE, an inland county of England on the south Welsh border, bounded north by Shropshire. east by Worcestershire, south by Monmouthshire and Gloucestershire, west by Radnorshire and Breconshire. Pop. (1951) 127,159. The area is 842.1 sq.mi.

Physical Features and Geology. — The surface rocks of the greater part of the county are Old Red Sandstone, the more resistant series of which form high ground (from 500 to 800 ft.) between the various valleys and the Black mountains in the southwest, while on the eastern boundary rise the Malvern hills, with Worcestershire beacon (1,395 ft.) and Herefordshire beacon (1,114 ft.). The Malvern hills form an inlier of Pre-Cambrian gneisses and volcanic rocks along the western edge of which occur Cambrian and Silurian rocks, the limestone bands of the latter forming wooded scarp faces. There is also a similar topography in the Woolhope region: where there is an oval-shaped inlier of Silurian rocks. Smaller patches crop out at Westhide east of Hereford and May hill, but the most important form the hills between Presteigne and Ludlow in the north of the county. The Breconshire boundary is formed by the Black mountains, which! formed of Old Red Sandstone, exceed 2,000 ft. On its sbutheastern margin the county just reaches the Carboniferous Limestone cliffs of the Wye valley below Ross-on-Wye, the scenery of uhich is famous. Glacial deposits, chiefly sand and gravel, are found in the lower ground along the river courses, while caves in the Carboniferous Limestone have yielded remains of the hyena, cave lion, rhinoceros, mammoth and reindeer.

The county is almost wholly drained by the Wye and its tributaries, but on the north and east includes a small portion of the Severn basin. The Wye enters Herefordshire from Wales at Hay, and with a sinuous and beautiful course crosses the southwestern part of the county, leaving it above the town of Monmouth. Of its tributaries, the Lugg enters near Presteigne and flows east to Leominster. where it turns south, receives the Arrow from the west and joins the Wye 6 mi. below Hereford. the Frome flowing in from the east immediately above the junction. The Monnow, rising in the mountains of Breconshire, forms the boundary between Herefordshire and Monmouthshire over one-half its course (about 20 mi.) and joins the main river at Monmouth. Its principal tributary in Herefordshire is the Dore. The Wye is celebrated for its salmon fishing, which is carefully preserved. while the Lugg, Arrow and Frome abound in trout and grayling, as does the Teme, a tributary of the Severn, which forms parts of the northern and eastern boundary. The Leddon, also flowing to the Severn, rises in the county and leaves it in the southeast, passing the town of Ledbury.

History. — The prehistoric period in Herefordshire does not seem to have been important, and the county was probably then heavily forested. The camp on the Herefordshire beacon (Malvern hills) is a noted earthwork and believed to date from the late La Tene A period. During the 7th century the West Saxons pushed across the Severn and established themselves between Wales and Mercia, with which kingdom they soon became incorporated. The district. now Herefordshire, was occupied by a tribe, the Hecanas, who congregated chiefly about Hereford and in the mining districts round Ross-on-Wye. In the 8th century Offa extended the Mercian frontier to the Wye, securing it by the earthwork known as Offa's dike, portions of which are visible at Moorhampton and near Kington. The district was the scene of constant border warfare with the Welsh under Gruffydd ap Llewelyn. king of Gwynedd, and Harold Godwinson, whose earldom included this county, only restored order in 1063 when he overcame the Welsh, caused them to assassinate Gruffydd and added to the county the country on the Welsh side of the Wye, Stradel and Archenfield.

Richard's castle in the north of the county and Ewyas Harold in the southwest were the first Norman fortresses erected on English soil. and Wigmore, Clifford, Weobley, Hereford and Kilpeck were all sites of Norman strongholds. Hereford and Weobley castles were held against Stephen by Milo, earl of Hereford, but were captured in 1138. Edward, afterward Edward I, was imprisoned in Hereford castle and made his famous escape thence to join the Mortimers in 1265. In 1326 after the deposition of Edward II the parliament assembled at Hereford and proclaimed his son as Edward III. In Herefordshire the influence of John Wycliffe's teaching was widely felt, and at the end of the 14th century and at the beginning of the 15th Lollardry was widespread. During the Wars of the Roses the county supported the Yorkist cause, and Edward, earl of March, afterward Edward IV, raised 23,000 men in the neighbourhood. The battle of Mortimer's Cross was fought in 1461 near Wigmore. During the civil war of the 17th century the county was royalist, and Hereford, the centre of, activity, changed hands several times. Brampton Brian castle, the home of Sir Robert Harley, a noted parliamentarian. was the scene of one of the most famous sieges of the war. Lady Harley, who commanded the castle in the absence of her husband, withstood the siege which lasted from July 23 until Sept. 6, 1643.

The earldom of Hereford was granted by William I to William FitzOsbern about 1067, but the title lapsed until conferred on Henry de Bohun in 1200. It remained in the possession of his family until the death of Humphrey de Bohun in 1373. In 1397 Henry, afterward King Henry IV. who had married Mary de Bohun, was created duke of Hereford. Edward VI created Walter Devereux, a descendant of the De Bohun family, Viscount Hereford in 1550, the title being the premier viscounty of England.

Herefordshire probably originated as a shire in the time of Aethelstan, and is mentioned in the ***Saxon*** *Chronicle* in 1051. *In* the Domesday survey parts of Radnorshire and Gloucestershire are assessed under Herefordshire, and the western and southern borders remained debatable ground until with the incorporation of the Welsh marches in 1535 considerable territory was restored to Herefordshire. At the time of the Domesday survey the divisions of the county were very unsettled. As many as 19 hundreds are

mentioned, but these were of varying extent, some containing only one manor, some from 20 to 30. Of the 12 modern hundreds only Greytree, Radlow, Stretford. Wolphy and Wormelow retain Domesday names. Herefordshire has been included in the diocese of Hereford since its foundation in 676. It was governed by a sheriff as early as the reign of Edward the Confessor. the shire court meeting at Hereford where later the assizes and quarter sessions were also held In 1606 an act was passed declaring Hereford free from the jurisdiction of the council of Wales, but the county was not finally relieved from the interference of the lords marchers until the reign of William and Mary.

Herefordshire has always been a rich agricultural area, manufactures being unimportant, with the sole exception of the woollen and the cloth trade which flourished soon after the Conquest. Iron was norked in Wormelow hundred in Roman times, and the Domesday survey mentions iron workers in Marcle. At the time of Henry VIII the towns had become much impoverished. Hops were grown soon after their introduction into England in 1524. In 1580 and again in 1637 the county was severely visited by the plague, but in the 17th century it had a flourishing timber trade and was noted for its orchards and cider.

Herefordshire was first represented in parliament in 1295, when it returned two members, the boroughs of Ledbury, Hereford, Leominster and Weobley being also represented. Hereford was again represented in 1299, and Bromyard and Ross in 1304, but the boroughs made very irregular returns, and from 1306 until Weobley regained representation in 1627, only Hereford and Leominster were represented. Under the act of 1832 the county returned three members and Weobley was disfranchised The art of 1868 deprived Leominster of one member, and in 1885 that town was disfranchised and Hereford lost one member. By the act of 1918 Hereford ceased to be a parliamentary borough.

Antiquities. — There are remains of several of the strongholds which Herefordshire possessed as a march county, some of which were maintained and enlarged, after the settlement of the border, to serve in later wars. To the south of Ross are those of Wilton and Goodrich, commanding the Wye. Of the several castles in the valleys of the boundary river Monnow and its tributaries, those in this county include Pembridge, Kilpeck and Longtown. In the north the finest example is Wigmore.

In addition to the cathedral of Hereford and the fine churches of Ledbury, Leominster and Ross-on-Wye, described under separate headings, the county contains some churches of almost unique interest. In that of Kilpeck the work of the Herefordshire school of Romanesque sculpture is seen. It consists of nave, choir and chancel divided by ornate arches. the chancel ending in an apse, with a beautiful and elaborate west end and south doorway. A similar plan is seen in Moccas church, above Hereford. The church at Bromyard exhibits Norman details. At Abbey Dore, the Cistercian abbey church, still in use, is a large and beautiful specimen of Early English work. At Madley, south of the Wye, 5 mi. W. of Hereford. is a fine Decorated church (with earlier portions), with the rare feature of a Decorated apsidal chancel over an octagonal crypt. Of the churches in mixed styles, those in the larger towns are the most noteworthy, together with that of Weobley.

The half-timbered style of domestic architecture beautifies many of the towns and villages. Among country houses, that of Treago, 9 mi. W. of Ross, is a remarkable example of a fortified mansion, parts of which may date back to the 13th century; Hellens, at Much Marele j mi. S.W. of Ledbury, is a mediaeval manor dating from 1292. Rudhall, near Ross-on-Wye, is a good specimen of 15th-century work. and portions of Hampton court, 8 mi. N. of Hereford, are of the same period. Holme Lacy, j mi. S.E. of Hereford, was built in the latter part of the 17th century. Downton castle possesses historical interest in having been designed in 1774 in a strange mixture of Gothic and Greek styles by Richard Payne Knight (1750–1824), a scholar and numismatist; while Eaton hall, now a farm, was the seat of the family of the famous geographer Richard Hakluyt.

Agriculture and Industries. — The soil is generally marl and clay, but in various parts contains calcareous earth in mixed proportions. Westward the soil is tenacious and retentive of water; on the east it is a stiff and often reddish clay. In the south is found a light sandy loam. More than four-fifths of the total area of the county is under cultivation, and less than half of this is in permanent pasture. The county is more heavily wooded than most of the other western counties, with about 8% of its total area under woodland. It is famous for its pear and apple orchards, about half of which produce fruit for the cider industry. Cider at one time was the staple beverage, and the trade in cider and perry is still large. Hops are another staple of the county. The hopyards occupy about 5,000 ac , mainly in the east, and their hop production is second only to that of Kent. Herefordshire has also given its name to a world-famous breed of beef cattle. The Hereford is characterized by its rich red body aith white face. crest and underline which gives a striking appearance of uniformity to the breed. These colour markings, being a dominant factor, type-mark the calves, no matter with what breed of cow the Hereford bull is crossed. Natural aptitude to fatten and early maturity are perhaps the predorriinant characteristics of the breed. Herefordshire's small, white-faced, hornless, symmetrical breed of sheep known as the Ryelands, originally from the district around Ross-on-Wye, made the county famous. From its original form the breed has been improved in stamina by crossing with the Leicester. The chief breeds of sheep on Herefordshire farms in the mid-20th century were Kerry, Clun, Ryeland, Shropshire and Radnor.

Manufacturing enterprise is of growing significance. In support of the county's major industry, agriculture, there are factories for agricultural implements, quarrying, fruit canning, jam making and milk processing. The cider industry is also concerned with the extraction of pectin New industries are coming into the county and, centred principally around Hereford itself, offer alternative employment for its growing number of citizens.

Communications. — Hereford is the railway centre of the county. The Worcester and Cardiff line (Western Region), entering on the east, runs to Hereford by Ledbury and then southwestward to south Wales. Another line runs north from Hereford by Leominster, proceeding to Shrewsbury, Crewe and Chester. None of the rivers is commercially navigable.

Population and Administration. — The area of the administrative county is 842.1 sq.mi., with a population (1951) of 127,159. The county contains 12 hundreds. It is divided into two parliamentary divisions, Leominster and Hereford, each returning one member. There are two municipal boroughs, Hereford (pop., 1951, 32,501) and Leominster (6,290). The urban districts are Bromyard, Kington, Ledbury and Ross-on-Wye. There are eight rural districts. The county is in the Oxford circuit and assizes are held at Hereford. It has one court of quarter sessions and is divided into ten petty sessional divisions. The borough of Hereford has a separate commission of the peace and a separate court of quarter sessions. The county is almost entirely in the diocese of Hereford, with small parts in those of Gloucester, Worcester and Llandaff. The National trust owned about 2,400 ac. in the county by the latter 1950s.

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HERERO, a Bantu-speaking people (pop. c. 50,000) inhabiting the central parts of South-West 'Africa and the northwestern districts of the Bechuanaland Protectorate. Predominantly a pastoral people, they live in small household groups scattered about irregularly. They have a double clan system, one set (*oruzo*) with patrilineal descent, the other (eanda) with matrilineal. The former is associated with religious observances, including the cult of the sacred fire, the latter with economic life and inheritance of property. Kinship terms are classificatory, and cross-cousin marriage is preferred. The dominant form of religion is ancestor worship.

See I. Irle, Die Herero (Giitersloh, 1906); H. Vedder, *South* West Africa in Early Times, tr. and ed. by C. G. Hall (London, 1938). (I. S.)

HERESY, in its primary meaning signifies an act of choice, whether good or bad (cf. LXX in Gen. xlix, j; Lev. xxii, 18, 21;

Neh. xii. 40; 1 Macc. viii. 30); it is the English equivalent of the Greek αἵρεσις. From this arose its later meaning of personal choice of an opinion or belief, or personal adhesion to a group or party advocating certain principles of belief; from this again it was used of the group or party as such, as a school or "sect." In Eusebius (*Hist.* x. 5) the Christian Church itself is described as the "most sacred heresy." But in the N.T. we see the word, acquiring the implication of disparagement or condemnation. It is applied to the Pharisees and Sadducees (Acts v. 17, xv. 5, xxvi. 5) and to Christianity itself by opponents (Acts xxiv. 14, xxviii. 22), with implied censure of a factious spirit. Specially noteworthy is its application to "divisions" due, not to matters of opinion, but to breaches of the law of love (Rom. xvi. 17; Gal. v. 20; 1 Cor. i. 10; iii. 3, 4; xi. 19). In one of the latest books of the N.T. the word is used of doctrinal errors and their advocates (2 Peter ii. 1, and Jude, 4, "false teachers," "sects of perdition"). In general, the apostolic writings show a vehement antagonism towards all teaching opposed to the gospel, whether the word "heresy" is used or not. This is explained by the character of the teachings or movements so attacked. They involved such a blending of the gospel with Jewish and Pagan elements as would have destroyed everything distinctive of it. Before illustrating the theological and ecclesiastical use of the word heresy in the history of Christianity, we must briefly examine its more general significance.

Heresy in Science.—It is evident that the normal conduct of human relations implies a general similarity in the constitution of the human mind, and demands some common ground of belief or (in this sense) an "orthodoxy." Within certain wide limits, all education presupposes the necessity of furnishing to mankind some common measure for the interpretation of the facts of life. Each generation hands on to its successor a common body of knowledge and belief about the facts of the past and the present. The acceptance of a large body of "orthodoxy"—that is, of beliefs commonly held as a basis of thought and conduct—is essential to the effective and coherent action of any organized society. Heresy as to the multiplication table is not allowed. In the life of the average man, the mental forces which are his own in the sense of originality or dissent or deviation from the norm are extremely small in their extent as compared with those due to education, sympathy, imitation and similar social influences. Even in science, the discovering mind has and must have a background or basis of knowledge and belief accepted without analysis or criticism. Science has its orthodoxy as well as religion. There are things which a scientific man may not believe, and other things which he may not disbelieve without treason to the brotherhood of his craft.

From this point of view a "heresy" may be compared to a "paradox," in the sense of a proposition contrary to the body of belief on a given subject held in a particular country or a particular age, or even by most men, always and everywhere. And this fact serves to call attention to the other side of the case which we have stated. Such a proposition is not necessarily false because of its paradoxical or heretical character. Many times in the history of human thought a belief once heretical has become a universally accepted truth, "sometimes a paradox, but now the time gives it proof" (Hamlet, iii., i. 115): so Hobbes described a paradox as "an opinion not yet generally received" (English Works, edit. Molesworth, v. 304). In every age of the world there have been established systems opposed from time to time by isolated and dissentient reformers (cf. De Morgan, Budget of Paradoxes, 1872, p. 4, *sqq*). Such an established system has sometimes fallen slowly and gradually, upset by the rising influence of some one man or undermined by gradual change of opinion in the many. It must be admitted that an opinion being "generally received" implies a preoccupation of the ground which must hold good until sufficient reason is adduced against it. To this extent there is a presumption against anything "heretical"; the burden of proof lies with him who maintains it. Nevertheless, the history of science is partly the history of paradoxes becoming commonplaces and heresies becoming orthodoxies, *e.g.*, the motion of the earth, the possibility of the antipodes, the pressure of the atmosphere (as against the dogma "Nature abhors a vacuum"), the circulation of the blood, the facts of hypnotism, the electrical phenomena produced by Galvani's experiments—to mention only a few of the cases now utterly beyond the reach of controversy. Contemporary science is enlarging indefinitely its conception of natural possibility; and hitherto unknown and unsuspected facts have emerged in regions of enquiry which might have been supposed exhaustively explored, *e.g.*, the constituent gases of the atmosphere. "Such experiences indicate the need of a spirit of caution in those who may be tempted to condemn avenues of scientific enquiry as bound in advance to be unfruitful. Yet it does not follow that the march of science is impeded by such premature judgments. Rather they may be regarded as sheep-dogs, which keep the scientific flock together in its progress to those fields of thought which for the moment offer the richest pasture" (H. A. L. Fisher, Orthodoxy, p. 37, 1922).

Heresy in Religion.—In the history of religion, and above all in the history of Christianity, "heresy" implies "orthodoxy." It is beyond dispute that the system of dogma, the essentials of which are formulated in the Apostles', Nicene, and Athanasian, creeds, emerged gradually in a development which can be historically traced (see the standard Histories of Dogma, especially Seeberg, Harnack and Loofs). This developing orthodoxy forms the *main* stream in the history of Christian thought; and the various heresies which emerged during the first four centuries were dealt with as "heresies" because in every case they endeavoured to open up a more or less dangerous divergence from the main stream. The significance of heresy reached its height when the Church was regarded as the divinely ordained depository of saving truth (cf. Cyprian, De *Unitate Ecclesiae*, sec. 3; Augustine, Epistle 185, and many other passages). The simple primitive creed which can be traced in the N.T.—"Jesus Christ is Lord (κύριος)"—was found insufficient as the movement spread; and even before systematic theology (with the aid of contemporary philosophic speculation) began to take shape, a "Rule of Faith" established itself, bringing together those elements (στοιχεῖα) of Christian faith which were accounted essential. The Rule of Faith (κήρυγμα ἀποστολικόν, or παράδοσις ἀποστολική) was not directly derived from the Scriptures, but was from the apostolic tradition current in the congregations which looked to apostles as their founders. Growing at first by oral tradition, it afterwards appeared in written forms, varying in statement rather than substance, and can be traced in the early fathers (cf. A. E. Burn, Introduction to the Creeds, 1899, and The Apostles' Creed, 1912). The final form of this early Rule of Faith is found in what is now known as the Apostles' Creed. The acceptance of the Rule of Faith explains the ancient conception of heresy. Every serious departure from this Rule was attacked as heresy, with much argument and often with much abuse (cf. Bethune-Baker, Zntroduction to *the* Early History *of Christian* Doctrine, 1903, pp. 2, seq.). The heretical movements emerging in the 1st and 2nd centuries constituted a serious danger to the Christian movement. If the main stream had been diverted into any one of these channels, it would have lost itself and historical Christianity (so far as we can see) would have disappeared. In the 1st century the Jewish-Christian tendency formed such a channel. The primitive Christian communities in Palestine were Jewish Christians because they had not realized the universal character of the gospel. The historic Jewish Christian tendency was left behind and survived for a period in the form of heretical sects (see EBIONITES). In the 2nd century another channel, deeper and more dangerous, was opened up by the Gnostic schools (see GNOSTICISM; MARCION; MARCIONITES; DOCETISM). The controversy with the Gnostics largely created the Rule of Faith. The appeal to Scripture was not sufficient (apart from the fact that the N.T. Canon was only in process of formation); because the heretics had their own methods of interpreting Scripture. Hence the fathers stepped back from the written word to tradition. Another group of important heretical movements arose within the Church itself in the same century. Some theologians (especially in Rome) found insuperable difficulties in the current trinitarian terminology and

were led to surrender either one or the other of the two factors which the leaders of the Church were determined to hold together —the human and the divine in Christ (see ADOPTIONISM; MONARCHIANISM). And at the end of the century we find an enthusiastic reaction against the Church as an organized institution, with authoritative doctrine, ritual and officials appearing to enter into alliance with the world (see MONTANISM). A kindred movement afterward appeared in the time of Augustine in a different form (see DONATISTS).

The influence of these controversies continued in the 3rd century, when new divergent tendencies emerged. A revised Adoptionism, embodied in a more elaborate theology, was taught by Paul of Samosata and by Lucian at Antioch (see PAULICIANS). It spread widely, and Arius was influenced by it. During the latter part of the 3rd and part of the 4th century, the movement said to have been founded by Mani, the Mesopotamian (see MANICHAEISM), at first sight looking like a revived Gnosticism, invaded the Church; Augustine adopted it for a time, and its influence is probably found in some of the enthusiastic movements characteristic of the early mediaeval period (see below). Manichaeism, however, was not a serious danger to the Church; and the controversies characteristic of the 4th century were those arising from the Adoptionist Christology as it spread in the east through Paul of Samosata and through Origen's doctrine of the subordination of Christ to the Father (see ORIGEN). The doctrinal struggle came to a head in the contest between the followers of Arius and their opponents, afterward led by Athanasius, at the Council of Nicaea in 325 (see ARIUS; ATHANASIUS, SAINT). Arianism became a heresy, but it found defenders down to modern times. The Nicene council is a turning point in the history of heresy. The earlier heresies (as indicated above) threatened to mingle with the gospel Jewish or pagan elements fatal to its essence; while many of the later heresies were differences in the interpretation of Christian truth which did not in the same way threaten the essence of Christianity. No vital interest of Christian truth justified the extravagant denunciations in which theological partisanship so recklessly and ruthlessly indulged. Again, in the ante-Nicene period only ecclesiastical penalties. such as reproof. deposition or excommunication. could be imposed; but in the post-Nicene the union of Church and state transformed theological error into legal offense. This greatly embittered the Christological controversies which sprang from the Council of Nicaea (see MONOPHYSITES; MONOTHELITES; NESTORIANS). From the end of the 4th century the emperors accepted the view that they were bound to use their secular power against heretics for the maintenance of orthodox doctrine.

The heresies of the middle ages were not matters of doctrine merely (however important), but were symptoms of spiritual movements, common to people of many lands, and in one way or another threatening the foundations of the Roman Catholic system (see BOGOMILS; CATHARI; WALDENSES). Such movements led to active ecclesiastical legislation against heresy, and several councils in the 12th and 13th centuries declared that the secular arm was bound to punish heretics. But it was maintained that heretics must in the first instance be brought before ecclesiastical courts, and this led to the erection of special Church courts with a procedure of their own *(see* INQUISITION). In evangelical Protestantism the older attitude survived in some of the earlier Protestant constitutions, where heresy is regarded as a crime punishable by the state. Logically, evangelical Protestantism, which declines to force the consciences of its members and appeals only to Scripture for the confirmation of its doctrines, can only denounce erroneous doctrine as erroneous and deal with them by persuasion and argument, although this consideration does not prevent or invalidate disciplinary action in reference to ministers or lay members who defy the official standards of the organized Church to which they claini to belong.

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HEREWARD, now sometimes called THE WAKE (though this style has no contemporary warrant and probably arose from a supposed connection with the Wake family, lords of Bourne, Lincolnshire), was originally a vassal of Peterborough abbey with property in several villages in the extreme south of Lincolnshire bordering on the fens. In 1070, expecting a Danish conquest of England, he and some followers joined a Danish force that had come to Ely. Together they sacked Peterborough abbey (June 2) at Hereward's instigation; he apparently felt that the Danes might as well have Peterborough's treasures as the Norman abbot then on his way to take up his appointment. Very soon after this raid the Danes returned to Denmark; Hereward maintained himself on the island of Ely, countenanced by Thurstan, abbot of Ely (appointed by King Harold). In 1071 Ely attracted several important fugitives, notably Earl Morcar, who had a connection with Hereward's part of Lincolnshire. A methodical assault by King William won the island, but Hereward, who had distinguished himself in its defense, made a bold escape with a few men. Marvellous tales of Hereward were popular among Normans and English by the middle of the 12th century. His end is, and probably was, obscure. Contemporary and nearly contemporary writers say nothing of his career after 1071, and its legendary endings, beyond suggesting that he survived for a time as an outlaw, command little confidence. His lands were held by others in 1086.

See J. H. Round, *Feudal England* (London, 1909); *The Peterborough Chronicle of Hugh Candidus,* ed. by *W.* T. Mellows (London, 1949), with Eng. trans. (Peterborough, 1941). (ER. S.)

HERFORD, a town in North Rhine-Westphalia. Ger., situated at the confluence of the Werre and Aa, on the Minden and Cologne railway, g mi. N.E. of Bielefeld, and at the junction of the railroad to Detmold. Pop. (1959 est.) 55,236. It owes its origin to a Benedictine nunnery. said to have been founded in 832, and confirmed by the emperor Louis the Pious in 839. From the emperor Frederick I the abbess obtained princely rank and a seat in the imperial diet. The foundation was secularized in 1803. Herford was a member of the Hanseatic league, and in 1631 it became a free imperial town, but in 1647 it was subjugated by the elector of' Brandenburg. It came into the possession of Westphalia in 1807 and in 1813 into that of Prussia.

Herford possesses a Gymnasium founded in 1540, while its churches include the Münsterkirche, a Romanesque building with a Gothic apse of the 15th century and the Marienkirche, in the Gothic style. The industries include cotton and flax spinning and the manufacture of linen cloth, carpets, furniture, machinery, sugar, chocolate, tobacco and margarine.

HERGENROTHER, JOSEPH VON (1824–1890), German Catholic theologian, was born at Wiirzburg, Bavaria, on Sept. 15, 1824. He studied at Wurzburg, at Rome and at Munich, where he became instructor in theology. In 1852 he was recalled to Wurzburg as professor of ecclesiastical law and history. He was one of the most learned theologians on the ultramontane side of the infallibility question, and in 1868 was sent to Rome to arrange the proceedings of the Vatican council. In 1870 he wrote *Anti*-Janus, an answer to The Pope and the Council by Janus (Döllinger and J. Friedrich), which made a great sensation at the time. In 1877 he was made prelate of the papal household, in 1879 cardinal deacon, and afterward curator of the Vatican archives. He died in Rome on Oct. 3, 1890.

His works include *Photius, Patriarch von Constantinopel. Sein Leben, seine Schriften und das griechische Schisma, 3* vol. (Regensburg, 1867–69), and an additional volume, *Monumenta Graeca ad Photium . . . pertinentia* (1869).

HERGESHEIMER, JOSEPH (1880–1954), U.S. author, whose novels are typically concerned with the decadent and sophisticated milieu of the very wealthy, was born in Philadelphia, Pa., Feb. 15, 1880, and was educated at a Quaker school and at the Pennsylvania Academy of Fine Arts. Beginning with The Lay Anthony (1914), he established himself as a popular and prolific

writer of novels, short stories, biography, history and criticism. His work is distinguished for the baroque lushness of its descriptive passages and its often penetrating psychological insights. He went into complete retirement in 1940 and died April 25, 1954, at Sea Isle City. N.J.

His publications include: *Mountain Blood* (1915); ***The*** *Three Black Pennys* (1917); *Gold and Iron* (1918); *Java Head* (1919); *Cytherea* (1922); *The Bright Shawl* (1922); *Balisand* (1924); and *The Foolscap Rose* (1934). *See* G. Hicks, *The Great Tradition* (1933), pp. 207–56.

HERING, EWALD (1834–1918), German physiologist and psychologist, was born at Alt-Gersdorf, Saxony, on Aug. 5, 1834. In 1862 he became lecturer in physiology at the university of Leipzig. He was professor of physiology at the medico-surgical Josephs-Akademie in Vienna (1865–70); at Prague (1870–95) and then again at Leipzig.

Hering's chief work was in physiological optics and more especially the perception of colour. He gave the four-colour theory authoritative form by making it a theory of antagonistic colour-pairs (black and white, blue and yellow. red and green); and formulated the logical conclusion of the principle of the nativistic theory of the visual perception of space against the "empiristic" doctrine of Helmholtz.

See O. Klemm, *A History of Psychology* (1914); F. Hillebrand, *E. Hering* (1918); G. S. Brett, *A History of Psychology* (vol. 3, 1921).

HERIOT, originally the arms and equipment (*O.* E. *geatwa*) of a soldier or army (here). The lord of a fee provided his tenant with arms and a horse, either as a gift or loan, which he was to use in the military service paid by him. On the death of the tenant the lord claimed the return of the equipment. When by the 10th century land was being given instead of arms, the heriot was still paid, but more in the nature of a "relief."

By the 13th century the payment mas made either in money or in kind by the handing over of the best beast or of the best other chattel of the tenant (see Pollock and Maitland, History *of* English Law). For the manorial law relating to heriots, see COPYHOLD.

HERISAU, the largest town in the Swiss canton of Appenzell, built on the Glatt torrent, and by rail 7 mi. S.W. of St. Gall or 13½ mi. N.W. of Appenzell. Pop. (1960) 14,361. The lower portion of the tower of the parish church dates from the 11th century or even earlier.

About ½ mi. to the southeast is Hundwil, where the *Landsgemeinde* of Ausser Rhoden meets in the odd years (in other years at Trogen) on the last Sunday in April. Some of the finest embroideries are manufactured in Herisau.

HERITABLE JURISDICTIONS, in the law of Scotland, grants of jurisdiction made to a man and his heirs. They included civil and criminal jurisdictions, and were a usual accompaniment of feudal tenures.

The power which they conferred on great families was recognized as a source of danger to the state, and led to frequent attempts being made by statute to restrict them, both before and after the union.

They were abolished in 1746, in consequence of the rising of 1745.

HERKOMER, SIR HUBERT VON (1849–1914), a popular British painter of Victorian and Edwardian times, was born at Waal, Bavaria, on May 26, 1849, the son of a woodcarver. In 1857 he was brought to Southampton, where he began his art training. In 1866 he entered the South Kensington schools and established his reputation with "The Last Muster" (Royal Academy, 1875). He was elected an associate of the Royal Academy in 1879, a member in 1890 and was appointed Slade professor at Oxford in 1885. He worked in enamel, practised engraving and illustrating, and widely influenced art education through the Herkomer school (founded 1883) at Bushey. His pictures "Found" (1885) and "The Council of the Royal Academy, 1907" are in the Tate gallery, London. He was knighted in 1907. He died at Budleigh Salterton on March 31, 1914.

See J. Saxon Mills, *Life and Letters of Sir H. Herkomer* (1923); Sir H. Herkomer, *My School and My Gospel* (1908). (D. L. FR)

HERLIN (HERLEN), **FRIEDRICH** (d. 1491), German artist, the most distinguished member of a family of painters of the Swabian school, in the 15th century. His name occurs in the archives of Nordlingen from 1461 until his death in 1491. In 146; he was made citizen and town painter at Nördlingen, "because of his acquaintance with Flemish methods of painting." One of the first of his acknowledged productions is a shrine on one of the altars of the church of Rothenburg on the Tauber, the wings of which were finished in 1466, with seven scenes from the lives of Christ and the Virgin Mary. In the townhall of Rothenburg is a Madonna and St. Catherine of 1467. In the church of Bopfingen portions of an altarpiece of 1472 representing the "Nativity" and the "Adoration of the Magi" and "Scenes From the Life of St. Blasius"; and in the town hall of Nordlingen a triptych of 1488, representing the "Nativity" and "Christ Amidst the Doctors," at the side of a votive Madonna attended by St. Luke and St. Margaret as patrons of the painter's family. In each of these works the painter's name certifies the picture. and the manner is that of a pupil of Rogier van der Weyden. Herlin's epitaph states that he died on Oct. 12, 1491. He was buried at Nordlingen.

HERMAE, properly the plural of the name Hermes (*q.v.*). The adoration ot baetyli (*q.v.*) was and continued to be a fairly common feature of Greek cult, particularly in the more backward districts, such as Laconia. where, for instance, a meteoric stone received worship as Zeus *Kappotas* (Zeus the Descender, *i.e.*, Thunderbolt). Not dissimilar objects were the posts. pillars or heaps of rough stones set up along roads or to mark boundaries. These, like the Latin Terminus. were sacred things, and connected with the cult of Hermes; indeed, some go so far as to derive his name from *herma* (stone, rock, piece of ballast).

With the development of artistic taste and the conception of the gods as having human form (anthropomorphism). these somewhat unsightly objects tended to be replaced, often by statues, frequently also by pillars, generally square and tapering towards the bottom, so as to suggest the human figure. These were surmounted by a head, usually that of Hermes (hence the name), and had a phallus in front, half-way up. They were used, not only as cult-objects, but for all manner of purposes, as mile-stones, boundary-marks, and so forth. But that most if not all of them were regarded with respect, if not actually worshipped, is clear from the famous mutilation of the Hermae. Just before the ill-fated expedition to Sicily sailed from Athens (415 B.C.), "all the stone Hermae in the city of Athens . . . or most of them, had their faces smashed" (Thucydides vi, 27, 1). The whole city was in an uproar of superstitious panic at this impiety, and numerous trials for sacrilege resulted.

Herms are not infrequent in Roman sculpture, for example with heads of Silvanus or Iuppiter Terminus. In later times, all manner of fanciful herms were made and used as ornaments; these are commonly known by compound names, as Hermathena, Hermanubis,-and the like; but it is not clear whether this means a herm with the head of Athena, Anubis, etc., instead of that of Hermes, or a double herm having the heads of both deities, Janus fashion.

Certainly both types of herms existed, and the heads were by no means always those of gods.

See the classical dictionaries, and especially P. Paris in Daremberg-Saglio (*s.v.*). For the mutilation of the Hermae, *see* the histories of Greece; for stone-heaps, J. G. Frazer, *Golden Bough,* (3rd ed.), ix, chap. 1.

HERMANDAD, a Castilian word meaning, strictly speaking, a brotherhood. In the Romance language spoken on the east coast of Spain in Catalonia it is written germandat or *germania* (Lat. germanus, full brother). In the form *germania* it has acquired the significance of "thieves' Latin" or "thieves' cant." and is applied to any jargon supposed to be understood only by the initiated. But the typical "germania" is a mixture of slang and of the gypsy language. The hermandades have played a conspicuous part in the history of Spain. The first recorded case of the formation of an hermandad occurred in the 12th century when the towns and the peasantry of the north united to police the pilgrim road to Santiago in Calicia, and protect the pilgrims against robber knights. Throughout the mid-

dle ages such alliances were frequently formed by combinations of towns to protect the roads connecting them, and were occasionally extended to political purposes. They acted to some extent like the Fehmic courts of Germany. The Catholic sovereigns, Ferdinand and Isabella, adapted an existing hermandad to the purpose of a general police acting under officials appointed by themselves endowed with large powers of summary jurisdiction even in capital cases. In Catalonia and Valencia the germanias were combinations of the peasantry to resist the exactions of the feudal lords.

HERMAN DE VALENCIENNES, 12th-century French poet, was born at Valenciennes, of good parentage. He became a priest and wrote the *Histoire de la Bible,* which includes a separate poem on the Assumption of the Virgin. The work is generally knon-n as *Le Roman de sapience,* the name arising from a copyist's error in the first line of the poem, the first word *Comens* being miswritten in one manuscript *Romens,* and in another *Romanz.* Indeed, the work has the form of an ordinary romance, and cannot be regarded as a translation. He selects Biblicai stories to suit his purpose, and adds freely from legendary sources, displaying considerable art in the use of his materials. This scriptural poem, very popular in its day, mentions Henry II of England as already dead, and must therefore be posterior to 1189.

See *Notices et extraits des manuscrits* (vol. 34), and J. Bonnard, *Les Traductions de la Bible en vers français au nzoyen âge* (1884).

HERMANN I (d. 1217), landgrave of Thuringia and count palatine of Saxony, was the second son of Louis II the Hard, landgrave of Thuringia, and Judith of Hohenstaufen, sister of the emperor Frederick I. About 1180 he received from his brother Louis the Saxon palatinate, and married Sophia, sister of a former count palatine. In 1190 Louis died and Hermann frustrated the attempt of the emperor Henry VI to seize Thuringia as a vacant fief of the empire, and established himself as landgrave. In 1197 he went on crusade. When Henry VI died in **1198** Hermann's support was purchased by the late emperor's brother Philip, duke of Swabia, but as soon as Philip's cause appeared to be weakening he transferred his allegiance to Otto of Brunswick, afterwards the emperor Otto IV. Philip accordingly invaded Thuringia in 1204 and compelled Hermann to come to terms by which he surrendered the lands he had obtained in **1198.** After the death of Philip and the recognition of Otto he was among the princes who invited Frederick of Hohenstaufen, afterwards the emperor Frederick II, to come to Germany and assume the crown. The Saxons consequently attacked Thuringia, but the landgrave was saved by Frederick's arrival in Germany in 1212. After the death of his first wife in 1195 Hermann married Sophia, daughter of Otto I, duke of Bavaria. By her he had four sons, two of whom, Louis and Henry Raspe, succeeded their father in turn as landgrave. Hermann died at Gotha on April **25,** 1217. Walther von der Vogelweide and other Minnesingers were welcomed to his castle, and Hermann figures in story and in opera as the promoter of the famous singing contest at the Wartburg.

See E. Winkelmann, *Philipp von Schwaben und Otto IV. von Braunschweig* (1873–78); T. Knochenhauer, *Geschichte Thüringens* (1871); and F. Wachter, *Thiiringische und obersiichsische Geschichte* (1826).

HERMANN, EDUARD (1869–1950), German linguist, who specialized in comparative studies of the Indo-European languages, was born in Coburg on Dec. **19, 1869.** He was professor successively at Kiel. Frankfurt, and Gottingen, and was the author of many articles in professional journals on widely varying linguistic subjects. His *Herkunft unserer Fragefiirworter* (1943) is a useful history of German interrogative pronouns, and his small volume of exhaustive linguistic commentary on certain passages in Homer (*Sprachwissenschaftlicher Kommentar zu ausgewuhlten Stiicken aus Homer,* 1914) is a very nearly perfect example of that kind of exegesis.

Hermann died in Gottingen on Feb. **16,** 1950. (MY. F.)

HERMANN, (JOHANN) GOTTFRIED (JAKOB) (1772–1848), German classical scholar and philologist who was leader of the school that held linguistic studies to be the sole aim of philology, was born at Leipzig on Nov. **28,** 1772. He studied at Leipzig university, and spent his life there as lecturer and professor, dying on Dec. **31, 1848.** Philipp August Boeckh and Karl Otfried Müller, the representatives of the historico-antiquarian school, opposed Hermann's view of philology, regarding it as inadequate and one-sided. His early work was done in grammar and metre, his most important books being *Elementa doctrinae metricae* **(1816)** and *De emendanda ratione Graecae grammaticae* **(1801).**

HERMANN OF REICHENAU (HERIMANNUS AUGIENSIS), commonly distinguished as Hermannus Contractus, *i.e.,* the Lame (1013–1054), German scholar and chronicler, was the son of Count Wolferad of Alshausen, Swabia. Hermann became a monk of the famous abbey of Reichenau and exercised a great personal and intellectual influence on the scholars that gathered round him. He died on Sept. **24,** 1054, at the family castle. Besides the ordinary monastic studies, he devoted himself to mathematics, astronomy and music, and constructed watches and various instruments.

His chief work is a *Chronicon ad annum 1054* (continued down *to* 1066 by his pupil Bertold) which furnishes important original material for the history of the emperor Henry III. The first edition, from a MS. no longer extant, was printed by J. Sichard at Basel in 1529. A critical edition is given in Pertz's *Monumenta Germaniae historica* (vol. v.), and a German translation by K. F. *A.* Nobbe in *Die Geschichtsschreiber der deutschen Vorzeit* (2nd ed., Leipzig, 1893). The separate lives of Conrad II. and Henry III., often ascribed to Hermann, appear to have perished. His *De mensura astrolabii* and *De utilitatibus astrolabii* (to be found, on the authority of Salzburg MSS., in Pez, *Thesaurus anecdotorum novissimus,* iii.) being the first important European contributions to this subject, Hermann was for a time considered the inventor of the astrolabe. A didactic poem by him, *De octo vitiis principalibus,* is printed in Haupt's *Zeitschrift für deutsches Alterthum* (vol. xiii.); and he is sometimes credited with the composition of the Latin hymns *Veni Sancte Spiritus, Salve Regina,* and *Alma Redemptoris. A martyrologium* by Hermann, discovered by E. Diimmler in a MS. at Stuttgart, was published by him in "Das Martyrologium Notkers und seine Venvandten" in *Forschungen zur deutschen Geschichte,* xxv. (Gottingen, 1885).

See H. Hansjakob, *Herimann der Lahme* (Mainz, 1875); Potthast, *Bibliotheca med. aev.;* and *J. R.* Dieterich, *Die Geschichtsschreibung der Abtei Reichenau* (1926).

HERMANN OF WIED (1477–1552), elector and archbishop of Cologne, was the fourth son of Frederick, count of Wied (d. 1487), and was born on Jan. **14,** 1477. He became elector and archbishop of Cologne in 1515. With the aid of his friend John Gropper (1503–1559), he began, about 1536, to institute certain reforms in his own diocese. One step led to another, and as all efforts at union failed the elector invited Martin Bucer to Cologne in 1542. Supported by the estates of the electorate, and relying upon the recess of the diet of Regensburg in 1541, he encouraged Bucer to press on with the work of reform, and in 1543 invited Melanchthon to his assistance. Summoned both before the emperor and the pope, the elector was deposed and excommunicated by Paul III. in **1546.** He resigned his office in 1547, and retired to Wied. Hermann, who was also a bishop of Paderborn from 1532 to 1547, died on Aug. 15, 1552.

See C. Varrentrapp, *Hermann von Wied* (Leipzig, 1878).

HERMANT, ABEL (1862–1950), French author and dramatist, was born in Paris on Feb. **3, 1862.** A brilliant wit and an exquisite stylist, he consistently devoted his talents to describing the lighter side of life. His most characteristic works are those grouped under the general title, *Mémoires pour servir à l'histoire de la sociktk* (20 vol., 1901–37), in which with unfaltering gaiety and a humour saved only by the delicacy of its expression from appearing scabrous, he mocked the aristocracy and wealthy bourgeoisie of France. He excelled in long series of amusing dialogues. *Le Caravanskrail* (1917), a study of rich foreigners plunged into the cosmopolitan circles of Paris, is perhaps his best-known work, but the series of *Scènes de* la *vie des cours et des ambassades,* which includes *La carrière* **(1894)** and *Le sceptre* (1900), no less pungently portrays the complications of diplomacy in a dignified central European court. Among his plays may be noted *La meute* (1896), a comedy of parasites, and *Sylvie, ou* la *curieuse d'amour* (1900), which with infinite grace displays the reactions of a light-headed woman to the successive phases of revolutionary and imperial France. A more ambitious work is the long novel, Le *cycle de lord Chelsea,* 4 vols. (1923).

See Peltier, *Abel Hermant* (1924).

HERMAPHRODITE, after Hermaphroditus (*q.v.*) in Greek mythology, any organism having both male and female reproductive organs. Statues and pictures from the Greco-Roman epoch depicted humans with fully developed female bodies and male sex organs. This extreme combination, being a particularly rare abnormality, is probably the product of artists' imaginations rather than a record of actual observation.

Medicine and comparative biology have adopted the term hermaphroditism to designate conditions of various degrees of mixed male and female sexuality, in contradistinction to gonochorism, the state of separate male and female sexes. Most flowering plants and many invertebrate animals (*e.g.*, earthworms, slugs and snails) are hermaphrodites, some of them reproducing by self-fertilization. Also a few fishes produce eggs as well as sperms. However, the overwhelming number of vertebrate species, particularly reptiles, birds and mammals, are gonochorists. In an evolutionary sense hermaphroditism is the primitive form of sex distribution out of which gonochorism arose by gradual suppression of one sex.

Human hermaphrodites. — Sex expresses itself in a number of characteristics which may be placed in five groups:

1. Every cell of the body carries the sex constitution. This is a combination of male-determining and female-determining hereditary factors (*see* GENE). Each cell type becomes recognizable under the microscope by characteristic chromosomal patterns. In resting cells, female nuclei contain sex-chromatin nucleoli not present in male nuclei (fig. 1). The difference serves as indicator of cytogenetic sex.

2. The ovaries and testes (gonads or sex glands) at maturity release eggs and sperms. The embryologist recognizes sexual differentiation as early as the seventh week of development.

FEMALE (LEFT) AND MALE (RIGHT) CELL NUCLEI FROM HUMAN EMBRYOS
Arrow points to the sex chromatin of the female nucleus

3. The secondary sex characters are gonaducts, external sex organs and puberal features. The first two differentiate during the embryo's development in the uterus. The ducts are either oviducts (tube, uterus, cervix, vagina) or sperm ducts (epididymis, deferent duct, prostate). Puberal sex characters (breasts, pubic hair, beard, change of voice) develop during adolescence.

4. Of adult endocrine organs, the hypophysis, or pituitary gland, releases gonad-stimulating hormones at a constant rate in men, but at 28-day cycles in women. The gonads are influenced to produce steroid hormones: testicular androgens stimulate male secondary sex characters; ovarian gynogens and progestins, affect female secondary sex characters.

5. Many behavioral and mental traits are sex specific in animals. However, at the human level their development is strongly influenced by environmental and social factors.

In the normal individual the characteristics of these five groups show the same direction of differentiation, either male or female. Combinations fall into the hermaphrodite class (see table). Two other special types of sexual abnormalities are: the gynandromorph (*q.v.*), a mosaic individual, composed of female and male cell territories. This type is not known to occur in man but has been reported for birds and insects. The other special type, the transvestite, is entirely of one sex, as far as criteria of groups 1 to 4 are concerned, but is possessed by a yearning to dress and live like the other sex (see also HOMOSEXUALITY).

Since statistical materials about incidence of all types are meagre, estimates of frequency in large populations can only be provisional, pending collection of more reliable data.

1. True hermaphrodites have gonads with ovarial and testicular territories: either ovotestes, or an ovary on one side and a testis on the other. Only about 200 cases have been reported.

2. Pseudomales have the female cell constitution, but male appearance. The testes produce sperm in subnormal quantity or are completely sterile. At adolescence the breasts often enlarge as in women. Usually the beard is sparse.

Hermaphrodites Classified According to Prevailing Combinations of Criteria of Sexual Differentiation

Class	Cytogenetic sex	Sex of gonads	Secondary sex characters	Hormonal type	Frequency estimate
True hermaphrodite	female or male	female and male	female and male	mixed	very rare
Pseudomale	female	male	male	male or mixed	1 out of 2,000
Pseudofemale	male	none	female castrate	castrate	1 out of 2,000
Male pseudohermaphrodite	male	male	female	female	1 out of
Female pseudohermaphrodite	female	female	mixed	male or mixed	1 out of 50,000

3. Pseudofemales have the male cell constitution, but gonaducts and external sex organs of female type. Gonads are absent, and the gonaducts consist of tubes, uterus, cervix and vagina. At puberty, stature and breasts remain infantile; menses do not become established.

4. Male pseudohermaphrodites have the male cell constitution and male gonads; but during embryonic development the testes do not adequately control the development of the secondary sex characters. In the extreme case, female gonaducts are present and the external appearance is that of a girl or woman. The lightest cases are males normal except for incomplete closure of the urethra on the underside of the penis (hypospadias). The testes may either remain in the body cavity or descend into the inguinal canals or the scrotal sacs.

5. Female pseudohermaphrodites have ovaries and are constitutional females. Development of the secondary sex characters starts along the female pattern. However, at some point in fetal or adult life pathogenesis of the adrenal glands or the ovaries causes a production of androgenic hormones, exerting a masculinizing influence. The clitoris is enlarged, so that the newborn baby sometimes is mistaken for a boy; adult women develop hairiness (hirsutism), beards and low voice.

Irregularities have been observed in the chromosome number of some hermaphrodites; their possible relationship to the abnormality of sex expression was being investigated in the early 1960s. It is thought that no human hermaphrodites, and few pseudohermaphrodites, have ever been able to reproduce. Their mental outlook, female or male, is mostly determined by how they are reared. See also SEX.

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HERMAPHRODITUS, in Greek mythology a being, partly male, partly female, of little importance in cult (first named in Theophrastus, *Charact.* 28 [16]); the Superstitious Man garlands the *Hermaphroditi* (see Jebb-Sandys *l.c.*). The conception undoubtedly had its origin in the east, where deities of a similar dual nature frequently occur. Within the Greek area, it is found in Cyprus. Here, according to Macrobius (*Saturnalia*, iii. 8,2) there was a bearded statue of a male Aphrodite, called *Aphroditos* by Aristophanes. The legend is a product of the Hellenistic period. In accordance with this, Hermaphroditus is the son of Hermes and Aphrodite, of whom the nymph of the fountain of Salmacis in Caria became enamoured. When he bathed in her fountain, she entreated the gods that she might be forever united with him. The result was the formation of a being 'half man, half woman. This story is told by Ovid (*Metam.* iv. 285 et *seq.*) to explain the peculiarly enervating qualities of the water of the fountain. Hermaphroditus was a favourite subject in later Greek art.

See articles in Daremberg and Saglio, *Dictionnaire des antiquités*, and Roscher's *Lexikon der Mythologie;* and for art, A. Baumeister, *Denkmäler des klassischen Alterturns* (1884–88).

HERMAS, SHEPHERD OF, one of the works representing the Apostolic Fathers (*q.v.*), a hortatory writing which "holds the mirror up" to the Church in Rome during the 3rd Christian generation. This is the period indicated by the evidence of the Muratorian Canon, which assigns it to the brother of Pius, Roman bishop c. 139–154. Probably it was not the fruit of a single effort of its author. Rather its contents came to him piecemeal and at various stages in his ministry as a Christian "prophet," extending over a period of years.

In its present form it falls under three heads: Visions, Mandates, Similitudes. These titles are somewhat misleading. In the four "Visions" the author appears to be transforming his personal religious history into a type (as Bunyan did in the *Pilgrim's Progress*). He is deeply impressed by the sad state of religion among professing Christians in Rome, and the "Visions" set forth his personal call to a mission of repentance and the awakened conscience. But before Hermas announces his message to the Roman Church, and thence to the churches abroad, there are added two Visions (iii. iv.) tending to heighten its impressiveness. He is shown the "holy church" under the similitude of a tower in building, and the great and final tribulation under that of a devouring beast, which yet is innocuous to undoubting faith.

The personal revelation given in the "Visions" is then elaborated in a fresh series of revelations through an angel in the guise of a Shepherd, who in a preliminary interview announces himself as the Angel of Repentance, sent to administer the special "repentance" which it was Hermas's mission to declare: "I was sent. quoth he. to show thee *again* all that thou sawest before, to wit the sum of the things profitable for thee. First of all write thou my mandates and similitudes; and the rest, as I will show thee, so shalt thou write." This programme is fulfilled in the xii. Mandates and Similitudes i.–viii., while *Simil.* ix. is "the rest" and constitutes a distinct "book"; while Sim. x. is really an epilogue in which Hermas is "delivered" afresh to the Shepherd, for the rest of his days. He is "to continue in this ministry" of proclaiming the Shepherd's teaching, "so that they who have repented or are about to repent may have the same mind with thee," and so receive a good report before God (Sim. x. 2 2–4). Only they must "make haste to do aright," lest while they delay the tower be finished (4. 4), and the new aeon dawn (after the final tribulation: cf. Vis. iv. 3. 5). Hermas sees that mere repentance is not enough to meet the backsliding condition in which so many Christians then were, owing to the recoil of inveterate habits of worldliness entrenched in society around and within. It is, after all, too negative a thing to stand by itself or to satisfy God. "Cease, Hermas," says the Church, "to pray all about thy sins. Ask for righteousness also" (Vis. iii. 1. 6).

Value of the Work.—Here lies a great merit of Hermas's book, his insight into experimental religion and the secret of failure in Christians about him, to many of whom Christianity had come by birth rather than personal conviction. Thus they were divided in soul between spiritual goods and worldly pleasures, and were apt to doubt whether the rewards promised by God to the life of "simplicity" (all Christ meant by the childlike spirit, including generosity in giving and forgiving) and self-restraint, were real or not. For while the expected "end of the age" delayed, persecutions abounded. Such "doubled-souled" persons, like Mr. Facing-both-ways, inclined to say, "The Christian ideal may be glorious, but is it practicable?" It is this most fatal doubt which evokes the Shepherd's sternest rebuke; and, he meets it with the ultimate religious appeal, viz., to "the glory of God." He who made man "to rule over all things under heaven," could He have given behests beyond man's ability? If only a man "hath the Lord in his heart," he "shall know that there is nothing easier nor sweeter nor gentler than these mandates" (Mand. xii. 3–4). So in the forefront of the Mandates stands the secret of all: "First of all believe that there is one God. . . . Believe therefore in Him, and fear Him, and fearing Him have self-mastery. For the fear of the Lord dwelleth in the good desire," and to "put on" this master-desire is to possess power to curb "evil desire" in all its shapes (*Mand.* xii. 1–2). Elsewhere "good desire" is analysed into the "spirits" of the several virtues, which yet are organically related, Faith being mother, and Self-mastery her daughter, and so on (Vis. iii. 8. 3, *seq.*; cf. *Sim.* ix. 15). These are the specific forms of the Holy Spirit power, without whose indwelling the mandates cannot be kept (*Sim.* x. 3; *cf.* ix. 13. 2, 24, 2).

The absence of the historic names, "Jesus" and "Christ," may be due to the form of the book as purporting to quote angelic communications. This would also explain the absence of explicit scriptural citations generally, though knowledge both of the Old Testament and of several New Testament books—including the congenially symbolic Gospel of John—is clear.

Hermas faithfully reflects the Roman Church of the early 2nd century (cf. E. von Dobschiitz, "Christian Life in the Primitive Church," 1904). Indeed the prime value of the Shepherd is the light it casts on Christianity at Rome in the otherwise obscure period *c.* 110–140, when it had as yet hardly felt the influences converging on it from other centres of tradition and thought. Thus Hermas's comparatively mild censures on Gnostic teachers in *Sim.* ix. suggest that the greater systems, like the Valentinian and Marcionite, had not yet made an impression there, as Harnack argues that they must have done by c. 145. This date, then, is a likely lower limit for Hermas's revision of his earlier prophetic memoranda, and their publication in a single homogeneous work. such as the Shepherd appears to be.

BIBLIOGRAPHY.—The chief modern edition is by **O.** von Gebhardt and **A.** Harnack, in Fasc. iii. of their Patr *apost* opera (Leipzig, 1877); it is edited less fully by F. X. Funk, *Patr.* apost. (Tübingen, 1901). **A** convenient edition, with text and translation, is contained in The *Apostolic* Fathers. vol.,ii., bv Kirsopp Lake (Loeb Classical Library). For the wide literature of the subject see the two former editions, also Harnack's Chronologie der altchr. Lit. i. 257 *seq.*, and **O.** Bardenhewer, *Gesch.* der altkirchl. Lit. i. 557, seq.

HERMENEUTICS, the science or art of interpretation or explanation, especially of the Holy Scriptures. (Gr. ἑρμηνευτική sc. τέχνη, Lat. ars hermeneuticn, from ἑρμηνεύειν to interpret, from Hermes, the messenger of the gods.)

KERMES, a Greek god, son of Zeus and Maia, daughter of Atlas, and often identified with Mercury (*q.v.*) and with Casmilus or Cadmilus, one of the Cabeiri (*q.v.*). The derivation of his name and his primitive character are very uncertain. The earliest centre of his cult was probably Arcadia, where Mt. Cyllene was reputed to be his birthplace. Here he was specially worshipped as the god of fertility, and his images were ithyphallic, as also were the "Hermae" (*q.v.*) at Athens. At Cyllene in Elis a mere phallus served as his emblem, and was highly venerated in the time of Pausanias (vi. 26, 3).

Both in literature and cult Hermes was constantly associated with the protection of cattle and sheep; at Tanagra and elsewhere his title was κριοφόρος, the ram-bearer. As a pastoral god he was often closely connected with deities of vegetation, especially Pan and the nymphs. His pastoral character is recognized in the Iliad (xiv. 490) and the later epic hymn to Hermes; and his Homeric titles ἀκάκητα, ἐριούνιος, δώτωρ ἐάων ("gracious," "the ready helper," "giver of good things") probably refer to him as the giver of fertility. In the Odyssey, however, he appears mainly as the messenger of the gods, and the conductor of the dead to Hades. Hence, in later times he is often represented in art and mythology as a herald. The conductor of souls was naturally a chthonian god; at Athens there was a festival in honour of Hermes and the souls of the dead, and Aeschylus (Persae, 628) invokes Hermes, with Earth and Hades, in summoning a spirit from the underworld. With this go his functions as a dream-god; he is called the "conductor of dreams" and the Greeks offered to him the last libation before sleep. As a messenger he may also have become the god of roads and doorways; he was the protector of travellers and his images were used for boundary-marks (see HERMAE). Treasure casually found was the gift of Hermes (ἕρμαιον), and any stroke of good luck was attributed to him; this and his function as a deity of gain, honest or dishonest (κερδῶος) are natural derivatives of his character as god of fertility. The trickery and cunning of Hermes is a prominent theme in literature from Homer downwards, al-

though it is very rarely recognized in official cult. In the hymn to Hermes the god figures as a precocious child (a type familiar in folk-lore), who, when a new-born babe. steals the cows of Apollo. In many respects he was a counterpart of Apollo, less dignified and powerful, but more human than his greater brother. Hermes was a patron of music. like Apollo, and invented the cithara; he presided over the games with Apollo and Heracles, and his statues were common in the stadiums and gymnasiums. He is god of eloquence also; like hpollo he is something of a prophet, though a much inferior one. presiding over some kinds of popular divination. For his oracle at Pharae, *see* ORACLE.

The sacred number of Hermes was 4, and the 4th of the month his birthday. Apart from the Hermae, in archaic art he was portrayed as a full-grown and bearded man, clothed in a long chiton. and often wearing a cap or a broad-brimmed hat and winged boots. Sometimes he was represented in his pastoral character, as when he bears a sheep on his shoulders; at other times he appears as the messenger or herald of the gods with the herald's staff, which is his most frequent attribute. From the latter part of the 5th century his art type was changed in conformity with the general development of Greek sculpture. He became a nude and beardless youth. the type of the young athlete. In the 4th century this type was probably fixed by Praxiteles in his statue of Hermes at Olympia.

HERMES, GEORG (1775–1831), German Roman Catholic theologian, was born on April 22, 177j, at Dreyerwalde, in Westphalia, and was educated at the gymnasium and university of Münster. He was ordained in 1799 and two years after the publication of his *Untersuchungen über die innere Wahrheit des Christenthums* (Münster, 1805), became professor of theology at Münster. There his rationalistic mode of teaching and his disagreements with the Vicar-General von Droste-Vischering did little to smooth the way for his *Einleitung in die clzristkatholische Theologie* (1819–29), a work which shows the influence of Kant and Fichte, though in the first part the author severely criticizes these thinkers, especially for their views on the existence of God and on revelation. In 1820 Hermes was appointed professor of theology at Bonn where he died on May 26. 1831. His *Christkatholische Dogmatik* was published posthumously (3 vols., 1831–34). After his death, the contests between his followers and their opponents grew so bitter that the dispute was referred to Rome. The judgment was adverse, and in 1835 a papal bull condemned the *Einleitung* and the *Dogmatik*. In 1847 the condemnation of 1835 was confirmed by Pius IX.

HERMESIANAX OF COLOPHOX (b. *c.* 320 B.C.), Greek elegiac poet, has importance as an early exponent of the Alexandrian type of poetry. He was a pupil of Philetas of Cos. Athenaeus has preserved 98 lines from Hermesianax' chief work, in three books, named *Leontion* after his mistress. They catalogue with excessive sentimentality the love affairs (most of them quite fictitious) of Greek poets from Homer to Philetas and of the philosophers Pythagoras, Socrates and Aristippus. Other fragments from the *Leontion* are concerned with bucolic themes. A lost poem called *Persica* may have been an epic.

Hermesianax possessed some skill in versification, but his merits have been exaggerated.

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HERMES TRISMEGISTOS, the Greek name applied to the Egyptian god Thoth (*q.v.*) as the reputed author or source of the "Hermetic" writings, works of revelation on occult subjects and on theology. Thoth was the scribe of the gods, the inventor of writing, and the patron of all the arts dependent on writing. including medicine, astronomy and magic. At least as early as Herodotus, Greeks had identified him with their god Hermes, and by the 3rd century B.C. the identification was official; on the Rosetta stone (196 B.C.) Hermes "the great, the great" is evidently Thoth. The epithet Trismegistos (Gr. "thrice-greatest") occurs only rarely outside of the Hermetic texts. It represents a development from the Egyptian *aa aa* ("great, great," *i.e.*, "greatest") which is found as an epithet of Thoth in late hieroglyphic.

The writings ascribed to Hermes-Thoth fall into two main classes: "popular" Hermetism dealt with astrology and the other occult sciences, "learned" Hermetism with theology and philosophy. From the Renaissance until the end of the 19th century little attention was paid to the popular Hermetic literature. More recent study has shown that its development preceded that of the learned Hermetism, and that it reflects ideas and beliefs which were widely held in the early Roman empire and are therefore significant for the religious and intellectual history of the time.

In the Hellenistic age it was chiefly works on astrology which were ascribed to Hermes; to these were later added treatises on medicine. alchemy, and magic. The concept which underlies astrology. that the Cosmos constitutes a unity and that all parts of it are interdependent, is basic also to the other pseudosciences. To make this principle effective in practice (and Hermetic "science," unlike Aristotelian. was intensely utilitarian) it was necessary to know the laws of sympathy and antipathy by which the parts of the universe were related. But since these assumed affinities did not, in fact. exist, and hence could not be discovered by ordinary scientific methods, recourse was had to divine revelation. There was a growing distrust of traditional Greek rationalism. and a breaking down of the distinction between science and religion. Hermes-Thoth was but one, if perhaps the most important, of the gods and prophets (chiefly oriental) to whom men turned for a divinely revealed wisdom.

The theological writings are represented chiefly by the 17 treatises of the *Corpus Hermeticum,* by extensive fragments in Stobaeus, and by a Latin translation of the *Asclepius,* preserved among the works of Apuleius; they date probably from the first three centuries A.D. All are marked by a sincere, if turgid, piety of a mystical type, but there is no single doctrine which is consistently set forth, and it is unlikely that there was any well-defined Hermetic community or "church." Though the setting is Egyptian the philosophy, like the language, is Greek.

Hermetism was extensively cultivated by the Arabs, and through them reached and influenced such men as Albertus Magnus in the west. There are frequent allusions to Hermes Trismegistos in late medieval and Renaissance literature.

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HERMIAS OF ALEXANDRIA (? fl. late 5th century A.D.), Neoplatonist philosopher, was a disciple of Proclus and belongs to the Athenian rather than the Alexandrian school of Neoplatonism, though he spent his later life in his native city and, probably. taught there. His chief works were a treatise on Porphyry's *Isagoge* and a commentary on Plato's *Phaedrus (In Platonis Phaedrum scholia,* ed. by P. Couvreur, Paris, 1901). This latter work shows clearly the Athenian method of interpreting Plato inaugurated by Iamblichus and developed on the largest possible scale by Proclus. (*See* also AMMONIUS HERMIAE.)

(A. H. AG.)

HERMIT, one who withdraws from intercourse with human beings to live a life of religious contemplation. and so distinguished from a "coenobite," one who shares a liie of withdrawal with others in a community.

See ASCETICISM and MONASTICISM.

HERMIT CRAB, a crustacean of the order Decapoda (Section *Anomura*), typically with soft, asymmetrical abdomen, which the hermit in adult life protects by thrusting it into a gasteropod mollusk shell. They are found in all seas, some at considerable depths; others lead a terrestrial existence in tropical and subtropical lands, returning, however, to the sea to spawn their young. Many live under commensal conditions by association with sea anemones, annelid worms, and others animals. (*See* CRAB; CRUSTACEA; MALACOSTRACA; SYMBIOSIS.) (W. L. ST.)

HERMITE, CHARLES (1822–1901), French mathemati-

cian distinguished for the elegance of his algebraic research, was born at Dieuze and died at Paris.

Most of his formal education was obtained at the Lycée Louis-le-Grand (1840–42) in Paris, and the École Polytechnique (1842–43), where he was disqualified for lameness. Although Hermite had great difficulty in his examinations, he was already a creative mathematician at the age of 20. Having barely passed his bachelor of science examination in 1848, he was given a minor teaching position at the Polytechnique, before being appointed at the Collège de France. It was not until he was 47 that Hermite obtained a worthy position. In 1869 he became professor at the École Normale and in 1870 at the Sorbonne.

Hermite was one of the principal developers of the theory of algebraic forms, the arithmetical theory of quadratic forms and the theories of elliptic and abelian functions. Two isolated results testify to his originality and power: he solved the general quintic equation by means of elliptic modular functions; he proved the transcendence of the number *e* (the base of the natural logarithms). Most of his work is of high artistic quality. Of a generous disposition, Hermite encouraged many young mathematicians in their first serious work. (E. T. B.; X.)

HERMOGENES, of Tarsus, Greek rhetorician, surnamed the Polisher, flourished in the reign of Marcus Aurelius (AD. 161–180). His precocity secured him a public appointment as teacher of his art while he was still a boy, but at the age of 25 his faculties gave way. He had. however, composed a series of rhetorical treatises which became popular textbooks and the subject of commentaries. Of his *Art of Speaking* the sections on legal issues, on the invention of arguments, on the various kinds of style, on the method of speaking effectively and rhetorical exercises are still extant.

HERMON, the most imposing if not the highest mountain in Syria, visible far and wide. It is attached to the southern end of Anti-Lebanon. Its snowy top and the beauty of its outline inspired many images of Hebrew poetry. The Sidonians named it Sirion and it was Senir to the Amorites (Deut. iii, 9). According to one view it was the Mount of Transfiguration. To the modern Arab it is Jebel esh-Sheikh ("old man mountain") or Jebel eth-Thelj ("snow mountain"). Conder explained the former name as given because the "sheikh' of the Druses sought retirement there in the 10th century, but the hoary appearance of the mountain itself may have determined the name.

The ridge of Hermon which rises to a sharp peak is 20 mi. long. "The formation of the lower part is Nubian sandstone, that of the upper part is a hard dark-gray crystalline limestone belonging to the Neocomian period, and full of fossils." The view from the summit is very extensive and a summer sunrise over Damascus viewed from that point of vantage is an awe-inspiring sight. Hermon is covered in the spring uith snow which never entirely disappears and in autumn there is always some snow left piled up in great drifts to 20 or 30 ft. in the gullies and ravines on the mountain top. The ravines and gorges of its lower slopes to the west and southwest are fertile and the vegetation is luxuriant.

To a height of 500 ft. oaks, poplars, and brush are met. Foxes, wolves, and Syrian bears still haunt its fastnesses, if in decreasing numbers. The summit splits into three peaks the highest of which is 9,232 ft. above sea level. On the southern are the ruins of a temple dedicated probably to Baal. This peak, too, is enclosed with a wall. On the plateau separating the peaks is a cave about eight yards square. Twelve other small temples, oriented east, are found on the slopes of the mountain. They are dated by archaeologists at *c.* A.D. zoo and from them several Greek inscriptions have been recovered. (E Ro.)

HERMSDORF (Pol. SOBIECIN), a village in Wroclaw province, Poland, formerly in Silesia, near Waldenburg (Walbrzych). Pop. (1946) 12,156. There are coal mines in the vicinity and matches are manufactured. It was formerly known as Niederhermsdorf to distinguish it from other places of the same name. Perhaps the most noteworthy of these was a village in Silesia at the foot of the Riesengebirge, chiefly famous for the ruins of the castle of Kynast. This castle, formerly the seat of the Schaffgotsch family, was destroyed by lightning in 1675. A third Hermsdorf is a village in Thuringia, Ger., where porcelain is made.

HERNÁNDEZ (FERNÁNDEZ), **GREGORIO** (*c.* 1576–1636), Spanish sculptor, famous for his carved altarpieces and religious subjects, all in polychromed wood, was born in Galicia. He was a pupil of Francisco del Rincón at Valladolid. The Passion was his favorite theme, evoked with baroque intensity of expression and dramatic gravity. Attention was concentrated on the head and on the body surface. His work can be seen chiefly at Valiadolid and other cities of northern Spain. The museum at Valladolid contains, among other pieces, a St. Veronica, a Pietà, a relief of the baptism of Christ and a St. Bruno. Two statues of Christ, stretched out on a sheet—an iconographical innovation of the artist—are at Madrid (the monastery of the Sacrament and the monastery of San Plácido), and another is at near-by El Pardo. Hernández died at Valladolid on Jan. 22. 1636.

See Maria Elena Gómez Moreno, *Gregorio Fernández* (1953); George Kubler and Martin S. Soria, *The Art and Architecture of Spain and Portugal and Their American Dominions, 1500–1800* (1959).
(M. S. S.)

HERNÁNDEZ, JOSÉ (1834–1886), Argentine poet, best known for his depiction of the gauchos, was born in the Chacra de Pueyrredón, province of Buenos Aires, on Nov. 10, 1834. At the age of 14, because of illness, he left Buenos Aires to live in the pampas, where he read extensively and learned the ways of the gauchos. From 1853 to 1868 he took part in the political struggle between Buenos Aires and the provinces on the side of the latter. To defend the rights of the gauchos, he founded, in 1869, the newspaper *El Rio de la Plata.* Because of his participation in the unsuccessful revolt against Pres Domingo Sarmiento's government in 1870, he fled to Brazil (Jan. 1871). He later returned to Buenos Aires and published his famous poem *El gaucho Martin Fierro* (1872), depicting the life of a persecuted gaucho. A true American epic, the poem is recognized as the best example of *poesía gauchesca.* In the second part. La *vuelta de Martin Fierro* (1879), the hero is reintegrated into the society he had abandoned.

Hernandez died at Belgrano (a suburb of Buenos Aires) on Oct. 21, 1886.

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(L. LL.)

HERNE, JAMES A. (JAMES AHERN), (1840–1901), U.S. playwright, who helped bridge the gap between the 19th-century melodrama and the 20th-century "drama of ideas," was born in Troy, N.Y., Feb. 1, 1840. After several years as a traveling actor, Herne scored an impressive success with his first play, *Hearts* of Oak (1878). Subsequent dramas, *Drifting Apart* (1885), *The Minute Men* (1886) and *Margaret Fleming* (1890), did not achieve its popularity, but in retrospect *Margaret Fleming* seems his major contribution, since it anticipates the later U.S. social drama. Herne's most popular play, *Shore Acres,* was first presented in 1892, and his last two, *The Reverend Griffith Davenport* (1899) and *Sag Harbor* (1900), were both moderately successful. Herne was especially strong in character delineation. (S. W. H.)

HERNE, a town in North Rhine-Westphalia, Ger., 15 mi. N.N.W. of Dortmund by rail. Pop. (1950) 111,591. It has coal mines, boilerworks, ammonia works, etc. Herne was made a town in 1897.

HERNE BAY, a seaside town and urban district in the Canterbury parliamentary division of Kent, Eng., 8 mi. N.E. of Canterbury by road. Pop. (1951) 18,348. It grew up after the coming of the railway in 1833 and now has a sand and shingle coast line of more than 7 mi. and a pier about $\frac{3}{4}$ mi. long. The church of St. Martin, at Herne, $1\frac{3}{4}$ mi. inland, has medieval brasses. The *Te Deum* was first sung there in English when Nicholas Ridley, later martyred, was vicar. At Reculver, 3 mi. E. through Bishopstone glen, is the site of the Roman station of Regulbium. Only traces of the walls remain. In Saxon times it was converted into a palace by Aethelbert, and in 669 a monastery was founded there by Ecgbert. Parts of the Early English church, taken down about 1805 because of the encroachment of the sea, were incorporated in St. Mary's, but its twin towers, known as the Sisters,

were preserved by Trinity house as a conspicuous landmark. The council owns caravan sites near the towers.

Catering for tourists and agriculture are the area's principal industries.

HERNIA, in surgery, the protrusion of a part from its normal cavity; thus. *hernia cerebri* is a protrusion of brain-substance, *hernia pulmonum*, a protrusion of a portion of lung. and *hernia iridis*, a protrusion of some of the iris through an aperture in the cornea, As a result of X-ray examinations herniae of abdominal viscera into the thorax through a defect in the diaphragm have been recognized. But, used by itself. hernia implies. in common language, a rupture. A rupture may occur at any weak point in the abdominal wall. The common situations are the groin (inguinal). the upper part of the thigh (femoral). and the navel (umbilical). The hernia may contain intestine alone. omentum alone. or both. The predisposing cause of rupture is abnormal length of the mesentery or of the omentum, together with some weak spot in the abdominal wall. as in an inguinal hernia. which descends along the canal in which the spermatic cord lies in the male and the round ligament of the womb in the female. **A** femoral hernia comes through a weak spot in the abdomen to the inner side of the great femoral vessels; a ventral hernia takes place by the yielding of the scar tissue left after an abdominal operation. The exciting cause of hernia is generally overexertion, as in lifting a heavy weight, jumping off a high wall, straining, constipation or excessive coughing. The pressure of the diaphragm above and the abdominal wall in front acting on the abdominal viscera causes a protrusion at the weakest point.

Rupture is either congenital or acquired. A child may be born with a hernia in the inguinal or umbilical region, owing to defective development in those parts; or the rupture may first appear, perhaps, in adult life as the result of a strain or hurt. Men suffer more often than women. because of their physical labours and greater liability to accidents, and because the canal for the spermatic cord out of the abdomen is wider than that for the round ligament of the womb.

At first a rupture is small but it gradually increases in bulk. It varies in size from a marble to a child's head. The swelling consists of three parts — the coverings, sac and contents. The coverings are the structures which form the abdominal wall at the part where the rupture occurs, thinned and matted together as the result of pressure or thickened from repeated attacks of inflammation. The sac is composed of the peritoneum or membrane lining the abdominal cavity; in some rare cases the sac is wanting. The neck of the sac is the narrowed portion where the peritoneum forming the sac becomes continuous with the general peritoneal cavity. The neck of the sac is often thickened, indurated and adherent to surrounding parts, the result of chronic inflammation. The contents are bowel, omental fat, or, in children, an ovary.

The hernia may be reducible, irreducible, or strangulated. A reducible hernia is one in which the contents can be pushed back into the abdomen. In some cases reduction is easy. in others, a matter of great difficulty. At any moment a reducible hernia may become irreducible, perhaps from inflammatory adhesions in and around the fatty contents. or from extra fullness of the bowel in the sac. **A** strangulated hernia is one in which the circulation of blood through the hernial contents is impeded by the pinching at the narrowest part of the passage. The interference is at first slight, but quickly becomes pronounced; the pinched bowel in the hernial sac swells as a finger does when a string is tightly wound round its base. Congestion is followed by inflammation, infection by microorganisms and gangrene. The rapidity with which these changes take place depends on the tightness of the constriction. As a rule, the more rapidly a hernia forms the greater the rapidity of serious change in the conditions of the bowel or omentum, and the more urgent are the symptoms. The constricting band may be one of the structures which form the boundaries of the openings through which the hernia has travelled, or it may be the neck of the sac, which has become thickened in consequence of inflammation—especially is this the case in an inguinal hernia.

Reducible **Hernia.**—With a reducible hernia there is a soft compressible tumour (elastic when it contains intestine, doughy when it contains omentum), its size increasing in the erect. and diminishing in the horizontal posture. As a rule. it causes no trouble during the night. It gives an impulse on coughing, and when the intestinal contents are pushed back into the abdomen a gurgling sensation is perceptible by the fingers. Such a tumour may be met with in any part of the abdominal wall. but the chief situations are as already given. Inguinal hernia is commoner in men, femoral. in women. As an inguinal hernia increases in size it passes into the scrotum in the male. into the labium in the female; while a femoral hernia gradually pushes upward to the abdomen.

The palliative treatment of a reducible hernia consists in pushing back the contents of the tumour into the abdomen and applying a truss or elastic bandage to prevent their again escaping. The younger the patient the more chance there is of the truss acting as a curative agent. The truss may generally be left off at night, but it should be put on in the morning before the patient leaves his bed. If. after the hernia has been once returned. it is not allowed again to come down, there is a probability of an actual cure taking place; but if it is allowed to come don·n occasionally, as it may do, even during the night, in consequence of a cough, or from the patient turning suddenly in bed, the weak spot is again opened out, and the improvement which might have been going on for weeks is undone. It is sometimes found impossible to keep up a hernia by means of a truss. and an operation becomes necessary. The principles involved in the operation are the emptying of the sac and its entire removal, and the closure of the opening into the abdomen by strong sutures: and, in this way, great advance has been made by modern surgery. In some cases tantalum screen mesh may be inserted to strengthen the ciosure. Experience has shown that few ruptures are unsuited for treatment by operation.

Irreducible Hernia. — The main symptom is a swelling in one of the situations already referred to, of long standing and perhaps of large size, in which the contents of the tumour. in whole or in part, cannot be pushed back into the abdomen. The irreducibility is the result of its large size or of changes which have taken place by indurations or adhesions. Such a hernia is a constant source of danger; its contents are liable to injury from external violence; it may at any time become strangulated. or the contents may inflame, and strangulation may occur secondarily to the inflammation. It gives rise to dragging sensations (referred to the abdomen), colic, dyspepsia and constipation. which may lead to stoppage of the passage of the contents through that portion of the intestinal canal which lies in the hernia. When an irreducible hernia becomes painful and tender a local peritonitis has occurred, which resembles in many of its symptoms a case of strangulation. and must be regarded with suspicion and anxiety. Indeed. the only safe treatment is by operation.

The treatment of irreducible hernia may be palliative; a "bag truss" may be worn in the hope of preventing the hernia getting larger; the bowels must be kept open. and all irregularities of diet avoided. But it must be repeated that a person with such a hernia is in constant danger, and if possible an operation should be performed.

In strangulated hernia the bowel or omentum is being nipped at the neck of the sac. and the flow of blood into and from the delicate tissues is stopped. The symptoms are nausea, vomiting of bilious matter, and, after a time. of faecal-smelling matter; a twisting. burning pain generally referred to the region of the navel, intestinal obstruction; a quick. wiry pulse and pain on pressure over the tumour; the expression grows anxious. the abdomen becomes tense and drumlike, and there is no impulse in the tumour on coughing, because its contents are practically pinched off from the general abdominal cavity. Sometimes there is complete absence of pain and tenderness in the hernia itself, and in an aged person all the symptoms may be slight. Sooner or later, from eight hours to eight days. if the strangulation is unrelieved, the tumour becomes livid. crackling uith gas. gangrene of the bowel at the neck of the sac takes place, followed by extravasation of the intestinal contents into the abdominal cavity; the patient has hiccough; he goes into shock and dies.

The treatment of a strangulated hernia admits of no delay; it must be operated on at once. There should be no attempt at treatment by hot bath or ice bag: operation is urgently needed. An anaesthetic should be administered, and perhaps one gentle attempt to return the contents by pressure may be made, but no prolonged attempts are justifiable, because the condition of the hernial contents may be such that they cannot bear the pressure of the fingers.

Attempts at replacement to be successful should be made in a direction opposite to the one in which the hernia has come down. The inguinal hernia should be pressed upward, outward and backward, the femoral hernia downward, backward and upward. The larger the hernia the greater is the chance of success, and the smaller the hernia the greater the risk of its being injured by manipulation and delay. In every case the handling must be absolutely gentle. If it does not succeed the surgeon must at once cut down on the swelling, carefully dividing the different coverings until he reaches the sac. The sac is then opened, the constriction divided, care being taken not to injure the bowel. The bowel must be examined before it is returned into the abdomen, and if its lustreless appearance, its dusky colour, or its smell, suggests that it is gangrenous, or is on the point of becoming gangrenous, it must not be put back or perforation would give rise to septic peritonitis, which probably would have a fatal ending. In such a case the damaged piece of bowel must be resected and the healthy ends of the bowel joined together by fine suturing. Matted or diseased omentum must be tied off and removed.

Modern pre- and postoperative care and the improvement in anaesthesia have almost eliminated the mortality from hernia operations. However, a few deaths still occur usually as a result of pulmonary embolism (a blood clot going to the lungs from the veins near the operative site or in the legs). Early ambulation tends to prevent these accidents.

HERNICI, an ancient people of Italy, whose territory was in Latium between the Fucine lake and the Trerus, bounded by the Volsci on the south, and by the Aequi and the Marsi on the north. In 486 B.C. they were still strong enough to conclude an equal treaty with the Romans (Dion. Hal., viii, 64 and 68). They broke away from Rome in 362–358 (Livy, vii, 6 ff.) and in 306 (Livy, iv, 42), when their chief town Anagnia (*q.v.*) was taken and reduced to a praefecture, and their league was broken up, though Ferentinum, Aletrium and Verulae, which had not rebelled, were allowed to remain free municipia. By 225 B.C. their territory was not distinguished from Latium generally, and it seems probable that they had then received the full Roman citizenship. The oldest Latin inscriptions of the district (from Ferentinum; *Corpus inscriptionum latinarum,* x, 5837–40) are earlier than the Social War.

HERNOSAND (HARNOSAND), a seaport of Sweden, chief town of the district (*lan*) of Vasternorrland, on the Gulf of Bothnia. Pop. (1950) 15,407. Hernosand was founded in 1584 and received its first town privileges from John III in 1587. It stands on the island of Harno (which is connected with the mainland by bridges) near the mouth of the Angerman river, 423 mi. N. of Stockholm by rail. It is the seat of a bishop and possesses a cathedral. There are engine works, timberyards and sawmills. The harbour is good, but generally icebound from mid-January to May. Timber, cellulose and wood pulp are exported.

HERO, a Greek word (ἥρως) of varying meaning whose etymology is unknown.

(1) **In Homer:** a complimentary term (roughly="gentleman," "noble"), applied to the chief characters of the poems, or even to persons of lower rank, or the free warriors generally. Hence in Hellenistic Greek, a great or noble man, a hero; sometimes also a great classical writer.

(2) **Hero-Cult.** After Homer we hear of what had probably existed before him, the cult of the distinguished dead (*see* ANCESTOR WORSHIP). The heroes, as the objects of this cult are called, are not disembodied spirits, nor demi-gods; their position is not intermediate between gods and men, but by the side of these they exist as a separate class, though minor divine figures are often confused with them. Even in Homer, traces of an earlier ancestor-worship appear; *e.g.,* in funeral games in honour of Patroclus and other heroes, while the Hesiodic account of the five ages of man is a reminiscence of the belief in the continued existence of souls in a higher life. This agrees with the clear traces in Mycenaean graves of a cult of the dead. This pre-historic worship and belief, for a time obscured, were subsequently revived. According to Porphyry (De abstinentia, iv. 22), Draco ordered the inhabitants of Attica to honour the gods and heroes of their country "in accordance with the usage of their fathers" with offerings of first fruits and sacrificial cakes every year, thereby clearly pointing to a custom of high antiquity. Heroic honours were bestowed upon the founders of a colony or city, and the ancestors of families; if their name was not known, one was adopted from legend, or invented, as the supposed ancestors of the noble and priestly families of Attica and elsewhere. Again, side by side with gods of superior rank, certain heroes were worshipped as protecting spirits of the country or state; such were the Aeacidae amongst the Aeginetans, Ajax son of Oileus amongst the Epizephyrian Locrians and Hector at Thebes.

Neglect of the worship of these heroes was held to be responsible for pestilence, bad crops, and other misfortunes, while, on the other hand, if duly honoured, their influence was equally beneficent. This belief was supported by the Delphic oracle, which was largely instrumental in promoting hero-worship and keeping alive its due observance. Special importance was attached to the grave of the hero and to his bodily remains. The grave was regarded as his place of abode, from which he could be absent only for a brief period; hence his bones were fetched from abroad (*e.g.,* Cimon brought those of Theseus from Scyros), or if they could not be procured, at least a cenotaph was erected in his honour. Their relics, the house of Cadmus at Thebes, the hut of Orestes at Tegea, the stone on which Telamon had sat at Salamis (in Cyprus) also were carefully preserved. Special shrines (ἡρῷα) were also erected in their honour, usually over their graves. Like the gods, the cult heroes were supposed to exercise an influence on human affairs, though not to the same extent, their sphere of action being confined to their own localities. Among the earliest known historical examples of the elevation of the dead to the ranks of heroes are Timesius, the founder of Abdera, Miltiades, son of Cypselus, Harmodius and Aristogeiton and Brasidas, the victor of Amphipolis, who ousted the local Athenian hero Hagnon. In course of time admission to the rank of a hero became far more common, and was even accorded to the living, such as Lysimachus in Samothrace and the tyrant Nicias of Cos. This is one of the sources of the Hellenistic and Roman cult of kings and emperors. In addition to persons of high rank, poets, legendary and others, legislators and physicians, the patrons of various trades or handicrafts, the heads of philosophical schools received the honours of a cult. Finally, hero sank into a mere complimentary term for any dead man.

The cult of the heroes exhibits points of resemblance with that of the chthonian divinities, but differs from that of the ordinary gods. Normally, sacrifice was offered at night, on a hearth (ἐσχάρα), not an altar: the blood of the victim, which was black and sacrificed with its head turned earthwards, was allowed to trickle on the ground or into a trench or tube leading to the grave to appease the departed; the technical expression for the sacrifice was not *thuein,* but *enagizein* (less commonly entemnein) and generally the flesh was not eaten but burned. The chthonian aspect of the hero is further shown by his attribute the snake, and in many cases he appears under that form himself. On special occasions a sacrificial meal of cooked food was set out for the heroes, of which they were solemnly invited to partake. The fullest description of such a festival is the account given by Plutarch (*Aristides,* 21) of the festival celebrated by the Plataeans in honour of their countrymen who had fallen at the battle of Plataea. Later theologians (see Plutarch, de defectu *oraculorum,* 10, 415B) arranged an ascending scale of heroes (beatified human souls), daimones and gods, and held that promotion from one grade to another was possible.

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Teutonic Legend.—Many of the chief characteristics of the ancient Greek heroes are reproduced in those of the Teutonic North. Superhuman qualities and powers are commonly ascribed to both, an important difference being that whatever worship may have been paid to the Teutonic heroes never crystallized into a cult. This applies equally to those who have a recognized historical origin and to those who are regarded as purely mythical.

During the 19th century the "degraded gods" theory was applied not only to such conspicuous heroes as Siegfried, Dietrich and Beowulf, but to a host of minor characters. (See also Henri de Tourville, *Histoire* de la formation *particulariste,* 1903.) It is now, however, admitted that, whatever influence the one may have from time to time exercised on the other, Teutonic myth and Teutonic heroic legend were developed independently. The Teutonic heroes are, in the main, historical personages; though, like the Greek heroes, they are sometimes endowed with semi-divine attributes or interpreted as symbolical representations of natural forces.

The origin of Teutonic heroic saga, which includes that of the Germans, Goths, Anglo-Saxons and Scandinavians, is to be looked for in the traditions connected with the period of the so-called migration of nations (A.D. 350–650), the earliest traces of which are found in the works of historical writers such as Ammianus Marcellinus and Cassiodorus. It consequently rests upon a distinct basis of fact, the saga being the oldest form of historical tradition. (See also Tacitus, Annals, ii. 88.) The next step in the development of epic narrative was the single lay of an episodic character, sung by a single individual, who was frequently a member of a distinguished family, not merely a professional minstrel. Then, as different stories grew up round the person of a particular hero, they formed a connected cycle of legend, the centre of which was the person of the hero (*e.g.,* Dietrich of Bern). The most important figures of these cycles are the following.

(1) Beowulf, king of the Geatas (Jutland), whose story is an amalgamation of the myth of Beowa, the slayer of the water-demon and the dragon, with the historical legend of Beowulf, nephew and successor of Hygelac (Cochilaicus), king of the Geatas, who was defeated and slain (c. 520) while ravaging the Frisian coast. Beowulf is the hero of spring and light who, after overcoming the spirit of the raging waters, finally succumbs to the dragon of approaching winter. Others regard him as a wind-hero, who disperses the pestilential vapours of the fens. Beowulf is also a culture-hero, indicating the blessings of a fixed habitation, secured against the attacks of the sea. (2) Hildebrand, the hero of the oldest German epic. He follows his master Theodoric to the court of Attila. After 30 years' absence, he returns to his home in Italy; his son Hadubrand, believing his father to be dead, suspects treachery, and a fight takes place, in which the son is slain by the father. (3) Ermanaric, the king of the East Goths, who according to Ammianus Marcellinus slew himself (c. 375) in terror at the invasion of the Huns. With him is connected the old German Dioscuri myth of the Hartungen. (4) Dietrich of Bern (Verona), the legendary name of Theodoric the Great. Attempts have been made to identify him as a kind of Donar or god of thunder. (5) Siegfried (M.H. Ger. Sivrit), the hero of the Nibelungenlied, the Sigurd of the related northern sagas, is usually regarded as a purely mythical figure, a hero of light who is ultimately overcome by the powers of darkness, the mist-people (Nibelungen). He is, however, closely associated with historical characters and events, *e.g.,* with the Burgundian king Gundahari (Gunther, Gunnar) and the overthrow of his house and nation by the Huns. Theodor Abeling (Das Nibelungenlied, Leipzig, 1907) traces the Nibelung sagas to three groups of Burgundian legends, each based on fact. (See also the article NIBELUNGENLIED.) (6) Hugdietrich, Wolfdietrich and Ortnit, whose legend. like that of Siegfried, is of Frankish origin. It is preserved in four versions, the best of which is the oldest, and has an historical foundation. Hugdietrich is the "Frankish Dietrich" (=Hugo Theodoric) king of Austrasia (d. 534), who was illegitimate, and had to fight for his inheritance with his relatives. As the myth of the Hartungen is connected with Ermanaric, so another Dioscuri myth (of the Hartungen) is combined with the Ortnit-Wolfdietrich legend. The Hartungen are probably identical with the divine youths (mentioned in Tacitus as worshipped by the Vandal Naharvali or Nahanarvali), from whom the Vandal royal family, the Asdingi, claimed descent. Asdingi would be represented in Gothic by Hazdiggos "men with women's hair" (cf. muliebri ornatu in Tacitus), and in Middle High German by Hartungen. (7) Rother, king of Lombardy. Desiring to wed the daughter of Constantine, king of Constantinople, he sends envoys to ask her in marriage. They are thrown into prison by the king. Rother, who appears under the name of Dietrich, sets out with an army, liberates the envoys and carries off the princess. The slaying of a tame lion by one of the followers of Rother is founded in an incident which actually took place at the court of Alexius during the crusade of 1101 under Duke Welf of Bavaria, while King *Rother* was composed about 1160 by a Rhenish minstrel. Rother may be the Lombard king, Rothari (636–650), transferred to the period of the Crusades. (8) Walther of Aquitaine, chiefly known from the Latin poem *Waltharius,* written by Ekkehard of St. Gall at the beginning of the 10th century, and fragments of an 8th century Anglo-Saxon epic Waldere. Walther is not an historical figure. (9) Wieland (Volundr), Wayland the Smith, the only Teutonic hero (his original home was Lower Saxony) who firmly established himself in England. He typifies the advance from the stone age to a higher stage of civilization (working in metals). (10) Hogni (Hagen) and Hedin (Hetel), whose personalities are overshadowed by the heroines Hilde and Gudrun (Kudrun, Kutrun). In one version occurs the incident of the never-ending battle between the forces of Hagen and Hedin. The battle represents the eternal conflict between light and darkness, the alternation of day and night. The historical background is the raids of the Teutonic maritime tribes on the coasts of England and Ireland. Famous heroes who are specially connected with England are Alfred the Great, Richard Coeur-de-Lion. King Horn, Havelok the Dane, Guy of Warwick, Sir Bevis of Hampton (or Southampton), Robin Hood and his companions.

Celtic Heroes.—The Celtic heroic saga in the British islands may be divided into the two principal groups of Gaelic (Irish) and Brython (Welsh), the first, excluding the purely mythological, into the Ultonian (connected with Ulster) and the Ossianic The Ultonian is grouped round the names of King Conchobar and the hero Cuchulainn, the defender of Ulster against all Ireland, regarded by some as a solar hero. The second cycle contains the epics of Finn (Fionn Fingal) mac Cumhail and his son Oisin (Ossian) the bard and warrior (See IRISH LITERATURE; SCOTTISH LITERATURE. WELSH LITERATURE)

Of Brython origin is the cycle of King Arthur (Artus), the adopted national hero of the mixed nationalities of whom the "English" people was composed. The original Welsh legend was spread by British refugees in Brittany, and was thus celebrated by both English and French Celts. From a literary point of view, however, it is chiefly French and forms "the matter of Brittany." Arthur, the leader (comes Britanniae *dux bellorum*) of the Siluri or Dumnonii against the Saxons, flourished at the beginning of the 6th century. He is first spoken of in Nenniu's History of the Britons (9th century), and at greater length in Geoffrey of Monmouth's History of the Kings of Britain (12th century), at the end of which the French Breton cycle attained its fullest development in the poems of Chrétien de Troyes and others.

Speaking generally, the Celtic heroes are differentiated from the Teutonic by the extreme exaggeration of their superhuman, or rather extra-human, qualities. Take, for instance, the description of some of Arthur's knights in the Welsh tale of *Kilhwch* and Olwen (in the Mabinogion); Sgilti Yscandroed, whose tread was so light that no blade of grass bent beneath his weight; Sol who could stand all day upon one leg; Sugyn who was so "broad-chested" that he could suck up the sea on which were 300

ships and leave nothing but dry land. Such figures as these make no human impression, and criticism has busied itself in tracing them to one or other of the shadowy divinities of the Celtic pantheon. Remnants of their primitive superhuman qualities cling to the Celtic heroes long after they have been transfigured, under the influence of Christianity and chivalry, into the heroes of the mediaeval Arthurian romance; while memories of early myths live on, strangely disguised, in certain of the episodes repeated uncritically by the mediaeval poets. So Merlin preserves his diabolic origin; Arthur his mystic coming and his mystic passmg.

The chief heroes of the mediaeval Arthurian romances are Arthur himself, who tends however to become completely overshadowed by his knights; Merlin (Myrddin) the famous wizard, bard and warrior, first introduced by Geoffrey of Monmouth, originally called Ambrose from the British leader, Ambrosius Aurelianus, under whom he is said to have first served; Perceval (Parzival, Parsifal), the Welsh Peredur, the most intimately connected with the quest of the Grail (*q.v.*); Tristan (Tristram), the ideal lover of the middle ages, whose name is inseparably associated with that of Iseult; Lancelot, son of Ban, king of Brittany, known chiefly from his amour with Guinevere; Gawain (Welwain, Welsh Gwalchmai), Arthur's nephew, the type of knightly courage and chivalry. Among less important figures may be mentioned Kay (Kai of the Mabinogion), Arthur's foster-brother and seneschal, the type of the bluff and boastful warrior, and Bedivere (Bedwyr), the type of brave knight and faithful retainer, who alone is with Arthur at his passing, and afterwards becomes "a hermit and a holy man." (See ARTHUR, MERLIN, PERCEVAL, TRISTAN, LANCELOT, GAWAIN.)

Heroes of Romance. — Another series of heroes, forming the central figures of stories variously derived but developed in Europe by the Latin-speaking peoples, may be conveniently grouped under the heading of "romance." Of these the most important are Alexander of Macedon and Charlemagne. Alexander's name, in the form of Iskander, is familiar in legend and story all over the East to this day; to the West he was introduced through a Latin translation of the original Greek romance (by the pseudo-Callisthenes) to which the innumerable oriental versions are likewise traceable. (See ALEXANDER ROMANCES.)

More important in the West, however, was the cycle of legends gathering round the figure of Charlemagne, forming what was known as "the matter of France." The romances of this cycle, of Germanic (Frankish) origin and developed probably in the north of France by the French, contain reminiscences of the heroes of the Merovingian period, and were influenced later by the Arthurian cycle.

Charlemagne is chiefly venerated as the champion of Christianity against the heathen and the Saracens. (See CHARLEMAGNE LEGENDS.) .

The most famous heroes who are associated with him are Roland, praefect of the marches of Brittany, the Orlando of Ariosto, slain at Roncevaux (Roncesvalles) in 'the Pyrenees and his friend, and rival, Oliver (Olivier); Ogier the Dane, the Holger Danske of Hans Andersen, and Huon of Bordeaux, probably both introduced from the Arthurian cycle; Renaud (Rinaldo) of Montauban, one of the four sons of Aymon; the traitor, Doon of Mayence; Gamelon, responsible for the treachery that led to the death of Roland; Archbishop Turpin, a typical specihen of muscular Christianity; William Fierabras, William au court nez, William of Toulouse and William of Orange (all probably identical), and Vivien, the nephew of the latter and the hero of Aliscans. The late Charlemagne romances originated the legends in English form, of *Sowdone* of Babylone, Sir Otnel, *Sir* Firumbras and Huon of Bordeaux.

The chief remains of the Spanish heroic epic are some poems on the Cid, on the seven Infantes of Lara and on Fernán Gonzales, count of Castile. The legend of Charlemagne, as told in the *Crónica* general of Alfonso X., created the desire for a national hero distinguished for his exploits against the Moors, and Roland was thus supplanted by Bernardo del Carpio. Another hero of a 14th century cycle of romance was Amadis of Gaul; its earliest form is Spanish, although the Portuguese have claimed it as a translation from their own language. There is no trace of a French original.

Slavonic Heroes. — The Slavonic heroic saga of Russia centres round Vladimir of Kiev (980–1015), the first Christian ruler of that country, whose personality is eclipsed by that of Ilya (Elias) of Mourom, the son of a peasant, who was said to have saved the empire from the Tatars. It is not known whether he was an historical personage. A much-discussed work is the Tale *of Igor,* the oldest of the Russian mediaeval epics. Mention may here be made of Wainamoinen, the great magician and hero of the Finnish epic *Kalevala.* The popular hero of the Serbians and Bulgarians is Marko Kralyevich, son of Vukashin, characterized by Goethe as a counterpart of the Greek Heracles. For the Persian, Indian, etc., heroes see the articles on the literature and religions of the various countries.

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HERO AND LEANDER, two lovers celebrated in Greek legend. Hero, virgin priestess of Aphrodite at Sestos, was seen at a festival by Leander of Abydos; they fell in love with each other, and he swam the Hellespont at night to visit her clandestinely, guided by a light from her tower. One stormy night the light was extinguished, and Leander was drowned; Hero, seeing his body, drowned herself likewise.

The story is preserved in Ovid (Heroides 18 and 10; authorship of both disputed), Musaeus (5th century A.D.), and in references elsewhere, none earlier than Virgil. It was also adapted by such later poets as Christopher Marlowe (Hero and Leander, completed by George Chapman) and alluded to by Lord Byron (*The* Bride of Abydos).

HEROD, the name borne by the princes of a dynasty which reigned in Judaea from 40 B.C.

HEROD THE GREAT (*c.* 73 B.C.–4 B.C.), the son of Antipater and king of Judaea (40–4 B.C.), was descended from a family of Idumaean origin. When he was 2j, his father, who had served in Caesar's campaign against Egypt, appointed him ruler of Galilee. He at once arrested Hezekiah the arch-brigand, who had overrun the Syrian border, and put him to death. For this he was cited in the name of Hyrcanus to appear before the Sanhedrin, whose prerogative he had usurped in executing Hezekiah. He appeared with a bodyguard, and the Sanhedrin was overawed. Only Sameas, a Pharisee, dared to insist upon the legal verdict of condemnation. But the governor of Syria had sent a demand for Herod's acquittal, and so Hyrcanus adjourned the trial and persuaded the accused to abscond. Herod returned with an army, but his father dissuaded him from wreaking vengeance upon his enemies.

About this time (47–46 B.C.) he was created strategus of Coelesyria by the provincial governor. In 43 B.C. Antipater was poisoned at the instigation of one Malichus, who was perhaps a Jewish patriot. Herod, with the connivance of Cassius, who was in Syria to collect war-tax, had Malichus assassinated. The country was now in a state of anarchy, owing to the extortions of Cassius and the encroachments of neighbouring powers. Antony, who became master of the East after Philippi, was ready to support the

sons of his friend Antipater; but he was absent in Egypt when the Parthians invaded Palestine to restore Antigonus to the throne of his father Aristobulus (40 B.C.). Herod escaped to Rome, where Antony, who had made him tetrarch, now persuaded the Senate to declare him king of Judaea.

In 39 B.C. Herod returned to Palestine and, when the presence of Antony put the reluctant Roman troops entirely at his disposal, he was able to lay siege to Jerusalem two years later. Secure of the support of Rome he endeavoured to legitimize his position in the eyes of the Jews by taking the Hasmonaean princess Mariamne to be his second wife. Jerusalem was taken by storm; the Roman troops withdrew to behead Antigonus the usurper at Antioch. In 37 B.C. Herod was king of Judaea, being the client of Antony and the husband of Mariamne.

The Pharisees, who dominated the bulk of the Jews, were content to accept Herod's rule as a judgment of God. Hyrcanus returned from his prison, and though his mutilation prevented him from holding office as high priest, he was able to exercise an influence favourable to the new dynasty. On the other hand, Herod's marriage with Mariamne brought some of his enemies into his own household He had scotched the faction of Hasmonaean sympathizers by killing 45 members of the Sanhedrin and confiscating their possessions. But so long as there were representatives of the family alive, there was always a possible pretender to the throne which he occupied. Mariamne's mother used her position to further the overthrow of her son-in-law; and she found an ally in Cleopatra of Egypt, who was unwilling to be spurned by him

The events of Herod's reign indicate the temporary triumphs of his different adversaries. His high-priest. a Babylonian, was deposed in order that Aristobulus III., Mariamne's brother, might hold the place to which he had some ancestral right. But the enthusiasm with which the people received him at the Feast of Tabernacles convinced Herod of the danger, and the youth was drowned by his order at Jericho. Cleopatra had obtained from Antony a grant of territory adjacent to Herod's domain and even part of it. She required Herod to collect arrears of tribute. So it fell out that, when Octavian and the Senate declared war against Antcny and Cleopatra, Herod, preoccupied in obedience to her commands, was prevented from fighting against the future emperor of Rome.

After the battle of Actium (31 B.C.) Herod executed Hyrcanus. He took in hand to deal with the Hasmonaeans, and in 25 B.C. the old intriguers, their victims like Mariamne, and all pretenders were dead. From this time onwards Herod was free to govern Palestine as a client-prince of the Roman empire should govern his kingdom. To put down the brigands and to check the raids of the Arabs on the frontier. he built or rebuilt fortresses, which were of assistance to the Jews in the great revolt against Rome He restored the temple at Jerusalem, erected magnificent buildings, founded cities. and established games in honour of the emperor, who recognized his successful government by putting the districts of Ulatha and Panias under him in 20 B.C.

But Herod found new enemies in his household His brother Pheroras and sister Salome plotted for their own advantage and against the two sons of Mariamne. The people still cherished a loyalty to the Hasmonaean lineage, although the young princes were also the sons of Herod The enthusiasm with which they were received aroused suspicion in their father's mind, and they were strangled at Sebaste On his deathbed Herod discovered that his eldest son, Antipater, had been plotting against him. He accused him before the governor of Syria and obtained leave from Augustus to put him to death. The father died five days after his son in 4 B.C He had done much for the Jews, thanks to the favour he had won from the successive heads of the Roman State; and he had observed the Law publicly.

See Josephus, *Ant.* xv., xvi., xvii. 1–8, B J i 18–33; Schiirer, ***Gesch.*** **d** iud *Völk* (4th ed., 1901–09) i., and bibliography in Herzog's *Realencyklopädie.*

HEROD ANTIPAS, son of Herod the Great by the Samaritan Malthace, and full brother of Archelaus, received as his share of his father's dominions the provinces of Galilee and Peraea, with the title of tetrarch. He fortified Sepphoris in Galilee and Betharamptha in Peraea, and founded the important town of Tiberias on the west shore of the Sea of Galilee. He reigned 4 B.C.–A.D. 39. In the gospels he is mentioned as Herod, and he it was who was called a "fox" by Christ (Luke xiii. 32). He is erroneously spoken of as a king in Mark vi. 14. It was to him that Jesus was sent by Pilate to be tried. But it is in connection with his wife Herodias that he is best known. He was married first to a daughter of Aretas, the Arabian king; but, making the acquaintance of Herodias, the wife of his brother Philip (not the tetrarch), during a visit to Rome, he arranged to marry her. Meantime his Arabian wife discovered the plan and escaped to her father, who completely defeated Herod's army. John the Baptist condemned his marriage with Herodias, and in consequence was put to death. Encouraged by his wife, Herod went to Rome to crave a crown from the emperor. Agrippa, his brother-in-law! influenced Caligula against him, and he was deprived of his dominions and banished to Lugdunum (Lyons. or Saint-Bertrand-de-Comminges), Herodias voluntarily sharing his exile.

HEROD PHILIP, son of Herod the Great by Cleopatra of Jerusalem, received the tetrarchate of Ituraea and other districts east and north-east of the Lake of Galilee. His subjects were mainly Greeks or Syrians. He is described as an excellent ruler, who loved peace and was careful to maintain justice, and spent his time in his own territories. The cities he built include Caesarea Philippi and Bethsaida, which he called Julias. He died after a reign of 37 years (4 B.C.–A.D. 34).

HEROD AGRIPPA I (10 B.C.–A.D. 44), king of Judaea A.D. 41–44, was the son of Aristobulus (Herod the Great's son by his second wife, Mariamne), who had married his cousin Berenice. His original name was Marcus Julius Agrippa (Julius because Julius Caesar had made his great-grandfather a Roman citizen; Agrippa because M. Vipsanius Agrippa had been a close friend of Herod the Great). When. in 7 B.C., Aristobulus was executed, Agrippa was sent by Herod the Great to Rome, where he grew up in the imperial court. enjoying the favour of Antonia, mother of the future emperor Claudius, and the friendship of Drusus Caesar, her nephew. So long as his mother was alive, his love of display mas kept within bounds, but after her death he soon became bankrupt. Returning to Judaea, he was rescued from utter poverty by his sister Herodias, who induced her husband Herod Antipas to give Agrippa a post as overseer of the market in his new capital, Tiberias. The two quarreled, however, and Agrippa was a wanderer once more. Eluding arrest in' Palestine for his debts to the imperial treasury and raising a loan in Alexandria, he returned to Rome in A.D. 36. There, thanks to Antonia. Tiberius appointed him tutor to his grandson Tiberius Gemellus. Agrippa also ingratiated himself with Gaius (Caligula), Tiberius' heir. An indiscreet remark that he made to Caligula, to the effect that it was high time Caligula became emperor, was repeated to Tiberius who imprisoned Agrippa (Sept. A.D. 36). Six months later, Tiberius was dead and Agrippa in favour with the new emperor. Caligula. He received the tetrarchy of Batanaea and Trachonitis, to the east of the Sea of Galilee, formerly held by his uncle Philip. Herod Antipas and Herodias tried to discredit him with the emperor, but only brought about their own banishment, Antipas' tetrarchy passing in A.D. 39 to Agrippa. Agrippa was in Rome when Caligula was assassinated in 41 and played a leading part in the elevation of Claudius, who rewarded him with the government of Judaea (which since the banishment of Archelaus had been ruled by Roman procurators) and made his brother (usually called Herod of Chalcis) king of Chalcis in southern Lebanon.

Agrippa was now king of all the territories formerly ruled by his grandfather. He showed himself a zealous champion of Jewry and Judaism (he had already used his influence with Caligula to prevent the erection of a statue of him in the temple in Jerusalem). He was therefore popular with his subjects, and his brief reign marked the peak of their material felicity. He did all in his power to crush the nascent Christian church, and after executing James, the son of Zebedee, he arrested Peter, who escaped from prison (*Acts* xii). Agrippa also started to build a third wall on the north of Jerusalem, to enclose the New City which the secu-

rity of the previous 50 years had brought into being. His sudden death in A.D. 44 from an internal disease at Caesarea during games in honour of Claudius was a disaster for Jewry, because with all his faults of sycophancy and ostentation he had successfully kept the balance between Rome and the Jews and shown that the two could co-exist to the advantage of both.

See A. H. M. Jones, *The Herods of Judaea* (1938) ; S. H. Perowne, *The Later Herods* (1958). (S. H. P.)

HEROD AGRIPPA II (A.D. 27–*c.* 100), king of Chalcis in southern Lebanon from AD. 48 and tetrarch of Batanaea and Trachonitis from A.D. 52, was the son of Herod Agrippa I (*q.v.*). Like his father, he was brought up at the Roman court. As he was only 17 when his father died in A.D. 44, the emperor Claudius re-established procuratorial government in place of the kingdom of Judaea, but Nero added Tiberias and other places to Agrippa's tetrarchy. As spiritual head of the Jews, with power to appoint the high priests, Agrippa II played a prominent role in the events which led up to the Jewish War (A.D. 66–73) and in the war itself. He was an ardent collaborator with Rome and did all in his power to prevent the rupture between Rome and Jewry, but in vain. He was known to have had incestuous relations with his sister Berenice, and this, combined with his "romanizing" views, deprived him of any real authority over his people. With his death (c. 100), the family of the Herods, of which he was the last representative, sank back into the obscurity from which his ancestor Antipater, father of Herod the Great, had raised it. It was before Agrippa that St. Paul appeared at Caesarea (Acts xxvi), and it was he who supplied Josephus with much of the material for his history of the Jewish War.

See works cited under HEROD AGRIPPA I. (S. H. P.)

HERODAS (HERONDAS) (3rd century B.C.), Greek poet, probably of Cos, was the author of mimiambi, short dramatic scenes in verse, which, apart from their intrinsic merit, are interesting in the history of Greek literature as being a new species illustrating Alexandrian methods. Mimes, of which Sophron was a leading exponent, were the Dorian product of southern Italy and Sicily—scenes of popular life written in the language of the people. They were adapted by Herodas in his mimiambi under strict conditions of technique. He used the scazon ("lame") iambic (with a dragging spondee at the end), but although he wrote in the old Ionic dialect with which that metre is associated, the structure of the sentences is close-knit Attic. The grumbling metre and quaint language suit the tone of common life which Herodas aims at realizing. His characters talk in vehement exclamations and emphatic turns of speech, with proverbs and occasionally the most naked coarseness of expression.

In mime I the old nurse calls on Metriche, whose husband is away in Egypt, and tries to interest her in a young man who is in love with her. Metriche declines with dignity, but consoles the old woman with a glass of wine. Mime II is a monologue by a tvhoremonger prosecuting a merchant for breaking into his establishment at night and attempting to remove one of the inmates, who is produced in court. The whole oration is a burlesque of an Attic speech at law. In III a desperate mother brings to the schoolmaster a truant urchin. In a stream of interminable sentences she narrates his misdeeds and begs the schoolmaster to flog him. Hoisted on another's back the boy is flogged, but his spirit does not seem to be subdued.

Mime IV is a visit of two women with an offering to the temple of Asclepius at Cos. While the cock is being sacrificed they admire the works of art, among them a highly praised procession by Apelles "the Ephesian." In V a jealous woman accuses her favourite slave of infidelity, has him bound and sent to receive 2,000 lashes. The only pleasing person in the piece is the maid-servant, who suggests to her mistress an excuse for postponing execution of the threat. A private conversation is related in VI; the subject is an ugly one, but the dialogue is clever. Interest centres on Cerdon, an artistic shoemaker who appears again in VII.

In VIII Herodas, posing as a farmer, narrates his dream of how a goat belonging to him was torn in pieces by goatherds, votaries of Dionysus, thus symbolizing contemporary criticism of his poems, and of how he afterward won a prize for leaping on greased skins, thus representing his recognition as the true successor to Hipponax, the premier choliambic poet. Of IX, "The Women at Breakfast," only a few lines survive. A few other short fragments are preserved by Athenaeus and Stobaeus.

Within the limits of 100 lines or fewer Herodas portrays an entertaining scene and characters clearly drawn. Some of these had been perfected no doubt upon the Attic stage, where the tendency in the 4th century had been to evolve accepted types. The execution has the qualities of first-rate Alexandrian work in miniature, and these little pictures bear the test of all artistic work; they do not lose their freshness with familiarity but gain in interest with increased appreciation of their subtler points.

BIBLIOGRAPHY.—The papyrus containing Mimiambi I–IX was first published by F. G. Kenyon (1891). For editions *see* J. A. Nairn, *The Mimes of Herodas* (1904); *W*. Headlam and *A*. D. Knox, *Herodas: the Mimes and Fragments,* with Eng. trans. (1922); A. D. Knox, in Loeb series, with Eng. trans (1929). For verse translation *see* H. Sharpley, *A Realist of the Aegean* (1906). (E. A. B.)

HERODIANS (Herodianoi) mentioned in the Gospels as taking up a hostile attitude to Jesus (once in Galilee and again in Jerusalem); cf. Mark iii, 6, xii, 13; Matt. xxii, 16; cf. also Mark viii, 15. In every case they are coupled with the Pharisees. The formation of the word (*cf*. "Caesariani" and "Pompeiani") favours the view that what is meant is a party among the Jews who favoured the Herodian dynasty, and were its political partisans.

Another view is that they represented a religious party known in Rabbinical literature as "Boethusians" *i.e.,* adherents of the family of Boethus, whose daughter Mariamne was one of the wives of Herod the Great, and whose sons were raised by him to the high priesthood.

HERODIANUS, Greek historian, flourished during the 3rd century A.D. He is supposed to have been a Syrian Greek. In 203 he was in Rome, where he held some minor posts; the statement that he was imperial procurator and legate of the Sicilian provinces rests upon conjecture only. His historical work (Rhodianou tes *meta Markon* Basileias historion *biblia* okto) deals with the years between the death of Marcus Aurelius and the proclamation of Gordianus III (180–238). His work supplements Dion Cassius and has the value that attaches to a contemporary record written with candour and independence of view. But while he gives a lively account of external events—such as the death of Commodus and the assassination of Pertinax—the barbarian invasions, the spread of Christianity, the extension of the franchise by Caracalla are unnoticed. The dates are often wrong, and little attention is paid to geographical details, which makes the narrative of military expeditions beyond the borders of the empire difficult to understand.

Extensive use has been made of Herodianus by later chroniclers, especially the "Scriptores historiae Augustae" and John of Antioch. His history was first translated into Latin at the end of the 15th century by Politian. The most complete edition is by G. W. Irmisch (1789–1805), with elaborate indices, but the notes are diffuse; critical editions by I. Bekker (1855), L. Mendelssohn (1883) and K. Stavenhagen (Teubner, 1922).

HERODIANUS, AELIUS, called o technikos Alexandrian grammarian. He settled at Rome, under the patronage of Marcus Aurelius (161–180), to whom he dedicated his treatise on prosody (Καθολική προσῳδία) in 21 books. Several epitomes of this work have been preserved.

His Ἐπιμερισμοί dealt with difficult words and peculiar forms in Homer. Of his many grammatical treatises, only one has come down to us in a complete form (Περὶ μονήρους λέξεως), on exceptional or anomalous words.

The best edition is by A. Lentz, *Herodiani Technici* reliquiae (1867–70); a supplementary volume is included in Uhling's *Corpus grammaticorum Graecorum.*

See W. Christ, *Geschichte der griechischen Literatur* (1898).

HERODOTUS (5th century B.C.), Greek author of a history of the Persian Wars, was born at Halicarnassus, a Greek city in southwest Asia Minor at that time under Persian rule. The precise dates of his birth and death are alike uncertain. There was

an ancient tradition that he was born in 484, but this may mean no more than that he "must have been in his prime, *i.e.,* 40 years old, in 444," when he was thought to have been in Athens and met Sophocles, and to have left for Thurii. The latest event alluded to in his History belongs to 430, but how soon after or where he died is not known. There is good reason to believe that he was in Athens, or at least in central Greece, in the early years of the Peloponnesian War, from 431; and that his work was published and known there before 425. He had been in the west for some time before this and perhaps became a citizen of Thurii (founded in 444–443).

Nor is there any means of dating his travels, which were very wide. His journey in the west indeed may well have been, as suggested, later than 443. His longer wandering covered a large part of the Persian empire: he went to Egypt, at least as far south as Elephantine (Aswan), and his visit there, or one of his visits, was after 460; to Libya; Syria; Babylonia; Susa in Elam; Lydia; Phrygia; up the Hellespont to Byzantium; to Thrace and Macedonia; by land or sea or both, northward to beyond the Danube; and to Scythia eastward along the northern shores of the Black sea as far as the Don and some way inland. These travels would have taken many years. If he were born in 484, he could hardly have started them before 450, for his mind mas already mature; he knew what he wanted to search for. But 484 is an uncertain date; he may well have been older.

Structure and Scope of the History.—Herodotus' theme in his History is the war between Greece and Persia and its preliminaries. As it has survived, it is divided into nine hooks (the division is not Herodotus' own): books i–v describe the background to the Graeco-Persian Wars (*q.v.*); books vi–ix contain the history of the wars, culminating in an account of Xerxes' invasion of Greece (book vii) and the great Greek victories of 480–479 B.C. "I am giving," he says in his opening words, "the results of my enquiries (*historiai*), so that the memory of what men have done shall not perish from the world nor their achievements, whether of Greeks or of foreigner. go unsung: they form my theme, and the cause why they went to war." Then after a brief, lighthearted narrative of mythical "aggressions" by one side or the other, culminating in the Trojan War, with different versions of them by the two sides, he goes on: "However I am not concerned with these stories: what 1 am going to narrate is the first known aggression against Greek states, and from it I shall proceed onward, mentioning many cities of men, great and small (for many that were once great are now small, and many now great were small before—human prosperity is a fragile thing). Croesus was a Lydian by birth . . ." and so the great narrative begins. But this, though not at all inconsistent with the form of the History as it was published, yet is not at all a full introduction to it; for, though they are wonderfully well combined into an organic unity, there are two parts in the History, one the systematic narrative of the war of 480–479 mith its preliminaries from 499 onward (including the Ionic revolt and the battle of Marathon, books vi–ix), the other the story of the growth and organization of the Persian empire and a description of its geography, social structure and history.

There has been much debate among modern scholars whether Herodotus from the first had this arrangement in mind or had begun with a scheme for only one part, a description of Persia, or a history of the war, and if so, with which; and the consideration which the problem has received is worthwhile even though no positive answer can be given. so skillfully has Herodotus combined all into one. The view put forward by A. Bauer in Germany, and most persuasively in England by R. W. Macan (see Bibliography) is the most probable, that he began with a plan for the history of the war, and that later he decided on a description of the empire when the question forced itself on his inquiring mind. For a man iike Herodotus was bound to ask himself. "Yes, but what do we mean when we say the Persian (or often the Mede) invaded Greece?" "How did it happen that Xerxes included in his army Scythians and Cappadocians, Lpdians, Lycians, Bactrians and Indians, besides his own Persians and Medes, and relied for his fleet on ships manned by Phoenicians and Egyptians and by some Greeks?" For Herodotus was deeply impressed not only by the great size of the Persian empire compared with all the little Greek states together, but also by the varied and polyglot nature of its army, which was yet united in a single command, in complete contrast to the Greek forces with their political divisions and disputatious commanders, although the Greeks shared a common language, religion and way of thought and the same feeling about what they were fighting for. This difference, and the meaning of "the Persian," had to be explained to his readers, and to this end he describes the empire.

A logical link between the two main sections is to be found in the account (book vii) of the march of the immense army—as on parade and as if on a parade ground—from Sardis to the Hellespont (nearly 200 mi.) on the way to the crossing by the bridge of boats into Europe. First comes a story of Xerxes' arrogance and petulance, followed by another of his savage and autocratic cruelty, then the parade—the baggage train in the van, then half the fighting force, all nations together, then a gap, for none of them came near the king; then 1,000 select Persian cavalry and 1,000 select spearmen, 10 sacred horses called Nisaean, richly caparisoned, the chariot sacred to Zeus drawn by 8 white horses with the driver walking, reins in hand (no man might ride in it), then Xerxes himself standing in his chariot drawn by Nisaean horses with his driver, a noble Persian, standing beside him. So Xerxes rode out from Sardis and, when he so minded, he would change to his carriage. Behind him were another 1,000 spearmen and select cavalry, followed by 10,000 chosen infantry and 10,000 cavalry; then a gap of two furlongs, then the rest of the army, the nations all together. With this account and with the detailed enumeration of all the national and racial elements in the force, naval and military, at the subsequent muster in Thrace, Herodotus has completed one thing that he set out to do—to explain the meaning of Xerxes' "Persian" invasion, as well as of the preliminary events of the previous 20 years; all woven into one intricate pattern.

One detail of arrangement supports this view of the development of Herodotus' theme. His method in the account of the empire is to describe each division of it not in a geographical order, but as each was conquered by Persia—by Cyrus, Cambyses and Darius; thus a picture is given of the formation of the whole, The one exception to this arrangement is Lydia which is treated at the very beginning of the history not because it was first conquered, but because it was the first foreign country to attack and overcome the Greek cities of Asia Minor; and was also of course their nearest neighbour, with whom they were already well acquainted. It would be pedantic to suggest that Herodotus would not have started in this fashion if his earliest project had been the description of the Persian empire; but for all that the form of the first section of book i fits very well with the other hypothesis and with the wording of his preface.

The first section. the history and description of Lydia and its conquest, is followed by the story of Cyrus himself, his defeat of the Medes and a description of Persia proper, his attack on the Massagetae (in the northeast, toward the Caspian) and his death. Book ii contains the succession of Cambyses, Cyrus' son, his plan to attack Egypt. and the immensely long account of that unique land and its history. This account is too long for the proportions of the whole book and is Herodotus' one failure as artist; but his zeal as historian and inquirer would not let him make it shorter. Book iii describes the conquest of Egypt. the failure of invasions to the south (Ethiopia) and west; the madness and death of Cambyses; the struggles over the succession in Persia, ending with the choice of Darius; the organization of the new vast empire by him. mith some account of the most distant provinces as far east as Bactria and northwest India; and the internal revolts suppressed by Darius. Book iv begins with the description and history of the Scythian peoples. from the Danube to the Don. whom Darius proposed to attack by crossing the Bosporus. and of their land and of the Black sea.

Then follows the story of the invasion of Scythia, which carried with it the submission of more Greek cities, such as Byzantium; of the simultaneous attack from Egypt on Libya, which had been

colonized by Greeks; and the description of the country and its colonization. Book v describes further Persian advances into Europe from the Hellespont and the submission of Thrace and Macedonia and many more Greek cities; then the beginning of the revolt of the Greek cities of Ionia against Persia, and so to the main subject of the whole work.

Method of Narration. — This bald account of the first half of Herodotus' History not only conceals its infinite variety, but is positively misleading in so far as it suggests a straightforward geographical, sociological and historical description of a varied empire. The History is more complex than that, and Herodotus' method of narration has also to be described. **A** more detailed account of the first section of the whole (Lydia), which is typical, will help to make clear the many sides of his problem.

First, he had, of course, no need to explain Greek geography, customs or political system, to his Greek readers; but he did wish to describe the political situation at the relevant times of the many Greek cities later involved in the war. This he does by means of digressions skillfully worked into his main narrative. Croesus, the king of Lydia, wishing to act before Cyrus, aho had just conquered Astyages the Mede, consulted many oracles of which that at Delphi seemed to him the truest when it appeared to encourage him in his purpose and advised him to seek Greek allies. He found that Athens and Sparta were then the most powerful of Greek cities, the one Ionian, the other Dorian (a digression on the past history of Ionians and Dorians explains the division in Greece). Athens, however, was at the time (546 B.C.) prevented from action by the struggle between Peisistratus, who was trying to confirm his position as tyrant, and the nobles; but Sparta had only a generation before established its own hegemony in the Peloponnese, and was ready to help (but was too late, Cyrus acting far more quickly than Croesus and his allies had thought possible). Similarly, much further on in the history the story is told of how Aristagoras from Miletus asked for help from Sparta and Athens for the Ionians in revolt (c. 500 B.C.), but was rebuffed at Sparta because he was too truthful about the size of the Persian empire and especially the length of the royal road from Ephesus to Susa, the Persian capital (with its regular stations and security posts and postal system — something quite unknown in Greece). However, he uas welcomed at Athens which had recently freed itself from tyranny and was full of energy and optimism. This carries with it the story of the overthrow of the tyranny, in which Sparta played a double part, which itself connects with the 6th-century history of tyranny at Corinth and Sicyon as well. Later again there is an account of fighting between Athens and Aegina, and of the heavy defeat of Argos by Sparta. All of this, and much besides, some of it only included because of Herodotus' personal interest, helps to explain the positions of these Greek states in 490 (battle of Marathon) and 480 (invasion of Xerxes).

Gift as a Storyteller. — There is a feature of Herodotus' History which is of the first importance and among the most remarkable — his love of and gift for storytelling: that is to say, his love of narrating history in the storyteller's manner (which is not unlike Homer's). For this he uses (besides narrative) dialogue and speech in the words of the speaker, which he can do because the storyteller knows what his own characters said as well as what they did. In the first chapters of his History, Herodotus begins with a story told in this manner of the accession to the throne of Lydia of Gyges, the first of the dynasty of kings of which Croesus was the fifth and last. This is followed by further stories: of Solon and Croesus; of Croesus and Adrastus (a tragic short story, told by a master of the art); of Croesus, now a captive; and of Cyrus. Such stories occur throughout the History, and are in every mood: the boyhood of Cyrus; Rampsinitus and the clever thief (an Arabian Nights sort of tale which Herodotus heard in Egypt); the comedy of the birth of Cypselus who became first tyrant of Corinth. and the grim tale of his son Periander (another masterpiece) and the latter's son Lycophron; the humorous little story uhich Herodotus himself does not believe but cannot refrain from telling, of Xerxes' narrow escape from shipwreck when he was returning from Greece. But this method of narration is not confined to the more or less separate "short story" told in digression, nor to the distant past; it is employed in the very core of the history, for instance, Miltiades' exhortation to Callimachus on the field of Marathon, Artabanus' warnings to Xerxes of the difficulties and risks of the invasion, the debates between the Greek leaders before the battle of Salamis. There is no need to doubt that Miltiades made such an exhortation, though not on the battlefield but to the assembly or council in Athens before the army moved out; and was, though not commander, the moral author of the victory; nor that such warnings as those of Artabanus were given to Xerxes; the strife between the Greek leaders and the tireless insistence of Themistocles is, without doubt, historically true. But these things are the more easily credible because of the convincing reality of Herodotus' writing, much of it in the storyteller's rather than the historian's manner.

Outlook on Life. — The story of Croesus in book i gives Herodotus the occasion to foreshadow, as it were, in Croesus' talk with Solon (a conversation chronologically impossible, but not of course invented by Herodotus), the generalized meaning of the story of the Persian Wars, and so of his whole History — that great prosperity is "a slippery thing," and may lead to a fall; more particularly if it is accompanied by arrogance and folly as in Xerxes, but not only then. Croesus is throughout a sympathetic figure, kindly, generous in the extreme to one in misfortune, only childishly pleased with his great wealth and confident that nothing can go wrong — so he laughs at Solon's warning that no man can be called happy before the end of his life, until tragedy comes to him, the death of his son; then he recovers, and lightheartedly, without due thought, undertakes the attack on Cyrus "before Persia grows too strong" — and total disaster follows. The main story — Xerxes' invasion of Greece — is an even clearer case: a war, which by all human reasoning should have been won, was irretrievably lost. This does not mean that Herodotus, any more than his older contemporary, the poet Aeschylus, simply accepted the old moral "pride goes before a fall"; it was a matter of common observation and proved overwhelmingly true by the greatest event of his time.

In this connection another point must be made. It is often asserted that for Herodotus (and for Aeschylus and others) men are but puppets of an all-powerful fate and that in consequence his story of "pride and fall, sin and retribution, has for him no ultimate moral significance." (J. E. Powell: introduction to his translation of Herodotus, p. xxi, published by Clarendon Press, Oxford; see Bibliography.) This is thought to be confirmed by the story of Croesus, who had been such a generous giver to Apollo's shrine at Delphi only to be rewarded at the end by the deceiving oracle "that if he should attack Cyrus he would destroy a great empire"; then, when after his fall he upbraided the oracle and asked if it were the Greek gods' habit to be ungrateful, he received the reply: "it was caused by the wrongdoing of Gyges your ancestor, in seizing the throne, a sin which fate decreed should be atoned in the fifth generation after, and not even the gods can override fate." But Herodotus has related as clearly as he can that Gyges had the choice whether to commit a crime or die rather than commit it, and "he chose to live"; and Croesus himself, when Delphi reminded him that in so grave a matter he should have inquired more fully into the meaning of a dubious oracle, admitted his responsibility. The story of Glaucus the Spartan who sought, with Delphic aid, to defraud a Milesian of his money, has a similar structure. Herodotus was not an analytic philosopher, but he knew the meaning of a man's responsibility for his actions.

Qualities as a Historian. — Herodotus was a great traveler, with an eye for detail and for the whole, a good geographer, and a man with an indefatigable interest in the customs and past history of his fellow men, and of the widest tolerance, with no bias in favour of Greek and against the barbarian. He was neither naïve nor easily credulous. It is this which makes the first half of his work not only so readable but of such historical importance. In the second half he is largely, but by no means only, writing military history; and it can easily be shown that he knew little of military matters: he moves immensely large armies from place to place as though they were single travelers and problems

of supply hardly existed; his detailed battle pieces are scarcely ever acceptable or even consistent. Yet he understood at least one essential of the strategy of Xerxes' invasion, the Persians' dependence on the fleet though they came by land, and therefore the decisive importance of the sea battle of Salamis (*q.v.*). Similarly in the political story: he is commonly content with a personal motive of a trivial (though psychologically revealing) kind —the contrast with Thucydides is as wide as can be. Yet here again he understood certain essentials: that the political meaning of the struggle between the great territorial empire of Persia and the small Greek states was not independence only. but the rule of law as the Greeks understood it; and that the political importance of the battle of Marathon for the Greek world was that it foreshadowed the rise of Athens (confirmed by Salamis) to a position of equality and rivalry with Sparta and the end of the long-accepted primacy of the latter. He knew that war was not only a question of victory or defeat, glorious as the Greek victory was, but brought its own consequences in its train, no matter who won. "The ships which Athens sent to help the Ionians in their revolt (499 B.C.) were the beginning of suffering for Greeks and non-Greeks" (v. 97). There was an earthquake at Delos in 490, when the Persian armament had just passed on its may to Marathon, which was unique and a portent of the evils which were to fall on Greece, "for during the next three generations more evil befell than during the 20 before, partly caused by Persia, partly by the leading Greek states themselves quarreling for power." Not, it will be noted, simply a portent of the glorious victory of Greek over barbarian.

Was the History Finished? — It has been questioned whether Herodotus died before his work was finished, on two grounds. He makes a couple of promises which he has not fulfilled, one of them, the account of Assyria, leaving a notable gap in the whole; but it is impossible now to be sure of the reason for this. Others have thought that he could not have intended to end where he does with the Greek capture of Sestos on the Hellespont in 479 B.C., for the war went on for another 30 years and did not formally cease until 449. Herodotus' main theme. however, was the invasion of 480–479 and with the revolt of the Ionians and the fall of Sestos the Persians practically ceased to be on Greek soil. Aeschylus' framework for his tragedy was the same and Thucydides agreed in this, as in so many other things, with Herodotus.

Conclusion. — Herodotus had had his predecessors in prose writing (whose works are now lost), especially Hecataeus of Miletus (*q.v.*), a great traveler whom Herodotus mentions more than once—to criticize for inaccuracy in his book and to praise as a practical statesman. But they, for all their charm: says Dionysius, also of Halicarnassus, wrote either chronicles of local events. of one city or another, covering a great length of time, or comprehensive accounts of travel over a large part of the known world. none of them creating a unity, an organic whole. In the sense that he created a work that is an organic whole Herodotus was not only the first of Greek, and so of European, historians; he was also the first European writer of prose. His true predecessor. Homer. wrote in verse; and Aristotle's praise of Homer by contrast with other poets of epic—who thought that 'if they had a single title of a city or a hero, *Thebais* or *Heracleias,* they had achieved artistic unity—is analogous to Dionysius' just estimate of Herodotus.

Herodotus' work is not only an artistic masterpiece; for all his mistakes (and for all his fantasies) he remains the leading authority not only for Greek history of the particular period with which he is concerned, but for much of that of western Asia and of Egypt.

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(A. W. GE.)

HEROET, ANTOINE, surnamed La MAISON-NEUVE (d. 1568), French poet, bishop of Digne, was born in Paris of a family connected with the chancellor Olivier. His poetry belongs to his early years, for after he had taken orders he ceased to write profane poetry. His chief work is *La Parfaicte Amye* (Lyons, 1542) in which he developed the idea of a purely spiritual love, based chiefly on the reading of the Italian Neo-Platonists. The book aroused great controversy. La Borderie replied in *L'Amye de cour* with a description of a very much more human woman, and Charles Fontaine contributed a *Contr' amye de cour* to the dispute. Héroet, in addition to some translations from the classics, wrote the *Complainte d'une dame nouvellement surprise d'amour,* an *Epistre a François Ier,* and some pieces included in the now very rare *Opuscules d'amour par He'roet, La Borderie et autres divins poetes* (Lyons, 1547). Héroet belongs to the Lyonnese school of which Maurice Scève may be regarded as the leader.

See H. F. Cary, *The Early French Poets* (1846).

HEROIC ROMANCES, the name of a class of imaginative literature which flourished in the 17th century, principally in France. The beginnings of fiction in that country took a pseudo-bucolic form with the celebrated *Astrée* (1610) of Honoré d'Urfé (1568–1625); but this ingenious and diffuse production was the source of a vast literature, which took many and diverse forms. Although its action was, in the main, languid and sentimental, there was a side of the *Astrée* which encouraged that extravagant love of glory, that spirit of "panache," uhich was now rising to its height in France. That spirit it was which animated Marin le Roy, sieur de Gomberville (1600–74), the inventor of the Heroic Romances. In these there was experienced a violent recrudescence of the mediaeval elements of romance. the impossible valour devoted to a pursuit of the impossible beauty, but the whole clothed in the language and feeling and atmosphere of a later age. In the *Carithée* of Gomberville (1621) we have a pastoral which is already beginning to be a heroic romance, and a book in which, under a travesty of Roman history, an appeal is made to an extravagantly chivalrous enthusiasm. A further development was seen in the *Polyxène* (1623) of François de Molière, and the *Endymion* (1624) of Gombauld; in the latter the elderly queen, Marie de' Medici, was celebrated under the disguise of Diana, for whom a beautiful shepherd of Caria nourishes a hopeless passion. The earliest of the Heroic Romances, pure and simple, is, however, the celebrated *Polexandre* (1629) of Gomberville. The author began by intending his hero to represent Louis XIII, but he changed his mind, and drew a portrait of Cardinal Richelieu. The story deals with the adventures of a hero who visits all the seacoasts of the world, the most remote as well as the most fabulous, in search of an ineffable princess, Alcidiane. This absurd, yet very original piece of invention enjoyed an immense success. There was an equal amount of geography and more of ancient history in the *Ariane* (1632) of Desmarets de Saint-Sorlin (1595–1676), which has been greeted by Paul Morillot as the most readable of all the Heroic Romances.

Calprenède and Scudéry.—The type of that class of literature, however, has always been found in the highly elaborate writings of Gauthier de Coste de la Calprenède (1609–63), which enjoyed for a time a prodigious celebrity. His *Cassandre,* which appeared in ten volumes between 1642 and 1645, is perhaps the most characteristic of all the Heroic Romances. It deals with the decline of the empire of Alexander the Great. It must not be supposed, however, that la Calprenhde makes the smallest effort to deal with the subject accurately or realistically. The figures are seigneurs and great ladies of the court of Louis XIII., masquerading in Macedonian raiment. The passion of love is dominant, and it is treated in the most exalted and hyperbolical spirit. La

Calprenede followed up the success of his *Cassandre* with a *Cléopâtre* (1647) in 12 volumes, and a *Faramond* (1661) which he did not live to finish. It should be said that la Calprenkde objected to his books being styled romances, and insisted that they were specimens of "history embellished with certain inventions." He may, in opposition to his wishes, claim the doubtful praise of being, in reality, the creator of the modern historical novel.

The vogue of the historical romance was carried to its height by a brother and a sister, Georges de Scudéry (1601–67) and Madeleine de Scudkry (1608–1701), whose elephantine romances remain as portents in the history of literature. These novels—there are five of them—were signed by Georges de Scudkry, but it is believed that all were in the main written by Madeleine. The earliest was *Ibrahim, ou l'Illustre Bassa* (1641); it was followed by *Le Grand Cyrus* (1648–53) and the final, and most preposterous member of the series was *Clélie* (1649–54). The romances of Mlle. de Scudkry (for to her we may safely attribute them) are much inferior in style to those of la Calprenkde. They are pretentious, affected and sickly. The author abuses the element of analysis. and pushes a psychology, which was beyond the age in penetration, to a wearisome and excessive extent.

Vogue in England.— In England the Heroic Romance had a period of flourishing popularity. All the principal French examples were translated, and "he was not to be admitted into the academy of wit who had not read *Astrea* and *The Grand Cyrus.*" The vogue of these books in England lasted from about 164j to 1660, and led to the composition of original works in imitation of the French The most remarkable of these was *Parthenissa,* published in 1654 by Roger Boyle, Lord Broghill and afterwards earl of Orrery (1621–79). Addison speaks in the *Spectator* of the popularity of all these huge books, "the *Grand Cyrus,* with a pin stuck in one of the middle leaves, *Clélie,* which opened of itself in the place that describes two lovers in a bower." M. Jusserand has analysed what may be considered the very latest of the race, *Pandion and Amphigenia,* published in 1665 by the dramatist, John Crowne.

See G. de Percel, *De l'usage des romans* (1734); J. J. Jusserand, *Le Roman anglais au XVII^e siècle* (1888); André Le Breton, *Le Roman au XVII^e siècle* (1890); P. Morillot, *Le Roman en France depuis 1610* (1894). (E. G.; X.)

HEROIC VERSE, a term exclusively used in English to indicate the rhymed iambic line or HEROIC COUPLET. In ancient literature the heroic verse was the hexameter. It was in this measure that the *Iliad* and *Odyssey* and the *Aeneid* were written. In English, however, it is not enough to designate a single iambic line of five beats as heroic verse because it is necessary to distinguish blank verse from the distich, consisting of two rhymed lines, each of ten syllables. In French the Alexandrine has always been regarded as the heroic measure of that language. The current form of English heroic verse appears to be the invention of Chaucer. who used it in his *Legend of Good Women,* and afterwards, with still greater freedom, in the *Canterbury Tales.* He was followed nearly a century later by the Scottish poet, called Blind Harry (*c.* 1475), whose *Wallace* holds an important place in the history of versification as having passed on the tradition of the heroic couplet. Another Scottish poet, Gavin Douglas, selected heroic verse for his translation of the *Aeneid* (1513) and displayed, in such examples as the following, a skill which left little room for improvement at the hands of later poets:—

> "One sang, 'The ship sails over the salt foam,
> Will bring the merchants and my leman home';
> Some other sings, 'I will be blithe and light,
> Mine heart is leant upon so goodly wight.'"

The verse so successfully mastered was, however, not very generally used for heroic purposes in Tudor literature. The early poets of the revival, and Spenser and Shakespeare after them, greatly preferred stanzaic forms. For dramatic purposes blank verse was almost exclusively used, although the French had adopted the rhymed Alexandrine for their plays. In Elizabethan England heroic verse was often put to somewhat unheroic purposes, mainly in prologues and epilogues, or other short poems of occasion; but it was nobly redeemed by Marlowe in his *Hero and Leander* and respectably by Browne in his *Britannia's Pastorals.* It is to be noted, however, that those Elizabethans who, like Chapman and Drayton, aimed at producing a warlike and Homeric effect, did so in shambling 14-syllable couplets. The one heroic poem of that age written at considerable length in the appropriate national metre is the *Bosworth Field* of Sir John Beaumont (1582–1628). Since the middle of the 17th century, when heroic verse became the typical and for a while almost the solitary form in which serious English poetry was written, its history has known many vicissitudes. After having been the principal instrument of Dryden and Pope it was almost entirely rejected by Wordsworth and Coleridge, but revised, with various modifications, by Byron, Shelley (in *Julian and Maddalo),* and Keats (in *Lamia).* In the second half of the 19th century its prestige was restored by the brilliant work of Swinburne in *Tristram* and elsewhere. Alfred Noyes, in *Drake,* and G. *K.* Chesterton, in *Lepanto,* varied the rhythm and increased the sonority of the line.

HEROIN, a derivative of morphine (diacetylmorphine) having a similar action. As an analgesic it is from four to eight times more powerful than morphine, but it also produces more undesirable side effects in the form of respiratory depression. Heroin was introduced as a substitute for morphine to minimize the danger of addiction, but subsequent experience showed it to be even more dangerous in this respect. It makes addicts more easily than morphine does, and the addiction is harder to cure. Its most important use in medicine is to relieve cough, but any advantages are more than offset by the addiction liability. Its manufacture and importation are forbidden in the United States, and it was deleted from the British pharmacopoeia in 1953. Heroin represents a major addiction problem, contributing a large portion of the total illicit traffic in narcotics. It has been estimated that 75% of drug addicts on the eastern seaboard of the United States are users of heroin. *See* also DRUG ADDICTION; MORPHINE.

(V. E.)

HÉROLD, LOUIS JOSEPH FERDINAND (1791–1833), French composer of early romantic operas, was born in Paris Jan. 28, 1791. He was a pupil of Charles Simon Catel and Joseph Méhul, winning the Prix de Rome in 1812. His first opera *La Gioventù di Enrico V* (the overture to which became known under its French title, *La Jeunesse de Henri V*) was produced in 1815 at Naples where Hérold was court pianist. On his return to Paris he collaborated with François de Boieldieu in the opera *Charles de France* (1816); he produced 12 light operas at the Opéra-Comique between 1817 and 1830. In 1823 he collaborated with Auber in *Vendôme en Espagne,* produced at the Paris Opéra where four of his ballets were given between 1827 and 1829, including the four-act *La Belle au bois dormant.*

In 1831 his *Zampa* and, the following year, *Le Pré aux clercs* were produced at the Opéra-Comique. Though these operas were later to be known only by their overtures, they revealed a novel use of instrumental colour deriving from Weber, and also a subtle sense of characterization. His last opera *Ludovic* was completed by Fromental Halévy. Like Auber and Boieldieu, Hérold brought the *opéra-comique* to the borders of romantic opera, and anticipated in his later works the style of Berlioz. Hérold was also a prolific composer of piano and chamber music, which includes four piano concertos and works for unusual combinations of wind instruments. He died in Paris, Jan. 19, 1833.

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HERON, any long-legged, long-necked wading bird of the suborder Ardeae. order Ciconiiformes. The boat-billed heron (*Cochlearius cochlearius),* ranging from Mexico to Brazil, constitutes the family Cochleariidae. About 30 genera and about 60 species, widely distributed over the world but commonest in the tropics, form the family Ardeidae. They have broad wings; long, straight, sharp-pointed bill; the feet have comb-edged middle claws, probably used for grooming. Egrets (*q.v.*) develop lacy nuptial plumes over the back. Bitterns (*q.v.*) are smaller, stouter, browner herons with shorter necks.

Herons perch hunched in trees, stand quietly in shallows or wade

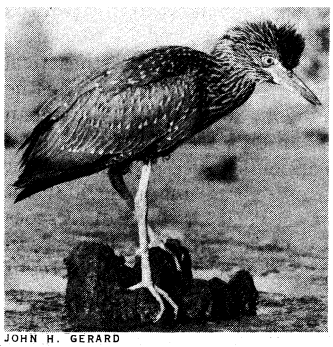
slowly for fish, frogs or other small animals, which they capture with a quick thrust of their daggerlike bill. They fly low over water, or high with leisurely flapping wings, head folded against body and legs trailing loosely. The nests are usually grouped in colonies called heronries. Each nest consists of a rough platform of sticks constructed in a tree or bush near water. Three to five pale, dull-blue eggs are usually laid. Helpless downy young grasp the parents' bill and receive partly-digested food.

ALLAN D. CRUICKSHANK FROM NATIONAL AUDUBON SOCIETY

GREAT BLUE HERON (ARDEA HERODIAS)

Some herons are insect feeders and land dwellers. Among these is the cattle egret *(Bubulcus ibis)* of Africa. Asia and southern Europe. It is often seen perched on the backs of water buffalo who transport the bird and serve as a source of ticks. During the period from about the 1940s to the 1960s, this species invaded the Americas where it has spread rapidly and has nested in numbers, especially in Florida and the tropics. It has been reported from Newfoundland to Bolivia.

The blue-gray heron *(Ardea cinerea),* 36 in. long, of Europe, Asia, Madagascar and Africa, mas once hunted with falcons. The great blue heron *(A. herodias),* 50 in. long, ranges from Alaska and Nova Scotia to southern Mexico and the Galapagos Islands. Other large dull herons live in South America, Africa, southern Asia, the Philippines and Australia. Africa is the home of the giant or goliath heron (A. *goliath)* which stands *j* ft. tall. The great white heron *(A. occidentalis)* breeds in southern Florida, Cuba, Jamaica and Yucatán.



JOHN H. GERARD

YELLOW-CROWNED NIGHT HERON (NYCTINASSA VIOLACEA)

The medium-sized purple heron (A, *purpurea)* is common over most of the old world. The little green heron *(Butorides virescens),* 18 in. long, is common from southern Ontario and Oregon to Panamá; a close relative *(B. striatus)* ranges over South America, Africa. southern and eastern Asia. Australia and nearby islands. The little blue heron *(Florzda coerulea),* 22 in. long, white when young, occurs from Delanare and the gulf states to Argentina; the white-bellied Louisiana heron *(Hydranassa tricolor),* 26 in. long, occurs in the Carolinas and gulf states to northern South America.

Night herons have thicker bills, shorter legs and are more active in the twilight hours and at night. The black-crowned night heron (*Nycticorax nycticorax)* ranges over the Americas. Europe, Africa and Asia; N. *caledonicus* in Australia, New Caledonia and the Philippines; yellow-crowned night heron *(Nyctinassa violacea)* from New Jersey and Indiana to southern Brazil.

(G. F. Ss.; Ht. Fn.)

HERO (Heros) OF ALEXANDRIA, Greek geometer and writer on mechanical and physical subjects. Hero's reference in his *Dioptra* to a lunar eclipse, visible in Alexandria in A D 62, shows that he lived in the 1st century A D

Of Hero's mechanical norks, the *Pneumatica, Automatopoietice, Belopoeica* and *Cheiroballzstra* survive in Greek. The *Pneumatica,* in tno books. describes many interesting contrivances such as siphons, "Heron's fountain," "penny-in-the-slot" machines, a fire engine, a water organ and arrangements employing the force of steam. The *Belopoeica* (on engines of war) purports by its title to be based on a work by Ctesibius, who lived about 250 B.C. in Alexandria. Hero's *Mechanics,* in three books, is extant in Arabic, though not in its original form. This work is cited by Pappus, as is also the *Barulcus,* "weight-lifter," probably the same treatise under a different name. Book ii of the *Mechanics* deals with the five mechanical powers and mechanical problems of daily life. and Book iii with the construction of engines of all sorts. Both the *Belopoeica* and the *Mechanics* contain Hero's solution of the problem of the two mean proportionals.

The geometrical works attributed to Hero that survive in Greek bear the titles *Metrica, Definitiones, Geometria, Geodaesia, Stereometrica* (i. ii), *Mensurae* and *Liber Geeponicus.* The *Metrica* was discovered as recently as 1896 by R. Schone in a manuscript at Constantinople. It is by far the most important, as it is the most genuine, of the geometrical works of Hero, and proves him to have been an accomplished mathematician. The other works containing. like the *Metrica,* problems of mensuration are not Hero's in their present form. A good part of their contents is based on geometrical rules developed in Mesopotamia in the second millennium B.C. and was commonly known in the Hellenistic period. A remarkable feature is the statement of a variety of close approximations to the square roots of numbers that are not complete squares; the *Metrica* describes a general method of finding successive approximations to the values of such surds. as well as a method of approximating the cube root of a noncube number; the former throws light on similar approximations to surds stated in Archimedes and in astronomical works; *e.g.,* Ptolemy's *Almagest.* Book i of the *Metrica* includes the mensuration of triangles, quadrilaterals, regular polygons from the equilateral triangle to the regular dodecagon, circles and segments thereof, an ellipse, a parabolic segment, and of the surfaces of cylinders, right cones, spheres and segments thereof. Book ii shows how to measure the content of solid figures, including cones, pyramids, frusta of such solids, a sphere and a segment thereof, the five regular solids, besides the two remarkable solid figures measured by Archimedes in his *Method* (a solid like a hoof cut off by a plane from the end of the cylinder, and a solid made up of eight such "hoofs"). Book iii gives some problems of the same type as those in Euclid's treatise *On Divisions* (of figures). Akin to the geometrical works is that *On the Dioptra,* a remarkable book on land surveying. so called from the instrument described in it, which was used for the same purposes as the modern theodolite; this treatise contains also an astronomical chapter which describes a graphical method for the determination of the distance between Alexandria and Rome by means of the difference of local time in the simultaneous observation of a lunar eclipse. Chapter 30 gives the proof of "Heron's .formula" for the area of a triangle in terms of its sides,

$$\Delta = \sqrt{\{s(s-a)(s-b)(s-c)\}}$$

This formula is, however, older than Hero; al-Biruni (d. 1048) quotes Archimedes for it.

Hero also wrote *Catoptrica* (on reflecting surfaces); and it seems certain that this is extant in a Latin translation by William of Moerbeke of a work which was formerly thought to be a fragment of Ptolemy's *Optics.* Hero explains the rectilinear propagation of light as well as the law of reflection by the principle of minimal distance. Of other treatises by Hero only fragments remain. One on water clocks in four books is referred to by Pappus and Proclus. Another was a commentary on Euclid's *Elements,* quotations from which are found in the extant Arabian commentary by An-Nairizi.

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Wiss. (1918). For accounts of Hero's works *see* Tittel in *A.* Pauly and G. Wissowa, *Real-Encyclopädie,* 8, 1, 992–1080 (1912); Sir T. L. Heath, *History of Greek Mathematics,* vol. ii, pp. 298–354; A. G. Drachmann, *Ktesibios, Philon, and Heron, a Study in Ancient Pneumatics* (1948). (T. L. H.; O. E. N.)

HEROPHILUS (*fl.* 300 B.C.), Alexandrian anatomist, was born at Chaludon, and was one of the founders of a school of anatomy at Alexandria.

Being one of the first to perform post-mortem examinations, he studied the eye and cataract, traced the sinuses of the dura mater to their meeting point, still called the torcular herophili, and described the ventricles of the brain, an organ which he regarded as the centre of the nervous system. The nerve trunks he distinguished into sensory and motor branches. He also gave careful accounts of the liver, salivary glands. pancreas and the genital tracts of both sexes, and emphasized the curative powers of drugs, dietetics and gymnastics. Herophilus wrote commentaries on the works of Hippocrates, a book for midwives and a treatise on the causes of sudden death.

HERPES is a term for skin eruptions of different origin in which grouped vesicles appear on a reddened base. Such eruptions are herpes simplex *(see* COLD SORE). herpes zoster *(see* SHINGLES), herpes gestationis, herpes tonsurans, etc.

HERPETOLOGY, the study of amphibians and reptiles (*qq.v.*).

HERR, HERBERT THACKER (1876–1933), U.S. engineer, made significant contributions to the field of steam turbine power by conibining the highly efficient reaction element of the Parsons system with the lighter weight impulse elements of the Curtis-Ratcau system *(see* TURBINE: STEAM) Herr covered this development in a paper published in 1913 entitled, "Recent Developments in Steam Turbines," for which he was awarded the Edward Longstreth medal of the Franklin institute, Philadelphia.

Herr also pioneered in production of "floating frame" reduction gearing. under Melville-McAlpine patents, for propulsion of merchant marine and naval vessels..

Born in Denver, Colo., March 19, 1876, he graduated from Yale university in 1899 with a degree in mechanical engineering. Herr became vice-president and general manager of the Westinghouse Machine company in 1908 and of the Westinghouse Electric and Manufacturing company in 1915. During World War I he served as advisory engineer to the Emergency Fleet corporation of the U.S. Shipping board. Herr died Dec. 19, 1933.

(PL. H.)

HERRERA, FERNANDO DE (called EL DIVINO) (1534–1597), Spanish lyric poet, a leading member of a group of humanists who constituted an informal academy under the count of Gelves. was born in Seville and spent all his life there. He was a conscientious man of letters, ever seeking to elevate the tone of his writings in accordance with Renaissance theory and his own idealistic temperament, both illustrated in his meticulous and extensive *Anotaciones a las obras de Garcilaso de la Vega* (1580), which aroused the anger of certain critics. His sonnets and elegies, of delicate workmanship! on Petrarchan models, express his platonic love for "Luz," the countess of Gelves, but his finest work consists of patriotic odes, rich in Old Testament rhetoric, and melodious eclogues; all show an important advance in style over the previous generation. Herrera also composed two prose treatises on historical subjects.

See A. Coster, *Fernando de Herrera (El Divino)* (1908).

(C. C. SH.)

HERRERA, FRANCISCO DE (EL VIEJO) (*c.* 1576–1656/57), Spanish painter and engraver, was born in Seville. He is said to have studied under Francisco Pacheco and to have been for a short time the master of Velázquez, and he has been claimed as the originator of a neu national style that culminated in the achievements of Velázquez. It seems, however, that Herrera was a follower rather than a forerunner of the new style. His earliest known works, an engraving of St. Ignatius Loyola (1610) and a painting of the "Pentecost" (1617; Toledo, Greco museum), are in the Mannerist tradition. far removed from the simple Caravaggesque naturalism of Velázquez' earliest works of about 1617. Later compositions, such as "The Apotheosis of St. Hermenegild" (c. 1624; Seville museum), echo the Venetian manner of Juan de las Roelas. A marked development in the direction of naturalism first appears in three scenes from the life of St. Bonaventura (Prado; Villandry) commissioned in 1627 by the Franciscan convent in Seville; and this may be attributed to the influence of Francisco de Zurbarán, who contributed four paintings to the series. Naturalism in Herrera is accompanied by a broad technique, akin to José (Giuseppe) Ribera's; but in later works, like the "St. Basil" (1637; Louvre), his brushwork becomes so coarse that it distorts the forms.

Some time after 1638, when he is Iast documented in Seville, Herrera moved to Madrid, where he probably remained for the rest of his life. He seems to have been unaffected by the later development of Velázquez or by other court painters. But the elongated forms and elaborate draperies of "St. Joseph" (1648; Madrid, Lázaro museum), his last documented work. suggest that he may have been influenced by the style of Van Dyck.

Herrera appears to have acquired considerable fame in Seville in his own time and though he can have played no part in the formation of Velázquez' style, he does, with Roelas, mark the transition from Mannerism to Baroque and had some influence on the later development of the school of Seville. "The Miracle of the Loaves and Fishes" (Madrid, archiepiscopal palace), for instance. was the model for Bartolomé Murillo's painting of this subject in the Hospital de la Caridad, Seville.

See J. S. Thacher, "The Paintings of Francisco Herrera, the Elder," *The Chicago Art Bulletin,* 19 (Sept. 1937). (E. Hs.)

HERRERA, FRANCISCO DE (EL MOZO) (1622–1685), Spanish painter and architect. born in Seville, was the son and pupil of Francisco Herrera *el viejo.* After fleeing from his father (who was noted for his bad temper), Herrera the Younger is said to have continued his studies in Rome, where he became famous for his paintings of still life with fish and was known as *lo spagnuolo degli pesci.* But as a painter he is now known only for a few religious compositions. "The Adoration of the Blessed Sacrament" (1656) and "The Ecstasy of St. Francis" (1657), painted on his return from Italy for Seville cathedral, reflect the latest developments of Roman baroque (violent movement, theatrical effect, etc.), nhich he probably introduced into Seville. Thus he may have influenced the development of Bartolomé Esteban Murillo and, more particularly, of Juan de Valdés Leal.

In 1660 Herrera the Younger was appointed vice-president under Murillo of the nenly founded Academy of Painting in Seville; but he soon left for Madrid where he was active as a painter of frescoes and altarpieces and as an architect and designer of retables. In 1672 he mas appointed painter to the king and in 1677 surveyor general As an architect he is said to have been the first to introduce the style of Francesco Borromini into Spain; and his design for the high altar of the church of Montserrat, Madrid, has been claimed as a model for José Churriguera. He died in Madrid, Aug. 25. 1685. (E. Hs.; X.)

HERRERA a province in southern Panamá, on the Gulf of Panama, is the smallest province of the country, and has the highest population density. Pop. (1950) 50,095; Area 907 sq.mi. The province consists mostly of level to rolling plains and is especially important in the production of corn. rice, sugar, and a variety of vegetables and fruits. It also ranks high in the number of beef and dairy cattle, swine and poultry. It ships quantities of these products by boat and truck to the Canal Zone, only about 100 mi. east. (C. F. J.)

HERRERA Y TORDESILEAS, ANTONIO DE (1559–1625), Spanish historian, secretary to Vespasian Gonxago and first historiographer of the Indies. His *Historia general* de *los hechos de los Castellanos en las islas y tierra firme del Mar Oceano* (1601) is borrowed largely from other manuscripts, especially those of Bartolomé de Las Casas and Cervantes de Salazar.

The nork is, on the whole, accurate and unprejudiced, though confused. It was translated into English in 1740.

HERRICK, MYRON T. (1854–1929), U.S. diplomat, was born at Huntington, O., on Oct. 9, 1854. He studied law in Cleveland and was admitted to the bar in 1878. He practised in Cleveland from 1878 to 1886 and then turned his attention to

banking and manufacturing. He also became interested in politics and held many local and state offices in the Republican organizations, serving six times as delegate to the Republican national convention and once (1892) as presidential elector from Ohio. From 1903–06 he was governor of Ohio, having been elected by the largest majority that had been given to an Ohio governor up to that time. He was forced by his business interests to decline appointments as secretary of the treasury under McKinley and again under Taft, but in 1912 accepted the latter's appointment as ambassador to France. He continued to serve under Wilson, and at the outbreak of World War I also assumed charge of the German and Austrian embassies and later those of Turkey and minor nations. During the Marne offensive of 1914 when the French government moved to Bordeaux, Herrick maintained headquarters in Paris. He formed the American committee, which gave help to Americans and others traveling in Europe at the outbreak of the war. With Mrs. Herrick he established the American Ambulance hospital at Neuilly, staffed and managed by Americans. After his return to America in Dec. 1914, he continued to devote much of his time to war relief activities, and in recognition of his services, France conferred upon him the cross of the Legion of Honour. Herrick was one of the initiators of the rural credit movement in the United States; he published *Rural Credits* (1914). In April 1921 he was again appointed ambassador to France and served in this post until his death in Paris on March 31, 1929.

See T. Bentley Mott, *Myron T. Herrick* (1929).

HERRICK, ROBERT (1591–1674), English poet in whom the spirit of the ancient classical lyric was born again, was the seventh child of Nicholas Herrick, of Cheapside, London, and was baptized there on Aug. 24, 1591. Nicholas died in 1592 under suspicion of suicide; his children inherited a few hundred pounds each. In 1607 Robert was apprenticed to his uncle, Sir William Herrick, one of the most prosperous and influential of London goldsmiths; and Robert doubtless took advantage of the situation to cultivate the society of the London wits. In 1613 he went to St. John's college, Cambridge, where he seems to have had a lively circle of friends. Apparently his money was still held in trust by Sir William, who had often to be reminded (in letters still extant) that the next instalment was due. Partly to reduce his expenditure he moved to Trinity hall and graduated from there in 1617, taking his M.A. in 1620. He was ordained in 1623. His reputation as a poet seems to have been highest about 1620–30, and he probably then lived in London again for a time, in touch with court society and enlarging his acquaintance with writers and musicians. In 1627 he went as a chaplain to the duke of Buckingham on the expedition to the Île de Ré. Two years later he was presented to the living of Dean Prior, Devonshire, where he lived, unmarried, for the rest of his life, except that in 1646, because of his Royalist sympathies, he was removed from his living and did not return to it until after the Restoration. He was buried at Dean Prior, Oct. 15, 1674. The only book he published was *Hesperides* with *His Noble Numbers* (1648), containing about 1,400 poems, mostly very short. From these and from other evidence it appears that he was sensible, affectionate and friendly, "much beloved by the Gentry for his florid and witty Discourse," occasionally bored in Devonshire, but appreciating the advantages of seclusion and simple living, the beauty of nature and the daily interest provided by the behaviour of ordinary men and women. And always there was the delight of composing and revising his poems and the faith that they would eventually make him famous.

The appeal of Herrick's poetry lies in its truth to perennial human sentiments and its perfection of form and style. Frequently light, worldly and hedonistic, and making few pretensions to passion or profundity, it yet covers a wide range of fancy and feeling, including moments of serious reflection and poignant sadness. It owes debts to ancient classical literature, especially to Anacreon, Horace, Ovid and Martial; to classical myths and English folklore; to English lyrics and Italian madrigals. It is also influenced by the Bible and patristic literature, the source of many doctrinal aphorisms in *His Noble Numbers;* and by contemporary English writers, notably Ben Jonson and Robert Burton. Variously intended and shaped, it includes elegies, epigrams, satires, love songs, marriage songs, complimentary verse to friends and patrons, celebrations of rustic and ecclesiastical festivals, and evocations of the superstitious beliefs and ceremonies of the countryside, the elves at their feasts and devotions, the night hag riding the storm, the charms to keep evil spirits at bay. Yet Herrick reveals himself less clearly in his poetry than a first reading may suggest. He had a dramatic bent and could easily slip into a fictitious character or an imaginary situation. One poem is addressed to "his supposed wife" and probably his numerous "mistresses," Julia, Anthea and the rest, were no more tangible. He believed, with reason, that he would be remembered as a poet of love; but he is remembered still more for poetry that tells of evanescence, of the rosebuds we are to gather while we may, the daffodils that fade too soon and the joyful meadows left desolate in autumn. "The Argument of his Book," prefixed to *Hesperides,* beginning

> I sing of Brooks, of Blossoms, Birds and Bowers,
> Of April, May, of June, and July-Flowers,

emphasizes his lighter subject matter, and does too little justice to his versatility.

But to Herrick, with his overruling concern for art, themes and occasions would be of smaller account than the poems that they help to create, the address to Julia more important than Julia herself. Sense or thread there must be, but often there is not much and attention fixes on the articulation, fluency and harmony of the phrasing. Often the effects are aural rather than visual or intellectual, and Herrick excels in the kind of poetry that comes nearest to music, by its "concord of sweet sounds," by its precision of outline, and by asking to be accepted more for what it is than for what it conveys. Hence it is rewarding to study his workmanship in detail, the interplay of thought, imagery and rhythm, the metrical accomplishment, the tensions and relaxations, the "sweet disorder" and the "wild civility." Such technical mastery can seldom be long sustained and nearly all Herrick's best things are little things. But no one of his time, not even Milton, sought perfection more devotedly, and because of this he has taken his place among the most accomplished, if not among the greatest, lyrical poets.

Herrick's reputation has varied considerably. The esteem in which he was held for a time is shown by the number of manuscript commonplace-books (dating *c.* 1620–40) that contain poems by him. Few were published before 1648. Of printed miscellanies in which he is represented, *Witts Recreations* (1650) has the largest number (75). Some were printed in songbooks, from 1652 onward. Otherwise his poetry went largely unnoticed until about 1800, after which a great revival set in. The first of many 19th- and 20th-century selections appeared in 1810 edited by J. Nott, the first complete reprint in 1823 edited by T. Maitland.

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HERRICK, ROBERT (1868–1938), U.S. writer and novelist, was born in Cambridge, Mass., April 26, 1868. After graduating from Harvard in 1890, he taught composition at Massachusetts Institute of Technology for three years. He left in 1893 to teach in the English department of The University of Chicago, remaining on the staff until 1923. He spent much of World War I in Europe, where he wrote signed articles for the *Chicago Tribune.* In 1935 he was appointed secretary to the governor of the Virgin Islands. He died there Dec. 23, 1938.

Almost all Herrick's stories are set in Chicago. He classified them as "idealistic" or "realistic." The idealistic group includes *The Real World* (1901), *A Life for a Life* (1910), *The Healer* (1911) and *Clark's Field* (1914). His three most important novels, however, were realistic: *The Common Lot* (1904), *The Memoirs of an American Citizen* (1905) and *Together* (1908). Herrick also wrote short stories, critical essays and textbooks.

HERRIES, JOHN MAXWELL, 4TH LORD (*c.* 1512–1583), Scottish politician, was the second son of Robert Maxwell, 4th Lord Maxwell (d. 1546). In 1547 he married Agnes (d. 1594), daughter of William Herries, 3rd Lord Herries (d. 1543), and in

1567 he obtained the title of Lord Herries. Maxweil had become prominent among the men who rallied round Mary queen of Scots, although during the earlier part of his public life he had been associated with the religious reformers and had been imprisoned by the regent, Mary of Lorraine. From March 1566, when Maxwell joined Mary at Dunbar after the murder of David Rizzio and her escape from Holyrood, he remained one of her stauchest friends, although he disliked her marriage with Bothwell. He led her cavalry at Langside, and after this battle she committed herself to his care.

Herries rode with the queen into England in May 1568, and he and John Lesley, bishop of Ross, were her chief commissioners at the conferences at York. After returning to Scotland, Herries was imprisoned by the regent Murray. He was among the supporters of the regent Lennox until his death on Jan. 20, 1583. His son William, 5th Lord Herries (d. 1604), was warden of the west marches.

HERRIN, a city of Williamson county, Ill., U.S., is 45 mi. N. of the Ohio river, about 55 mi. N.N.E. of Cairo. It is strategically located within a cluster of coal belt towns, and although no longer dependent on coal, abandoned mines and their lonely chimneys still linger. First settled in the early 19th century, the city was incorporated in 1900.

Though generally a quiet, conservative community, Herrin was the scene of a tragic labour dispute known as the "Herrin massacre" in 1922. In that year, when the nation's coal fields were closed by strikes and lockouts, a mining company attempted to operate a strip mine with nonunion labour. On June 22 several hundred striking union miners forced the nonunion workers at the mine to surrender and promised them safe conduct. After being marched to a point near Herrin the captives were ordered to run for their lives under fire; more than 20 were killed and others were wounded. A grand jury returned 214 indictments for murder and other offenses. After several acquittals by trial juries the remaining indictments were dismissed.

Soon after World War II, Herrin's citizens raised $900,000 to attract new industries. The effort was successful and local factories now make washing machines, neon signs, upholstery, dresses and staple machines. By the 1960s Herrin's economy was stabilized. Nearby Crab Orchard lake provides adequate water supply and a variety of recreational facilities. For comparative population figures *see* table in ILLINOIS: *Population.* (D. A. PR.)

HERRING, a fish, probably the world's most plentiful, belonging to the genus *Clupea,* more specifically, the Atlantic herring (C. *harengus*) and the Pacific herring *(C. pallasi*). These two species are circumpolar in distribution and may be merely geographical varieties of the same species. They are beautifully coloured fish with silvery, iridescent sides and deep blue, metallic backs.

In the Atlantic ocean herring are caught from the Bay of Biscay northward to the White sea and in the Baltic. They extend westward and northward to Spitsbergen, Iceland, Greenland and along the North American coast from Labrador to Long Island. In the Pacific ocean they are caught from the United States-Mexican border north to Golovin bay, near Nome, Alaska, across the Aleutian chain, and along the Siberian coast south to Vladivostok and among the islands of Japan.

About eight other species of the genus *Clupea* are recognized, including the sprat (*q.v.*) or brisling *(C. sprattus)* of western Europe and the Mediterranean sea, *C. antipodum* and *C. muelleri* of New Zealand, *C. fuegensis* of the Strait of Magellan and the Falkland Islands, *C. bentincki* of Chile, *C. bassensis* of southern Australia and New Zealand, *C. arcuata* extending from Uruguay to northern Patagonia, and *C. melanostoma* of the Río de la Plata.

The family Clupeidae, to which the herring belongs, embraces small species of fishes throughout the world. The subfamily Clupeinae, includes about 18 closely related genera, of which the most important are the sardines or pilchards *(Sardina* and *Sardinops*), the menhaden *(Brevoovtza),* the shad *(Alosa)* and the alewife *(Pomolobus). (See* SARDINE; PILCHARD; MENHADEN; SHAD; ALEWIFE.)

Herring move in vast schools and are caught with seines, gill nets, otter trawls and weirs or pound nets.

In Europe the majority of the catch is salted, pickled in barrels or cured by smoking as kippers or bloaters. In eastern Canada and northeastern United States most of the herring utilized are young fish taken in inshore weirs or seines, which are canned as sardines. The bulk of the herring taken in the Pacific ocean is used in the manufacture of fish oil and meal. and smaller quantities are pickled and smoked.

Herring usually move shoreward to spawn; the female extrudes the eggs as she swims about on her side and rubs her body against clean seaweed, rocks or kelp, to which the adhesive eggs cling tightly. The male fish swims closely behind the female fertilizing the eggs as they are deposited. When a large school of herring is spawning, the sea water takes on a milky appearance from the white milt extruded by the males.

In the Pacific, herring have only one spawning season in each locality, which varies with the latitude and local temperature conditions. The season commences in December in California and becomes progressively later to the northward. Herring were observed spawning in June at St. Michael, near Nome. The majority of the herring in the Atlantic ocean also spawn as water temperatures become suitable in the spring, but certain populations of herring in western Europe south of Norway spawn in late summer and autumn; they are called autumn spawners to distinguish them from the spring spawners in the same localities.

The Atlantic herring usually spawns in water from a few fathoms to more than 100 fathoms deep, and may spawn on gravelly banks many miles from land. The Pacific herring, on the other hand, spawns chiefly on the seaweeds and kelp along the shore, and in many localities a large portion of the deposited spawn is exposed at each ebb tide. Each female deposits from 10,000 to 60,000 eggs per spawning, depending on her size and age. The eggs hatch in two to three weeks or longer depending on the temperature. The larval herring at first drift with the current, but they soon become free swimming, as indicated by the small areas occupied by local races of herring, even in localities such as southeastern Alaska with a strong residual current.

The growth rate of herring varies tremendously with the locality —usually it is slow in enclosed waters or waters of low salinity, as the Baltic, where mature herrings as small as four inches are found. Thus, slow-growing herring are found in the Baltic, the White sea. the Lyseforden (west Norway), the Zuider Zee, the east coast of Sweden, San Francisco bay and the interior waters of southeastern Alaska (Stephens passage). Herring in some of the fiords on the Baltic coast of Sweden are slower growing than those of the main Baltic. Fast-growing herring are found in the western North sea, the Atlantic ocean, around Iceland, the outside waters of Norway, around Kodiak Island and along the Aleutian Islands. Herring from Dutch Harbor in the Aleutians may exceed 1 lb. in weight and 1 j in. in length.

Herring feed on a great variety of the smaller marine forms, such as decapod larvae, copepods and pteropods, and occasionally even feast on small fish. Herring mature chiefly at four years of age, but do not reach a suitable size for pickling until about five to eight years old, depending on the locality. They are normally long-lived and a study of the annual marks on their scales formed by the seasonal rhythm in growth shows that some may attain 20 years of age. Most herring, however, are either eaten by predators or caught before they are 10 years of age.

Different areas are inhabited by different races or populations of herring, as shown by studies of the number of vertebrae and other structural characters and by tagging. North American investigators devised means of tagging these small fish by inserting small steel or nickel tags inside the body cavity. After the liberated fish are recaptured, the tags are recovered either by an electronic device as the herring pass along a conveyer during unloading or from the fish meal as it passes over an electromagnet during continuous process manufacture.

After spawning, the schools of mature herring disperse, but the herring later gather in large schools on the feeding grounds. Different races may feed on the same grounds, but they return to their own localities for spawning. The herring fisheries are subject

to great fluctuations, since the survival of the young varies widely from year to year. A fishery may thus for several years be largely dependent on the progeny from a single spawning. This circumstance also causes a change in the size of the herring taken each year in the same locality, as the herring of the single year class increase in size. Variations in spawning success are keenly felt in the Maine sardine fisheries, which depend chiefly on the young immature herring for their supply. (G. A. RL.)

HERRINGBONE, in masonry construction, the use of courses or rows in which the individual bricks or stones are set at an angle of approximately 45° to the horizontal and with alternate courses at right angles to each other. Herringbone work is occasionally found in late Roman brick construction, and was common in Romanesque architecture (*q.v.*), sometimes decoratively, as in much of the brickwork of north Italy, sometimes structurally, with the apparent idea that long, thin stones could be more efficently used in this manner than if laid horizontally. In modern construction, the herringbone is almost entirely restricted to decorative brickwork and paving. A similar pattern is often used in hardwood floors.

HERRIOT, EDOUARD (1872–1957), French statesman and man of letters who personified in his time the Radical-Liberal tradition in French life and politics, was born at Troyes on July j, 1872, the son of an army officer. Educated at the Paris Lycée Louis-le-Grand and at the École Normale Supérieure, he graduated with high honours in 1894. His book on the Jewish school of Alexandria, *Philon le Juif* (1897), was crowned by the Academy of Moral and Political Sciences. He taught at the *lycée* of Nantes and then at Lyons, where he won a high reputation as a scholar of distinction and a teacher of eminence. This reputation was enhanced by his study of *Madame Récamier et ses amis* (1904) and by the powers of acute literary criticism shown in his *Précis de l'histoire des lettres françaises* (1905). He also engaged in journalism and popular lecturing.

Like many French statesmen, Herriot entered politics through local government. He became a municipal councilor of Lyons in 1904, and mayor in 1905. He remained mayor of the city for the rest of his life with only one brief interruption during World War II. Cnder his guidance that growing industrial city developed every sort of municipal amenity and his local prestige became unshakeable. In 1910 he became a member of the *conseil général* and in 1912 senator for the *département* of Rhbne. He belonged throughout his career to the Radical party, consistent in his liberalism and his faith in republican democracy.

He first held ministerial office during World War I, from Dec. 1916 to March 1917, as minister of public works, transport and supplies in Aristide Briand's cabinet. He showed political acumen and administrative ability in his reorganization of the essential services of supplies and transport in wartime. Before the war ended he was turning his attention to problems of reconstruction. In 1916 he organized the Lyons fair and in the crisis of 1917 published *Agir,* pleading for continued faith in the culture and civilization of France as the path to national victory. In 1919. when victory had come. he published *Crier,* a program of reconstruction dedicated to the youth of France.

Herriot gave up his seat as senator in Nov. 1919 and was elected a member of the chamber of deputies for the *département* of Rhône. There he became leader of the Radical party. He owed his rapid rise in parliament to his powers of oratory and persuasion, and the genial warmth of his personality. He showed himself adept as a politician, skillful in managing committees and in the eloquent presentation of his arguments.

He led the opposition to the postwar *Bloc national.* When the *Cartel des gauches,* a left-wing coalition of Radicals and Socialists. was formed to fight the parliamentary elections of May 1924, it was led by Herriot. and its electoral triumph enabled him to form his first ministry in June 1924. He also took the ministry of foreign affairs. He forced the resignation of Alexandre Millerand, president of the republic, who had openly electioneered on behalf of the right. He extended *de jure* recognition of the U.S.S.R. which he had visited two years before. He arranged with the British prime minister. Ramsay MacDonald. to hold conierences in London on the subject of reparations, wherein France accepted the Dawes plan and agreed to evacuate from the Ruhr the troops which Raymond Poincaré had sent in to enforce payment of reparations by Germany. The following autumn the two premiers prepared the so-called Geneva protocol, *i.e.,* a treaty of collective security. Although rejected by MacDonald's successor the protocol inaugurated the era of Locarno. of improved relations between France, Great Britain and Germany. In April 1925 Herriot's ministry fell, and in July 1926 his second ministry lasted only three days. He then joined the great Poincaré cabinet of national union in which he was minister of education (1926–28). It was June 1932 before another electoral swing to the left brought him back to power as premier and foreign minister. He fell six months later when the chamber refused to pay the December installment of France's war debts to the United States. He served as vice-premier under Gaston Doumergue in 1934 and again under Pierre-Etienne Flandin in 1934–35. In June 1936 he was elected president of the chamber of deputies, an office which he filled with dignity and trust until France's capitulation in June 1940 during World War II.

Though criticized by some for his acquiescent attitude during German occupation (he abstained from voting when on July 10, 1940, at Vichy, the national assembly accorded full powers to Marshal Philippe Pétain) and for having refused to leave France to help in resistance, he suffered no taint of collaboration with the invaders. When Pétain in Aug. 1942 dissolved the permanent bureaus of the chamber and senate, Herriot joined with Jules Jeanneney, president of the senate, in lodging a joint protest. For this he was arrested and was later deported to Germany. In April 1945 he was freed from his internment at Wannsee, near Berlin, by Russian troops. Having meanwhile been re-elected mayor of Lyons, he returned there to resume his duties. He also resumed his place as president of the Radical party, and was elected to both the constituent assemblies of 1945 and 1946. In 1946, too, he was elected a member of the Académie Française. The following year he was elected president of the new national assembly of the Fourth Republic, retaining this office until his retirement in Jan. 1954.

He took part from 1948 onward in the body which became the Council of Europe, an advisory body urging a federal solution to European problems. In 1952–54, however, he opposed the European Defense community because its consequence would be the rearmament of Germany. In June 1955 he was presented with the Soviet peace prize (the former Stalin prize). He died in Lyons on March 26, 1957. Herriot clung throughout his life to liberal ideals of international co-operation, and because of his intellectual gifts and honesty inspired respect and affection, though he lacked great powers of leadership.

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(D. **Ts.**)

HERRNHUT, a town of Germany, in the district of Dresden, 18 mi. S.E. of Bautzen. and situated on the Löbau-Zittau railway. Pop. (1950) 2.025. It is the principal seat of the Moravian or Bohemian brotherhood, the members of which are called *Herrnhuter.* A colony of these people, fleeing from persecution in Moravia, settled at Herrnhut in 1722 on a site presented by Count Zinzendorf. The buildings of the society include a church, a school and houses for the brethren. the sisters and the widowed of both sexes. The town is remarkable for its ordered, regular life and its scrupulous cleanliness. Linen and various minor articles are manufactured.

Berthelsdorf, a village about a mile distant, has been the seat of the directorate of the community since about 1789.

HERSCHEL, CAROLINE LUCRETIA (1750–1848). English astronomer, whose assistance was invaluable to her brother Sir William Herschel in his astronomical researches, was born at

Hanover, Ger., on March 16, 1750. She assisted her mother in the management of the household until 1772, when her brother took her to Bath, Eng., where he had established himself as a teacher of music.

When her brother accepted the private office of court astronomer to George III in 1782, she executed the laborious calculations that were connected with his observations. During her leisure hours she swept the heavens with a small Newtonian reflector and by this means she detected three nebulae in 1783, and eight comets between 1786–97.

In 1798 she presented to the Royal society an Index to Flamsteed's observations, together with a catalogue of 560 stars omitted from the *British Catalogzte,* and a list of the errata in that publication. She returned to Hanover in 1822, and in 1828 completed the cataloguing of 2,500 nebulae and many star clusters discovered by her brother. Caroline Herschel received the gold medal of the Astronomical society in 1828. and the gold medal for science from the king of Prussia in 1846. She died at Hanover on Jan. 9, 1848.

See Mrs. John Herschel, *Memoir and Correspondence of Caroline Herschel* (1876). (O. J. E.)

HERSCHEL, SIR JOHN FREDERICK WILLIAM, BART. (1792–1871), English astronomer and able successor to his father, Sir William, in the field of nebular observation and discovery. Born in Slough, Bucks, on March 7, 1792, he was educated for a short time at Eton, then by a private tutor and then at St. John's, Cambridge, where he graduated as senior wrangler in 1813. During his undergraduateship he and two of his fellow students who subsequently attained to very high eminence. George Peacock and Charles Babbage, entered into a compact that they would "do their best to leave the world wiser than they found it"—a compact loyally and successfully carried out by all three to the end. As a commencement of this laudable attempt Herschel associated with these two friends in the production of a work on the differential calculus, and on cognate branches of mathematical science, which changed the style and aspect of mathematical learning in England, and brought it up to the level of the continental methods. Two or three memoirs communicated to the Royal society on new applications of mathematical analysis at once placed him in the front rank of the cultivators of this branch of knowledge. Of these his father had the gratification of introducing the first, but the others were presented in his own right as a fellow.

With the intention of being called to the bar, he entered his name at Lincoln's Inn on Jan. 24, 1814, and placed himself under the guidance of an eminent special pleader. Probably this temporary choice of a profession was inspired by the extraordinary success in legal pursuits which had attended the efforts of some noted Cambridge mathematicians. Be that as it may, an early acquaintance with W. H. Wollaston in London soon changed the direction of his studies.

He took up astronomy in 1816; and in 1820, assisted by his father, he completed for a reflecting telescope a mirror of 18-in. diameter and 20-ft. focal length. This, subsequently improved by his own hands, became the instrument that enabled him to effect the astronomical observations forming the chief basis of his fame. In 1821–23 he was associated with Sir James South in the re-examination of his father's double stars. For this work he was presented in 1826 with the Astronomical society's gold medal; and with the Lalande medal of the French institute in 1825; while the Royal society had in 1821 bestowed upon him the Copley medal for his mathematical contributions to their *Transactions.* In 1831 the honour of knighthood was conferred on him by William IV, and two years later he again received the recognition of the Royal society by the auard of one of their medals for his memoir "On the Investigation of the Orbits of Revolving Double Stars."

Before the end of the year 1833, Sir John Herschel had re-examined all his father's double stars and nebulae, and had added many similar bodies to his own lists; thus accomplishing, under the conditions then prevailing, the full work of a lifetime. For it should be remembered that astronomers were not as yet provided with those valuable automatic contrivances that at present materially abridge the labour and increase the accuracy of their determinations. John Herschel then determined to explore the southern, besides re-exploring northern, skies. "I resolved," he said, "to attempt the completion of a survey of the whole surface of the heavens; and for this purpose to transport into the other hemisphere the same instrument which had been employed in this, so as to give a unity to the results of both portions of the survey, and to render them comparable with each other" So, he and his family embarked for the Cape of Good Hope on Nov. 13, 1833; they arrived in Table bay on Jan. 15, 1834; and he began regular observations on March 4.

To give an adequate description of the vast mass of labour completed during the next four busy years of his life at Feldhausen would require the transcription of a considerable portion of the *Cape Observations* (published in 1847, nine years after the author's return to England), for the cogent reason that, as he said, "The whole of the observations, as well as the entire work of reducing, arranging and preparing them for the press, have been executed by myself." It contains catalogues and charts of southern nebulae and star clusters, a catalogue of the relative positions and magnitudes of southern double stars and his observations on the varying and relative brightness of the stars. Herschel returned to his English home in 1838, and was welcomed with an enthusiastic greeting. He was created a baronet by Queen Victoria at her coronation.

Herschel was a highly accomplished chemist. His discovery in 1819 of the solvent power of hyposulfite of soda on the otherwise insoluble salts of silver was the prelude to its use as a fixing agent in photography; and he invented in 1839, independently of Fox Talbot, the process of photography on sensitized paper. He was the first person to apply the now well-known terms "positive" and "negative" to photographic images, and to imprint them upon glass prepared by the deposit of a sensitive film. Perhaps no man can become a truly great mathematician or philosopher if devoid of imaginative power. John Herschel possessed this endowment to a large extent; and he solaced his declining years with the translation of the *Iliad* into verse.

But the main work of his later life was the collection of all his father's catalogues of nebulae and double stars combined with his own observations and those of other astronomers into a single volume. A complete list of his contributions to learned societies will be found in the Royal society's great catalogue, and from them may be gathered most of the records of his busy scientific life. Sir John Herschel met with an amount of public recognition that was unusual in the time of his illustrious father. He was a member of almost every important learned sdciety in both hemispheres. For five years he held the same office of master of the mint, which a century before had belonged to Sir Isaac Newton.

He died on May 11, 1871, and was buried in Westminster abbey close to the grave of Sir Isaac Newton.

Besides the laborious *Cape Observations,* Sir John Herschel was the author of several books, one of which at least, *On the Study of Natural Philosophy* (1830), possesses an interest that no future advances of the subjects on which he wrote can obliterate. In 1849 came the *Outlines of Astronomy,* a volume still replete with charm and instruction. His articles, "Meteorology," "Physical Geography" and "Telescope," contributed to the 8th edition of the *Encyclopædia Britannica,* were afterward published separately. Less known are his volumes, *Familiar Lectures on Scientific Subjects* (1866) and *Collected Addresses* (1857), in which he is seen in his happiest and most instructive mood.

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(A. Po.)

HERSCHEL, SIR WILLIAM (originally FRIEDRICH WILHELM) (1738–1822), English astronomer, called the founder of sidereal astronomy for his systematic observations of the heavens, was born in Hanover, Ger., on Nov. 15, 1738. His father was a

musician in the Hanoverian guard. and in 1757 Herschel was sent to England to earn his living as a musician.

Beginnings.—In 1766 he worked as organist in Bath. During the next five or six years he became the leading musical authority. In 1772 he revisited Hanover to bring to England his sister Caroline Lucretia Herschel (*q.v.*), whose services he much needed, as he was already studying astronomy in the time he could spare from his musical engagements. She thus describes her brother's life soon after her arrival: "He used to retire to bed with a bason of milk or a glass of water. with Smith's *Harmonics* and Ferguson's *Astrononty*, etc., and so nent to sleep buried under his favourite authors; and his first thoughts on waking were how to obtain instruments for viewing those objects himself of which he had been reading." It was in this way that he was introduced to the writings of Ferguson and Keill, and subsequently to those of Lalande, uhereby he educated himself to become an astronomer of undying fame.

In those days telescopes were rare, very expensive and not very efficient, and Herschel used a small Gregorian reflector of about two-inch aperture. Finding it impossible to obtain a reflector of larger dimensions, he decided to construct his own and, in 1774, had the satisfaction of viewing the heavens with a Newtonian telescope of six-foot focal length made by his own hands. He had from the very first conceived the gigantic project of surveying the entire heavens, and, if possible, of ascertaining the plan of their general strucrure. For this he required adequate instruments, and he, his brother and his sister toiled at the grinding and polishing of hundreds of specula After 1774 every available hour of the night was devoted to the long-hoped-for scrutiny of the skies. In May 1780 his first two papers on the variable star Mira Ceti and the mountains of the moon were communicated to the Royal society.

Rotation of the Planets.—In 1781 he communicated to the Royal society the first of a series of papers on the rotation of the planets and of their several satellites. These inquiries occupy the greater part of seven memoirs (1781–97). While engaged on them he noticed the curious appearance of a white spot near to each of the poles of the planet Mars. On investigating the inclination of its axis to the plane of its orbit, and finding that it differed little from that of the earth, he concluded that its changes of climate also would resemble our own, and that these white patches were probably polar snow. He also discovered that the times of the rotations of the various satellites round their axes conform to the analogy of our moon by equalling the times of their revolution round their primaries.

In the same year (1781) Herschel made a discovery that completely altered the character of his professionai life. In the course of a methodical review of the heavens he lighted on an object that averred itself to be a new planet, moving outside the orbit of Saturn. He assigned to it the name Georgium Sidus. but this was later changed to Uranus. The object was detected with a 7-ft. reflector having an aperture of 6½ in. Seven memoirs on the subject were communicated by him to the Royal society (1781–1815).

For the discovery of the planet he was awarded the Copley medal of the Royal society, elected a fellow, and in the following year (1782) he accepted George III's offer to give up music and become his private astronomer. So Herschel and his sister moved first to Datchet and in 1786 to Slough. There he resumed his astronomical pursuits with extraordinary vigour, although for a time he had to supplement his income by making and selling telescopes. The necessity for this interruption in his observations was overcome in 1788 when he married the wealthy widow of a London merchant.

Double Stars.—A material part of the task that Herschel had set himself embraced the determination of the relative distances of the stars from our sun and from each other. This resulted in a most important series of observations. He had observed many stars in apparently very close contiguity, but often differing greatly in relative brightness. He concluded that. on the average, the brighter star would be the nearer to us, the fainter enormously more distant.

In the hope, therefore, of detecting an annual parallactic displacement of one star with respect to another, he mapped down the places and aspects of all the double stars that he met with, and communicated in 1782 and 1785 very extensive catalogues of the results. His last scientific memoir, sent to the Royal Astronomical society in 1822, when he was its first president and already in his 84th year, related to these investigations. In the memoir of 1782 he threw out the hint that these apparently contiguous stars might be genuine pairs in mutual revolution. Eleven years afterward (1793), he remeasured the relative positions of many such couples and his prediction was verified, for he ascertained that some of these stars revolved round each other, after the manner required by the laws of gravitation. This discovery, announced in 1802, would of itself suffice to immortalize his memory.

In 1783 he wrote his first memorable paper on the "Motion of the Solar System in Space"—a sublime speculation, yet through his genius realized by considerations of the utmost simplicity. He returned to the same subject with fuller details in 1805. In a series of papers (1784–1818), he used his method of star gauging and concluded that our sun was a star situated not far from the bifurcation of the Milky Way, and that all the stars visible to us lie more or less in clusters scattered throughout a comparatively thin but immensely extended stratum. On either side of this assemblage of stars, Herschel discovered a canopy of discrete nebulous masses, such as those from the condensation of which he supposed the whole stellar universe to have been formed.

Hitherto there has been nothing said about his construction of the great reflecting telescope, of 40 ft. focal length and 4 ft. aperture. On the day that it was finished (Aug. 28, 1789) Herschel saw at the first view, in a grandeur not witnessed before, the Saturnian system with six satellites, five of which had been discovered long before, while the sixth he had glimpsed two years before, in his exquisite little telescope of 6½-in. aperture, but now saw in unmistakable brightness. On Sept. 17 he discovered a seventh, which proved to be the nearest to the globe of Saturn.

Herschel died at Slough on Aug. 25, 1822, a description of him given a few years before by Campbell being: "A great, simple, good old man. His simplicity, his kindness, his anecdotes, his readiness to explain his own sublime conceptions of the universe, are indescribably charming."

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HERSCHELL, FARRER HERSCHELL, 1ST BARON (1837–1899), English lord chancellor noteworthy for his quickness of apprehension, his common sense and his broad treatment of constitutional and social questions. He was born at Brampton, Huntingdonshire, on Nov. 2, 1837, the son of the Rev. Ridley Haim Herschell, a dissenting minister converted from Judaism. Farrer Herschell, being excluded by dissent from Oxford and Cambridge, was educated at University college, London. He entered Lincoln's Inn in 1858, and became a pupil of Thomas Chitty. In 1860 he was called to the bar, and joined the still undivided northern circuit, where at first he did not find much work. His prospects improved in 1866 when J. R. Quain, for whom he devilled (*i.e.*, worked and understudied), took silk.

In 1872 Herschel1 himself was made a queen's counsel. He had all the necessary qualifications for a leader—a clear voice; a calm, logical mind; a sound knowledge of legal principles; and an abundance of common sense. His only weak point was cross-examination.

Herschell entered parliament for Durham city as a liberal in 1874 In 1880 he was appointed solicitor general by Gladstone, and knighted. Herschell's public services from 1880 to 1885 were of great value, particularly in dealing with the "cases for opinion" submitted by the foreign office and other departments. He helped controversial government measures through the house, notably the

Irish land act, 1881. In 1886 he accepted Gladstone's offer of the lord chancellorship, and was created Baron Herschell Losing office on the fall of Gladstone in Aug. 1886, he was again lord chancellor in 1892–95. His public services outside his judicial work included the chancellorship of the University of London (1894) and the chairmanship of the Imperial institute. which he held from its foundation (1892).

In 1898 Herschell was appointed. jointly with Lord Justice Collins, to represent Great Britain on the Venezuela Boundary commission. which assembled in Paris in the spring of 1899 He also sai, as president, on the joint high commission appointed to adjust certain boundary and other questions pending between Great Britain and Canada on the one hand and the United States on the other.

Herschell died in Washington, D.C., on March 1. 1899. as the result of an accident. (W. T Ws)

MERSFELD, a town of Germany, in the Land of Hesse, situated at the confluence of the Geis and Haun with the Fulda, on the railway from Frankfurt am Main to Bebra, 24 mi. N.N.E. of Fulda. Population (1950) 21.285. Some of the old fortifications of the town remain. The principal buildings are the Stadt Kirche, a beautiful Gothic building, erected about 1320 and restored in 1899; the old town hall (Rathaus) and the ruins of the abbey church. This church was erected on the site of the cathedral in the beginning of the 12th century; it was built in the Byzantine style and was burnt down by the French in 1761. Outside the town are the Frauenberg and the Johannesberg, on both of which are monastic ruins. The town has important manufactures of cloth, leather, machinery, vast-line and cordage; it has also dye-works. The Benedictine abbey of Hersfeld was founded by Lullus, afterwards archbishop of Mainz, about 769. It was richly endowed by Charlemagne and became an ecclesiastical principality in the 12th century, passing under the protection of the landgraves of Hesse in 1423. It was secularized in 1648. Hersfeld became a town in the 12th century and in 1370 the burghers, having shaken off the abbot's authority, placed themselves under the protection of the landgraves of Hesse. Hersfeld, with electoral Hesse, was united with Prussia in 1866.

HERSHEY, MILTON SNAVELY (1857–1945), **U.S.** confectioner and philanthropist, was born in Derry Township, Dauphin county, Pa., on Sept. 13, 1857. He attended the local schools and then served for a time as a printer's devil on the *Lancaster Farmer.* After a brief period in that capacity, he turned to the manufacture of candy and at 21 years of age had his own shop in Philadelphia. He later removed to New York city. There success crowned his efforts, and within 25 years he sold his business for $1,000,000. Returning to his native home in Pennsylvania, he again began the manufacture of chocolate bars, converting the scene of his early struggles into the model industrial town of Hershey, Pa., and developing his business along lines most beneficial to his employees. About 1903 he and his wife, Mrs. Catherine S. Hershey (d. 191j), determined to found an industrial school and home for orphan boys, the school receiving its first pupils in 1910. It is open to male orphans: (1) born in Dauphin, Lebanon and Lancaster counties; (2) born elsewhere in Pennsylvania (3) born elsewhere in the United States. Boys are accepted at four or five years of age and may remain until they reach the age of 18 years. Freedom in the selection of trades is permitted, but it is required that each boy learn to be self-supporting. In 1918 Hershey transferred his entire wealth, estimated at $60,000,000, to the Hershey Trust company for maintenance of the Hershey Industrial school, making it probably the second richest school of its kind in the United States. In 1944 he resigned as president of the Hershey Industrial school, the Hershey corporation and the Hershey Trust company. He remained, however, as chairman of the board of directors of the Hershey Chocolate corporation. He died on Oct. 13, 1945, at Hershey, Pa.

HERSTAL or HERISTAL, a town of Belgium, less than 2 m. N. of Liége and practically one of its suburbs. The second Pippin was born here. His grandson, Pippin the Short, died at Herstal in A.D. 768, and it disputes with Aix-la-Chapelle the honour of being the birthplace of Charlemagne. It is now a very active centre of iron and steel manufactures. The Belgian national small arms factory and cannon foundry are here. Pop. (1955 est.) 28,-32j. The name may come from *Heerstelle* (permanent camp).

HERTFORD, EARLS AND MARQUESSES OF. The English earldom of Hertford was held by members of the powerful family of Clare from about 1138, when Gilbert de Clare was created earl of Hertford, to 1314 when another earl Gilbert was killed at Bannockburn. In 1537 EDWARD SEYMOUR, viscount Beauchamp, a brother of Henry VIII.'s queen, Jane Seymour, was created earl of Hertford, being advanced ten years later to the dignity of duke of Somerset and becoming protector of England. His son EDWARD (c. 1540–1621) was styled earl of Hertford from 1547 until the protector's attainder and death in January 1552, when the title was forfeited; in 1559, however, he was created earl of Hertford. In 1560 he was secretly married to Lady Catherine Grey (c. 1538–1568), daughter of Henry Grey, duke of Suffolk, and a descendant of Henry VII. Queen Elizabeth greatly disliked this union, and both husband and wife were imprisoned, while the validity of their marriage was questioned. Catherine died on Jan. 27, 1568 and Hertford on April 6, 1621. Their son Edward, Lord Beauchamp (1561–1612), who inherited his mother's title to the English throne, predeceased his father; and the latter was succeeded in the earldom by his grandson WILLIAM SEYMOUR (1588–1660), who was created marquess of Hertford in 1640 and was restored to his ancestor's dukedom of Somerset in 1660. The title of marquess of Hertford became extinct when JOHN, 4th duke of Somerset, died in 1675, and the earldom when ALGERNON, the 7th duke, died in February 1750.

In August 1750 FRANCIS SEYMOUR CONWAY, 2nd baron Conway (1718–1794), a direct descendant of the protector Somerset, was created earl of Hertford. Hertford was ambassador to France from 1763 to 1765; was lord-lieutenant of Ireland in 1765 and 1766; and lord chamberlain of the household from 1766 to 1782. In 1793 he became earl of Yarmouth and marquess of Hertford, and died on June 14, 1794. His son FRANCIS INGRAM SEYMOUR CONWAY (1743–1822), known during his father's lifetime as Lord Beauchamp, was sent as ambassador to Berlin and Vienna in 1793 and from 1812 to 1821 he was lord chamberlain. His son FRANCIS CHARLES, the 3rd marquess (1777–1842), an intimate friend of the prince regent, afterwards George IV., is the original of the "Marquis of Steyne" in Thackeray's *Vanity Fair* and of "Lord Monmouth" in Disraeli's Coningsby. The 4th marquess was his son, RICHARD (1800–1870), whose mother was the great heiress, Maria Emily Fagniani, and whose brother was Lord Henry Seymour (1805–1859), the founder of the Jockey Club at Paris. When Richard died unmarried in Paris in August 1870 his title passed to his kinsman, FRANCIS HUGH GEORGE SEYMOUR (1812–1884), a descendant of the 1st marquess, whose son, HUGH DE GREY (1843–1912) became 6th marquess in 1884. The 4th marquess left his great wealth and his priceless collection of art treasures to Sir Richard Wallace (1818–1890), his reputed half-brother, and Wallace's widow, who died in 1897, bequeathed the collection to the British nation. It is now in Hertford House, formerly the London residence of the marquesses of Hertford.

HERTFORD, a market town! municipal borough and the county town of Hertfordshire. Eng.. in the Hertford parliamentary division. 22 mi. N. of St. Paul's cathedral. London by road. Pop. (1951) 13.884. Area 6.1 sq.mi. The Mimram, Beane and Lea flow through the town. Hertford was possibly the scene of a synod in 673. Its communication with London by way of the Lea and the Thames gave it strategic importance during the Danish occupation of East Anglia. In 1066 and later it was a royal garrison and burgh; it was incorporated in 1554. Fairs, now discontinued. were granted from the 13th century, but there are still corn and cattle markets. Hertford's economy is mainly residential and agricultural with a few industries such as gloving, motor engineering, brewing and the making of toothbrushes. stationery and leather goods. The castle, used as municipal offices, retains the wall and part of a tower of the Norman period. Other buildings include the Shire hall by James Adam; the County hall (1939); Hale's grammar school (17th-century); Hertford Grammar school for boys (1930); Christ's Hospital school for girls, moved from

London in 1683 (buildings date from 1695 to 1953). There are many old timber houses in Hertford. Bengeo. in the north of the borough, has a Norman church which is little altered. Two miles S.E. of the town is Haileybury and Imperial Service college, the former founded in 1862 and the latter in 1912. They were amalgamated in 1942 at Haileybury, occupying the buildings formerly used by the East India company.

HERTFORDSHPRE, a county of England, bounded on the northeast by Cambridgeshire, northwest by Bedfordshire. east by Essex, south by Middlesex and southwest by Buckinghamshire. Pop. (1951) 609,775. Area 632.1 sq.mi. The northwest of the county is on the chalk ridge, an extension of the Chilterns; the hills there rarely exceed 600 ft. and sink gradually toward the northeast. Much of the chalk is covered with glacial drift of clays, gravels and loams, the scarp faces northwestward and there is a gentle dip to the southeast until, south of Hertford and St. Albans, it disappears beneath the Eocene Reading beds of yellow clays and sands and London clay. The many small rivers have cut deep valleys and the whole county is undulating and well wooded. The Lea river rising near Luton, Beds.. flows southeastward to Hatfield, eastward to Ware, then southward to the Thames; with its tributary the Stort, it forms part of the boundary with Essex; lesser tributaries, the Ash, Rib, Beane and Mimram are known for their parklike valleys. In the west the Colne and its tributaries flow past Watford to join the Thames at Staines. The New river (1613). to augument London's water supply, was cut from Amwell and Chadwell near Ware to the Lea at Broxbourne and south to the reservoirs at Hornsey and Stoke Newington.

History **and** Antiquities — Thechalk and gravel soils yielded Palaeolithic flints; Mesolithic flints were found along the banks of the Lea; long and round barrows are on the hills above Therfield and a beaker barrow was found in a gravel working at Ware. The Icknield way along the chalk ridge was one of the main prehistoric trackways and scattered finds suggest the county was completely, if sparsely, occupied during the Bronze Age. The few Iron Age camps are small and unimpressive, but the county was a centre of Belgic power, with Cassivelaunus' *oppidum* at Wheathampstead, which Caesar took in 54 B.C., and towns at Braughing. Prae Wood and Welwyn; numbers of Belgic coins have been found. The Roman occupation was thorough; with Ermine street to York, Watling street to Chester, Stane street, linking Verulamium to Colchester, and the replanned Icknield way, as the major roads. A municipium was at Verulamium (partly excavated in the latter 1950s, with a good museum and a Romano-British theatre); a walled town at Braughing; and posting stations at 10-mi. intervals along the roads, of which traces have been found at Cheshunt, Ware, Baldock, Welwyn and Elstree. Villas or farms are common, but in a stoneless country they leave few structural traces beyond the barrows of their former owners.

Saxon settlement was early; pagan burials occur along the line of the Icknield way., and Ermine street appears to have been the boundary of the East Saxon kingdom and later of the diocese of London. Hertford was possibly the scene of a synod in 673 and Hatfield of a witenagemot in 67j. In 793 Offa of Mercia founded the abbey of St. Albans and endowed it with estates in western Hertfordshire, which became both an independent liberty and archdeaconry, maintaining these statuses until 1874 and 1845 respectively. By Alfred's treaty of Wedmore the county east of the Lea was included in the Danelagh; he defeated the Danish fleet in the Lea valley and Edward the Elder built a burgh at Hertford about 913.

William I reached Berkhamsted in 1066 in the course of encircling London and there received the submission of the Saxon leaders. He built castles there and at Hertford. The king confiscated at least 13 rnanors while the abbey of St. Albans retained the 15 manors with which it had previously been endowed. The archbishop, the bishops of London, Winchester. Bayeux, Lisieux and Chester, and the abbots of Ely and Westminster, each had their holdings. Count Eustace of Boulogne, the chief lay tenant, held a fief in the northeast of the county. At the time of the Domesday survey the boundaries were approximately those of the present day. Of the nine Domesday hundreds, Danais and Tring were

J. ALLAN CASH

ROMAN THEATRE AT VERULAMIUM, A ROMANO-BRITISH TOWN SITUATED CLOSE TO ST. ALBANS. THE THEATRE WAS EXCAVATED IN 1847

consolidated in about 1200 under the name of Dacorum: the modern hundred of Cashio, held by the abbots of St. Albans. was known as Albaneston, while the remaining six hundreds correspond with those of the present day.

Hertfordshire was originally in the dioceses of London and Lincoln; but the abbot of St. Albans was exempt from all control except that of the pope. The bishopric of London embraced the area of the deanery of Braughing and of the archdeaconry of Middlesex. The deaneries of Berkhamsted, Hitchin. Hertford and Baldock were under the jurisdiction of the bishop of Lincoln. After the dissolution, the archdeaconry of St. Albans was placed under the bishop of London. In 184j the whole county was formed into the archdeaconry of St. Albans and placed within the diocese of Rochester until 1877 when a new diocese of St. Albans was formed with jurisdiction over Hertfordshire, Bedfordshire and Essex; Essex later became an independent diocese.

Hertfordshire has always been a battleground for the London area. The Danes. Maud, Stephen and John all fought for the possession of Hertford. while Berkhamsted has seen sieges, especially that of Louis, the dauphin, in the Barons' wars. During the Peasants' Revolt in 1381. there was much rioting between the peasants and the servants of the abbot of St. Albans. In the Wars of the Roses. the county witnessed two battles at St. Albans (1455 and 1461), and the battle of Barnet in 1471. The civil wars in the 17th century found Hertfordshire predominantly puritan, and no major battles were fought in the county.

Architecture. — The churches generally have been heavily, though well: restored and the county has many pleasant. if few remarkable, buildings; St. Albans abbey with its Norman brickwork and mediaeval tombs and watching chamber stands out; Reed has some 11th-century work; Bengeo (Hertford) has a Norman apsidal church. with wall paintings; and good Norman work can be found in Hemel Hempstead, Weston and Abbot's Langley. Baldock and Royston are churches of new towns of the 13th century, created by the Knights Templars and Augustinian canons, respectively, and Ashwell and Wheathampstead are of the 13th and 14th centuries; the town churches of Ware and Hitchin and innumerable village churches have attractive Perpendicular work. Buntingford's Carolean brick, Offley's Georgian Gothic chancel and Ayot's classical St. Lawrence's are examples of work rare in Hertfordshire. Brasses. Jacobean and Georgian monuments form a remarkably fine series.

Fragments of Hertfordshire's many priories survive. often in-

corporated in later houses; the domestic buildings of Ware's friary are complete. as is much of its priory.

Castles at Berkhamsted (Norman earthwork), Hertford (13th-century walls and 16th-century gatehouse), Bennington (Norman keep), are not remarkable. Rye house (1445) is the earliest of a series of brick buildings of great interest which include Hatfield Old palace (c. 1480–go), Berkhamsted school, Standon Lordship (1546), Little Hadham hall (1570); Hatfield house (1608–12); and Knebworth house (one wing of the original Tudor house remains). Hertfordshire is a county of many lesser houses in timber and plaster, often mediaeval. and there are admirable Georgian country houses in fine parks of the period. A tablet in a field at Standon near Ware marks the spot where Vincent Lunardi landed in his balloon in 1784. The National Trust owned 3,946 ac. in 1955, mainly at Ashridge, and 110 ac. were under its protection. In the same year the Tring reservoirs were established as a nature reserve; they are visited by waterfowl and other birds on migration and many species nest there.

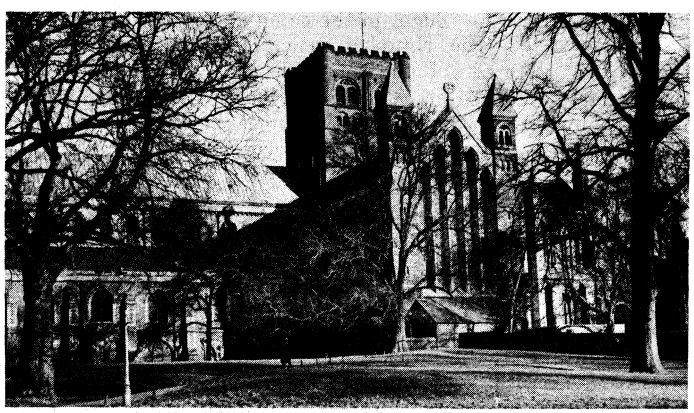
Agriculture and Industries.—Hertfordshire has always been a corn-growing county and even at the time of Domesdap Book the shire on its eastern side was noticeably free from wasteland; its corn markets were famous in the 16th century and malting and brewing of local barley were important from an early date.

In 1955 the total acreage farmed was 275,596 ac., of this 199,722 ac.. was arable; grain covered 118,020 ac.; potatoes 5,266 ac.; and there were substantial areas under root crops. Permanent pasture was 75,874 ac. and temporary pasture 43.938 ac. The northern part of the county is chiefly arable. The southern part, particularly on the London clay, has mixed farms carrying pedigree dairy stock. The southeast of Kertfordshire includes the Lea valley nursery and glasshouse district supplying salad vegetables and flowers to London. Watercress is widely grown, and roses, farm and garden seeds are other crops. The Rothamsted Experimental station (*q.v.*) at Harpenden, the first agricultural research station, was founded in 1833. and in 1949 the John Innes Horticultural institution moved to Bayfordbury.

Although agriculture retains the lead, other industries increased vastly during the first half of the 20th century. Papermaking and printing, developed experimentally at Hertford and St. Albans in the early 16th century, centre on the Watford district and Hertford. Agricultural and general engineering, coachbuilding and aircraft, food processing and drugs. chemicals and light industries of all types continue to develop particularly in the south and in the new towns. This made it necessary for the county council to expand its educational facilities at an unprecedented rate. There are many public, grammar and preparatory schools, some of ancient foundation, within the county.

Communications.—Many railways pass through Hertfordshire including the London-Cambridge line. the London-York line, the London-Leicester line. and the London-Birmingham line. all with branches. Electric services of London transport serve the Watford, Rickmansworth and Barnet areas.

Three great highways from London traverse the county; the Great North road—the trunk road to Edinburgh—enters the county north of Mill Hill. bypassing Barnet by means of a road that supersedes the old Great North road to Hatfield; thence it follows the old route leaving the county north of Baldock. The Holyhead road follows the route of the old Roman road. Watling street, entering the county at Elstree and passing through St. Albans, Redbourn and Markyate. The road to Carlisle and Glasgow branches off the Great North road at South Rlimms to pass through St. Albans and Harpenden. Another well-known road is that to Cambridge, the Old North road, along the Lea valley to Ware whence it follows Ermine street, to Royston.



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THE NORMAN ABBEY CHURCH OR CATHEDRAL AT ST. ALBANS. HERTFORDSHIRE, BUILT OF ROMAN BRICKS FROM THE RUINS OF VERULAMIUM

Communications by river and canal from Hertford, Ware and Bishop's Stortford, southward to the Thames dockland by the Lea and Stort navigation, and the Grand Junction canal from London to the northwest. which traverses the southwest of the county by Rickmansworth and Tring, were little used in the 1950s.

Administration and Population.—From the time of the Conquest and up to the year 1567 the county shared a sheriff with Essex. The possessions of the abbot of St. Albans were formed into a liberty, over which he had wide jurisdiction and his own jail. A separate commission of the peace was granted to the liberty which held its own separate quarter sessions until 1874. The county sent two members to parliament in 1290. Before 1375 members were sent by Hertford? St. Albans, Bishop's Stortford and Berkhamsted, but this representation lapsed in the time of Henry V. St. Albans regained its franchise in 1553, but was deprived of it for malpractices in 1852. From 1623 Hertford had two members, reduced to one in 1868 and abolished in 1885.

For parliamentary purposes the county is divided into seven county divisions and Watford borough.

The population of the administrative county in 1951 was 609,775. To Letchworth, the pioneer garden city (1910), Welwyn Garden city was added in 1923 and Hatfield was linked with the latter; Hemel Hempstead and Stevenage, new towns, were developed after World War II to accommodate industry and population from London, and the London county council built major housing estates at Boreham Wood and Oxhey. Watford (pop., 1951, 73,130), St. Albans city (44,098). Hertford (13,884) and Hemel Hempstead (23,437) are municipal boroughs, and there are 19 urban districts and 11 rural districts and the New Town corporations.

The county is in the southeastern circuit and assizes are held at Hertford, which is the administrative centre. There are two quarter sessions and 13 petty sessional divisions. The southern part of the county is in the metropolitan police district and a wider area is in the London postal district.

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HERTHA or **NERTHUS,** in Teutonic mythology, the goddess of fertility, "Mother Earth," stated by Tacitus to be worshipped with orgies and mysterious rites at night by Teutonic tribes. Her veiled statue was moved from place to place by sacred cows. After the rites the image, vestments and vehicle were bathed in a lake.

HERTLING, GEORG, COUNT VON (1843–1919), German statesman, was born in Darmstadt on Aug. 31, 1843. He was appointed professor of philosophy at Bonn (1880), and at Munich (1882). From 1875 to 1890 and again from 1896 to 1912 he was a member of the *reichstag,* from 1909 being for a short time the leader of the Centre (Catholic) party. In 1912 he was appointed president of the Bavarian ministry and minister for foreign affairs. and in 1914 was elevated to the rank of count by King Ludwig III. On Nov. 1, 1917, he accepted the chancellorship of the reich, and for 12 months he strove against the encroachments of the military authorities upon the political affairs of the

empire. The failure of the German offensives in 1918 finally destroyed his hopes of being able to negotiate with the Allies on anything like equal terms and he resigned on Sept. 30. 1918. He returned to his home at Ruhpolding in Upper Bavaria, where he died on Jan. 4, 1919.

In philosophy. Hertling was a Neo-Thomist. Starting from a teleological conception of the world. he elaborated a political and social philosophy, and declared the conscious furthering of the divine world plan to be a duty for man. With Baeumker. he collaborated in the production of the invaluable series. *Beiträge zur Gesch. der Phil. des Mittelalters,* himself contributing the volume? *Albertus Magnus, Beiträge zu seiner Würdigung* (1914). Hertling's other works include: *Über d. Grenzen d, mechan. Naturerklarung* (1875); *Naturrecht u. Sozialpolitik* (1893); *Kleine Schriften zur Zeitgesch. u. Politik* (1897); *Recht, Staat u. Gesellschaft* (1906); and *Erinnerungen aus meinem Leben,* 2 vol. (1919).

HERTWIG, the name of two eminent German biologists, who were brothers.

(Wilhelm August) Oskar Hertwig (1849–1922) was renowned for his work in the fields of embryology and cytology. He was born on April 21, 1849, in Friedberg, Hessen, attended school in Mülhausen, Thuringia, Ger., and then studied medicine and zoology in Jena, Zurich and Bonn. He obtained a lectureship in anatomy at the University of Jena in 1875 and was elected to the professorship in 1881. From 1888 to 1921 he was professor of anatomy and evolutionary history at the University of Berlin and director of the Anatomisch-Biologischen Instituts. He died in Berlin on Oct. 25, 1922.

Richard (Carl Wilhelm Theodor) von Hertwig (1850–1937) was particularly noted for his development of the germ-layer theory and for his contributions to the study of Protozoa. Born on Sept. 23, 1850 at Friedberg, he shared his brother's education. He became lecturer in zoology at Jena in 1875, professor of zoology at the universities of Konigsberg in 1881, Bonn in 1883 and Munich from 188j to 1925. He died in Munich on Oct. 3, 1937.

Work of the **Hertwig** Brothers.— The brothers were influenced by the works of Ernst Haeckel (*q.v.*) (theory of evolution)., Karl Gegenbauer (comparative morphology) and Max Schultze (cytology). Jointly they worked on Haeckel's "gastraea" theory of coelom formation and the germ-layer theory. Oskar was the first to recognize the fusion of ovum and sperm nuclei as the essential factor in fertilization; he was also the first to compare ovum and sperm maturation in *Ascaris* and to recognize the significance of reduction division (meiosis). Other fields of study were: nuclear transmittal of hereditary characters (the idioplasm theory of K. W. von Nägeli; *q.v.*); biogenetic theory; and the effect of radium rays on somatic and germ cells. He was also concerned with the importance of biology in relation to social problems.

Richard Hertwig was the first to describe the artificially stimulated development of sea urchins (parthenogenesis; *q.v.*) He then turned to research on Protozoa, and interpreted the changes in the nucleus during the conjugation of paramecia as reduction and fertilization processes. He studied the nucleoplasmic ratio in association with cell division and sexuality problems, originated the chromidia theory and experimented in the determination of sex in Amphibia.

Prominent among their numerous publications are: Oskar and Richard: *Die Colomtheorie* (1881) and *Entwicklung des mittleren Keimblattes der Wirbeltiere* (1883); Oskar only: *Lehrbuch der Entwicklungsgeschichte des Menschen und der Wirbeltiere* (1886; 10th ed., 1915; Eng. trans., 1892); *Die Zelle und die Gewebe* (1893–98; Eng. trans., 2nd ed., 1909); *Allgemeine Biologie* (1905; 7th ed. with Günther Hertwig, 1923); *Der Kampf um Kernfragen der Entwicklungs- und Vererbungslehre* (1909); *Das Werden der Organismen* (1916); *Der Staat als Organismus* (1920); Richard only: *Der Organismus der Radiolarien* (1879); *Die Aktinien der Challenger-Expedition* (1882); *Über die Konjugation der Infusorien* (1889); *Über die Entwickelung des Unbefruchteten Seeigeleies* (1896); *Lehrbuch der Zoologie* (1891–92; 15th ed., 1931); *Die Protozoen und die Zelltheorie* (1902); *Abstammungslehre und neuere Biologie* (1927). (P. Hg.)

HERTZ, GUSTAV (1887– **j,** German physicist, was awarded the Nobel prize for physics jointly with James Franck in 192j for work on the laws of impact between an electron and an atom. Hertz was born on July 22, 1887, at Hamburg, and studied in the universities of Gottingen, Munich and Berlin, in the last of which he was appointed in 1913 an assistant in physics. After service in World War I. in which he was severely wounded, he returned to Berlin as *Privatdozent* (official but unpaid lecturer) in 1917. From 1920 to 1925 he worked in the physics laboratory of the Philips organization (lamp manufacturers) at Eindhoven, Neth. In 192j he was appointed professor of physics in the University of Halle. and in 1928 he became professor of physics at the Technische Hochschule in Berlin-Charlottenburg. He resigned on political grounds in 1934 and soon afterward became director of one of the research laboratories of the Siemens company.

Hertz was in Berlin in 1945 when the Russian forces entered the city and, while it was not known what happened to him. there had been a report that he survived and that he continued his researches for the U.S.S.R. The experiments of Hertz and Franck on the electron-atom collision showed that for ionization of the atom the electron must possess a certain minimum energy. measured in volts as "ionization potential." which varied for different gases; and the measurements made showed quantitatively that a series of spectral lines so obtained corresponded to a series of stationary states in the internal energy of the atom. as demanded by Siels Bohr's theory of the structure of the atom, which included the application of Max Planck's quantum theory. according to which energy could be taken up by the atom only in discrete quantities. Hertz succeeded in devising a method of separating the isotopes of neon by means of diffusion. (D. McK.)

HERTZ, HEINRICH RUDOLF (1857–1894), German physicist. was the first to demonstrate the production and reception of radio waves. He was born at Hamburg on Feb. 22. 18j7. On leaving school he studied engineering. but abandoned it in favour of physics. Hertz went to Berlin. where he studied under Hermann von Helmholtz. In 1883 he went to Kiel. becoming *Privatdozent* (official but unpaid lecturer). and there he began the studies in Maxwell's electromagnetic theory which a few years later resulted in the discoveries that rendered his name famous. These were actually made between 1885 and 1889, when he was professor of physics in the Karlsruhe Polytechnic. Helmholtz drew Hertz's attention to a prize offered by the Berlin Academy of Sciences for the experimental establishment of a relation between electromagnetic actions and the polarization of a dielectric, and promised him the assistance of the institute if he decided to work on the subject. Hertz did not take it up seriously at that time because he could not think of any procedure'likely to prove effective. Later he was able to discover the progressive propagation of electromagnetic action through space. to measure the length and velocity of electromagnetic waves and to show that in the transverse nature of their vibration and their susceptibility to reflection, refraction and polarization they are in complete correspondence with the waves of light and heat. The result was to establish beyond doubt the electromagnetic nature of light. In 1889 Hertz was appointed to succeed R. J. E. Clausius as ordinary professor of physics in the University of Bonn. There he continued his researches on the discharge of electricity in rarefied gases, only just missing the discovery of the X-rays described by W. C. Rontgen a few years later, and produced his treatise on the *Principles of Mechanics.*

This was his last work, for after a long illness he died at Bonn on Jan. 1, 1894 By his premature death science lost one of its most promising disciples.

See also Electricity : *Hertz's Experiments.*

Hertz's scientific papers were translated into English by D. E. Jones and published in three volumes: *Electric Waves* (1893), *Miscellaneous Papers* (1896) and *Principles of Mechanics* (1899).

HERTZ, HENRIK (originally Heyman) (1797 or 1798–1870), Danish author who, like his friend, J. L. Heiberg (*q.v.*), opposed the late romantic tendency to formlessness both in his critical writings and in his poems, plays and ballad operas. Born in Copenhagen of Jewish parents, probably on Aug. 25, 1797 or

1798, he received the first name Heyman, but took the name Henrik at his baptism in 1832. He graduated in law but never practised, instead devoting himself to belles-lettres. His first play, *Herr Burchardt og hans Familie,* a comedy in the line of direct descent from Holberg, appeared in 1827 and was followed by *Kærlighed og Politi* ("Love and the Police"), a vaudeville or ballad opera inspired by those of Heiberg. He greatly admired Heiberg with whom he allied himself, notably in *Gengangerbreve* ("Letters of a Ghost," 1830), in a campaign against the lack of form and intellectual content in Adam Öhlenschläger's mature romanticism. As a poet, Hertz was prolific, versatile and always distinguished, whether in lyric, narrative or didactic vein, but he has been overshadowed by his outstanding contemporaries, Ludwig Bødtcher, Christian Winther and Frederick Paludan-Miiller. None the less, his carefully wrought and eminently actable plays, which continued to appear until 1869, are among the best of his time. They include *Amors Genistreger* ("Cupid's Pranks," 1830), a rhymed comedy, the charm and deftness of which are comparable to those of Alfred de Musset; *Debatten i Politivennen* ("The Debate in 'The Friend of the Police'," 1836) and other entertaining vaudevilles; *Sparekassen* ("The Savings Bank," 1836), a prose comedy; *Svend Dyrings Hus* (1837), a "ballad-tragedy"; and *Kong René's Datter,* a lyric drama anonymously produced in 1845 and soon translated (English by T. Martin, 1850) and acted in many European languages.

Hertz died in Copenhagen, Feb. 25, 1870. His collected poems, *Digte,* appeared in 4 vol. (1851–62); his *Dramatiske Vaerker,* in 18 vol. (1854–73).

See H Kyrre, *Henrik Hertz, Liv og Digtning* (1916); *M.* Brøndsted, *Henrik Herizes Teater* (1946). (B. W. D.)

HERTZ, JOSEPH HERMAN (1872–1946), chief rabbi of the United Hebrew Congregations of the British Empire, was born in Rebrény, Hung.. on Sept. 25, 1872. Emigrating to the Gnited States 'as a child he was educated at New York City college, Columbia university, where he took the degree of Ph.D., and at the Jewish Theological Seminary of America. He was a rabbi in Johannesburg, South Africa, from 1898 to 1911 and, during the Boer War, was expelled by Pres. Paul Kruger for pro-British sympathies and for advocating the removal of religious disabilities from Jews and Catholics. From 1906 to 1908 he was professor of philosophy at Transvaal University college. Hertz was elected to the chief rabbinate in succession to Hermann Adler in 1913. In 1920–21 he undertook an extensive pastoral tour, visiting the Jewish communities in South Africa, Australia, New Zealand and Canada. In 1925 he was made a governor of the University of Jerusalem. His *A Book of Jewish Thoughts* went through numerous editions, and his commentaries in English on the Pentateuch and the Standard Prayer Book are widely accepted and used by orthodox and conservative Jews. Hertz died in London on Jan. 14, 1946.

HERTZBERG, EWALD FRIEDRICH, GRAF VON (1725–1795), Prussian statesman, was born at Lottin, Pomerania, on Sept. 2, 1725. He studied law at Halle, and entered the Prussian government service, rising rapidly until he became chief minister in 1763. For more than 40 years Hertzberg played an active part in the Prussian foreign office. In this capacity he had a decisive influence on Prussian policy, both under Frederick the Great and Frederick William II. At the beginning of the Seven Years' War (1756) he took part as a political writer in the Hohenzollern-Habsburg quarrel. After the defeat at Kolin (1757) he organized the national defense in Pomerania and collected the necessary troops for the protection of the fortresses of Stettin and Colberg. In the same year he conducted the peace negotiations with Sweden, and helped to bring about the peace of Hubertusburg (1763).

In 1772, in a memoir based upon comprehensive historical studies, he defended the Prussian claims to certain provinces of Poland. He also supported by his writings the negotiations on the Bavarian succession (1778) and the peace of Teschen (1779). But in 1780 he failed to uphold Prussian interests at the election of the bishop of Münster. In 1784 appeared Hertzberg's memoir containing a thorough study of the Fürstenbund. He championed this creation of Frederick the Great's mainly with a view to an energetic reform of the empire, though the idea of German unity was naturally still far from his mind. Though the Fiirstenbund failed to effect a reform of the empire, it at any rate prevented the fulfillment of Joseph II's old desire for the incorporation of Bavaria with Austria. The last act of state in which Hertzberg took part under Frederick the Great was the commercial treaty concluded in 1785 between Prussia and the U.S.

Under Frederick William II Hertzberg was raised to the rank of count in 1786. His political system remained on the whole the same as it had been under Frederick, mainly characterized by opposition to the house of Habsburg and by a desire to win for Prussia the support of England. His diplomacy was directed also against Austria's old ally, France, and it was chiefly owing to him that in 1787 Prussia intervened in Holland in support of the stadholder William V against the democratic French party. The success of this intervention marks the culminating point in his career. The opposition between him and the new king became marked when Hertzberg, relying upon the triple alliance (Holland, England, Prussia), sought to take advantage of the entanglement of Austria with Russia in the war with Turkey to secure for Prussia an extension of territory by diplomatic intervention. According to his plan, Prussia was to offer her mediation at the proper moment, and in the territorial readjustments that the peace would bring, was to receive Danzig and Thorn as her portion. Beyond this he aimed at preventing the restoration of the hegemony of Austria in the empire, and secretly cherished the hope of restoring Frederick the Great's Russian Alliance.

Deep-rooted differences between him and the king were revealed during these diplomatic campaigns. Hertzberg wished to effect everything by peaceful means, while Frederick William II was for a time determined on war with Austria. On Polish and British policy, too, their ideas came into conflict. At the conferences at Reichenbach in the summer of 1790, this opposition became more and more acute, and Hertzberg was only with difficulty persuaded to come to an agreement merely on the basis of the *status quo,* as demanded by Pitt. The king's renunciation of any extension of territory was in Hertzberg's eyes impolitic, and this view of his was later endorsed by Bismarck. A letter which came to the eyes of the king, in which Hertzberg severely criticized the king's foreign policy, led to his dismissal on July j, 1791. The king showed himself more and more personally hostile to the ex-minister, and in later years pursued Hertzberg, now quite embittered, with every kind of petty persecution.

Wilhelm von Humboldt excepted, Hertzberg was the most learned of all the Prussian ministers. As a member of the Berlin Academy especially, and, from 1786 onward, as its curator, Hertzberg was active in the world of learning. His yearly reports dealt with history, statistics and political science. The most interesting is that of 1784: *Sur la forme des gouvernements, et quelle est la meilleure.* This is directed exclusively against the absolute system (following Montesquieu), upholds a limited monarchy and is in favour of extending to the peasants the right to be represented in the diet. He spoke for the last time in 1793 on Frederick the Great and the advantages of monarchy. After 1783 these discourses caused a great sensation, since Hertzberg introduced into them a review of the financial situation, which in the days of absolutism seemed an unprecedented innovation. Hertzberg exerted himself as an academician to change the strongly French character of the Academy and make it into a truly German institution. He showed a keen interest in the old German language and literature. He also stood in very close relations with many of the German poets of the time, and in 1780 he boldly took up the defense of German literature, which had been disparaged by Frederick the Great in his famous writing *De la littérature allemande.* He died in Berlin on May 27, 1795.

BIBLIOGRAPHY.—The *Mémoires de l'Académie* from 1780 on contain Hertzberg's discourses. An "Autobiographical Sketch" was published by Höpke in Schmidt's *Zeitschrift für Geschichtswissenschaft,* vol. i (1843). *See* also P. F. Weddigen, *Hertzbergs Leben* (1797); E. L. Posselt, *Hertzbergs Leben* (1798); *Allgemeine deutsche Biographie* (1880); G. Dressler, *Friedrich II und Hertzberg in ihrer Stellung zu den holländischen Wirren* (1882); K. Krauel, *Hertzberg als Minister Friedrich Wilhelms II* (1899); A. T. Preuss, *Ewald Friedrich, Graf von Hertzberg* (1909).

HERTZOG, JAMES BARRY MUNNIK (1866–1942), South African politician, was born at Wellington, Cape Colony, April 3, 1866. Educated at Victoria College, Stellenbosch and Amsterdam university, he became a judge in the Orange Free State in 1895, and served through the South African War of 1899–02. He voted against peace at Vereeniging and, frankly hostile to the British connection, he helped to keep alive this anti-British feeling after the war. On the grant of responsible government in 1907, he became attorney general and minister of education in Fischer's ministry, and forthwith began to undo the work of the Crown Colony Administration. He tried to force upon the schools in the Orange River State a system of compulsory bilingualism — Dutch and English — which was crude and impracticable. The director of education resigned, and one of the three inspectors, dismissed without enquiry, won an action for libel against Hertzog in a *cause célèbre*.

In the first Union Cabinet, in 1910, Hertzog became minister of justice under Botha, but his attitude made the position untenable. Hertzog derided Botha's work at the Imperial Conference in London, and repudiated all suggestions of state-aided immigration and of a naval contribution, which Botha was suspected to have favoured. Botha resigned in 1912, took office again, reconstructed his cabinet and left Hertzog out. Hertzog then (Dec. 1913) formed an opposition party with complete independence of Britain as its goal, and his perfervid nationalism made him a power among the old Republican Boers. He made full use of the racial appeal, and fought unremittingly against the Botha-Smuts policy of South African development within the British Empire. His original five supporters in the South African parliament were increased by 1924 to 63, and a working alliance with the Labour party gave Hertzog a majority. Smuts fell, and the Coalition came to power with Hertzog as prime minister, which office he held for 15 years. In 1933 he formed, in coalition with Gen. Smuts, a National party which was returned to power. When World War II broke out, Hertzog opposed a South African declaration of war against Germany, declaring that such action was a '(crime"; he was defeated in the assembly, however, by a vote of 80 to 6 and resigned forthwith. He was succeeded by Gen. Smuts. Thereafter Hertzog continued to urge a separate peace with the nazis. He resigned from parliament in Dec. 1940 and died Nov. 21, 1942 at Cape Town.

HERTZSPRUNG, EJNAR (1873–), Danish astronomer, was born at Frederiksberg, near Copenhagen; on Oct. 8, 1873 He was educated in technological colleges in Denmark and became a chemical engineer. After several years in this profession he was called to Gottingen, Ger., in 1909 as professor of astronomy and later moved to Potsdam, Ger. He was appointed assistant director of the university observatory at Leyden, Netherlands, in 1919 and became director in 1935; he resigned in 1945.

There is hardly a phase of modern stellar astronomy not affected by Hertzsprung's work. In papers published in 1905 and 1907, he showed that there is a relationship between the colours of the stars and their true or absolute brightness. The great majority lie along a sequence ranging from the blue and white stars (the Orion group, Sirius, and Vega) through the yellow (Procyon, α Centauri, and the sun) to the orange (61 Cygni) and red. Along this sequence the true brightness decreases smoothly and rapidly; the blue and white stars are larger and much more luminous than, the sun; the orange and red stars are smaller and fainter. In addition to this main sequence, Hertzsprung called attention to a number of yellow, orange and red giants (Xrcturus. Pollux. Aldebaran and Betelgeuse); these are far less numerous in space than the main sequence stars of the same colour, and they were described as "whales among the fishes.!'

This description of stellar types was refined by the later work of Hertzsprung and H. N. Russell. and culminated in the "Hertzsprung-Russell diagram" — perhaps the fundamental diagram of stellar astronomy.

Later work indicated that there are faint white stars (the so-called white dwarfs), but the over-all picture suggested by Hertzsprung was completely confirmed. He also noted that the great majority of stars in our region of space are smaller and absolutely fainter than the sun.

One of the most important fields in contemporary astronomy originated in Hertzsprung's discovery, that there is a relationship between the strength of certain features in the spectrum of a star and its true brightness. This furnishes a means of estimating the true brightness — that is, the absolute magnitude — simply from the appearance of a stellar spectrum. (W. W. **M.**)

HERULI, a Teutonic tribe belonging either to the northern or the southern portion of the Jutish peninsula. In the reign of Gallienus (A.D. 26—68), they were with the Goths ravaging the coasts of the Black Sea and the Aegean. Soon afterwards, in AD. 289, they appeared in the region about the mouth of the Rhine. During the 4th century they frequently served together with the Batavi in the Roman armies. In the 5th century the Heruli made piratical incursions in the western seas. At the same time they had a kingdom in central Europe, in or around the basin of the Elbe.

About the beginning of the 6th century they were completely overthrown in war by the Langobardi. Part of them migrated to Sweden, while others crossed the Danube and entered the Roman service, where they were frequently recorded later in connexion with the Gothic wars. In English, Frankish and Scandinavian works they are never mentioned, and there can be little doubt that they were known among the western Teutonic peoples by some other name. Probably they were identical either with the North Suabi or with the Iuti. The name Heruli itself is identified by many with the AS. *Eorlas* (nobles).

The Heruli remained heathen until the overthrow of their kingdom, and retained many striking primitive customs. When threatened with death by disease or old age, they were required to call in an executioner, who stabbed them on the pyre. Suttee was also customary Entirely devoted to warfare, they served not only in the Roman armies, but also in those of all the surrounding nations. They disdained the use of helmets and coats of mail, and protected themselves only with shields.

See Georgius Syncellus; Mamertinus, *Paneg. Maximi;* Ammianus Marcellinus; Zosimus i. 39; Idatius, *Chronica;* Jordanes, De *origine Getarum;* Procopius, esp *Bellum Goticum,* ii. *14 et seq.; Bellum Persicum,* ii. *25*; Paulus Diaconus, *Hist. Langobardorum,* i. *no.*

HERVEY OF ICKWORTH, JOHN HERVEY, BARON (1696–1743), English statesman and writer, eldest son of John, 1st earl of Bristol, by his second marriage, was educated at Westminster school and at Clare Hall, Cambridge. In 1716 his father sent him to Paris, and thence to Hanover to pay his court to George I. He was a frequent visitor at the court of the prince and princess of Wales at Richmond, and in 1720 he married Mary Lepell, who was one of the princess's ladies-in-waiting, and a great court beauty. In 1723 he received the courtesy title of Lord Hervey on the death of his half-brother Carr, and in 1725 he was elected M.P. for Bury St. Edmunds. In 1730 he attached himself to Walpole. He was assumed by William Pulteney to be the author of *Sedition and Defamation display'd with a Dedication to the patrons of The Craftsman* (1731). Pulteney replied, and the quarrel resulted in a duel from which Hervey narrowly escaped with his life. Hervey's influence with the queen enabled him to render valuable service to Walpole. He was vice-chamberlain in the royal household and a member of the privy council. In 1733 he was called to the House of Lords by writ in virtue of his father's barony. He was lord privy seal when the fall of Walpole drove him from his office (July 1742). He predeceased his father, but three of his sons became successively earls of Bristol.

Hervey wrote detailed and brutally frank memoirs of the court of George II. from 1727 to 1737. He gave a most unflattering account of the king, and of Frederick, prince of Wales, and their family squabbles. For the queen and her daughter, Princess Caroline, he had a genuine respect and attachment, and the princess's affection for him was commonly said to be the reason for the close retirement in which she lived after his death. The ms. of Hervey's memoirs was preserved by the family, and published in 1848 under the editorship of J. W. Croker. The ms. had already been subjected to a certain amount of mutilation, and Croker himself softened in some cases the plainspokenness of the original.

HERVIEU, PAUL (1857–1915), French dramatist and nov-

elist, was born at Neuilly (Seine) on Nov. 2, 1857. He was called to the bar in 1877, and, after serving some time in the office of the president of the council, qualified for the diplomatic service, but resigned on his nomination in 1881 to a secretaryship in the French legation in Mexico. He contributed novels, tales and essays to the chief Parisian papers and reviews, and published a series of clever novels, of which the most famous are *Peints par eux-mêmes* (1893), an ironical study written in the form of letters and *L'Armature* (1895), dramatized in 1905 by Eugene Brieux. But his most important work consists of a series of plays: *Les Paroles restent* (Vaudeville, Nov. 17, 1892); *Les Tenailles* (Théâtre Franqais, Sept. 28, 1895); La *Loi de l'homme* (Théâtre Franqais, Feb. 15, 1897); *La Course du flambeau* (Vaudeville, April 17, 1901); *Point de lendemain* (Odéon, Oct. 18, 1901), a dramatic version of a story by Vivaut Denon; *L'Enigme* (Théâtre Franqais, Nov. 5, 1901); *Théroigne de Méricourt* (Théâtre Sarah Bernhardt, Sept. 23, 1902); *Le Dédale* (Théâtre Français, Dec. 19, 1903); and *Le Réveil* (Théâtre Français, Dec. 18, 1905). These plays, which are nearly all *pièces à thèse,* are built upon a severely logical method, the mechanism of which is sometimes so evident as to destroy the necessary sense of illusion. The closing words of *La Course du flambeau*—*"Pour ma fille, j'ai tue ma mère"*—illuminate the Hervieu method. The riddle in *L'Enigme* (staged at Wyndham's Theatre, London, March 1, 1902, as *Caesar's Wife)* is, however, worked out with great art, and *Le Dédale,* dealing with the obstacles to the remarriage of a divorced woman, is reckoned among the masterpieces of the modern French stage. His last play was *Le Destin est Maître* (1914). He was elected to the French Academy in 1900, and died in Paris on Oct. 25, 1915.

See A. Binet, *in L'Année psychologique,* vol. x.; and *Portrait psychologique de Paul Hervieu* (1914); *H.* Burckhardt, *Studien zu Paul Hervieu* (1917).

HERWEGH, GEORG (1817–1875), German revolutionary poet, was born at Stuttgart on May 31, 1817. Expelled from the theological college at Tiibingen, he became a journalist. He was called up for military service, but committed an act of insubordination and fled to Switzerland. There he published *Gedichte eines Lebendigen* (1841), political poems expressing the aspirations of German youth. Although the book was confiscated, it ran through several editions. Herwegh returned to Germany in 1842, greeted by demonstrations showing popular sympathy; Frederick William IV received him in Berlin with the memorable words: *"Ich liebe eine gesinnungsvolle Opposition" ("I* admire an opposition, when dictated by principle"). In 1844 the second volume of *Gedichte eines Lebendigen* was published in Paris, where Herwegh was living, and was also confiscated. At the head of a column of German workingmen, recruited in Paris, Herwegh took part in a south German rising in 1848, but was defeated on April 27 at Schopfheim, Baden. He escaped to Switzerland, but was permitted (1866) to return to Germany, and died at Lichtental, Baden, on April 7, 1875. *Neue Gedichte* appeared in 1877. Herwegh also translated the works of Alphonse de Lamartine.

BIBLIOGRAPHY.—**Herwegh's** works were ed. by H. Tardel, 3 vol. (1909); his correspondence was published in 1896; his *Briefen an seine Braut* in 1906 and his correspondence with Marie d'Agoult in M. Herwegh, *Au printemps des dieux* (1929). *See* also Victor Fleury, *Le Poète Georges Herwegh* (1911); *E.* Baldinger, *Georg Herwegh: Die Gedankenwelt der "Gedichte eines Lebendigen"* (1917); B. Kaiser, *Der Freiheit eine Gasse* (1947). (A. Gs.)

HERZBERG, a town in the *Land* of Lower Saxony, situated under the south-western declivity of the Harz, on the Sieber, 25 mi. N.W. from Nordhausen by the railway to Osterode-Hildesheim. Pop. (1950) 9,606. It has manufactures of machinery and art silk and weaving and dyeing works. On a hill southwest of the town lies the castle of Herzberg, which in 1157 came into the possession of Henry the Lion, duke of Saxony, and was one of the residences of a branch of the house of Brunswick.

HERZBERG, a town in Germany, in the district of Cottbus, on the Schwarze Elster, 25 mi. S. from Jiiterbog by the railway Berlin-Roderau-Dresden. It has a church (Evangelical) dating from the 13th century and a medieval town hall. Its industries include the founding and turning of metal, agricultural machinery and furniture. Pop. (1950) 7,415.

HERZEN, ALEXANDER IVANOVICH (1812–1870). Russian author, was born in Moscow on March 25, 1812, the illegitimate son of Ivan Yakovlev, a noble. A year later the family returned to Moscow, where Herzen attended the university In 1834 he was arrested with other youths suspected of revolutionary tendencies, and in 1835 he was exiled to Viatka and worked as a clerk in the civil service. There he remained for seven years, at the end of which he was allowed to exchange to Vladimir, where he edited the official gazette. In 1840 he was allowed to return to Moscow, where he became one of the leaders of the westerners, but he was again arrested, and sent to serve in the Government offices at Nóvgorod until his retirement in 1842. In 1846 his father died, leaving him by his will a very large property. Early in 1847 he left Russia, never to return. From Italy, on hearing of the revolution of 1848, he hastened to Paris, whence he afterwards went to Switzerland. In 1852 he quitted Geneva for London, where he settled for some years, and established a Russian press for the publication of works which could not be printed in Russia. In 1864 he returned to Geneva, and after some time went to Paris, where he died on Jan. 9, 1870.

In 1847 appeared his novel *Kto Vinovat?* (Whose Fault?), and about the same time were published in Russian periodicals the stories which were afterwards collected and printed in London in 1854, under the title of *Prervannuie Razskazui* (Interrupted Tales). In 1850 two works appeared, translated from the Russian manuscript, *Vom anderen Ufer* (From another Shore) and *Lettres de France et d'Italie. Vom anderen Ufer* is perhaps his greatest work. It is the bitter fruit of disillusion after the failure of the revolution of 1848; in it he seeks to destroy the romanticism of the revolutionaries and to replace it by the will to revolution. In French appeared also his essay *Du Développement des idées révolutionnaires en Russie,* and his *Memoirs.* Herzen's *Memoirs* are indispensable in the history of the revolution in Europe for the portraits of the revolutionary leaders; and they give a true and vivid picture of his own personality and upbringing. From his "Free Russian Press" in London he issued a great number of Russian works, all levelled against the system of government prevailing in Russia. Some of these were essays, such as his *Baptized Property,* an attack on serfdom; others were periodical publications, the *Polyarnaya Zvyezda* (or Polar Star), the *Kolokol* (or Bell), and the *Golosa iz Rossii* (or Voices from Russia). The *Kolokol* soon obtained an immense circulation, and exercised an extraordinary influence. For three years, it is true, the founders of the "Free Press" went on printing, "not only without selling a single copy, but scarcely being able to get a single copy introduced into Russia"; but after the death of the emperor Nicholas in 1855 Herzen's writings, and the journals he edited, were smuggled wholesale into Russia, and their words resounded throughout that country, as well as all over Europe. For some years his influence in Russia was a living force; the circulation of his writings was a vocation zealously pursued. When the Polish insurrection of 1863 broke out, and he pleaded the insurgents' cause, his reputation in Russia received its death-blow. From that time it was only with the revolutionary party that he was in full accord.

In 1873 a collection of his works in French was commenced in Paris. A volume of posthumous works, in Russian, was published at Geneva in 1870. His *Memoirs* (Eng. trans. by C. Garnett, 6 vols., 1924–27, and by J. D. Duff, Yale, 1923), supply the principal information about his life, a sketch of which appears also in A. von Wurzbach's *Zeitgenossen,* pt. 7 (Vienna, 1871). *See* also the *Revue des deux mondes* for July 15 and Sept. 1, 1854. *Kto Vinovat?* has been translated into German under the title of *Wer ist schuld? in* Wolffsohn's *Russlands Novellendichter,* vol. iii.

HERZL, THEODOR (1860–1904), founder of modem political Zionism (*q.v.*), was born in Budapest on May 2, 1860, and died at Edlach on July 3, 1904. He received a legal education at Vienna, where he afterwards acquired high repute as a literary journalist and a dramatist. All his other claims to renown, however, sink into insignificance when compared with his work as the reviver of Jewish hopes for a restoration to political autonomy. The new nationalism of 1848 did not deprive the Jews of political rights, but it denied them both the amenities of friendly

intercourse and the opportunity of distinction in the university, the army and the professions. Many Jews refused to see in the new anti-Semitism (*q.v.*) which spread over Europe in 1881 any more than a temporary reaction against the cosmopolitanism of the French Revolution. In 1896 Herzl published his famous pamphlet "Der Judenstaat." Holding that the only alternatives for the Jews were complete merging by intermarriage or self-preservation by a national reunion, he boldly advocated the second course. He did not at first insist on Palestine as the new Jewish home, nor did he attach himself to religious sentiment; his solution was economic and political.

Herzl rallied the masses with sensational success, and unexpectedly gained the accession of many Jews by race who were indifferent to the religious aspect of Judaism, but he failed to convince the leaders of Jewish thought, who (with such conspicuous exceptions as Max Nordau and Israel Zangwill) remained deaf to his pleading. He assembled several congresses at Basle, Switz. (beginning in 1897). where remarkable scenes of enthusiasm for his ideal of "establishing for the Jewish people a publicly and legally assured home in Palestine" were enacted. Diplomatic interviews. exhausting journeys, impressive mass meetings, brilliant literary propaganda—all these methods were employed by him to the utmost limit of self-denial. In 1901 he was received by the Turkish sultan; the pope and many European rulers and statesmen gave him audiences. In 1903 the British government offered land for an autonomous settlement in east Africa, but an extra-Palestinian site for the Jewish state was strongly opposed by many Zionists. This somewhat embittered "territorial" controversy told on Herzl's failing health, and he died in the summer of 1904. His remains were removed, to the Holy Land, in accordance with his wish, and were buried in Jerusalem in 1949.

See *Theodor Herzls Tagebücher 1895–1904,* 3 vol. (Berlin, 1922–23); *A.* Friedemann, *Das Leben Theodor Herzls,* 2nd ed. (Berlin, 1919); B. Hagani, *Le Sionisme politique et son fondateur T. Herzl* (Paris, 1917); *A.* Bein, *Theodor Herzl, a Biography* (Philadelphia, 1941).

HERZOG, HANS (1819–1894), Swiss general, was born, and died, at Aarau. In 1870 he was commander-in-chief of the Swiss army, which guarded the Swiss frontier, in the Jura, during the Franco-German War, and in February 1871, as such, concluded the Convention of Verrières with General Clinchant for the disarming and the interning of the remains of Bourbaki's army, when it took refuge in Switzerland. In 1873 he became the commander-in-chief of the Swiss artillery.

HERZOG, JOHANN JAKOB (1805–1882), German Protestant theologian, was born at Basle on Sept. 12, 1805. He died on Sept. 30, 1882, at Erlangen, where he had been professor of church history from 1854 to 1877. He prepared the *Realencyklopädie für protestantische Theologie und Kirche* (1853–68, 22 vols.), of which he undertook a new edition with G. L. Plitt (1836–80) in 1877, and after Plitt's death with Albert Hauck (b. 1845). Hauck began the publication of the third edition in 1896 (completed in 22 vols., 1909).

His other works include *Joh. Calvin* (1843), *Leben Ökolampads* (1843), *Die romanischen Waldenser* (1853), *Abriss des gesamten Kirchengeschichte* (3 vols., 1876–82, 2nd ed., 1890–92).

HERZOGENBERG, HEINRICH VON (1843-goo), Austrian musician and friend of Brahms, was born at Graz, Styria, on June 10, 1843, and studied at the Vienna conservatoire. He settled in Leipzig in 1872, and from 1875 to 1885 was conductor of the Bach *Verein.* He was later professor at the Berlin Hochschule, and at Kiel, retiring in 1888. He wrote much chamber music and scholarly church and orchestral works, all of which bear the impress of his intimacy with Brahms.

See J. Kalbeck, *Brahms, in Briefwechsel mit Heinrich und Elisabeth Herzogenberg* (a vols., 1907).

HESILRIGE (or **HESELRIG**), **SIR ARTHUR,** 2ND BART. (d. 1661), English parliamentarian, was the eldest son of Sir Thomas Hesilrige, 1st baronet (c. 1622), of Noseley, Leicestershire. He sat for Leicestershire in the Short and Long Parliaments in 1640, and took a principal part in Strafford's attainder, the Root and Branch Bill and the Militia Bill of Dec. 7, 1641, and was one of the five members impeached on Jan. 3, 1642. He raised a troop of horse for Essex, fought at Edgehill, commanded in the West under Waller, being nicknamed his *fidus Achates,* and distinguished himself at the head of his cuirassiers, "The Lobsters," at Lansdown on July 5, 1643, at Roundway Down on July 13, at both of which battles he was wounded, and at Cheriton, March 29, 1644. On the occasion of the breach between the army and the parliament, Hesilrige supported the army, took Cromwell's part in his dispute with Manchester and Essex, and on the passing of the Self-denying Ordinance gave up his commission and became one of the leaders of the Independent party in parliament. On Dec. 30, 1647 he was appointed governor of Newcastle, which he successfully defended; he defeated the Royalists on July 2, 1648 and regained Tynemouth. In October he accompanied Cromwell to Scotland, and gave him valuable support in the Scottish expedition in 1650. Hesilrige, though he approved of the king's execution, had declined to act as judge on his trial. Cromwell's expulsion of the Long Parliament threw him into antagonism, and he opposed the Protectorate and refused to pay taxes. He was returned for Leicester to the parliaments of 1654, 1656 and 1659, but was excluded from the two former. He succeeded in again obtaining admission to the Commons in January 1658. On Cromwell's death Hesilrige refused support to Richard; after Richard's downfall he attempted to maintain a republican parliamentary administration, "to keep the sword subservient to the civil magistrate," and when Lambert expelled the parliament, Hesilrige turned to Monk for support, and helped him by securing Portsmouth on Dec. 3, 1659. He marched to London, was appointed one of the council of state, and on Feb. 11 became a commissioner for the army. He was completely outwitted by Monk, and trusting to his assurance of fidelity to "the good old cause" consented to the retirement of his regiment from London. At the Restoration his life was saved by Monk's intervention, but he died in the Tower on Jan. 7, 1661.

See article on Hesilrige by *C.* H. Firth in the *Dict. of Nat. Biography,* and authorities there quoted.

HESIOD, the father of Greek didactic poetry, probably flourished during the 8th century B.C. His father had migrated from the Aeolic Cyme in Asia Minor to Boeotia; and Hesiod and his brother Perses were born at Ascra, near Mount Helicon (*Works and Days,* 635). Here, as he fed his father's flocks, he received his commission from the Muses to be their prophet and poet, a commission which he recognized by dedicating to them a tripod—still in existence at Helicon in the age of Pausanias *(see Tkeogony,* 2—34, *W. and D.* 656; Pausanias ix. 38.3)—won by him in a contest of song *(see* below) at some funeral games at Chalcis in Euboea. After the death of his father Hesiod is said to have left his native land in disgust at the result of a law-suit with his brother and to have migrated to Naupactus. There was a tradition that he was murdered by the sons of his host in the sacred enclosure of the Nemean Zeus at Oeneon in Locris (Thucydides iii. 96; Pausanias ix. 31); his remains were removed for burial by command of the Delphic oracle to Orchomenus in Boeotia, where the Ascraeans settled after the destruction of their town by the Thespians, and where, according to Pausanias, his grave was to be seen.

Hesiod's earliest poem, the famous *Works and Days,* and according to Boeotian testimony the only genuine one, embodies the experiences of his daily life and work, and, interwoven with episodes of fable, allegory, and personal history, forms a sort of Boeotian shepherd's calendar. The first portion is an ethical enforcement of honest labour and dissuasive of strife and idleness (1–383); the second consists of hints and rules as to husbandry (384–764); and the third is a religious calendar of the months, with remarks on the days most lucky or the contrary for rural or nautical employments. The connecting link of the whole poem is the author's advice to his brother, who appears to have bribed the corrupt judges to deprive Hesiod of his inheritance. In the *Works and Days* the episodes which rise above an even didactic level are the "Creation and Equipment of Pandora," the "Five Ages of the World" and the much-admired "Description of Winter" (by some critics judged post-Hesiodic). The poem also contains the earliest known fable in Greek literature, that of "The Hawk and the Nightingale." It is in the *Works and Days* especially that we glean indications of Hesiod's rank and condition in

life, that of a stay-at-home farmer of the lower class, whose sole experience of the sea was a single voyage of 40 yards across the Euripus, and an old-fashioned bachelor whose misogynic views and prejudice against matrimony have been conjecturally traced to his brother Perses having a wife as extravagant as himself.

The other poem attributed to Hesiod or his school which has come down in great part to modern times is the *Theogony,* a work of grander scope, inspired alike by older traditions and abundant local associations. It is an attempt to work into system, as none had essayed to do before, the floating legends of the gods and goddesses and their offspring. This task Herodotus (ii, 53) attributes to Hesiod, and he is quoted by Plato in the *Symposium* (178 B) as the author of th'e *Theogony.* The first to question his claim to this distinction was Pausanias, the geographer (A.D. 200). The Alexandrian grammarians had no doubt on the subject; and indications of the hand that wrote the *Works and Days* may be found in the severe strictures on women, in the high esteem for the wealth-giver Plutus and in coincidences of verbal expression. Although, no doubt, of Hesiodic origin, in its present form it is composed of different recensions and numerous later additions and interpolations. The *Theogony* consists of three divisions: (1) a cosmogony, or creation; (2) a theogony proper, recounting the history of the dynasties of Zeus and Cronus; and (3) a brief and abruptly terminated heroogony, the starting-point not improbably of the supplementary poem, the *κατάλογος* or "List of Women" who wedded immortals, of which all but a few fragments are lost.[1] The proem (1–116) addressed to the Heliconian and Pierian muses, is considered to have been variously enlarged, altered and arranged by successive rhapsodists. The poet has interwoven several episodes of rare merit, such as the contest of Zeus and the Olympian gods with the Titans, and the description of the prison-house in which the vanquished Titans are confined, with the Giants for keepers and Day and Night for janitors (735 *sqq.)*

The only other poem which has come down to us under Hesiod's name is the *Shield of Heracles,* the opening verses of which are attributed by a nameless grammarian to the fourth book of *Eoiai.* The theme of the piece is the expedition of Heracles and Iolaus against the robber Cycnus; but its main object apparently is to describe the shield of Heracles (141–317). It is clearly an imitation of the Homeric account of the shield of Achilles *(Iliad,* xviii, 479) and is now generally considered spurious. Titles and fragments of other lost poems of Hesiod have come down to us: didactic, as the *Maxims of Cheiron;* genealogical, as the *Aegimius,* describing the contest of that mythical ancestor of the Dorians with the Lapithae; and mythical, as the *Marriage of Ceyx* and the *Descent of Theseus to Hades.*

Recent editions of Hesiod include the 'Aybv *Ὁμήρου κα Ἡσιόδου,* the *Contest* (of song) *between Homer and Hesiod,* at the funeral games held in honour of King Amphidamas at Chalcis. This little tract belongs to the time of Hadrian, who is actually mentioned as having been present during its recitation, but is founded on an earlier account by the sophist Alcidamas (*q.v.*). Quotations (old and new) are made from the works of both poets, and, in spite of the sympathies of the audience, the judge decided in favour of Hesiod. Certain biographical details of Homer and Hesiod are also given.

A strong characteristic of Hesiod's style is his sententious and proverbial philosophy (as in *Works and Days,* 24–25, 40, 218, 345, 371). There is naturally less of this in the *Theogony,* yet there, too, not a few sentiments take the form of the saw or adage. He has undying fame as the first of didactic poets, the accredited systematizer of Greek mythology and the rough but not unpoetical sketcher of the lines on which Virgil wrought out his exquisitely finished *Georgics.*

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On the date of Hesiod *see* T. W. Allen in *J. H. S.* (1915), xxxv, who would place his *floruit,* on astronomical and other grounds, *c.* 800 B.C.

(J. DA.; J. H. F.)

[1] Part of the poem was called Eoiai, because the description of each heroine began with *ἢ οἵη,* "or like as." *(See* BIBLIOGRAPHY.)

HESPERIDES, "daughters of evening," in Greek mythology, clear-voiced maidens who guarded the tree bearing golden apples which Earth gave Hera on the occasion of her marriage to Zeus. According to Hesiod *(Theogony,* 215) they were the daughters of Erebus and Night; in later accounts, their parents were Atlas, the scene of whose toil was nearby *(Theogony,* 517), and Hesperis, or Phorcys and Ceto. They were usually supposed to be three in number—Aegle, Erytheia, Hesperis (or Hesperethusa)—but according to some there were four, or even seven. They lived far away in the west beyond the Ocean stream, where the sun sets. Hence the sun sails in the golden bowl made by Hephaestus from the abode of the Hesperides to the land where he rises again. According to other accounts their home was among the Hyperboreans. The golden apples were guarded by Ladon, the ever-watchful dragon, offspring of Phorcys and Ceto. As Ladon is the name of an Arcadian river, Arcadia is possibly the original site of the garden. Heracles *(see* HERCULES) slew the dragon or put it to sleep and stole the apples, or else had Atlas get them for him. The golden apples, the gift of Aphrodite to Hippomenes before his race with Atalanta, were plucked from the garden of the Hesperides.

See H. J. Rose, *A Handbook of Greek Mythology* (1928).

(G. E. DK.)

HESPERORNIS, a genus of extinct birds known from the upper Cretaceous deposits of the Great Plains area of the United States (Kansas, South Dakota and Montana), classified in the order Hesperornithiformes. The first specimen, part of a tibio-tarsus, was found by Othniel C. Marsh in Dec. 1870, in fossil beds near the Smoky Hill river in western Kansas. Bitterly cold weather and the presence nearby of hostile Indians prevented further work at the time, but the following June Marsh's party, under strong military escort, excavated a nearly complete skeleton, the type of *Hesperornis regalis.* This was a highly specialized aquatic bird, a diver in habit, about 5 ft. in length.

The head was long, with 14 teeth on the maxilla and 33 on the mandible on either side, placed in a continuous groove. The bare premaxilla seems to point to the beginning of the toothless condition of living birds. The brain appears to have been similar to that of modern birds. The body was elongate and compressed, with the wings functionless and reduced so that the humerus, the only wing bone known, was slender and curved, with so slight an articulation with the scapular arch as to indicate that it had little power. The remaining wing elements, the forearm and hand, were either missing or so rudimentary that they have not been preserved in

the specimens found. The sternum was flat and without a keel, another indication that the wing had no function. The pelvis on the other hand was long and strong, the legs were heavy boned, and the toes strong. The first attempts to reconstruct the skeleton placed the bird in an upright attitude like an auk. But further study revealed that the head of the femur was articulated with the pelvis at such an angle that the leg stood out at the side: and on land the bird must have remained prostrate on the breast. That the leg muscles were extraordinarily strong is indicated by the conformation of the processes for muscular attachment. The patella in particular was especially long and well developed.

Because of the primitive condition of the skull and the flat sternum, Marsh was led to believe that *Hesperornis* was ancestral to the Struthioniformes (an order of flightless ratite birds including the ostrich) so that he referred to it as a "carnivorous, swimming ostrich." On further investigation it developed that characters of the fossil which seemed to ally it with the ratites are rather those marking it as a primitive type, as these fossil species belong in a group apart.

Parts of more than 60 individuals of the *Hesperornis* group had been found, including two additional species of the type genus, *Hesperornis crassipes* of Kansas, larger than *H. regalis,* and *H. montana* named by Robert W. Shufeldt from a vertebra found in Montana. *Hesperornis gracilis* and *Coniornis altus* are additional species of the family Hesperornithidae, which with the family Baptornithidae (for *Baptornis advenus)* form the order Hesperornithiformes.

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(A. WT.)

HESPERUS, the evening star, son or brother of Atlas [Gr. *Esperos;* Lat. Vesper]. Although as a mythological personality he is regarded as distinct from Phosphoros or Heosphoros (Lat. Lucifer), the morning star or bringer of light, the son of Astraeus (or Cephalus) and Eos, the two stars were early identified by the Greeks.

HESS, MYRA (1890–), British pianist known for her interpretations of Bach, Mozart, Beethoven and Schumann. Born in London, Feb. 25, 1890, she studied at the Guildhall School of Music, and from 1902 to 1907 at the Royal Academy of Music under Tobias Matthay, whose theories of touch, related to the weight of the arm and muscular relaxation, she illustrated in her playing. She first appeared in London in 1907 and in the U.S. in 1922. From 1939 to 1946 she organized a series of daily midday concerts at the National gallery, London, which were of great service to both music and the public during World War II and for which, in 1941, she was made a dame of the British empire. In her earlier years she cultivated an intimate chamber music style, and it was in this sensitive manner that she gave her memorable performances of the concerto of Schumann. The more powerful style of her later years became evident in her performances of the concertos of Beethoven and Brahms.

HESS, VICTOR FRANCIS (1883–). Austrian physicist, shared the 1936 Nobel prize for physics with C. D. Anderson (*q.v.*) for his discovery of cosmic radiation. Born at Schloss Waldstein. Aus., on June 24. 1883, he was educated at Graz and Vienna. From 1910 to 1920 he was 'assistant at the Institute for Radium Research of the Vienna Academy of Sciences and lectured on physics at the Vienna Veterinary college. Appointed associate professor at Graz in 1920, in 1921 he became director of the research laboratory of the U.S. Radium corporation and consulting physicist to the U.S. department of the interior (bureau of mines). He returned to Graz in 1923 and became professor of physics in 1925 and professor and head of the new Institute for Radiation Research at Innsbruck in 1931. In 1938 he became professor of physics at Fordham university, New York, and was naturalized in 1944.

Hess's researches dealt mainly with radioactivity and atmospheric electricity. As early as 1911 he studied the electrical conductivity of the atmosphere during balloon ascents and on high mountains. and found that ionization increased rapidly with altitude. His experiments proved what had long been suspected; *i.e.,* that an extremely penetrating radiation enters the earth's atmosphere from outer space. Further investigation of the radiation, which was given the name of cosmic rays by R. A. Millikan in 1925, led to discovery of the positron, or positively charged electron, by Anderson, and opened up new fields of research in modern physics. (W. J. BP.)

HESS, WALTER RUDOLF (1881–), Swiss physiologist, shared with Antonio Egas Moniz (*q.v.*) the 1949 Nobel prize for medicine "for his discovery of the functional organization of the interbrain as a coordinator of the activities of the internal organs." Hess was born at Frauenfeld, Switz., on March 17, 1881. After studying medicine at several Swiss and German universities he obtained his M.D. at Zurich in 1906 and practised for six years as an ophthalmologist. In 1911 he devised the Hess screen which is widely used in the investigation of squint. From 1912 he devoted himself to the study of physiology and in 1917 was appointed director of the physiological institute in Zürich. During advanced study in England he came under the influence of J. N. Langley, Sir C. S. Sherrington and other pioneer neurophysiologists. His own researches dealt with the viscosity of the blood, the dynamics of blood pressure, the physiology of respiration and finally with the central control of the internal organs in general through the vegetative or autonomic nervous system. He studied cerebral localization by the application of fine electrodes which permitted of strictly local stimulation or destruction of brain tissue. By these means he was able to prove that the cerebral centre for the control of blood pressure lies in a group of cells in the medulla and diencephalon. His work is complementary to that of C. Heymans (*q.v.*) on the peripheral mechanisms involved in the regulation of blood pressure. (W. J. BP.)

HESSE, HERMANN (1877–), German-born Swiss writer and poet, was born at Calw on July 2, 1877. He wrote a long series of novels, Indian travel sketches and other works. His collected poems appeared in 1942. Four years later he received the Nobel prize for literature.

HESSE, a *Land* of Germany. Hesse, as constituted at the end of World War II, has an area of 8,147 sq.mi. and a population (1950) of 4,323,801. The *Land* lies between the Rhine plateau and the Thuringer Wald and consists mainly of richly wooded hill land, cut by two fault troughs, the west and east Hesse depressions, which have been since earliest times important corridors and along which most of the main towns were founded in the middle ages. The Vogelsberg, a great basaltic mass, and the Rhon, rising to the Wasserkuppe (3,117 ft.), Hesse's highest mountain, dominate the area. The Spessart and the Odenwald (*qq.v.*) both belong in part to Hessian territory. Hesse is drained by the Rhine and its tributaries the Main and the Lahn, by the Weser, and by the Werra and Fulda. Towns of more than 50,000 people in 1950 were: Frankfurt am Main (532,037); Wiesbaden. the capital (220,741); Cassel (Kassel), capital of the former Prussian province of Hesse-Nassau (162,132); Darmstadt (94,788); and Offenbach (89,030). There are two universities, Frankfurt and Marburg. Legislative power (in spheres where this rests with the *Liinder)* is vested in the *Landtag,* according to the constitution of Dec. 1, 1946. The minister president is elected by the *Landtag.* Hesse is divided administratively into Wiesbaden, Cassel and Darmstadt. Cattle is an important type of farming and in the Rhine and Main valleys vegetables and fruit, including vines, are grown.

Hesse is noted for its mineral springs. Many minerals are mined, notably copper and brown coal. The copper deposits, around Sontra, are the only ones in west Germany. Iron is also mined and petroleum and natural gas are found.

Hesse's geographical position, situated as it is at the centre of German lines of communication, has greatly furthered its industrial development. The Rhine-Main area is the industrial centre, with Frankfurt, Cassel, Offenbach, Wiesbaden and Darmstadt all great

manufacturing towns. Vehicles, machinery, chemicals, iron, tin, electrical goods, scientific instruments and textiles are among the products of these and other towns. New industries grew up after World War II, stimulated by the refugees, among them glass, toys and musical instruments.

HISTORY

The country of Hesse has had different boundaries at different times. The earliest inhabitants of the area were the Chatti, a Frankish tribe whom Tacitus describes and with whom the Hessi may be identified. The Hessians were converted to Christianity after the fall of the Roman empire, mainly through the efforts of St. Boniface. Their land was included in the archbishopric of Mainz, and religion and culture were alike kept alive among them largely by the Benedictine abbeys of Fulda and Hersfeld.

As part of the Carolingian empire, Hesse contributed also to the movement against the imperial power which followed the death of Charlemagne. The Hessian Conrad of the Franks was elected as Conrad I in 911, but on his death the crown passed out of Frankish hands to Henry of Saxony. From 1130 to 1247 Hesse formed part of Thuringia. But on the death, childless, of the Thuringian ruler Henry Raspe in 1247 a conflict about the succession broke out; and Hesse was won by Sophie of Brabant for her son, Henry, the Child of Brabant. It thereupon became an independent landgraviate. In 1292 Henry was raised to the rank of prince of the empire. The landgraves were constantly at variance with the archbishop-electors of Mainz, who had possessions in Hesse. In the 15th century the country was twice divided among members of the ruling family, but no lasting division took place before the Reformation.

From 1509 to 1567, the difficult Reformation years, Philip the Magnanimous (*q.v.*), the most famous of all Hessian rulers, was landgrave. A reformer in both senses of the word, he promoted the Protestant faith and cared for the education and general welfare of his country; in 1527 he founded the Protestant University of Marburg. On his death in 1567 Hesse was divided among his four sons into Hesse-Cassel, Hesse-Marburg, Hesse-Rheinfels and Hesse-Darmstadt.

Hesse-Cassel.—Hesse-Cassel (later known also as Electoral Hesse) consisted of about half the former country and was apportioned to Philip's eldest son, William IV. A later ruler, Charles (1670–1730), is notable for being the first to adopt the system of hiring out his soldiers as mercenaries to help the national finances. As many as 22,000 Hessian troops later fought on the English side in the American Revolution. Charles also improved the prosperity of his land by bringing in the Huguenots.

The reign of William IX (1785–1821) was important for Hesse-Cassel As compensation for the loss of lands on the left bank of the Rhine (ceded to France in 1801 by the peace of Lunéville) he was in 1803 granted some of the former French territory around Mainz and was raised to the dignity of an elector as William I William refused alike to join the Confederation of the Rhine and an alliance proposed by Prussia; and in 1806 Napoleon recognized his neutrality. But the French emperor suspected William's designs and after the battle of Jena expelled him, adding Hesse-Cassel to his brother Jerome's kingdom of Westphalia. A rising in 1809 under Fritz von Dörnberg came to nothing, but after the battle of Leipzig (1813) the French were driven out and the elector returned in triumph.

The Restoration, however, brought reaction rather than progless The estates, indeed, were summoned in 1815 but an attempt to agree on a constitution broke down and they were dissolved in May 1816. The constitutional crisis came to a head under William TI, who succeeded his father in 1821. Disturbances folloned the Paris July revolutiori, the elector was forced to summon the estates and on Jan 5, 1831, a constitution was signed. But a year later the strongly conservative Hans Daniel Hassenpflug became minister, and nith him the struggle against the constitution gained new force In 1852 the constitution was formally repealed, after the defeat of the revolutionary movements of 1848–49; Bavarian and Austrian troops had intervened to make this possible, after an appeal by Hassenpflug to the *Bundestag*. After considerable unrest the constitution was restored in 1862. But four years later, at the end of the Austrian-Prussian war, in which Hesse-Cassel fought for Austria, the country was annexed by Prussia. In 1868 it was formed (except for some small districts) into the province of Hesse-Nassau with lands accruing to Prussia as a result of the war: part of the former duchy of Nassau, the free city of Frankfurt and some other territories. In 1944 the territory was split into two provinces, Nassau and Electoral Hesse. On Sept. 9, 1945, both provinces (except for a small area, which was joined to Rhineland-Palatinate) were united with the part of Hesse-Darmstadt right of the Rhine to form Great Hesse, later called simply Hesse.

Hesse-Marburg.— This was formed in 1567 for the second of Philip's sons, Louis. The line died out in 1604 and the land was eventually divided between Hesse-Cassel and Hesse-Darmstadt after disputes lasting until 1648.

Hesse-Rheinfels.—Formed in 1567 for Philip's third son, Philip, Hesse-Rheinfels was short-lived. On Philip's death in 1583 the land passed to the other lines.

Hesse-Darmstadt.—Philip's fourth son, George, received what was at first only the small territory of Upper Katzenelnbogen with Darmstadt, but additions were later made to it. Hesse-Darmstadt sided with the Habsburgs in the Thirty Years' War, during which it suffered severely from the ravages of the Swedes. In this struggle Hesse-Cassel took the other side, and the rivalry between the two landgraviates was increased by the dispute over Hesse-Marburg.

During the 18th century the War of the Austrian Succession and the Seven Years' War dealt heavy blows at the prosperity of the landgraviate, which was always loyal to the house of Austria. Louis IX (1768–90), who served in the Prussian army under Frederick the Great, was the husband of Henrietta Caroline, "the great Landgravine," who counted Goethe, J. G. von Herder and Jacob Grimm among her friends and who was described by Frederick the Great as *femina sexu, ingenio vir* ("a woman in sex, in wisdom a man").

In April 1790, just after the outbreak of the French Revolution, Louis X, an educated prince who shared the tastes and friendships of his mother, became landgrave. Re supported Napoleon with troops from 1805 to 1813, but after the hattle of Leipzig he joined the allies. In 1815 Louis secured again a district on the left bank of the Rhine, including the city of Worms and, in 1816, Mainz, but he made cessions of territory to Prussia and to Bavaria and he recognized the independence of Hesse-Homburg *(see* below). His title of grand duke, taken in 1806 when he entered the Confederation of the Rhine, was confirmed, and he entered the Germanic federation. Soon the desire for liberty made itself felt in Hesse, and in 1820 Louis gave a constitution to the land; some reforms were carried through; and in 1828 Hesse-Darmstadt joined the Prussian *Zollverein.* Many concessions were made to the popular will by Louis III in the revolutionary year 1848, but during the subsequent reaction these were withdrawn, and the period between 1850 and 1871, when Karl Friedrich Rheinhard, Freiherr von Dalwigk, was chiefly responsible for the government, was mainly one of repression. During the war of 1866 the grand duke fought on the Austrian side, the result being that he was compelled to pay a heavy indemnity and to cede certain districts to Prussia. In 1871 Hesse-Darmstadt became one of the states of the new German empire.

Many reforms were introduced, and, in general, the grand duchy may be said to have passed largely under the influence of Prussia. After its annexation by Prussia in 1866 the grand duchy was known simply as Hesse. The ruling house lost its power at the same time as the rest of the German princes in 1918. In 1945 the part of Hesse-Darmstadt on the right of the Rhine (which belonged to the U.S. occupation zone) was united in one *Land* with Electoral Hesse (see *Hesse-Cassel* above), while that portion left of the river became part of the French-occupied *Land* of Rhineland-Palatinate.

Hesse-Homburg.— Formed in 1622. Hesse-Homburg belonged to a younger line of the Hesse-Darmstadt family and its rulers had only limited sovereignty. It was separated from Hesse-Darmstadt in 1768. From 1806–15 it was again included in the larger state, but its independence was restored in 1815 by the congress of Vienna and Meisenheim was then added to it. On the death of the landgrave (childless) in 1866, however, Meisenheim passed to Prussia and the rest to Hesse-Darmstadt; but this latter part was also ceded to Prussia later in the same year and became part of Hesse-Nassau (see *Hesse-Cassel* above).

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(M. KL.)

HESSIAN: see BURLAP.

HESSIAN FLY (Phytophaga destructor), a small fly native to Asia, transported into Europe and later intd North America in hay or straw. It is especially destructive to wheat crops, particularly in the United States and Canada. It is dark in colour and lays its eggs on the leaves of wheat, barley and rye, the whitish larvae feeding on the stem. The winter is passed in the "flaxseed" stage (puparium) in the axils of the leaves. There are from one to three generations annually. Eggs laid on the first and second leaves rarely develop to adults, so late spring seeding aids in control. Some varieties of wheat are resistant. Deep fall plowing prevents emergence of the flies. The common name is derived from the fact that the fly is supposed to have been introduced into America in straw bedding by Hessian troops during the Revolutionary War. (See DIPTERA; ENTOMOLOGY.) (C. H. CN.)

HESSUS, HELIUS EOBANUS (1488–1540), German scholar! considered the foremost Latin poet of his age, was born at Halgehausen in Hesse-Cassel, on Jan. 6, 1488. His family name is said to have been Koch. He entered the University of Erfurt in 1504 and became professor of Latin there in 1517. He took part in the political, religious and literary quarrels of the period, finally declaring in favour of Luther and the Reformation. Through the influence of Camerarius and Melanchthon, he obtained a post at Niirnberg (1526). He again went back to Erfurt (1533), but found the university deserted. In 1536 the landgrave of Hesse made him professor of poetry and history at Marburg, where he died on Oct. 5, 1540. Described as "brilliant but bibulous." Hessus was a facile versemaker but not a true poet. He wrote local, historical and military poems, idylls, epigrams and occasional pieces. collected under the title of Sylvae (1539). His most popular works were translations of the Psalms into Latin distichs (1538), which reached 40 editions, and of the Iliad into hexameters (1540). His most original poem was the *Heroïdes* Christianae (1514–1532) in imitation of Ovid, consisting of letters from holy women.

BIBLIOGRAPHY.—His *Epistolae* were edited by his friend Camerarius, who also wrote his life (1553). There are later accounts of him by M. Hertz (1860), G. Schwertzell (1874) and C. Krause (1879).

HESTIA, in Greek mythology the hearth goddess (see VESTA), daughter of Cronus and Rhea. She is not mentioned as a goddess in Homer, but the hearth is recognized as a place of refuge for suppliants. In post-Homeric religion she is one. of the 12 Olympian deities. When Apollo and Poseidon became suitors for her hand she swore to remain a maiden forever, whereupon Zeus bestowed upon her the honour of presiding over all sacrifices. She was worshiped chiefly as goddess of the family hearth; but. as the city union was only the family union on a large scale. she had also. at least in some states, a public cult at the civic hearth in the *prytaneion* or town hall. where the common hearthfire round which the magistrates met was ever burning. From this fire, as the representative of the life of the city, intending colonists took the fire that was to be kindled on the hearth of the new colony. In later philosophy Hestia became the hearth goddess of the universe—the personification of the earth as the centre of the universe, identified with Cybele and Demeter (*q.v.*). She is seldom represented in works of art and plays no important part in legend.

HESTON AND ISLEWORTH, a municipal borough and parliamentary division. except for two wards in the Feltham division, of Middlesex, Eng., on the north bank of the Thames, 10 mi. W.S.W. of Hyde Park corner, London, by road. Pop. (1961) 102,897. The Great West road, opened in 1925, crosses the Bath road within the borough which was created in 1932, Heston and Isleworth parishes having been united since 1875. Cranford was added in 1934. Hounslow, in the centre, contains the council offices and to the southwest is Hounslow heath. Syon monastery, founded in 1415, was pulled down in the 16th century by the duke of Somerset who built Syon house on the site. This was remodeled and redecorated by Robert Adam who did the same to the Elizabethan Osterley house. By the latter 1950s there were about 200 industrial undertakings in the borough.

HESYCHASM, a type of Eastern Christian monastic life, uhose purpose is to achieve divine quietness (Gr. hesychia) through the contemplation of God in uninterrupted prayer. Such prayer, involving the entire human being, soul, mind and body, is often called "pure" or "intellectual" prayer. or the "Jesus prayer." St. John Climacus (*q.v.*), one of the greatest writers of the hesychast tradition, writes, "Let the remembrance of Jesus be present with each breath, and then you will know the value of the hesychia." In the late 13th century, St. Nicephorus the Hesychast produced an even more precise "method of prayer," advising novices to fix their eyes during prayer on the "middle of the body," in order to achieve a more total attention. and to "attach the prayer to their breathing." This practice was violently attacked in the first half of the 14th century by Barlaam the Calabrian, who called the hesychasts *omphalopsychoi* (*i.e.*, people having their souls in their navels).

St. Gregory Palamas (*q.v.*), a monk of Mount Athos and later archbishop of Thessalonica, defended the hesychast monks. In his view, the human body. sanctified by the sacraments of the church, is able to participate in the prayer, and human eyes may become able to see the uncreated light which once appeared on Mt. Tabor on the day of Transfiguration. The teachings of Palamas were confirmed by the Orthodox Church in a series of councils held in Constantinople. Hesychast spirituality is still practised by Eastern Christians and gained wide popularity in Russia.

BIBLIOGRAPHY.—The main collection of hesychast spiritual texts is the *Philocalia* (1782); partial English trans. by E. Kadloubovsky and G. E. H. Palmer (1951–53). The main work of Palamas is *For the Defense of the Holy Hesychasts* (Gr. text and Fr. trans.), 2 vol. (1959). *See* also J. Meyendorff, *St. Grégoire Palamas et la mystique orthodoxe* (1959), *A Study on Gregory Palamas* (1963). (J ME.)

HESYCHIUS, grammarian of Alexandria, probably flourished in the 5th century A.D. He was probably a pagan; and the explanations of words from Gregory of Nazianzus and other Christian writers are later interpolations. He has left a Greek dictionary, explaining peculiar words, forms and phrases, often with a reference to the author who used them or to the district of Greece where they were current. Hence the book is of great value for the study of the Greek dialects: and in the restoration of the text of classical authors, and particularly of such writers as Aeschylus and Theocritus, who used many unusual words. Many of the explanations give important facts about the religion and social life of the ancients. Hesychius says that his lexicon is based on that of Diogenianus (itself extracted from an earlier work by Pamphilus), but that he has also used similar works by Aristarchus, Apion, Heliodorus and others.

The best edition is by M. Schmidt (1858–68); in a smaller edition (1867) he attempts to distinguish the additions made by Hesychius to the work of Diogenianus.

HESYCHIUS OF MILETUS, Greek chronicler and biographer, surnamed *Illustrius,* son of an advocate, flourished at Constantinople in the 5th century A.D. during the reign of Justinian. According to Photius, who considered him a truthful historian (cod. 69), he was the author of three important works. (1) *A Compendium* of Universal History in six books, from Belus, the reputed founder of the Assyrian empire, to Anastasius I (d. 518). A considerable fragment has been preserved from the sixth book, a history of Byzantium from its earliest beginnings till the time of Constantine the Great. (2) *A* Biographical Dictionary (Ὀνοματόλογος or Πίναξ) of Learned Men, the chief sources of which were Herennius Philo and the Μουσικὴ ἱστορία of Aeluis Dionysius. Suidas incorporated much of it in his lexicon but his words leave us uncertain whether he himself epitomized Hesychius, or used an already existing epitome. The second view is more generally held, and the epitome referred to, which substituted alphabetical order for arrangement by classes, and included articles on Christian writers, is assigned from internal indications to the years 829–837. Both it and the original work are lost, with the exception of the excerpts in Photius and Suidas. A smaller compilation, chiefly from Diogenes Laertius and Suidas, with a similar title, is the work of an unknown author of the 11th or 12th

century. (3) A *History* of the reign of Justin I (518–527) and the early years of Justinian, completely lost.

Editions: J. C. Orelli (1820) and J. Flach (1882); fragments in C. W. Miiller, *Frag. Hist. Graec.* iv, 143 and in T. Preger's *Scriptores originis Constantinopolitanae,* i (1901); *Pseudo-Hesychius,* by J. Flach (1880); *see* generally C. Krumbacher, *Geschickte der byzantinischen Literatur* (1897).

HETERODYNE RECEPTION is the process of receiving radio waves by combining the received current with locally generated alternating current. The locally generated frequency is commonly different from the frequency of the received current, thus producing beats. This is then called beat reception.

HETEROGAMY, a condition in which the gametes are unlike *(see* ISOGAMY). The term is commonly used to designate differences of both size and structure, implying a differentiation into male and female sex cells.

Usage has tended, however, toward a separation of heterogamy into two categories: namely, anisogamy, in which the uniting gametes appear to differ only in size; and oogamy, in which they differ in both size and structure. In all cases of gametic union it is probable that the pairing gametes are differentiated physiologically whether they appear alike or unlike. The term is also used for the bearing of two different kinds of flowers on the same plant, as in certain sedges, or in many Compositae (*q.v.*) where the discoid florets are perfect and the radiate florets are neutral or pistillate. In zoology, heterogamy is used for a type *of* alternation of parthenogenetic generations with a sexual generation, as in certain aphids. (J. M. Bl.)

HETERONOMY, the state of being under the rule of another person. In ethics the term is specially used as the antithesis of "autonomy," which, especially in Kantian terminology, treats of the true self as will, determining itself by its own law, the moral law "Heteronomy" is therefore applied by Kant to all other ethical systems, inasmuch as they place the individual in subjection to external laws of conduct.

HETMAN, a military title formerly in use in Poland; the *hetman wielki,* or great hetman, was the chief of the armed forces of the nation, and commanded in the field, except when the king was present in person. The office was abolished in 1792. From Poland the word was introduced into Russia in the form *ataman,* and was adopted by the Cossacks as a title for their head, who was practically an independent prince, when under the suzerainty of Poland. After the acceptance of Russian rule by the Cossacks in 1654, the post was shorn of its power. "Ataman" or "hetman" was also the name of the elected elder of the *stanitsa,* the unit of Cossack administration. *See* COSSACKS.

HETTSTEDT, a town of Germany, in the district of Halle, on the Wipper, and at the junction of the railways Magdeburg-Eisleben and Hettstedt-Halle, 23 mi. N.W. of the last town. Pop. (1950) 16,316. Hettstedt is mentioned as early as 1046; in 1220 it possessed a castle; and in 1380 it received civic privileges. When the countship of Mansfeld was sequestrated, Hettstedt came into the possession of Saxony, passing to Prussia in 1815. It manufactures pianofortes and cigars. In the neighbourhood are mines of argentiferous copper. Silver, sulfuric acid, nickel and gold are also found in small quantities.

HETZER (HAETZER), **LUDWIG** (d. 1529), Swiss Anabaptist, was born at Bischofzell, Switzerland, and studied at Freiburg-im-Breisgau. In 1j23 he published *Judicium Dei,* a small tract against the religious use of images. In 1524 he brought out a tract on the conversion of the Jews, and published a German version of Johann Bugenhagen's brief exposition of the epistles of St. Paul (Ephesians to Hebrews). He was expelled from Augsburg in the autumn of 1525, and made his way through Constance to Basel, where Oecolampadius received him kindly, and then to Ziirich. He had gone to the length of rejecting all sacraments, and his relations with Zwingli were difficult; he returned to Basel, and then went to Strasbourg, where, in 1526, he fell in with Hans Dengk or Denck, who collaborated with him in the production of his *opus magnum,* the translation of the Hebrew prophets, *Alle Propheten nack hebraischer Sprach verdeutscht* (Worms, 1527; Augsburg, 1527 and 1528). It was the first Protestant version of the prophets in German, preceding Luther's by five years. Hetzer was arrested in Constance in the summer of 1528 and beheaded on Feb. 4, 1529. Hetzer's papers included an unpublished treatise against the essential deity of Christ, which was suppressed by Zwingli; the only extant evidence of his anti-trinitarian views being contained in eight quaint lines of German verse preserved in Sebastian Frank's *Chronica.*

See Breitinger, "Anecdota quaedam de L. H." in *Museum Helveticum,* parts 21 and 23 (1746); Wallace, *Antitrinitarian Biography* (1850); *Dutch Martyrology* (Hanserd Knollys society) (1856); Th. Keim, in Hauck's *Realencyklopadie* (1899).

I-IEUGLIN, THEODOR VON (1824–1876), German traveler in northeast Africa, was born on March 20, 1824, at Hirschlanden, Wurttemberg. In 1850 he went to Egypt where he learned Arabic, afterward visiting Arabia Petraea. In 1853 he was appointed Austrian consul at Khartoum. He traveled in Abyssinia and Kordofan, making a collection of natural history specimens. He died at Stuttgart, on Nov. 5, 1876. It is principally by his ornithological labours that Heuglin has taken rank as an independent authority.

His chief works are *Systematische Ubersicht* der *Vogel Nordost-Afrikas* (1855); *Reisen in Nordost-Afrika, 1852–53* (1857); *Syst. Übersicht der Säugetiere Nordost-Afrikas* (1867); *Reise nach Abessinien, den Gala-Landern,* etc., *1861–62* (1868); *Reise in das Gebiet des Weissen Nil,* etc *1862–64* (1869); *Reisen nach dem Nordpolarnzeer, 1870–71* (1872–74); *Ornithologie von Nordost-Afrika* (1869–7j); *Reise in Nordost-Afrika,* 2 vol. (1877).

HEULANDITE, mineral of the zeolite family consisting of hydrous calcium and aluminum silicate, and the name of a group of zeolites including brewsterite and epistilbite. Crystals are monoclinic, and have a characteristic coffin-shaped habit. They have a perfect cleavage parallel to the plane of symmetry on which the lustre is markedly pearly; on other faces the lustre is vitreous. The mineral is usually colourless or white, sometimes brick-red. The hardness is 3.5–4, and the specific gravity 2.2. It closely resembles stilbite (*q.v.*) in appearance, and differs from it chemically only in containing rather less water of crystallization.

Heulandite occurs with stilbite and other zeolites in cavities of basaltic volcanic rocks, and occasionally in gneiss and metalliferous veins. The best specimens are from the basalts of Berufjord in Iceland and the Faeroe Islands, and the Deccan traps near Bombay, India. Crystals of a brick-red colour are from Campsie Fells in Stirlingshire, Scot., and the Fassathal in the Tirol. Heulandite also is found near Paterson, N.J., and in Nova Scotia.

For discussion of composition, origin and characteristics *see* ZEOLITE.

HEVELIUS (HEWEL or HÖWELCKE), **JOHANNES** (1611–1687), German astronomer whose careful charting of the lunar surface entitles him to be called the founder of lunar topography, was born at Danzig on Jan. 28, 1611. In 1641 he built an observatory in his house, provided with excellent equipment. Besides composing his *Selenographia* (1647), he catalogued 1.j64 stars, made observations of sunspots, discovered four comets, and suggested the revolution of such bodies in parabolic paths about the sun. He published two books on comets, *Prodromus cometicus* (1665) and *Cometographia* (1668). Hevelius died at Danzig on Jan. 28, 1687. His wife, Elizabeth, had collaborated in his study of the surface of the moon, his catalogue of the stars and his work on comets. After his death she edited and published his *Prodromus Astronomiae* (1690). (0. J. E.)

HEVESY, GEORGE CHARLES DE (188j–), Hungarian chemist who became a Swedish subject, codiscoverer of the element hafnium and pioneer in the use of radioactive isotopes, received the Nobel prize for chemistry in 1943. He was born on Aug. 1, 1885, in Budapest, Hung., and educated there and in the Technische Hochschule at Berlin and at Freiburg. He was elected professor in Budapest in 1918, left there to work in the institute of theoretical physics in Copenhagen, where he became professor in 1920, and then returned to Freiburg as professor of physical chemistry in 1926. In 1943, a refugee from Germany, he became professor in the institute of organic chemistry in Stockholm university. In Copenhagen in 1923 he discovered,

with D. Coster, a new element, named hafnium; on his return to Freiburg he applied a method based on the fluorescent radiations excited by X-rays to calculate the relative abundance of the different chemical elements. In 1934, after the preparation of a radioactive isotope of phosphorus, he used this discovery to study various physiological processes by means of such "labeled" radioactive isotopes to trace the course of particular substances in the body. Thence he showed the dynamic state of the constituents of the body; for this and similar work he received the Nobel prize. (D. McK.)

HEWART, GORDON HEWART, 1ST VISCOUNT, OF BURY (1870–1943), British lord chief justice remembered for the independence of his views, was born on Jan. 7, 1870, at Bury, Lancashire. A scholar of University college, Oxford, he was called to the bar at the Inner Temple in 1902 and practised on the northern circuit. After an unsuccessful contest in northwest Manchester in 1912, in which year he took silk, he was elected as a liberal for Leicester in 1913, and later represented the eastern division of that city. In Dec. 1916 he was appointed solicitor general in Lloyd George's coalition government. He was made attorney general in Jan. 1919, and was admitted to the cabinet in 1921. He played, as law officer. a leading part in a great deal of litigation arising under the Defence of the Realm acts; while in the house of commons he proved himself a powerful debater. He took an active part in the final phase of the negotiations with Sinn Feiners. He acted as president of the War Compensation court from 1922. Hewart was knighted in 1916; on Jan. 16, 1918, he was sworn in as a member of the privy council, and on March 24, 1922, mas appointed lord chief justice; at the same time he was created Baron Hewart of Bury. He resigned as chief justice in 1940 and in that year was created Viscount Hewart of Bury. As a judge, Hewart was prone to reach a decision too soon and on insufficient material, and so seemed to take sides. His book The *New* Despotism (1929) was a powerful but not always temperate or just indictment of the quasijudicial powers granted to the executive and of the use made of them. He died on May 5, 1943, in Totteridge, Hertfordshire. (W. T. Ws.)

HEWITT, ABRAM STEVENS (1822–1903j, U.S. manufacturer and political leader, was born in Haverstram, N.Y., July 31, 1822. His father John, a Staffordshire man, was one of a party of four mechanics who were sent by Boulton and Watt to Philadelphia about 1790 to set up a steam engine for the city waterworks and who in 1793–94 built at Belleville, S.J., the first steam engine constructed wholly in America. He graduated at Columbia college in 1842, and taught mathematics at Columbia. With Edward Cooper, son of Peter Cooper, he went into the manufacture of iron girders and beams under the firm name of Cooper, Hewitt and Co. His study of the making of gun-barrel iron in England enabled him to be of great assistance to the U.S. government during the Civil War, when he refused any profit on such orders. The men in his works never struck—indeed irom 1873 to 1878 his plant was run at an annual loss of $100,000. In 1871 he was prominent in the reorganization of Tammany after the fall of the "Tweed ring"; from 1875 until the end of 1886 (except in 1879–81) he was a representative in congress; he was one of the house members of the joint committee which drew up the famous Electoral Count act providing for the electoral commission. In 1886 he was elected mayor of New York city over Henry George and Theodore Roosevelt. He broke with Tammany, was not renominated, ran independently for re-election and was defeated. He died in New York city on Jan. 18, 1903. He gave liberally to Cooper union, of which he was trustee and secretary.

HEWITT, HENRY KENT (1887–), U.S. naval officer, was born at Hackensack, N.J., Feb. 11, 1887, and graduated from the Cnited States Naval academy, Annapolis, Nd., in 1906. Hewitt commanded amphibious forces in a series of successful landings during World War II: in Morocco, Nov. 1942; the U.S. forces in Sicily, July 1943; the Allied forces at Salerno, Sept. 1943; and in southern France. Xug. 1944. He became commander of the U.S. naval forces in Europe on Aug. 16, 1945, retaining this post until Sept. 1946. He subsequently served as U.S. naval representative on the military staff committee of the United Nations from 1947 until his retirement as admiral in 1949. (J. B. HN.)

HEWLETT, MAURICE HENRY (1861–1923), English novelist, was born on Jan. 22, 1861, the eldest son of Henry Gay Hewlett, of Shaw hall, Addington, Kent. He was educated at the London International college, Spring Grove, Isleworth, and was calked to the bar in the year 1891. He published in 1895 two books on Italy, *Earthwork Out of Tuscany,* and (in verse) *The Masque of Dead Florentines. Songs and Meditations* followed in 1897, and in 1898 he won an immediate reputation by his *Forest Lovers,* a romance of medieval England. In the same year he printed the pastoral and pagan drama of *Pan and the Young Shepherd,* produced at the Court theatre in March 1905, when it was followed by the *Youngest of the Angels,* dramatized irom a chapter in his *Fool Errant.* In *Little Novels of Italy* (1899), a collection of brilliant short stories, he showed a close knowledge of medieval Italy. The new and vivid portraits of Richard Coeur de Lion in his *Richard Yea-ad-Nay* (rgoo), and of Mary, queen of Scots, in *The Queen's Quair* (1904), showed real historical sense. *The New Canterbury Tales* (1901) was another volume of stories of English life, but he returned to Italian subjects with *The Road in Tuscany* (1904); in *Fond Adventures, Tales of the Youth of the World* (1905), two are Italian tales, and *The Fool Errant* (1905) purports to be the memoirs of Francis Antony Stretley, citizen of Lucca. Other novels followed, but his main interest was directed to verse. *The Song of the Plow* (1916) is one of the most considerable English narrative poems of the new century; it describes the fortunes of the English farm labourers from the earliest times down to the present, and contains many fine passages. Other poems were *The Village Wife's Lament* (1918) and *The* Lore of *Proserpine* (1913). The popularity of his earlier fiction perhaps accounts for the limited appreciation of the real strength and originality of his later work. He died on June 15, 1923, at Broad-Chalke, near Salisbury.

HEXACHORD, in music, the scale of six degrees attributed to Guido d'Arezzo (11th century) and introduced as an improvement on the Greek scale system based on tetrachords or groups of four notes. The six notes making up each hexachord received the names *ut,* re, *mi,* fa, sol, la from the initial syllables of the lines of a certain hymn to St. John, the melody of which happened to be such that each line began on successive degrees of the hexachordal scale. As, however, the hexachords could begin on either C, F or G the syllabic names of the notes associated with the alphabetical names were not always the same. Thus in the scale of C the note G was sol, or G sol, whereas in the scale of F it was re and was therefore called G re, while in the scale of G itself it became naturally G *ut.* Hence in the complete gamut (a word derived from the note just named, *gamma-ut*) each alphabetical note was given a compound name according to the different syllabic names which coincided with it, *e.g.,* G sol re *ut, A* la mi re, and so on. These names remained in use for centuries until the whole system was superseded with the adoption of the octave as the standard group unit and recognition of the modern principles of key-relationship. But the same syllables—*ut,* re, mi, etc.—are still retained, with the addition of si for the seventh note, in the musical nomenclature of France and Italy as the names for the notes of the existing diatonic scale of C major.

See GUIDO OF AREZZO; MUSICAL NOTATION.

HEXAMETER, the earliest known form of classical verse in dactylic rhythm. The word indicates that each line contains six feet of measures of which the last is always a spondee (– –) or a trochee (– ⏑). When the last foot is a trochee, the pause at the end of the line makes up for the short syllable. The fifth foot is usually a dactyl (– ⏑ ⏑); the rest indifferently dactyls or spondees.

In Latin and Greek hexameter is the invariable metre of epic and didactic poetry; in Latin it is also the metre of satire irom the period of Horace onward. In modern languages. Longfellow, Charles Kingsley, Arthur Clough and several German poets have written hexameters of a sort, substituting accent for quantity. The English verses are usually unsatisfactory, owing to the lack of any real equivalent for a spondee; and the German are much worse, on-ing to the scarcity of really short syllables. Accent alone cannot give the true effect of either spondee or dactyl. Even the classic Greek poets made many variations in their treatment of the hexameter.

In 1898 William J. Stone defined the rules of the hexameter in On *the* Use *of* Classical *Metres in* English Verse, and Robert Bridges attempted to apply them in his experiments with quantitative verse. Though he followed the rules closely, his hexameters sound artificial, and he had even more difficulty than Longfellow in finding true spondees:

Now in | wintry de | lights, and | long fire | side medi | tation.
'Twixt studies | and rou | tine pay | ing due | court to the | Muses, . . .
(Epistle I from Robert Bridges, *Poems in Classical Prosody,* by permission of the Clarendon Press, Oxford.)

Richmond Lattimore's translation of the Iliad into English hexameters retains the swift pace and vigour of the original, but he is forced to take some liberties with the meter because of the great number of unstressed syllables in English, as the following lines indicate:

Nine days | up and | down the | host ranged | the god's | arrows,
but on the | tenth A | chilleus | called the | people to as | sembly;
a thing put | into his | mind by the | goddess of the | white arms, |
Hera, . . .

(I, 53–55)

(Richmond Lattimore, *Thr Iliad of Homer,* Chicago: The University of Chicago Press, p. 60 © 1951 by The University of Chicago.)

It will be noticed, however, that the extra syllables are extremely light and do not interfere with the basic rhythm. *See* METRE; VERSE.

BIBLIOGRAPHY.—Robert Bridges, *Milton's Prosody* (1901), which includes William J. Stone's On *the Use of Classical Metres in English Verse* (mentioned above); and Max Kaluza, *A Short History of English Versification* (1911). (G. W. A.)

HEXAPLA, the term for an edition of the Bible in six versions. and especially the edition of the Old Testament compiled by Origen.

HEXAPODA, an alternative name for insects (*q.v.*), having reference to their three pairs of walking legs.

HEXATEUCH, the name given to the first six books of the Old Testament (the Pentateuch and Joshua) to mark the fact that these form one literary whole, describing the early traditional history of the Israelites from the creation of the world to the conquest of Palestine. See BIBLE: *Old Testament;* DEUTERONOMY; EXODUS; GENESIS; JOSHUA, BOOK OF; LEVITICUS; NUMBERS.

HEXHAM, a market town and urban district in the Hexham parliamentary division of Northumberland, Eng., 20 mi. W. of Newcastle upon Tyne by road and on the Tyne river. Pop. (1961) 9,897. Its great abbey church of St. Andrew, standing by the market place, is a fine monument of Early English work. It was largely built of stone from Roman *Covstopitum* near Corbridge, 4 mi. E. of Hexham, and was reconstructed about 1112; the nave was rebuilt in 1907–08. There are also fragments of the monastic buildings remaining, and west of the churchyard is the monks' park, known as the Seal. In the town are two castellated 14th-century towers known as the Moot hall (*c.* 1100–1178), which now houses the Brough library, and the Manor office, which was built as a prison in the 14th century. Aydon castle near Corbridge is a fortified house of the 14th century; and Dilston or Dyvilston is a typical border fortress dating from Norman times. There is an Elizabethan grammar school.

Hexham (in 685 *Hagustaldes ham,* "the estate of the hagusteald," or squire) and its abbey were the victims of many raids from Danes, Scots and English. In 1464 at the battle of Hexham the Lancastrians under the duke of Somerset were defeated. In 1536 the last prior was hanged for being concerned in the Pilgrimage of Grace. In 1761 many people were killed in a riot over enlistment. The church and monastery were founded about 673 by Wilfrid, archbishop of York. The church in 678 became the head of the new see of Bernicia, united to that of Lindisfarne about 821 and restored to the archbishop of York by Henry II. In 1545 the archbishop exchanged Hexhamshire with the king for other property. Hexham was a borough by prescription from 1276 until 1853. Many fairs and markets were granted from the 13th century onward. In the neighbourhood are market gardens. especially on the rich alluvium near Haugh lane. The chief industries are agricultural, including the marketing of cattle and other livestock, the making of agricultural implements and the buying and sorting of wool.

HEYDEN, JAN VAN DER (1637–1712), Dutch painter, was born at Gorinchem. Neth. In 1650 he moved with his parents to Amsterdam, where he lived for the rest of his life, and where he died on March 28, 1712. There are recurrent subjects in his paintings which afford evidence of a journey southward to Brussels. Cologne and perhaps even farther. It is probable that he had already made this journey by the time of his marriage in 1661. There is the possibility also of a later journey to London, for according to an early authority he painted the royal exchange and Sir Christopher Wren's monument commemorating the fire of London, which was not completed until 1677. Although in his late years Van der Heyden painted landscapes and also produced some still-life subjects at the beginning and end of his career. his reputation rests entirely, and rightly, upon his architectural subjects! the town views which he painted in early maturity. In this department of Dutch 17th-century art he has no rival, for he succeeded in combining breadth and truth of general effect with an astonishing attention to the minutest details. In particular, his manner of separately realizing every individual brick of his houses has never ceased to amaze as a technical tour de force. His pictures are well composed and harmoniously coloured. especially where he exploits the contrast of mellow brick with the foliage of the trees which line the canals in his Dutch townscapes. Although they carry the conviction of a factual record. they are by no means all topographically accurate. Van der Heyden took liberties with actuality in the interests of design. sometimes even fusing elements of different towns into a single composition. His *Brandspuitenboek* ("fire engine book"), published in 1690, contains etched illustrations of high quality. (R. E. W. J.j

HEYMANS, CORNEILLE JEAN FRANÇOIS (1892–), Belgian physiologist, was awarded the 1938 Nobel prize for medicine and physiology "for his discovery of the role played by the sinus and aortic mechanisms in the regulation of respiration." He was born at Ghent, Belg., on March 28, 1892. After taking his M.D. degree at Ghent in 1920 he studied physiology in Paris, Lausanne. Vienna, London and the United States. In 1930 he succeeded his father, J. F. Heymans (1859–1932), as professor of pharmacology in the University of Ghent. His researches, which were begun in collaboration with his father, were mainly concerned with the physiology of the respiratory and circulatory systems.

The work for which he received the Nobel prize dealt with the part played by the carotid sinus, the carotid body and the aortic arch structures situated at the bifurcation of the common carotid artery in the neck—in regulating blood pressure and respiration, by their response to pressure stimuli and to changes in the oxygen tension of the blood. Heymans travelled and lectured extensively and is probably the best known modern Belgian medical scientist. (W. J. BP.)

HEYNE, CHRISTIAN GOTTLOB (1729–1812), German classical scholar. was born on Sept. 25, 1729, at Chemnitz, Saxony. In 1748 he entered the University of Leipzig. In 1752 he went to Dresden on the invitation of Count von Brühl, the prime minister, from whom, however, he obtained only a post as clerk in the count's library. He published his first edition of *Tibullus* in 1755, and in 1756 his *Epictetus.* In the latter year the Seven Years' War broke out, and Heyne was compelled to support himself by tutoring. The bombardment of Dresden on July 18, 1760. destroyed all his possessions. including an almost finished edition of Lucian. based on a valuable codex of the Dresden library. In 1763 he obtained a professorship at Göttingen, where he died on July 14, 1812. He was the lirst to attempt a scientific study of Greek mythology.

Of Heyne's numerous writings, the following may be mentioned. Editions. with copious commentaries. of Tibullus (1755–98), Virgil (1775–89), Pindar (1744–98j, Apollodorus, *Bibliotheca Graeca* (1803), Homer, *Iliad* (1802–04); *Opuscula academica* (1785–1812), dissertations of which the most valuable are those relating to the colonies of Greece and the antiquities of Etruscan art and history. His *Antiquarische Aufsätze* (1778–79) is a valuable collection of essays connected with the history of ancient art.

See biography by A. H. Heeren (1813) which forms the basis of the interesting essay by Carlyle (*Misc. Essays,* ii); J. E. Sandys, *Hist. Class Schol.,* 3rd ed., vol. 3 (1921); A. Hessel, *Heyne als Bibliothekar* (1928).

HEYROVSKY, JAROSLAV (1890–), Czech chemist awarded the 1959 Nobel prize for chemistry "for his discovery and development of polarography" (*q.v.*), was born in Prague on

Dec. 14, 1890.

He was educated at the Charles University of Prague and at University college, London, where he worked under Sir William Ramsay and F. G. Donnan and, in 1913, held the post of demonstrator in the chemistry department. Returning to the University of Prague he was in turn assistant in the chemistry department (1920), lecturer (1922), assistant professor (1924) and professor of physical chemistry and director of the Institute of Physical Chemistry (1926–54). Heyrovsky then became director of the institute of polarography of the Czechoslovak Academy of Sciences. The work which led eventually to the discovery of polarography was begun during his student days in London, when he investigated the electrode potential of aluminum at the suggestion of Donnan.

The polarograph is an instrument for measuring the current which flows when a predetermined potential is applied to two electrodes immersed in the solution being analyzed. The first polarographic apparatus was made and described in 1925, but the method did not come into common use until some ten years later. Polarography permits of some determinations which are difficult or impossible to carry out by other means and the method finds increasing applications in both qualitative and quantitative chemical analysis. Heyrovsky's monograph *Polarographie* appeared in 1941.

In Nov. 1955 he revisited London to deliver his presidential address to the Polarographic society.

See J. Heyrovsky, "The Development of Polarography," *Nature*, 177:266–267 (1956); G. W. C. Milner, *Principles and Applications of Polarography and Other Electroanalytical Processes* (1957). (W. J. Bp.)

HEYSE, PAUL JOHANN LUDWIG VON (1830–1914), German novelist, dramatist, poet, and Nobel laureate was born at Berlin on March 15, 1830, the son of the philologist K. W. L. Heyse (1797–1855). He studied classics, and then the Romance languages, and after a year's stay in Italy, he was summoned, early in 1854, by King Maximilian II to Munich.

Heyse was a master of the short story. He published at Munich in 1855 four in one volume. one of which, *L'Arrabbiata,* showed his genius. Many other volumes of stories appeared in due course and in these his most characteristic work is to be found. Heyse worked on his stories in the spirit of a sculptor; he depicted piquant problems and strong passions in a highly polished style. He also wrote several novels, the more important being *Kinder der Welt* (1873, Eng. trans. 1894) and *Im Paradiese* (1875)—the one dealing with the religious and social problems of its time, the other with artist life in Munich. He was a prolific dramatist, but met with little success, being out of sympathy with the realistic trend of his time.

There are masterly translations by him of G. Leopardi, G. Giusti and other Italian poets *(Italienische Dichter seit der Mitte des 18ten Jahrhundert,* 4 vol., 1889–90). Some of the translations of Shakespeare in the Bodenstedt edition are by him. His collected works contain also original lyrics and verse tales. Heyse received the Nobel prize for literature in 1910.

He died at Munich on April 2, 1914.

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HEYWARD, (EDWIN) DUBOSE (1885–1940), U.S. novelist, dramatist and poet, whose first novel, *Porgy,* was also a highly successful play, opera and motion picture.

Born in Charleston, S.C., on Aug. 31, 1885, he was educated in private and public schools there. At the age of 17 he worked on the waterfront, where he observed the Negro life that was to bulk large in his work.

The novel *Porgy* (1925) was set in Catfish Row, a Charleston tenement. Heyward and his wife Dorothy dramatized it (1927) and in 1935 the opera *Porgy and Bess* was produced, the libretto and words being by Heyward and Ira Gershwin and the music by George Gershwin. A motion picture version appeared in 1959. Other plays include *Brass Ankle* (1931), about miscegnation, and *Mamba's Daughters,* also dramatized by him and his wife from the novel (1929).

Heyward's first published work was poetry, *Carolina Chansons* (1922) being a joint publication with Hervey Allen; other volumes include *Skylines and Horizons* (1924) and *Jasbo Brown and Selected Poems* (1931).

Other novels include *Angel* (1926), about mountain people in North Carolina; *Peter Ashley* (1932), about pre-Civil War Charleston; and *Star Spangled Virgin* (1939), about the Virgin islands during the New Deal.

He died at Tryon, N.C., on June 16, 1940.

See Frank Durham, *DuBose Heyward* (1954).

HEYWOOD, JASPER (1535–1598), English priest and poet whose translations of Seneca had some importance in the development of English drama, was born in London in 1535, the son of John Heywood (*q.v.*). Educated at Merton college, Oxford, he entered the Jesuit society in Rome (1562) and became professor in 1564 at the Jesuit college at Dillingen, Ger. In 1581 Heywood replaced Robert Parsons as head of the Jesuit mission to England, and was imprisoned from Dec. 1583 to Jan. 1585, when he was exiled.

Heywood died in Naples, on Jan. 9, 1598.

His English translations of the *Troas* (1559), the *Thyestes* (1560) and the *Hercules Furens* (1561) of Seneca were issued, with other translations, as *Seneca his tenne Tragedies, translated* (1581).

HEYWOOD, JOHN (b. 1497), English dramatist, known to his contemporaries as "merry John Heywood," was probably the son of William Heywood, who was coroner of Coventry in 1505–06.

In 1519 John Heywood was in receipt of a quarterly payment in the king's music book as "player of the virginals," and later he appears as a "singer." In 1528 he was granted a pension of £10 a year; from time to time he received emoluments and grants which show that he was in high favour at court under Edward VI and Mary. As early as 1538 he "played an interlude with his children" before the princess Mary. He may have owed his introduction to her to Sir Thomas More, for he evidently belonged to the More circle; two at any rate of the pieces commonly attributed to him show strong evidence of More's influence. Moreover, his wife, Joan Rastell, was a daughter of the printer John Rastell, who was More's brother-in-law. He was attached to the old religion, and in 1564, when a commission was appointed by Elizabeth I to enforce the Act of Uniformity, he left England and took refuge at Malines. From there he wrote in 1575 to Lord Burghley, saying that he was an old man of 78, and asking that his daughter might collect his rents. The date of his death is unknown.

Heywood's name was actually attached to four interludes: *The Playe Called the Foure PP; A Newe and a Very Mery Interlude of a Palmer, a Pardoner, a Potycary, a Pedler* (not dated) is a contest in lying, easily won by the palmer, who said he had never known a woman out of patience. *The Play of the Wether, a New and a Very Mery Interlude of all Maner of Wethers* (printed 1533) describes the chaotic results of Jupiter's attempts to suit the weather to the desires of a number of different people. *The Play of Love* (printed 1533) is an extreme instance of the author's love of wiredrawn argument. *The Dialogue of Wit and Folly* is more of an academic dispute than a play. But two pieces usually assigned to Heywood, though printed by Rastell without any author's name, are *The Mery Play Betwen the Pardoner and the Frere, the Curate and Neybour Pratte* (printed 1533, but probably written much earlier), and the *Mery Play Betwene Johan Johan the Husbande, Tyb the Wyfe, and Syr Jhan the Preest* (printed 1533). These two pieces show the strong influence of Sir Thomas More, but there does not seem to be any ground for excluding them from the list of Heywood's plays.

Heywood's other works are a collection of proverbs and epi-

grams, the earliest edition of which now extant is dated 1562.

HEYWOOD, THOMAS (1574?–1641), English playwright and miscellanist who excelled in dramas of domestic sentiment, was born in Lincolnshire, probably in 1574. Cambridge was apparently his university and Emmanuel his college. Though his stay from 1591 may have been cut short, he left with some classical scholarship, acquiring later several modern languages. Philip Henslowe first mentioned a "bocke" by him in Oct. 1596. Thereafter he was active as playwright and player until the late 1630s, claiming in 1633 to have had "either an entire hand, or at the least a maine finger" in 220 plays. Twenty-four surviving plays are generally accepted as by Heywood in whole or in part; and cases have been made out for shares in about 12 more.

His voluminousness. facility in collaboration and readiness to throw any material into a play made him, along with Thomas Dekker. the best representative of the journeymen-playwrights who wrote primarily for immediate effect. He took more care in his middle and later years, as the appeal of the theatre to the *bourgeoisie* diminished. But "the prose Shakespeare," as Charles Lamb called him. remained a practical purveyor of theatrical fare, making no high claims for his plays as literature and explaining that he was not anxious to usher them, "into the world in Volumes, to beare the title of Workes." like Ben Jonson. If he was sometimes complacent. it was at his stage successes; as when *If you know not me, You know nobody* (1605) so filled the cockpit that the printers pirated the play from shorthand notes; or when the *Ages* were acted by two companies concurrently; or when Charles I and his queen saw *Love's Mistress* three times in eight days. Heywood's plays are theatrical *mélanges,* his recipe being two or more contrasted plots with little integration and a lacing of clowning.

In one prologue he boasts of the variety of plots on the English stage. He dabbled in every field; but he made that of domestic sentiment his own. It is the chief ingredient of his masterpiece. *A Woman killed with Kindness* (1607), with its main plot of the erring wife and the forgiving husband. *The English Traveller* (1633) is a variant on the same theme; and so are the Jane Shore episodes of *Edward IV*, pts. 1 and 2 (1 599), and the Generous story in *The late Lancashire Witches* (1634, with Richard Brome). Other plays with a domestic emphasis are *How a man may choose a good Wife from a bad* (1602), *The Rape of Lucrece* (1608), *The Wise-woman Of Hogsdon* (1638) and *If you know not me,* pt. 2 (1606).

Part 1 of the last-named play, with some scenes in part 2. is a chronicle-history of Elizabeth as princess and queen. Other chroniclcs, based on pseudo-history, are *Nobody and Somebody* (1606) and *The Royall King, and the Loyall Subject* (1637). Adventure plays include the naive *Foure Prentises of London* (1615), *The Fair Maid of the West* (1 631) and *Fortune by Land and Sea* (with William Rowley, 16jj). The five *Ages* (*Golden, Silver, Brazen* and, in two pts., *Iron*) are a mythological cycle dramatizing much of Heywood's *Troia Britanica,* Lucian. Homer, Vergil and Ovid. *Love's Mistress* (1636) is a charming masque play also based on mythology. Still another group of plays are essays in Fletcherian romance: *The Captives, A Maidenhead well lost* (163j) and A *Challenge for Beauty* (1636).

Heywood also wrote many books and pamphlets in prose, verse, or a mixture of both. The verse is mostly included in *Troia Britannica* (1609), an engaging version of William Caxton's *Recuyel of the Histories of Troy* with two further cantos of universal history; *Tlze Hierarchy of the Blessed Angels* (1635), a folio of angelology and diabolology with copious notes; *Pleasant Dialogues and Dramas* (1637). consisting of dialogues and miscellanea; and seven lord mayor's pageants between 1631 and 1639. His celebrity as a symbolist in the pageants probably secured him his commission to devise the carving for the "Sovereign of the Seas." launched in 1637. He published *A True Description of His Majesties Royal Ship* in the same year. Other prose works are a translation of Sallust (1608) from the French; *An Apology for Actors* (1612); *Gynaikeion: or, Nine Books of Various History. Concerning Women* (1624); *Englands Elizabeth* (1631); *The Exemplary Lives . . . of nine of the most worthy Women of the World* (1640); and *Tlze Life of Merlin* (1641). From 163s on Heywood turned out 12 or more pamphlets coining down, not altogether surprisingly, on the anti-Laudian and Parliamentary side.

Heywood was married. perhaps twice. and had several children. He was buried in Clerkenwell, London. where he had lived for many years. on Aug. 16,1641.

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HEYWOOD, a municipal borough (1881) in the Heywood and Royton parliamentary division of Lancashire., Eng., 9 mi. N. of Manchester by road. Pop. (1951) 25,201. Area 13.3 sq.mi. It owes its rise to the grandfather of the statesman Sir Robert Peel, who first introduced cotton manufacturing to the town. It is still a big cotton centre. Other industries include tanning and engineering. Behind Heywood hall (1611), which belongs to the town, is Queen's park, opened in 1879 and covering 43 ac. There is an air force maintenance unit on the outskirts. and in the town are an art gallery and museum attached to the technical school.

HEZEKIAH, son and successor of Ahaz, one of the greatest of the kings of Judah, flourished at the end of the 8th and the beginning of the 7th century B.C. in critical times. There are difficulties about the chronology of his reign, the one fixed point being 701 B.C. when Judah was invaded by Sennacherib. Whether he came to the throne before or after the fall of Samaria (722–721 B.C.) is disputed. Shortly before 701 B.C. the whole of western Asia was in a ferment; Sargon had died and Sennacherib had come to the throne (in 705); vassal kings plotted to recover their independence and Assyrian puppets were removed by their opponents. Judah was in touch with a general rising in southwest Palestine, in which Ekron, Lachish, Ascalon (Ashkelon) and other towns of the Philistines were supported by the kings of Musri and Meluhha. Sennacherib completely routed them at Eltekeh (a Danite city), and thence turned against Hezekiah. In this invasion Sennacherib claims entire success; 46 towns of Judah were captured, 200,150 men and many herds of cattle were carried off among the spoil, and Jerusalem itself was closely invested. Hezekiah was imprisoned.

The briei account in II Kings xviii, 14–16, supplements the Assyrian record by the statement that Sennacherib besieged Lachish, a fact which is confirmed by a bas-reliei (now in the British museum) depicting the king in the act of besieging the town. This historical iragment is followed in II Kings by two narratives which tell how the king sent an official from Lachish to demand the submission of Hezekiah and concludes %-ith the unexpected deliverance of Jerusalem. Both these stories appcsr to belong to a biography of Isaiah, and are open to the suspicion that historical iacts have been subordinated to idealize the work of the prophet (cf. the similar accounts about Elijah and Elisha). (*See* KINGS, FIRST AND SECOND ROOKS OF.)

The narratives are (1) II Kings xviii, 13, 17–xix, 8; *cf.* Isa. xxxvi, i–xxxvii, 8. and (2) xix, 9b–35; *cf.* Isa. xxxvii, 9–36 (II Chron. xxxii, 9 *et seq.* is based on both). Jerusalem's deliverance is attributed to a certain rumour (xix, 7), to the advance of Tirhakah, king of Ethiopia, and to a remarkable pestilence which finds an echo in a famous story related, not without some confusion of essential facts, by Herodotus (ii, 141). It has been widely assumed that the two narratives are duplicates, but it is much more probable that they refer to different events. Sennacherib really made two expeditions against Judah. In the first of these, 701 B.C., the Assyrian monarch was bought off by payment of a heavy tribute (*cf.* II Kings xviii, 14–16) and deprived Judah of a good deal of territory. In the second expedition, which took place aiter the accession of Tirhakah, king of Egypt, 691 or 688 B.C., occurred the disaster described in II Kings xix, 9–35; cf. Herotlotus ii, 141. An attractive solution of the chronological difficulty would be to reckon the 15 years, extension to Hezekiah from 705, in which case his reign would have been prolonged to 690.

The reforms mentioned in II Kings xviii, 1–8, cannot have been carried out until after 701 when the prestige of the Prophet and the Temple had been enormously enhanced by the deliverance of Jerusalem. The most striking of the reforms was the destruction of the brazen serpent, the cult oi which was traced back to the time of Moses (Num. xxi, 9).

According to Prov. xxv, I, Hezekiah was a patron of literature. The hymn which is ascribed to the king is of postexilic origin but is further proof oi the manner in which the Judaean king mas idealized in subsequent ages, partly, perhaps, in the belief that the deliverance of Jerusalem mas the reward for his piety. (S. A. C.; G. H. B.)

HIALEAH, a city of Florida, U.S., in Dade county and part of greater Miami, is widely known for the Hialeah racecourse, maintained as a public park, which annually attracts many visitors, exclusive of the racing season, to the exquisitely landscaped grounds, Hundreds of flamingos live on islands in the enclosed lake of the course, and are "paraded" annually on Flamingo day around a part of the infield turf. The birds were originally imported from Cuba, but most of the present flock was raised at Hialeah, where they were successfully propagated outside their native habitat. Their wings are clipped to keep them in the park.

Founded as a suburb of Miami in 1922 by James Bright, pioneer stockman, and Glenn Curtiss, aviation promoter, the city was incorporated in 1925. Hialeah developed as a distribution and manufacturing centre for processed foods, bricks, fibre glass, steel and concrete products, furniture and fabricated homes; areas that were vacant land in the 1940s are covered with warehouses and factories. With a navigable canal, two railroads, several federal and state highways, the city has solicited commercial enterprises for its industrial parks. More than 10,000 residents of Hialeah are employed in the airline shops and offices at the nearby Miami International airport.

Points of interest include the Fire Engine museum with its collection of fire fighting equipment, two automobile race tracks, the nearby *jai alai frontón* and Miami-Battle Creek sanitarium.

Hialeah grew slowly with a population of 3,958 by 1940 and participated in the phenomenal growth of the city of Miami and of Dade county after World War II. By 1950 the population had reached 19,676; in the special census of 1955, 43,135; and 66,972 in 1960. For comparative population figures see table in FLORIDA: *Population* (J. E. D.)

HIAWATHA ("he makes rivers"), a legendary chief (*c.* 1450) of the Onondaga tribe of North American Indians. The formation of the League of Six Nations, known as the Iroquois, is attributed to him by Indian tradition. In his miraculous character, Hiawatha is the incarnation of human progress and civilization. He teaches agriculture, navigation, medicine and the arts, conquering by his magic all the powers of nature which war against man. He was adopted as the hero of the well-known poem by Longfellow.

HIBBING, a village of St. Louis county, Minn., U.S., 76 mi. N.W. of Duluth, centrally located on the Mesabi range 1,527 ft. above sea level. Organized as a lumbering centre and named after Frank Hibbing, a timber cruiser, it was platted and incorporated in 1893. Digging a well to secure drinking water resulted in the discovery of iron ore. The finding of rich deposits under the village streets in 1919 caused the entire village to be moved one mile south. Old Hibbing became the site of one of the world's largest open-pit mines, 400 ft. deep and covering 1,300 ac. Wealth derived from the mines is evidenced by a combined high school-junior college erected in 1921 costing $3,800,000. Mining over 121,000,000 tons of ore during World War II exhausted the rich deposits and the village, again relocated by 1950, turned to the processing of nonmagnetic taconite and the promotion of a strong retail trade. The original Northland-Greyhound bus line was established near Hibbing in 1926 by Carl E. Wickman and Andrew G. Anderson. For comparative population figures see table in MINNESOTA: *Population.* (E. F. GR.)

HIBERNATION AND ESTIVATION, broadly speaking, are states of dormancy in which bodily functions and activities of certain animals are greatly reduced. During hibernation, commonly known as winter sleep, certain animals endure prolonged periods of cold. Estivation or summer torpidity is a comparable state of suspended animation entered into by some animals in periods of heat or drought. Both hibernation and estivation permit survival during periods when food supply is short. While cold is usually considered as the most important stimulus for hibernation, other environmental factors as well as internal seasonal rhythms must be recognized as playing some part in bringing on the sleep.

There is a fascination for man in those warm-blooded animals which can hibernate, partly because man cannot do it and partly because of the hope that man might prolong his own life if he learned how to survive near-freezing body temperatures. By mid-20th century lowered body temperature (hypothermia) had been used in surgical anesthesia.

Many living cells, such as sperm for artificial insemination and red blood cells for transfusion, can be stored frozen, and some simple very small animals can be repeatedly frozen and thawed without apparent damage. The harm of freezing comes from the slow formation of ice crystals. Some living tissues can be cooled rapidly in liquid air to a vitrified state and later rewarmed rapidly without harm. In slow freezing there are changes in the distribution of water and salts that kill cells. For living cells to endure storage in a frozen state, they must undergo preliminary dehydration and salt dilution by some nonaqueous solvent. As freezing proceeds, only free water crystallizes at first into ice, then water which has been bound to organic and other molecules becomes frozen.

Probably no animal can withstand freezing of all its body water and still recover afterward but a few mammals have been frozen experimentally to the extent of becoming rigid for a few minutes and have recovered. Although the outer tissues of fish can be frozen, reports of complete freezing of fish appear fallacious.

Many insects are frozen for long winter periods. In these insects there is some dehydration during gradual winter-hardening and their body fluids become supercooled by many degrees; *i.e.*, the temperature falls below the freezing point, yet the body fluids remain liquid; but if an ice crystal forms, the temperature rises to the freezing point. Some animals can remain in a supercooled condition for long periods; certain fish in deep fiords live in this state permanently.

Hibernation **by Mammals and Birds.**—Warm-blooded (homoiothermic) animals are distinguished from cold-blooded (poikilothermic) ones in having higher metabolism, hence greater heat production; in being protected against heat loss by insulation of fur, feathers and subcutaneous fat; by being able to divert warm blood away from the body surface; but most of all by having a temperature-regulating centre ("thermoregulator") in the brain. When the temperature centre is stimulated, either by nerve impulses from skin cold receptors or by direct cooling of the blood, various protective mechanisms are called into action and body heat is conserved. The first protective responses against cold are by diverting blood from the skin to the interior of the body, by improving insulation by erection of fur or feathers and then by shivering and increasing heat production. A set of responses in the opposite direction serves to increase heat dissipation when the temperature centre is activated by high temperatures. Hormonal responses occur to each temperature stress.

All mammals and birds show fluctuations in body temperature characteristic of the time of day or night. Night prowlers or flyers have their sleep period of low body temperature in the daytime, In some bats heat regulation lapses during rest and they enter a coma; during each day's sleep they go into a condition similar to winter dormancy, with their body temperature dropping to near air temperature. Similar cessation of activity, slowdown of heart and breathing and fall in body temperature, occurs in sleeping hummingbirds, some swifts and poorwills. This cooling during sleep conserves body reserves but it delays the animal's becoming active on awakening. Primitive mammals such as the Monotremata (*q.v.*; platypus, spiny anteater), Marsupialia (*q.v.*; kangaroo, opossum) and Edentata (*q.v.*; sloth, armadillo) tend to have lower temperatures normally than other mammals. Seasonal hibernators are found among the Monotremata, the Insectivora (shrews and hedgehogs) and bats (the insect-eating ones). Best-known hibernators are rodents of temperate and arctic latitudes; *i.e.*, ground squirrels, woodchucks, marmots, hamsters, dormice (*qq.v.*).

The warm-blooded animals that can hibernate are able to turn down the setting of their thermoregulators, so to speak, so that over a wide range of temperature they are essentially cold-blooded. They then enter a sleep in which their body temperature fluctuates with the temperature of the air around them. Some animals pass abruptly into the hibernation state; others require much preparation. Some, such as ground squirrels, gain much fat prior to hibernation and their body fats change to a less saturated form.

Others, for example, hamsters, store up much food and delay entrance into hibernation.

Most hibernating mammals seek a sheltered hiding place, or burrow into the ground. The temperature in the den is usually several degrees warmer than outside, 59°–63° F. when it is 46°–50° F. outdoors. The burrow usually extends below the frost line; the alpine marmot burrows 9 ft. into the ground, the steppe marmot as much as 30 ft. and closes the entrance with stones and hay. Cold temperature is normally the stimulus for hibernation, but it may be hastened by lack of food, shortened days and other factors. As an animal enters hibernation, its temperature regulation becomes poor; when its body temperature falls, it fails to respond in the usual manner by fluffing fur, shivering and increasing metabolism. The body temperature falls to conform with that of the air and may go down to a few degrees above freezing (39°–41° F.). Breathing becomes slow and irregular, the heart beats only periodically and slowly (7 to 10 times per minute, compared with the 300 per minute normal in the ground squirrel), metabolism is reduced by 30 to 100 times. Various nervous reflexes cease to function when the body temperature falls to 64°–77° F.; and electrical activity of the brain is no longer detected at below 52°–66° F. The exact limiting temperature can be different for each animal species. The breathing centre remains sensitive to carbon dioxide, however. During the sleep, body fats are slowly used up; a brown bat may lose 35% of its weight and a fattened ground squirrel 80% during a winter.

If the air temperature drops to freezing (32° F.), many hibernators begin to breathe faster; they raise their heat production and maintain their body temperature at about 39" F.; some awaken. Those that fail to respond to the freezing air die as a result of the extreme cold. Many hibernators awaken periodically during the winter, some of them to feed and drink. Bats apparently are not stimulated to awaken by extreme cold but they usually hibernate in comparatively warm moist caves and move about occasionally. The energy expended by a ground squirrel in awakening every 11th day has been calculated to be more than that used during the entire 10 intervening days of dormancy.

Arousal from hibernation is a dramatic process. It can be elicited experimentally by a rise in temperature, by mechanical, sound and other stimulation. The body temperature may rise by as much as 86° F. during three or four hours. The warming process of a hibernating mammal uses self-produced heat in contrast to the warming of a cold-blooded animal which absorbs heat from outside. The heart begins to beat regularly, breaths come more frequently, heat is produced by heart and chest muscles. and the anterior half of the body warms before the hind part. The region of the brain concerned with autonomic function is active before higher centres. As the animal warms, its oxygen consumption overshoots the normal level, and muscular activity begins irregularly.

Many body functions in hibernators are different from those in nonhibernators, but the most important seems to be the setting down of the thermoregulator to a little above freezing temperature. The net effect is to permit the animal to remain alive without additional food during the period when temperatures are low and food is scarce.

Many mammals sleep a great deal during the winter but do not hibernate, that is, their body temperature remains high. Bears, skunks, pocket gophers, chipmunks and opossums take long winter sleeps. Brown and black bears enter protected dens; the anus becomes plugged with a tappen composed partly of pine needles, and they do not defecate until spring. However, the young are born during the winter.

No birds are able to enter a state of prolonged hibernation. Those that lack sufficient insulation to survive long cold winter nights without eating migrate to warmer climates. (See MIGRATION, BIRD.)

Hibernation and Estivation by Cold-Blooded Vertebrates. — In ninter many of the Amphibia become inactive in a protected niche. At low temperatures aquatic amphibians, such as frogs, burrow into bottom mud. Reptiles also spend the winter in a torpid state. A few fish spend long periods resting on the lake or river bottom or in mud when their activity is limited by temperature. Most fish, however, continue to be active in winter.

Many reptiles, amphibians and fish undergo estivation brought on not so much by heat as by drought. Crocodiles, alligators and water turtles may remain buried in mud until water reappears. Frogs have frequently been dug out of clay near the edges of dried-up ponds and streams. The bladder may retain water and Australian aborigines are said to use such frogs as a source of water. The best-known of estivating fish are the dipnoans or lungfish (*q.v.*). The African lungfish *Protopterus* burrows deep into the mud when its swamp stream starts to dry. The gills become useless, but it breathes by means of its gas bladder and in its torpid state uses fat reserves slowly. Its bladder accumulates quantities of urea but when the fish is released by the rains it reverts to .the excretion of ammonia.

Invertebrates. — Many fresh-water Protozoa form cysts under such adverse conditions as cold, heat, drying or fouling of the water in which they live. Encystment is entered by some protozoans in the normal process of reproduction and dispersal. The protozoan secretes a protective cyst wall, which may be either carbohydrate or keratinous in nature. and a transparent inner membrane. Reorganization of cell contents occurs. Encysted protozoans may survive high heat, subfreezing (liquid air) temperatures and drying. There are reports of revival of soil flagellates and amoebae from cysts which had been dried for more than 40 years. Cysts of ciliates attached to grass survive long periods of drought. In suitable surroundings and temperature excystment occurs in a few minutes.

Fresh-water sponges form resistant gcmmules, and bryozoans (*see* POLYZOA) form statoblasts as part of their normal liie cycles. Both gemmules and statoblasts are surrounded by a hardened, resistant double membrane and may survive repeated freezing and drying. Some of the fresh-water Copepoda and Tardigrada (*qq.v.*) form resistant cysts in unfavourable conditions, either winter or summer. Land snails protect themselves for either hibernation or estivation by closing the shell mouth with a resistant, sometimes calcareous, membrane. Slugs burrow into the soil and protect themselves with a mucous mantle. Desert snails may survive several years without food or water in a state of estivation.

Insects winter in several ways, many as nymphs or pupae in a state of diapause or rest. Diapause can be brought on by cold or lack of food and water; some species, such as meal moths and blowflies, breed continuously in favourable conditions, but enter diapause in unfavourable conditions. In other species, particularly certain moths and butterflies, pupal diapause is a necessary stage of the life cycle, and the butterfly or moth cannot emerge until diapause is broken by exposure to cold. Other insects, for example mosquitoes, spend the winter as resistant eggs, and many spend it as larvae or adults. These may seek locations protected from freezing, or a place where only their outer layers may freeze. In preparation for wintering they become somewhat dehydrated, and may contain more bound and less free water than previously. They may become supercooled by about 41°–68° F., and thus they do not freeze. Experiments indicate that when invertebrates do freeze only slightly more than half of their body water is frozen.

Various animals suspend vital activities in different ways during periods of prolonged cold and drought. Cold, especially gradually decreasing temperatures, is only one stimulus, perhaps the most important, for hibernation. And drought is only one of the stimuli for estivation. Investigations of the processes of hibernation and estivation may aid in bringing about an understanding not only of the limits of vital function but also of the preservation of tissues in a state of suspended animation. *See* also ANIMAL *HEAT*.

See C. P. Lyman and P. O. Chatfield, "Physiology of Hibernation in Mammals," Physiol. **Rev.,** 35:403 (1955). (C. L. PR.)

HIBERNIA, in ancient geography, one of the names by which Ireland was known to Greek and Roman writers. Other names were Ierne. Iouernia. Iberio. All these are adaptations of a stem from which also Erin is descended. The island was well known to the Romans through the reports of traders, so far at least as its coasts, but it never became part of the Roman empire.

Agricola (*c.* A.D. 80) planned its conquest but the Roman government forbade it. *See* IRELAND: *History.*

HIBISCUS, a genus of plants of the mallow family (Malvaceae), one of which is popularly known as rose mallow. The genus comprises about 150 or more Species of herbs, shrubs and trees, native to temperate and tropical regions but most abundant in the latter. They bear palmately veined, lobed or parted leaves and mostly bell-shaped, frequently very large, scarlet, pink, yellow or white flowers, with the parts, except the numerous stamens, usually in fives. A few species yield food and fibre products, but in Great Britain they are grown chiefly, and in the U.S. frequently, for ornament. Representative economic species are *H. esculentus* (okra or gumbo); *H. tiliaceus,* the mahoe, a tropical plant which yields a fibre; and *H. sabdariffa,* the roselle, the cooked calyx of which has a cranberrylike flavour and is used in the southern United States. Among the best-known ornamental species are *H. syriacus* (rose of Sharon or shrubby althea); H. *rosa-sinensis* (rose of China or shoeblack plant, widely cultivated in many handsome varieties); and *H. trionum* (flower of an hour). The North American *H. moscheutos,* the rose mallow, is native to salt or brackish marshes near the coast from Massachusetts to Florida and occurs sparingly, westward to Indiana and Missouri, in fresh marshes. It is the source of many fine garden forms cultivated for ornament. These varieties, which are treated as annuals or perennials, require deep, rich, moist soil. They may be grown from seed or roots; most are hardy late summer and fall bloomers in temperate regions, but they may benefit from a mulch during the winter. *See* FIBRES; GUMBO; MALVACEAE. (N. TR.; X.)

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THE NORTH AMERICAN HIBISCUS (HIBISCUS MOSCHEUTOS)

HICHENS, ROBERT SMYTHE (1864–1950), English novelist, mas born at Speldhurst, Kent, on Nov. 14, 1864. He was educated at Tunbridge Wells and Clifton college, and then became a student at the Royal College of Music, London. He first attracted serious attention as a writer with *The Green Carnation* (18943, but his best-known work in fiction was a series of novels with an eastern setting, beginning with *The Garden of Allah* (1905) and including *The Call of the Blood* (1906) and *Bella Donna* (1909). *The Dweller on the Threshold* (1911) is a good example of his tales of the supernatural. Of his dramatized novels, *Bella Donna,* produced in 1911–12, and *The Garden of Allah,* produced first in New York and (1920) at Drury Lane, were the most successful. *The Paradine Case* (1933) was filmed and released in the U.S. in 1948. He died at Zürich, Switz., on July 20, 1950.

HICKES, GEORGE (1642–1715), English clergyman and scholar, was born in Yorkshire on June 20, 1642. He was appointed rector of St. Ebbe's, Oxford (1675), vicar of All Hallows, Barking, London (1680), chaplain to the king (1681) and dean of Worcester (1683). He opposed both James II's declaration of indulgence and Monmouth's rising, and he tried in vain to save from death his nonconformist brother John. At the revolution Hickes, as a nonjuror, was first suspended and afterward deprived of his deanery. After remaining some time in concealment in London, he was sent by Sancroft and the other nonjurors to James II in France to discuss episcopal succession; upon his return in 1694 he was consecrated suffragan bishop of Thetford. He died on Dec. 13, 1715. A posthumous publication of his *The Constitution of the Catholick Church and the Nature and Consequences of Schism* (1716) gave rise to the celebrated Bangorian controversy *(see* HOADLY, BENJAMIN).

His chief writings are the *Institutiones Grammaticae Anglo-Saxonicae et Moeso-Gothicae* (1689) and *Linguarum veterum Septcntrionalium Thesaurus grammatico-criticus et archaeologicus* (1705), a work of great learning. His two treatises, one *Of the Christian Priesthood* and the other *Of the Dignity of the Episcopal Order* (1707), were reprinted in the *Library of Anglo-Catholic Theology* (1847).

See J. H. Overton, ***The Nonjurors*** (1902).

HICKOK, JAMES BUTLER ("WILD BILL") (1837–1876), U.S. marshal, soldier and scout, was born May 27. 1837, at Troy Grove, Ill. Early in life he became recognized as an excellent pistol shot. In 1855 he went west where for a time he drove a stage over the Santa Fe and Oregon trails. He had many violent encounters. Once he was almost fatally injured from an attack by a cinnamon bear which he killed with a knife. In 1861 he fought singlehandedly the McCanles outlaw gang at Rock Creek Station in Jefferson county, Neb., killing McCanles and two of his men. During the American Civil War he served as a scout in the Union army. His career as an Indian fighter and as a U.S. marshal at Hays City and Abilene, Kan., led to numerous combats with thieves and outlaws. For a brief period of time he was an unsuccessful member of one of William ("Buffalo Bill") Cody's famed Wild West shows. When not otherwise employed, Hickok liked to gamble at cards, and it was while playing in a poker game at Deadwood City. Dakota Terr., that he was fatally shot from behind by Jack McCall, Aug. 2, 1876.

See William E. Connelley, ***Wild Bill*** and ***His Era*** (1933); Richard O'Connor, *Wild* ***Bill Hickok*** (1959). (O. W.)

HICKORY, the common name for the genus *Carya,* one of the most valuable timber and nut-producing groups of hardy trees indigenous to eastern North America. The recognized American species are native to the eastern U.S., westward to Texas and Nebraska, with a few species extending into southeastern Canada and northern Mexico. These are pecan, *C. illinoensis;* and the following hickories: bitternut, C. *cordiformis;* black, *C. texana;* Carolina, *C.* carolinae-septentrionalis; Fernow, *C. fernowiana;* hammock, *C. ashei;* mockernut, *C. tomentosa;* nutmeg, *C. myristicaeformis;* pignut, *C. glabra;* red, *C. ovalis;* sand, *C. pallida;* scrub, *C. floridana;* shagbark, *C. ovata;* shellbark, *C. laciniosa;* swamp, *C. leiodermis;* and water, *C. aquatica.* A few hickory species, including C. *cathayensis, C. poileana* and *C. tonkinensis,* are found in southeast Asia, along with the closely related trees of the genera *Annamocarya* and *Rhamphocarya.* Fossil forms referred to *Carya* have been found over wider regions, including western U.S. (including Alaska), Greenland, Iceland, Europe and a considerable part of China.

JOHN H. GERARD

TRUNK OF THE SHAGBARK HICKORY (CARYA OVATA)

All hickories are nut bearers; the pecan, shagbark, shellbark, Carolina hickory and their hybrids are of particular value on this account. Bitternut and water hickory are inedible because of tannin in the skin covering their convoluted kernels, but a few pecan-bitternut and shagbark-bitternut hybrids are cultivated for their nuts and are among the most vigorous trees of the genus. Many hickories have special ornamental value, since the foliage is rich green in summer and may become bright yellow in fall. The wood of all hickories is valuable as fuel, and that of shagbark, shellbark, Carolina, mockernut, pignut and red is much prized as material in making tool handles.

Although cultivated to a limited extent, the shagbark, shellbark and hybrid hickories are propagated in numerous varieties which yield high-quality nuts farther northward than the pecan. Among the pomological varieties are the shagbarks Harold, Etter

No. 54, Anthony, Bernath, Davis, Fox, Grainger, Neilson, Schinnerling, Shaul, Weschcke and Wilcox; the shellbarks Scholl. Ross Etter NO. g and Wagner; and the hybrids De Acers, Fairbanks and Stratford. The first two shagbarks and the last three hybrids are among the few that appear permanently compatible when grafted on stock of the bitternut species. Shagbark, shellbark, pecan and hybrids between them make more useful stocks in nurseries. Grafting is by bark, modified cleft or plate budding methods.

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FRUIT AND LEAVES OF THE SHAGBARK HICKORY (CARYA OVATA)

Pleas is the only pecan-bitternut hybrid with good-flavoured nuts. *See* also NUT; *PECAN.*

(J. C. McD.)

HICKS, ELIAS (1748-1830), U.S. Quaker liberal, influential in the early days of the abolition movement, was born on the Hempstead plain, Long Island, N.Y., on March 19, 1748. A carpenter's apprentice, he married Jemima Seaman in 1771 and settled on the Seaman farm at Jericho, L.I. Recorded a minister in 1778, he repeatedly passed through the British and American lines during the Revolutionary War. On horseback or by gig he journeyed 40,000 mi. in the ministry, from Canada to North Carolina and as far west as Richmond, Ind. Walt Whitman wrote of the "pleading, tender, nearly agonizing conviction" of Hicks's speech. Hicks urged Friends to establish local schools and helped found an important boarding school. After assisting in freeing the Society of Friends of slavery, he worked for general abolition. He urged a boycott on the products of slave labour and advocated the establishment of an area in the southwest as a home for freed slaves. Several editions of his *Observations on the Slavery of the Africans and Their Descendants* (1811) were published. He helped secure legislation bringing slavery to an end in New York state. Hicks's sermons dwelt much on simplicity, temperance and peace. He combined the Quaker teaching of God's individual guidance with the use of human reason, and was one of the first teachers of the doctrine of progressive revelation. He successfully opposed the adoption by the Baltimore yearly meeting in 1817 of a set creed. Called a heretic for opposing the rising evangelical movement among Friends, he was unjustly held responsible for the Quaker schism in America of 1827–28. His followers, who called themselves the Liberal branch, were termed Hicksites by the orthodox party, which in the beginning they outnumbered. (*See* FRIENDS, SOCIETY OF.) Hicks died at Jericho on Feb. 27, 1830.

Hicks's *A Series of Extemporaneous Discourses* was published in 1825, his *Journal* in 1832 and his *Letters* in 1834.

See B. Forbush, *Elias Hicks: Quaker Liberal (1956).* (B. FH.)

HICKS, THOMAS HOLLIDAY (1798–1865), U.S. politician, governor of Maryland at the outbreak of the Civil War, was born on a farm in Dorchester county, Md., Sept. 2, 1798. He became a constable when 21 years old and was elected sheriff when 26. In 1830 he was elected to the state legislature; in 1836 he was made a member of the electoral college and returned to the legislature; and in 1838 he was appointed register of wills in his home county, a position he held for almost 17 years. He was elected governor of Maryland in 1857.

The state was divided on the question of secession. The southern and eastern parts generally favoured the cause of the seceding states; the northern and western counties did not. In 1860–61 Hicks resisted great political pressure to call a special session of the state legislature, avoiding any official action on secession. This and the fact that the state lay north of Washington and quickly came under control of the federal government at the outbreak of the war kept Maryland from joining the Confederacy. Hicks represented the state in the U.S. senate from 1862 to 1865. He died at Washington, D.C., on Feb. 13, 1865.

HIDALGO (*hijo de algo*, "son of something"; *cf.* Port. *fidalgo*) a Spanish term originally used to describe a member of the louest grade of nobility entitled to the style of "don." It is now generally used to denote a man of gentle birth.

See M. J. Gounon-Loubens, *Essais sur l'admiuistration de la Castille au XVIe siècle (1860).*

HIDALGO, an inland central plateau state of Mexico. Pop. (1960) 983,161. Area 8,058 sq.mi. It is bounded on the north by San Luis Potosí and Veracruz, on the east by Puebla, on the south by the states of México and Tlaxcala and on the west by Querktaro. Hidalgo was part of the state of México until 1869 when it was established as a separate state in honour of the revolutionary patriot Miguel Hidalgo y Costilla (*q.v.*), the priest who began the struggle which ended in Mexico's independence from Spain in the early 19th century. Its northern and eastern parts are among the most mountainous in Mexico. The peak at Navajas reaches 10,538 ft. and is near the spot where the Aztecs obtained obsidian for their knives. The south and west of the state is relatively flat and semiarid elevated tableland, sloping off into tropical lowlands. In the plains area is Lake Metztitlán and the valley of Tulancingo, centre of textile industries.

Hidalgo has a number of natural thermal baths, such as those at Ixmiquilpan. With cool to temperate climates and considerable ranges of moisture, a variety of agricultural products are cultivated including rice, cereals, coffee, maguey (American aloe) for pulque, peppers, tobacco, fibres and woods. Hidalgo is one of the most highly mineralized states of Mexico. The first mines were founded in 1534 in Pachuca, and the government-owned Cia. del Real del Monte y Pachuca is one of the most extensive properties in the world. Much of the silver carried to Spain by the famous "silver fleet" came from the rich mines of Hidalgo. Silver, gold, mercury, copper, iron, lead, zinc and antimony as well as sulfur, jasper, opals and a little coal are produced. Although fairly well urbanized, Hidalgo still has numerous indigenous groups, such as the Otomi, living in primitive but picturesque agricultural villages and settlements such as Tenango de Doria and Metepec. Tula, 40 mi. W. of Pachuca (*q.v.*), the state capital, was once the capital of the Toltecs and is an archaeological site. Tulancingo (pop., 1950, 18,543) and Huejutla de Reyes (30,331) are important commercial centres. (H. R. HY.)

HIDALGO Y COSTILLA, MIGUEL (1753–1811), "father of hlexicnn independence" was born May 8, 1753, at Corralejo, a farm near Guanajuato. He was educated for the priesthood at Valladolid (now Morelia, Michoacán) and was ordained in 1789. His early career was uneventful, though his interest in the economic advancement of his parishioners in Dolores, through the introduction of newer methods of agriculture, made him suspect by the Spanish authorities. He was thought to be too much under the influence of the Enlightenment (*q.v.*).

In 1808 Spain was invaded by French troops and Napoleon forced the abdication of Ferdinand VII in favour of his brother Joseph Ilonaparte. Though Spanish officials in Mexico mere loath to oppose the new king, many Mexicans formed secret societies, some in support of Ferdinand, others of independence from Spain. Father Hidalgo belonged to such a group in San Miguel, near Dolores. When the plot was betrayed to the Spanish, several members were arrested. Warned to flee, Hidalgo decided instead to act promptly. On Sept. 16, 1810, he rang the church bell in Dolores to call his parishioners, announcing a revolution against the Spanish. But what had begun in San Miguel as a movement for independence under white leadership became a social and economic war of the masses against the upper classes. Thousands of Indians and mestizos flocked to Hidalgo's banner of the Virgin of Guadalupe. The hosts rolled over Guanajuato and other major cities west of Mexico City. Soon Hidalgo was at the gates of the capital. Yet he tarried, and the opportunity was lost. His followers melted away. The responsible elements in Mexico were frightened by the prospect of social upheaval. In the end Hidalgo fled north, hoping to escape into the United States. He was captured, degraded from the priesthood and shot as a rebel in Chihuahua on July 31, 1811. Though he accomplished little, Father Hidalgo's name became the symbol of the independence movement for most Mexicans and Sept. 16, the anniversary of *grito de Dolores* ("cry of Dolores"), is celebrated as hlexico's Independence day. (R. E. Q.)

HIDATSA. A native American people of Siouan family,

one of three agricultural "village tribes" on the upper Missouri, the others being the Mandan (*q.v.*) and Arikara (*q.v.*); the surrounding groups were buffalo-hunting nomads of the plains. Culturally the Hidatsa resembled the Mandan; in speech, the Crow (*q.v.*). They are also known as Minitari and Gros Ventre of the River.

HIDDENITE: *see* SPODUMENE.

HIDE. This word can most accurately be rendered by the phrase "family land"!; originally it denoted the amount of land necessary for the support of a free peasant family. The actual amount of land covered by this term is still and is long likely to be a matter under discussion. In the 12th and 13th centuries, when records are first abundant, the hide commonly appears as 120 ac. of arable, with the meadow and the pasture-rights locally considered appurtenant to such a tenement. But the scanty evidence which comes from an earlier time suggests that, at least in Wessex, the hide had once been much smaller than this, and there are facts which point to a pre-Conquest southern hide of 48 ac. The large hide of 120 ac. is best recorded in the eastern midlands, and its appearance there may in part be due to the influence of the large Scandinavian tenements introduced into the neighbouring country by the Danish settlements of the 9th century. In any case, throughout England, the hide underlay the whole local organization of early English society. It was the basis of the earliest taxation, the contributions made by different districts to the support of kings and ealdormen, and it seems to have formed also the basis according to which the primitive English militia, the *fyrd*, was raised. By the end of the old English period it had become unusual for a single peasant to hold an entire hide. The quarter hide, or yardland (Lat. virgata) had become. and long continued to be, the normal peasant tenement. Long after the Norman Conquest, however, the hide was the unit according to which assessment to national taxation, such as danegeld (*q.v.*), was expressed. The Norman administration maintained the old English system by which most villages in the midlands and the south and west of England were assessed at some round number of hides, such as j, 10 or 25, an arrangement which undoubtedly descends from the time when the hide was the essential unit of agrarian economy.

(F. M. S.)

BIBLIOGRAPHY.—The voluminous literature relating to the hide may conveniently be approached through J. H. Round, *Feudal England* (1895); *F. W.* Maitland, *Domesday Book and Beyond* (1897); F. Liebermann, "Hufe" in *Die Gesetze der Angelsachsen* (1898–1916); *P.* Vinogradoff, *English Society in the Eleventh Century* (1908). The system of assessment based on the hide will be found explained in any of the articles on Domesday survey contributed by Round in the *Victoria History of the Counties of England,* ed., *H. A.* Doubleday (1900).

HIDE. This term is generally used to describe the pelts taken from cows, steers and bulls of the bovine species and also the pelts from horses. The pelts of other animals are commonly called skins. viz., sheepskins. goatskins, calfskins. etc. Hides are almost entirely a by-product of the meat industry. the supply being determined by the demand for beef. For the preservation and tanning of hides see LEATHER. (E. L. D.; X.)

HIDEYOSWI, TOYOTQMI (1536–1598), one of the generals who brought about the reunification of Japan in the 16th century. Although of humble birth, he rose to become one of the most powerful barons in the service of Oda Nobunaga. After Nobunaga's death in 1582, Hideyoshi utilized his military power to defeat rival barons. At first he patronized the European missionaries and traders whose imports of firearms had helped make his victories possible, but in 1587 he turned against the Jesuits and ordered them to leave. although the orders were not immediately enforced. Measures designed to restore the stratiication of feudal society followed.

In 1592 Hideyoshi's ambitions turned toward the mainland. An expedition sent to Korea withdrew after Korean ships threatened its supply lines. A second expedition to Korea followed in 1597, but Hideyoshi died before it was withdrawn. (M. B. J.)

HIERAPOLIS, the name of two ancient cities, one in Syria, the other in Asia Minor.

Syrian Hierapolis.— This is now a ruin, the site of which is partly occupied by modern Membij (Manbij), about 50 mi. N.E. of Aleppo in the Aleppo *mohafazet* (district) of Syria. The place first appears in Greek as Bambyce. but Pliny (*Natural* History, v, 23) states that its Syrian name was Mabog. It was doubtless an ancient Commagenian sanctuary. The Seleucids made it the chief station on their main road between Antioch and Seleucia-on-Tigris. As a centre of the worship of the Syrian nature-goddess Atargatis (*q.v.*), it became known to the Greeks as the Holy City (Hierapolis). Lucian (or some anonymous writer) in the tract De Dea *Syria* has described the orgiastic luxury of the shrine. The warship was of a phallic character, votaries offering little male figures of wood and bronze. Huge phalli were also set up before the temple and were climbed once a pear, with certain ceremonies, and decorated. For the rest the temple was Ionic.

The temple was sacked by Crassus on his way to meet the Parthians (53 B.C.). In the 3rd century of the empire Hierapolis was the capital of the Euphratensian province and one of the great cities of Syria. It was in ruins, however, when Julian collected his troops there. and Khosrau I held it to ransom after Justinian had failed to put it in a state of defense. Harun al-Rashid restored it at the end of the 8th century and it became a subject of dispute among Byzantines. Arabs and Turks. The crusaders captured it from the Seljuks in the 12th century, but Saladin retook it (1175) and later it became the headquarters of Hulagu and his Mongols, who completed its ruin. A colony of Circassians was settled there in 1879 after the Russo-Turkish War.

The remains are extensive, but almost wholly of late date, as is to be expected in the case of a city that survived into Muslim times. A sacred lake survives.

Phrygian Hierapolis.— This is an ancient city in the Denizli *il* (province) of Turkey, situated, at a height of 1.200 ft., on the Coruh Su, a tributary of the Buyuk Menderes (Maeander) river, about 6 mi. N. of the ruins of Laodicea (*q.v.*). There, at an early date, a religious establishment (hieronj existed, and the town that grew round it became one of the greatest centres of Phrygian native life but of nonpolitical importance. The chief religious festival was the Letoia, named after the goddess Leto, a local variant of the Great Mother of the Gods! who was honoured with orgiastic rites. There was also a worship of Apollo Lairbenos.

Hierapolis was the seat of an early Christian church (Col. iv, 13), with which tradition closely connects the apostle Philip.

The ruins of Hierapolis are remarkable, particularly for a long avenue of tombs in the west of the city and for a very perfect, partly excavated theatre.

HIERO I, the brother of Gelo, and tyrant of Syracuse from 478 to 467 B.C. During his reign he greatly increased the power of Syracuse. He removed the inhabitants of Naxos and Catana to Leontini, peopled Catana (which he renamed Aetna) with Dorians, concluded an alliance with Acragas (Agrigentum), and espoused the cause of the Locrians against Anaxilaus, tyrant of Rhegium. His most important achievement was the defeat of the Etruscans at Cumae (474), by which he saved the Greeks of Campania. A bronze helmet (now in the British Museum). with an inscription commemorating the event, was dedicated at Olympia. Though despotic in his rule, Hiero was a liberal patron of literature. He died at Catana in 467.

See Diod. Sic. xi. 38–67; Xenophon, **Hiero,** *6. 2*; E. Liibbert, *Syrakus zur Zeit des Gelon und. Hieron* (1875); for his coins see NUMISMATICS: *Greek Coins:* Italy and Sicily.

HIERO II, tyrant of Syracuse from 270 to 216 B.C., was the illegitimate son of a Syracusan noble, Hierocles, who claimed descent from Gelo. On the departure of Pyrrhus from Sicily (27j) the Syracusan army and citizens appointed him commander of the troops. He materially strengthened his position by marrying the daughter *of* Leptines, the leading citizen. In the meantime, the Mamertines, a body of Campanian mercenaries who had been employed by Agathocles, had seized the stronghold of Messana, whence they harassed the Syracusans. They were finally defeated in a pitched battle near Mylae by Hiero, uho was only prevented from capturing Messana by Carthaginian interference. His grateful countrymen then chose him king (270). In 264 he again returned to the attack, and the Mamertines called in the aid of Rome. Hiero at once joined the Punic leader Hanno, who had

recently landed in Sicily; but being defeated by the consul Appius Claudius, he withdrew to Syracuse. Pressed by the Roman forces, in 263 he was compelled to conclude a treaty with Rome, by which he was to rule over the southeast of Sicily and the eastern coast as far as Tauromenium (Polybius i, 8–16; Zonaras viii, 9). From this time till his death in 216 he remained loyal to the Romans, and frequently assisted them with men and provisions during the Punic wars (Livy xxi, 49–51; xxii, 37; xxiii, 21). He kept up a powerful fleet for defensive purposes, and employed his famous kinsman Archimedes in the construction of those engines that, at a later date, played so important a part during the siege of Syracuse by the Romans.

A picture of the prosperity of Syracuse during his rule is given in the 16th idyll of Theocritus, his favourite poet. *See* Diod. Sic, xxii, 24; xxvi, 24; Polyhius i, 8; vii, 7; Justin xxiii, 4.

HIEROCLES (fl. *c.* A.D. 535), Byzantine grammarian, whose *Synekdemos* (a list of eparchies and cities under Justinian I) is fundamental for the study of the political geography of the Byzantine empire. It was a source for George of Cyprus and for Constantine VII Porphyrogenitus' book on the themes.

See edition by *E.* Honigman with introduction and notes (1939).

HIEROCLES OF ALEXANDRIA (fl. *c.* A.D. 430), Alexandrian Neoplatonist who, after studying under Plutarch of Athens and visiting Constantinople, spent the rest of his life in Alexandria, where he won a reputation as a teacher of philosophy. His commentary on the *Chrysa Epe* ("Golden Words," 71 hexameters ascribed to Pythagoras) is written with sincerity in a clear and simple style. His other work, *Peri Pronoias* ("On Providence"), is known only from the summary and fragments in Photius' *Bibliotheca,* 214, 251.

He rejected the multiplicity of entities introduced by the Athenian school of Keoplatonism. His teaching on morals and psychology is a mixture of Platonic, Aristotelian and Stoic elements. His theory of creation seems to show Christian influence.

This Hierocles should not be confused with the Stoic Hierocles of Alexandria who lived in the 1st/2nd century A.D.

BIBLIOGRAPHY.—The commentary is cd. by F. W. Mullach, *Fragmenta philosophorum Graecorum,* vol. 1, pp. 416–484 (1860); word index (together with Longinus and Eunapius) by R. Robinson (1772); Eng. trans. by N. Rowe (1756). *See* bibliography to NEOPLATONISM. *See* also K. Praechter in Pauly-Wissowa, *Real-Encyclopädie der classischen Altertumswissenschaft,* vol. 8, col. 1479–87 (1913); K. Pracchter, "Christlich-neoplatonische Bezichungen," *Byzantinische Zeitschrijt,* 21:1–27 *(1921).*

HIEROGLYPHS, a term broadly used to denote any system of writing composed of pictures. Hieroglyph, "sacred carving," is a Greek translation of the Egyptian "the god's words." which was used at the time of the early Greek contacts with Egypt to distinguish the older hieroglyphs from the handwriting of the day (demotic). Modern usage has extended the term to other writing systems, such as Hieroglyphic Hittite, Mayan hieroglyphs and early Cretan. There is no connection between Egyptian hieroglyphs and these other scripts, the only certain derivative from the Egyptian writing being that used for Meroitic.

Egyptian hieroglyphic writing was composed entirely of pictures, though the object depicted cannot be identified in every instance. The earliest examples which can be read show the hieroglyphs used as actual writing, that is, with phonetic values, and not as picture writing such as that of the Eskimos or American Indians. The origins of the script are not known. It apparently arose in the late predynastic period (just before 3100 B.C.). There were contacts between Egypt and Mesopotamia at this time, and it has been thought that the concept of writing was borrowed from the Sumerians. This is certainly possible, but even if this was the case, the two systems were so different in their use of signs that it is clear that they developed independently.

Except for names and a few titles, the oldest inscriptions cannot be read. In many cases individual hieroglyphs were used which are familiar from later periods, but the meaning of the inscription as a whole is obscure. It is apparent that this writing did not represent the sounds as completely as was the case later. This fact may be illustrated by personal names of this period and by formulas from later times which still reflected the usage of this period. The royal name Wedymuw was written simply*, that is, with (later read d) for *wdy* and for "water," read *mw* (the vowels were not written). Later writing was fuller, indicating the *w* and perhaps also the *y* of *wdy*, and used three wavy lines for *mw*, reserving the single one for the consonant n. The formula "(may he) live, be prosperous and healthy!" constantly used throughout later times after royal names, was written with the sign for "live" , which represented all the consonants in the word ('nx—the' was the equivalent of Arabic ayin) at all periods, the sign for *ǧ*? (? was a glottal stop), which stood for *wǧ*? "prosper," and the sign for *s*, which stood for the word *snb* "be healthy." The abbreviated nature of these writings shows that early hieroglyphic had not developed a consistent representation of the sounds. It was as much an aid to memory as it was a system of writing.

Nevertheless, even in the oldest period the basic principles of hieroglyphic writing were in operation.

1. A hieroglyph could be used to represent the original object or action pictured. might be "sun"; a man with his hand to his mouth might be "eat."

2. A hieroglyph might be used to represent another word suggested by the picture. might be "day" or the sun-god Re (Ra); might be used for "be silent," as if the man were putting his hand on his mouth to keep himself from saying anything.

3. A hieroglyph might be used phonetically to represent a word or part of a word having the same (or nearly the same) consonants. The consonants must be in the same order. "mace," which had the consonants *ḥǧ*, could also be used for hg "be bright"; *pr* "house" might represent *pry* "go out."

By the 3rd dynasty (about 2700 B.C.) these principles had been elaborated into a more regular representation of the language, and a system of writing was established which remained in use for approximately 3.000 years. While there must have been some conscious direction of the process, there was no absolutely consistent, logical system introduced into the spelling. Usage brought about general agreement on how signs might be used. Middle Egyptian spelling was the most consistent, and the following description is based primarily on this period. In general it also reflects Old Egyptian. *See* EGYPTIAN LANGUAGE.

Egyptian, like Semitic, mas a language in which the roots were usually composed of consonants, which might combine with any number of different vowel patterns, as well as suffixes and prefixes. The word for "face" was something like * *ḥar* but "his face" more like * *ḥrif*. Since only the consonants remained the same in different usages of the same root, the hieroglyph for that root came to be associated with just the consonants. "face" represented only the two consonants *hr*. When the sign was used for a similar sounding word, only the consonants were taken into consideration. The sign for house could be used for *par, pur, pir, pra, pru, pri* or for *pr* with no vowel. The result was that Egyptian hieroglyphic writing did not have any way of indicating vowels. (Modern scholars have a conventional way of pronouncing Egyptian which has nothing to do with ancient Egyptian pronunciation.)

In any example of Egyptian writing most of the signs represented consonants, not ideas. A small number of signs came to represent single consonants. A horned viper was f, a hand was d, a loaf of bread *t*, an owl *m*, and so on. In a few cases there were several signs for the same consonant, as or for *w*. As there was at least one sign for each of the 24 consonants, the Egyptians had in these signs a potential alphabet (*q.v.*), equal to that later developed by the Canaanites. They never took advantage of this fact but continued to write in the complex manner outlined here as long as hieroglyphs were used.

Within the system, however, many words were written out with these signs and so spelled alphabetically (as far as the consonants were concerned).

The use of signs representing single consonants arose in several ways. In some cases the first letter of the word was taken, as f from *ỉt* "horned viper," *r* from *r*ʾ "mouth." On the other hand the cobra, originally *ʾǧyt,* was used for *ǧ*. In this, as in many other things. there was no absolute consistency. Some scribe used for *ǧ,* and others followed suit. The phonetic principle of hieroglyphic writing did not demand complete identity of consonants in this early period. This is further illustrated by some of the signs which came to represent two or three consonants. There does seem to be a pattern: however, in what consonants might be ignored. Only the glottal stop (ʾ), y, w and the suffix-t (a feminine ending) might be dropped.

About 78 hieroglyphs came into general use as representing two consonants each. The house stood for *pr,* an eye for *yr* (from *yrt* "eye," with the *-t* dropped). In a few cases a sign stood for more than one combination, as for both *bḥ* and ***hw,*** or several signs for the same sounds, as both and for *mr*. In all about 76 different combinations, out of a possible 576, could be written with commonly used phonetic signs.

A hieroglyph representing all the consonants in a word might stand for up to three or even more consonants. "Head" was *tp* or *ǧʾǧʾ* (*tp* was more frequent in Middle Egyptian); "day" was *hrw;* "build" was *qd*. Only a few signs came to be used as general phonetic signs ior three consonants. The most common of these was *tyw* (used only as a phonetic sign); another was *xpr* (from *xprw* "dung beetle"), used in *xpr* "become" and other words.

Egyptian spelling combined all of the above elements in a manner which was usually clear but was often clumsy. Words were ordinarily nritten with a combination of signs. some representing the general idea or even picturing the object or action, others giving the sound. Since a given sign might have several different sound values, other signs were added to make sure that the reader knew which was meant. For example, an animal ear might be *msǧr* "ear" or *sǧm* "hear." *Msǧr* might be written or . In the single stroke was added to show that the hieroglyph was to be read as the object pictured, that is as *msǧr* "ear." This was not a foolproof system, however, and it was usually considered better to add at least some phonetic signs. In the word was written out in phonetic signs in addition to the ear. is *ms;* is *ǧr*. Each of these had another consonant added, which repeated the last consonant of the preceding sign (*s* and r). There could have been no ambiguity here, as the signs and regularly stood ior *ms* and *gr,* but the addition oi the other two signs was typical of Egyptian writing. The nord was actually spelled *ms-s-ǧr-r* (ear). Such multiple nriting has been of considerable help to scholars in determining the sounds of each word. The other value of the ear noted above, *sǧm* "hear," was usually written , the ear being followed by an *m* ( ) to show that it was to be read *sǧm,* not *msǧr* or some other word.

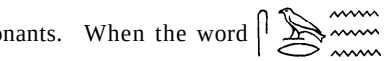
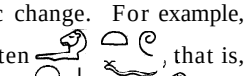
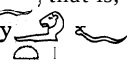
Just as a limited number of hieroglyphs came to have regular phonetic value, others came to be regularly used to designate words belonging to a certain type or class. These are known as determinatives. The seated man (originally *z* "man") came to be used after many words designating persons, often as engaged in a profession or trade: *smr* "courtier," *smdt* "subordinates, staff." The seated man with hand to mouth used as a determinative in large numbers of words suggested by this gesture, such as those for "call," "lamentation," "complaint," "thirst," "message," "mourn," "interpreter," "boasting," "swallow," "bite," "answer," "denounce." The sparrow never represented the bird itself. It rather became a symbol of that which was restricting, bad or defective and was used as a determinative in words such as *šw* "empty," *mr* "sick," *ʾq* "to perish." The papyrus roll tied with a string came to be associated not only with writing but also with abstract concepts, so that it was used as a determinative in *rx* "know," hrt "contentment" and many others. Very frequently several determinatives were used in the same word: *nmḥ* "waif, orphan" (written *n-nm-m-ḥ* [child with hand to mouth] [sparrow]).

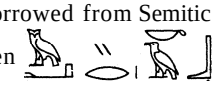
There were a number of ways of writing noun plurals. One of these was to repeat the word or the word sign three times: *rnw* "names" (rn "name"), *prw* "houses." Another way was to add three strokes: *prw* "houses" (the stroke beside showed that it was to be read as what it pictured, not as *pry* "go out" or some other word). The ending could also be written out phonetically, but it was customary to add the plural strokes to such a spelling. Since the plural ending was *w,* the plural strokes were often added to a word ending in *w,* even though no plural was intended, as *nfrw* "shortage" (note the use of the "bad bird"). The triple writing might be used in the same way: *nfrw* "beauty." (These two words had the same consonants. They undoubtedly had different vowel patterns. but these are unknown. They illustrate the fact that Egyptian writing was clearer than purely alphabetic writing of only the consonants would have been.) The plural strokes might also be used as a determinative in words indicating quantity, as *ʿš*ʾ "many," or mass. as , *ʿd* "fat."

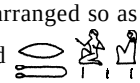
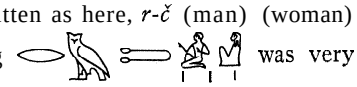
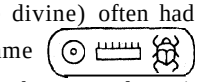
Many other examples of this type oi derived value, based on the associations of a hieroglyph in the spelling system, might be given. For example, the exclamation "oh!" was written , with the appropriate determinative. This group of signs was then used to represent the same consonant (a glottal stop) elsewhere, in words in which the determinative has no bearing, as in , a late Middle Egyptian nriting ior *ʾnn* "we" (note plural strokes).

On the basis of the uses noted here, hieroglyphs have been classified into logograms (also called ideograms or nord signs; more accurately described as representing morphemes), determinatives and phonograms (phonetic signs). This classification is convenient. but it is often impossible to determine which classification fits a hieroglyph in a particular word. The inexactness is due to the nature of Egyptian writing, which does not lend itself to modern analysis into set categories.

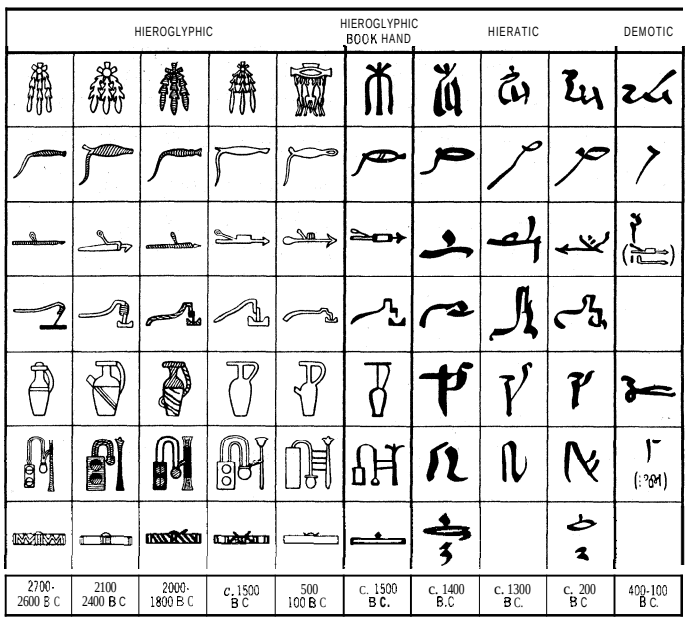
The Egyptian oiten looked upon the writing of a word as a unit, and the old phonetic spelling was usually kept even after sound

change had altered the consonants. When the word  swr "drink" (written *s-wr-r* [water] [man with hand to mouth]) became swy through the change of *r* to y, the y () was simply added to the spelling:  . There was a minimum of this kind of writing in Old and Middle Egyptian, but Late Egyptian spelling abounded in signs added, sometimes erroneously, to try to compensate for linguistic change. For example, in Late Egyptian "his beginning" was written  , that is, *ḥ³t-t* (stroke) t-w-f, where Middle Egyptian wrote only  *ḥ³t-t* (stroke) f. The word *ḥ³t* "beginning" had become something like *ha by Late Egyptian times, so that the writing  represented a word which, standing alone, had in current pronunciation no *t* at the end. The word still had the *t* before suffixes such as f "his," and the signs  (t-w, to be read simply *t*) were added to show this. The whole spelling represented only the consonants h t f.

It is readily seen from these examples that while there was a basic core of uniformity, there was also a large area of permissible variation in hieroglyphic spelling. In addition to the regular system, several special types of spelling arose. The most important of these was "group writing," in which each consonant was aritten with a sign or group of signs which normally indicated tno consonants. No texts were written in this spelling. but it was used occasionally for individual words from Old Egyptian times onward. In Late Egyptian it was primarily used to write foreign names and other loan words. The word "chariot," borrowed from Semitic (probably Canaanite **markabtu*), was written  . This would normally have been transcribed *m-y-r³-k-³-b-w-ty-y-t* ("wood"), but in group writing it represented only m-r-k-b-t. Attempts have been made to demonstrate that such writing was syllabic and so indicated the vowels. This has not been proved. It is possible that it was an Egyptian way of spelling out words using the names of hieroglyphs, like the English pronunciation of abbreviations such as NBC, some of the names having different vowel associates. There would, then, be a partial correspondence of the signs to the vowels of the word. There were also cryptographic scripts, such as the secret writing used for certain religious inscriptions in the 19th and 20th dynasties.

Order of Signs.—Hieroglyphs could be written either right to left or left to right. the lines being either vertical (reading down) or horizontal (reading across). The hieroglyphic figures always faced the beginning of the line. In an inscription which read right to left the signs faced the right. They were reversed for one reading left to right. Hieroglyphs were chosen and arranged so as to fill the space neatly and symmetrically. The word  *rmč* "people" was regularly written as here, *r-č* (man) (woman) (plural strokes). The writing  was very rare, as the *m* (the owl) made the group untidy. In other instances neatness caused the order of the consonants to be changed in the writing; for example,  may be t-w as it is written, or w-t. Signs were transposed for honorific reasons also. Phrases containing words such as "god," "king" or the names of deities (including the king, who was considered to be divine) often had these words first, out of deference. The name  "Menkheperre" ("enduring is the becoming of the sun-god Re") was written *r'-mn-xpr*, though it must be read mn-xpr-r'. Hm *nčr* "servant of god" (a type of priest) was written *nčr-ḥm:* .

Hieroglyphs and Religious Beliefs.—A number of hieroglyphs were used as amulets. The signs for "life"  , "stability"  and "protection"  were among those frequently reproduced as charms or included in dress or jewelry designs. The sacred eye of the god Horus  , according to legend scratched from its socket and torn into pieces by the wicked god Seth and later restored by the good god Thoth, was a talisman signifying wholeness and soundness. (The individual parts of the eye also served to indicate the fractions of a standard grain measure, the eyebrow being one-eighth, the pupil and iris one-fourth. etc.) As used in the tombs. hieroglyphs were not considered as mere writing. The portrayal of a person, animal or object, either as a picture on the wall or as a hieroglyph, was believed to be as effective as the original. The drawings of food in an offering list were therefore not just pictures; they were symbols which could become real food for the deceased Since hieroglyphs also depicted persons and animals which could harm the occupant of the tomb or deprive him of his food by eating it themselves, measures were sometimes taken to prevent this. In the Pyramid texts hieroglyphs representing human beings or animals who might eat the food needed by the deceased were usually incompletely drawn. The head, shoulders and arms (enough to show which sign was meant) would be used instead of a seated or standing man. An animal, such as a lion, would be shown cut in two pieces. A snake, on the other hand, was left nhole. since it would not be interested in man's food. In funerary texts of the Middle Kingdom fear is also shown of snakes, as well as other animals, by such incomplete drawing.



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EGYPTIAN HIEROGLYPHS AND THEIR CURSIVE EQUIVALENTS

The hieroglyphs depict: (1) three foxskins tied together; (2) a whip; (3) a single-barbed harpoon; (4) an adz at work on a block of wood; (5) a stone jug with handle; (6) a scribe's outfit; (7) a roll of papyrus tied with a cord

Hieroglyphs as Art.—At all periods the hieroglyphs were part of the artistic expression of ancient Egypt As noted above, the very choice and order of signs was influenced by considerations of symmetry. The actual execution of the signs was the business of sculptors and painters. Kina M Davies has listed seven ways in which the hieroglyphs were made on walls and like surfaces: (1) carved in low relief; (2) carved and then touched up with different colours; (3) modeled on plaster which had been applied to the surface and then painted; (4) carved into the surface (incised) and the interior of the sign painted a solid blue or green; (5) incised deeply and the details carved on the sunken surface (a feature of the New Kingdom and later); (6) in silhouette (painted solid in blue or black); (7) painted directly on the surface in different colours. Although most inscriptions were done as a matter of routine and many were quite poorly executed, there were

also many of fine artistic quality with exquisite detail. The colours applied sometimes corresponded to those in nature but as often did not. The pastel shades of many painted hieroglyphs as seen today are the result of fading. The original colours were bright and contrastive.

Handwriting.— The scribes wrote with fine reed pens, using red ink for rubrics and black ink elsewhere. The hieroglyph for "scribe" shows the palette. with the two depressions for red and black ink, a bag to hold the powdered pigments and a holder for the reed pens:  . Examples of handwriting are known from very early times, though they are rare from the first few dynasties. The signs were written with thick strokes. giving the characteristic features of the hieroglyph in broad outline. This cursive script is known as hieratic, three types of which came into use: a book hand, used for literary works and official documents; a business hand. also used for private letters; and a religious book hand, which was a closer approximation to hieroglyphic than the other two. Some hieratic forms reflect hieroglyphs which were not used in contemporary inscriptions, such as  , which goes back to a hieroglyph of a falcon on a standard  . There were also spelling conventions for hieratic which werk slightly different from those used for hieroglyphic.

Hieratic became more and more cursive in the course of time. The changes were gradual but distinct enough to afford a good basis for dating manuscripts on paleographic grounds alone. Late Egyptian hieratic was considerably different from the older stages, as a result not only of the changes in the shape of the characters but also of the new spellings introduced. About 650 B.C. a new cursive, demotic, replaced hieratic. Demotic was a development from hieratic and retained all the features of the hieroglyphic system, including word signs, determinatives and phonetic signs. However, the script became so cursive that it is far more difficult to read. Seven demotic signs were borrowed to suppiement the Greek letters used to write Coptic when the ancient Egyptian hieroglyphic system was finally abandoned.

The latest known use of hieroglyphs was at Philae about A.D. 394. The latest use of demotic was about A.D. 470. After this, knowledge of hieroglyphs was completely lost until they were deciphered in the early 19th century (see also EGYPTIAN LANGUAGE).

Decipherment.— Attempts made before 1800 to decipher the hieroglyphic inscriptions were completely unsuccessful. as the picture was believed to be composed of mystic symbols. This medieval concept was slow to die out even after the discovery, in 1799, of an inscription. the Rosetta stone (*q.v.*), in three languages, hieroglyphic Egyptian, demotic and Greek. In 1802 the French scholar A. I. Silvestre de Sacy and the Swedish diplomat Jean David Xkerblad identified a number of proper names in the demotic text by comparing it with the Greek. Akerblad also correctly assigned phonetic values to a few of the demotic signs.

Several 13th-century scholars had believed that the ovals. or cartouches, found in the inscriptions contained proper names. There were six cartouches on the Rosetta stone, but they all contained the same name, which was quickly identified as Ptolemy. The English physicist Thomas Young made a study of this and cartouches found on other inscriptions. Five of the phonetic values he assigned to hieroglyphs were correct (*p*, *t*, i, *n* and *f*). He completed his paper in 1819 and it was published by the *Encyclopædia Britannica* in 1824.

The first person who was actually able to read not merely proper names and a few isolated words but longer passages and connected texts was the French scholar Jean François Champollion. He made an exhaustive study of the Rosetta stone, comparing the different versions sign by sign and preparing lists of equivalents. He recognized that demotic writing was developed from hieratic (which he knew from other documents) and hieratic from hieroglyphic. On identifying the name Cleopatra in demotic. he transcribed it back into hieratic and then into hieroglyphs. He later obtained a copy of an obelisk inscription written in both Greek and hieroglyphs in which he found Cleopatra written almost as he had reconstructed it. Comparing the names Ptolemy and Cleopatra, which had the sounds *p*, *t*, *o*, *l* and *e* in common, he was able to identify not only the hieroglyphs for these letters (including two for *t*) but also the others used in these two cartouches. Not all of the values he assigned to the hieroglyphs were exact from the point of view of present knowledge, but they were close enough to provide a firm basis for further work.

Champollion was still not convinced that hieroglyphs were regularly used in a phonetic way to write the ancient Egyptian language, since the names which had been deciphered were foreign (Greek and Roman). In Sept. 1822 he received copies of inscriptions from older periods, which included cartouches with the names Rameses and Tuthmosis. Working from his meagre alphabet and skillfully applying his knowledge of Coptic and of the Rosetta stone, he successfully deciphered them. He then knew that he had the key to the ancient language itself. The phonetic values found in the proper names could now be used to read the Egyptian texts. He announced this in his letter to M. Dacier of Sept. 22, 1822.

See Alan Gardiner, *Egyptian Grammar*, 3rd ed rev. (1957); Nina M. Davirs, *Pirture Writing in Ancient Egypt* (1958). (C. T. HE.)

HIGDEN (HIGDON), **RANULF** (d. 1364), Benedictine monk and chronicler. famous as the author of the *Polychronicon*, a universal history, entered the monastery of St. Werburgh at Chester in 1299. The *Polychronicon* was written in Latin but translated into English by John de Trevisa in 1387 and again in the 15th century. It enjoyed very great popularity, and well over 100 manuscripts survive. Beginning with the creation and ending originally in 1327, the chronicle was continued in a later recension to 1352, and Higden's autograph manuscript is in the Huntington library, San Marino, Calif. The *Polychronicon* is of less value for English history than its numerous continuations, the best known of which is that of John of Malvern. It belongs rather to literature and throws light on the general historical, geographical and scientific culture of the age. It was printed by William Caxton (1482), by Wynkyn de Worde (1495) and Peter Treveris (1527). Higden also wrote a number of theological works, such as his *Speculum curatorum* (1340), some of which survive. It has been believed, but is unlikely, that he was the author or translator from French into English of the Chester mystery plays. He died at the abbey of St. Werburgh, Chester, on March 12. 1364.

See C. Babington and J. Lumby (eds.), *Polychronicon Ranulphi Higden*, 9 vol. (1865–86); V. H. Galbraith, "An Autograph MS of Ranulph Higden's *Polychronicon*," *Huntington Library Quarterly*, vol. xxiii (i) (1959). (V. H. G.)

HIGGINS, ALEXANDER PEARCE (1865–1935), British international lawyer remembered primarily as an expert in maritime international law, was born at R'0rcester on April 24, 1865. He was educated at Worcester Cathedral (King's) school and at Downing college. Cambridge, and was called to the bar in 1908. He taught international law for many years at Cambridge, at the London School of Economics and at the Royal Naval War and Staff colleges. He published his principal work, *The Hague Peace Conferences*, in 1909. containing the texts of the Hague conventions of 1899 and 1907, together with some kindred instruments and valuable detailed commentaries. During World War I his special knowledge enabled him to render great service as adviser in international law and prize law to the procurator-general and treasury solicitor. In 1920 he succeeded L. F. L. Oppenheim as Whewell professor of international law at Cambridge. Pearce Higgins was a member of the Permanent Court of Arbitration at The Hague (1930) and president of the Institut de Droit International (1929–31). He died on April 2, 1935. His published work includes contributions to basic textbooks on international and maritime law, as well as studies in international law and in history. (McN.)

HIGGINSON, THOMAS WENTWORTH STORROW (1823–1911), U.S. reformer, soldier and author, was born at Cambridge, Mass., on Dec. 22, 1823. He entered Harvard college at the age of 13 and graduated in 1841. He spent two years in teaching. thought for a time that he might become a poet, and then entered the Harvard divinity school, where he graduated in 1847.

Although still a bit uncertain as to his calling he was ordained in Sept 1847, married his cousin Mary Channing a few weeks later and accepted the pastorate of the Religious Society of Newburyport. During the next two years he set the pattern he was to follow for the remainder of his life. He preached a social gospel that was too liberal even for Unitarians. He organized an evening school for workers; wrote editorials for newspapers; ran for congress on the Free Soil ticket; and took such extreme positions on temperance, women's rights, labour and slavery that, as he said, he literally "preached himself out of his pulpit."

The loss of his pulpit intensified his reforming zeal. On the passage of the Fugitive Slave act in 1850, he joined the Boston Vigilance committee to aid escaping slaves, advocated breaking up the Union and denounced those who refused to use force against slavery. In May 1854 he took a leading part in the liberation of the fugitive slave Anthony Burns in Boston. It was Higginson who purchased the axes and helped break down the door of the courthouse. For his part in the affair, he was arrested but never brought to trial. Next he turned his efforts to sending settlers and supplies to Kansas. He visited the territory twice and supported John Brown both in Kansas and in the raid on Harpers Ferry. Later he sponsored a move to rescue by force Brown's men still held in prison.

With the outbreak of the Civil War in 1861 Higginson helped to raise and drill troops in his own community. In 1862 he resigned his commission as captain in a newly organized Massachusetts company to accept appointment as colonel of the first Negro regiment in the Union army.

After the war, Higginson spent his time writing and gained ready access to the *Atlantic, Scribner's, Harper's* and the *North American Review*. Many of his articles were later gathered into books. He wrote a *Young Folks' History* of *the United States* (1875), a *Larger History of the United States* (1885) and the lives of Margaret Fuller Ossoli, Henry Wadsworth Longfellow, John Greenleaf Whittier and Francis Higginson. first minister of the Massachusetts Bay Colony, for a popular biographical series of the day His only novel. *Malbone,* never won the recognition given his magazine articles. He died in Cambridge on May 9. 1911.

(AY. CN.)

HIGHAM FERRERS, an ancient market town and municipal borough in the Wellingborough parliamentary division of Northamptonshire, Eng , 15 mi. E N.E. of Northampton by road. Pop. (1961) 3,756. Area 3 sq.mi. It stands high above the river Nene. The fine church of St. Mary is mainly Early English and Decorated; close by stand the beautiful Perpendicular schoolhouse and the bedehouse, both founded by Archbishop Chichele (*q.v.*); in the town are remains of Chichele's college. The local industries are leather dressing and shoemaking.

Higham (Hecham, Heccam, Hegham Ferrers) was evidently a large village before the Domesday survey, when it was held by William Peverel of the king. It was granted in 1199 to William Ferrers, earl of Derby, who gave the first charter (confirmed 1251); after passing through various hands it went to Henry, earl of Lancaster; it subsequently formed part of the duchy of Lancaster and so remains. The castle, mentioned in 1322, no longer existed by 1540. A mayor was elected from about 1343; a town hall is mentioned in 1395. The borough, incorporated in 1556, returned one member until 1832.

HIGH COMMISSION, COURT OF. The Act of Supremacy (1534) recognized Henry VIII as "Supreme Head in earth of the Church of England" and assigned to the crown the power of ecclesiastical visitation. This was given practical effect in 1535 when Thomas Cromwell was appointed vice-gerent, invested with the plenitude of royal authority in ecclesiastical affairs and directed to delegate part of it from time to time to such persons as he thought fit. The first general commission to a number of men was issued by Edward VI in 1549. The royal powers were confirmed by the Elizabethan Act of Supremacy (1559), which declared the queen to be "Supreme Governor of this realm . . . as well in all spiritual or ecclesiastical things or causes as temporal" and authorized the crown to nominate by letters patent persons to exercise on its behalf "all manner of jurisdictions . . . touching . . . any spiritual or ecclesiastical jurisdiction . . . and to visit, reform, redress, order, correct and amend all . . . errors, heresies, schisms, abuses, offences, contempts and enormities whatsoever."

The device of an ecclesiastical commission was thus adopted in the first place as a means whereby the crown could effectively enforce the laws of the Reformation settlement and exercise control over the church. The existing archiepiscopal and subordinate church courts were inadequate for this purpose. The men in charge of them were often unreliable; their organization was incapable of dealing with the increased business consequent upon the Reformation; and their coercive powers were insufficient to ensure obedience to orders given, secularism breeding increasing disrespect for ecclesiastical censures. By the high commission the authority of the church was to be at once controlled and supplemented by that of the state.

Until 1565 the work performed by the commissioners was mainly visitatorial, and their authority was regarded as temporary. But the continued difficulties experienced in enforcing the settlement, the development of additional administrative functions by the commission itself and the increasing delegation to it of ecclesiastical or semiecclesiastical business from the privy council gave the commissioners a sufficiently permanent tenure to enable them to establish traditions and judicial forms which, in time, transformed a temporary device into a permanent, regularized prerogative court. These developments were reflected in the appearance of the term "high commission" by 1570 and the title of "court" about ten years later.

That these developments took place in the 1570s was due to the fact that during that decade the position of the established church became most critical in face of growing opposition by Romanists and Puritans alike. The crown was forced to adopt firmer measures to protect the settlement. The intrinsic authority of the bishops and their courts was still declining, and in consequence an increasing burden was thrust upon the commissioners. It was also found necessary in the early 1570s to set up local ecclesiastical commissions, offshoots of the parent body in London, to deal with particularly disordered parts of the country.

Composition and Jurisdiction.— The total membership of the commission varied between 24 in 1549 and 108 in 1633; but of these any three were normally empowered to act, provided one of them was "of the quorum" (which numbered 11 in 1549, 68 in 1633). The effective nucleus of the commission appears to have consisted of a group of canon lawyers, who were joined by bishops or other men of superior standing as the importance of the business or quality of the offenders before the court might determine. The commission (as its visitatorial duties demanded) originally sat anywhere in the province of Canterbury, but came later, as its form and procedure hardened, to sit only in London on certain fixed days and to keep the law terms. Its jurisdiction, best summarized in connection with the other ecclesiastical courts as concurrent, appellate and equitable, though vague, was by no means unlimited. It could assume jurisdiction only *in personam* in criminal matters (though here the interpretation was rather loose); and it could not initiate cases of party and party. In matters of discipline its procedure was normally based upon the administration of the oath ex officio; *i.e.,* an oath imposed by the judge in virtue of his office. .This device was borrowed from the procedure of the ordinary church courts, being naturally employed by canon lawyers on the commission as the form most familiar to them. On the other hand, the penalties inflicted were generally secular in character: fine and imprisonment. The commission did not employ torture or inflict the death penalty.

That the commission's appellate jurisdiction in cases of party and party was popular is evident from the numbers who applied to it even in its last years. As an instrument for the maintenance of ecclesiastical discipline it seems to have been generally successful except in cases where it was concerned to coerce those whose opposition to the church settlement was dictated by sincere religious conviction. Secular penalties were of no more avail in such circumstances than the excommunication of a despised church: rather, indeed, they served to strengthen the sects by

providing them with a martyrology.

Opposition and Suppression. — The opposition which eventually destroyed the commission derived principally from the Puritans, the common lawyers and the common-law judges. The Puritans resented the commission's enforcement of orders relating to the conduct of services which they regarded as idoiatrous; and they complained that the use of the ex officio oath compelled a man to convict himself. The common lawyers' opposition to the commission stemmed from the traditional hostility between the lay and ecclesiastical courts. Though in part actuated by jealousy and self-interest, by a desire to extend their jurisdiction and hence enlarge their income irom fees, they could also claim with some justification that the commission's activities bred jurisdictional confusion. Recusancy, for instance, was a secular as well as an ecclesiastical offense.

Under James I the common-law judges first attempted. by prohibitions and pronouncements, to limit the commission's activities; and then, encouraged by the support of the parliamentary opponents of the royal prerogative, they embarked upon a vigorous attack upon its jurisdiction and procedure in general. The Supremacy act of 1559 had purported merely to restore to the crown the "ancient jurisdictions" allegedly "usurped" by the bishop of Rome; and the crown claimed accordingly that its power to exercise ecclesiastical jurisdiction through commissioners rested on its own inherent, ancient rights, not on any authority specifically conferred by parliament. The common-law judges had accepted this point of view as late as 1591 (Cawdrey's case); but now, under the Stuarts, they began to insist that the commissioners' jurisdiction was based on statutory permission, not prerogative right, and to interpret the terms of the act of 1559 in an indefensibly narrow fashion. They took exception to the use of fine and imprisonment because these were not strictly ecclesiastical penalties; and they challenged the legality of the ex officio oath as being contrary to common-law practice.

As the constitutional struggle developed between the Stuart kings and their parliaments the legal opposition to the commission became merged into the general political conflict. Abortive bills on the subject of the commission were introduced in the parliaments of 1607 and 1609–10; and in 1610 a petition of the commons denounced the act of 1559 as "inconvenient and of dangerous extent."

In 1641, when Charles I had to give way to parliament, the clause of the act of 1559 that gave the crown power to exercise its supremacy through commissioners was repealed, the court was abolished and it was provided that no similar court should again be set up. The commissioners were accused of having, "to the great and insufferable wrong and oppression of the King's subjects, used to fine and imprison them, and to exercise other authority not belonging to ecclesiastical jurisdiction restored by that Act." At the Restoration, when the other ecclesiastical courts were revived, the prohibition upon the use of a high commission was retained. It was nevertheless re-established by James II in 1686, only to be condemned finally by the Bill of Rights in 1689 as "illegal and pernicious."

See R. G. Usher, *The Rise and Fall* of *the* ***High*** *Commission* (1913); W. S. Holdsworth, History of *English* ***Law,*** vol. i and vi, rev. ed. (1922–24). (F. D. PE.)

HIGH COURT OF JUSTICE, one of the two major divisions of the English supreme court of judicature (*q.v.*), the other being the court of appeal (*see* COURT OF APPEAL [BRITISH]), was created by the Judicature act, 1873. This measure, among other changes, abolished the historic courts with their separate jurisdictions, such as the courts of chancery, queen's (or king's) bench, common pleas, admiralty and so on, and substituted a high court of justice sitting in three divisions: the chancery division; the queen's (or king's) bench division; and the probate, divorce and admiralty division. Each division has certain classes of work assigned exclusively to it, but apart from these any division may deal with any matter and the remedies available in one division are available in another, so that, *e.g.,* the chancery division may award damages and the queen's bench grant an injunction. *See* COURT: *England;* JUDICIARY AND COURT OFFICERS: *English Judicial System.* (W. *T.* WS.)

HIGHER EDUCATION. During most of the 19th century higher education was understood as referring to the training provided in established colleges and universities; and this was essentially a nontechnical and nonprofessional liberal arts education. In the 20th century the term has come to be applied to a great variety of postsecondary institutions of learning, including not only universities and colleges, but also large numbers of professional schools, separate from the universities, which provide preparation in such fields as law, theology, music and art and, in addition, separately organized teacher-training schools, junior colleges (a peculiarly American institution) and various kinds of institutes of technology.

This article reviews the growth in curriculum offerings in the traditional institutions and the development of new institutions of higher education accompanying the increasing specialization of knowledge and of technology and the expanding number of students seeking higher education. For details on traditional educational institutions *see* COLLEGE; UNIVERSITIES; UNIVERSITY COLLEGES; LAND-GRANT COLLEGES AND UNIVERSITIES. *See* also EDUCATION, HISTORY OF. For institutions 01 higher education in particular countries, *see* education sections of separate articles on those countries.

EXPANSION OF THE CURRICULUM

Historical Background. — In spite of the fact that the 19th century witnessed a steady expansion of scientific knowledge, the curriculum of the established higher educational institutions was virtually untouched. Higher education followed a single dimension. This was the century of Faraday, Von Helmholtz, Joule, Darwin, Lister, Wundt, Pasteur and Koch. Yet, until the end of the century, most of the significant research was done outside the walls of higher educational institutions. In Great Britain it was the Royal society and other such societies that fostered advanced studies and encouraged research. In 1828 Yale college issued what was, in effect, a manifesto, proclaiming that a single prescribed course of study, nontechnical and nonprofessional, was the only proper course for a higher educational institution. When, in 1847, Abbott La rence notified the president and fellows of Harvard college that he was prepared to give $50,000 for the support of scientific education, the college organized a separate school, the Lawrence scientific school. The basic curriculum of Harvard college remained intact. Cardinal Newman, lecturing in Dublin on "The Idea of a University" in 1852, stated that the task of the university was to prepare young men "to fill any post with credit, and to master any subject with facility." Higher education was for the gentleman.

The German University. — While Newman's words epitomized the views held in most colleges and universities in the United States, Great Britain and continental Europe, the end of the 19th century saw the beginnings of the expansion of the entire enterprise. Earlier, in 1807, J. G. Fichte (*q.v.*) drew up a plan for the proposed new university of Berlin, of which he became rector (1810–12) and which mas dedicated to the scientific approach to knowledge. By the third quarter of the 19th century the influence of German *Lernfreiheit* (freedom of the student to choose his own program) and *Lehrfreiheit* (freedom of the professor to develop the subject and to engage in research) was being felt throughout the academic world. When Charles W. Eliot was named president of Harvard in 1869, he advocated greater flexibility in the college curriculum. By 1900 Eliot's free elective system had been widely adopted by U.S. colleges and universities.

The German conviction that investigation and research were the primary functions and responsibilities of institutions of higher education was embodied in the new Johns Hopkins university, founded in 1876, the first U.S. institution of higher education organized along modern university lines. It was followed by Clark university. Worcester, Mass., in 1887 and The University of Chicago in 1891. The polytechnic (*q.v.*) idea caught on in Great Britain in the 1890s. The first civic universities in England came into existence at the turn of the century — Birmingham was chartered March 24, 1900. Higher education was expanding.

20th-Century Expansions. — In the 20th century the unfolding scientific revolution, the growth of a technological society, the expansion of the cities, the changes in the intellectual and social climate brought new demands upon the formal educational program. The whole world of organized knowledge exploded as new areas of study emerged and old areas expanded beyond recognition. Auguste Comte (1798–1857) is called the father of the "social sciences" — sociology, anthropology, economics and political science — but it is the 20th century that has seen their development. Psychology as a field of study is essentially a 20th-century phenomenon. The pioneers, Wilhelm Wundt (1832–1920), William James (1842–1910), G. Stanley Hall (1846–1924), Sigmund Freud (1856–1939), bridged the 19th and 20th centuries. The physical sciences began the exploration of the atom, and the biological sciences expanded in new directions.

At the beginning of the second half of the 20th century higher educational institutions still accepted as their proper role the transmission of the cultural heritage; but they also stood at the forefront of research — much of the original work on the use of atomic energy was done in the laboratories of the universities of Chicago and California. The curriculum had expanded. and at some of the large state universities in the United States it was possible to study everything from atomic physics to television repairing and driver training.

Teacher Training. — This expansion of the functions of institutions of higher education is illustrated by the developments in teacher training and technical education in the United States and Great Britain. During the first part of the 20th century US. teacher training was a limited type of postsecondary training carried on in normal schools. It was not until the second and third decades that there was a move toward collegiate-level programs. By the 1960s, however, a national program of accreditation had been set up and many of the normal schools had extended their offerings to include functions other than teacher training — though this remained their primary role — and had dropped the word "normal" or "teachers" from their titles. (See also TEACHERS, TRAINING OF.)

The United States had established a system of tax-supported secondary education much earlier than had Great Britain, and it was only after the British Education act of 1944 completely revised secondary schooling in England and Wales that British teacher training was thoroughly reorganized. Prior to the act of 1944 teacher training was carried on in schools having little status and operating under great diversity of form and sponsorship. By 1949, however, the responsibility for training teachers, as had been proposed in the McNair report of 1943, had been taken over by 16 area training organizations, for 13 of nhich the universities and university colleges had accepted administrative responsibility.

Thus, by the middle of the 20th century. the training of elementary- and secondary-school teachers, training for specific vocations, had come to be considered an integral part of higher education in Great Britain and the United States Debate continued about the nature of the training, the courses to be included and the locus of administrative responsibility for the programs in the university, but teacher training had become "higher education."

Technical Education. — Technical education had not proceeded as far in gaining status as had teacher training, but it too was more frequently being included under the general category of "higher" education. As an applied science, engineering in all of its branches had gained acceptance into the university curriculum during the first part of the 20th century, largely because of the strong emphasis engineering programs placed upon theory and general principles. The expanding technology, however demanded for every graduate engineer a score of persons with less training in theory but with basic insights into technical applications In the United States tno- and three-year technical institutes experienced a spectacular growth in enrollment following World War II. During the 1950s some of these technical programs found their way into the curriculums of established higher educational institutions, and regional accrediting agencies adopted new policies for the recognition of qualified, separately organized technical institutes as higher educational institutions.

In Great Britain the universities strongly opposed the offering of degrees by technical colleges, a prerogative the technical colleges sought with equal fervour. The Percy committee in 1945 recommended the establishment of regional advisory councils on which the universities and technical colleges would be represented with industrial and local authorities. In 1948 the ministry of education established a national advisory council on education for industry and commerce to co-ordinate the work of the regional councils and advise on matters of national policy. Various national technical schools were established, such as the National College of Rubber Technology (Northern Polytechnic, London, 1948). Technical colleges strengthened their programs and increased their emphasis on research.

Advanced programs in separately organized art and music schools also gained status, and in the United States many were classified by the office of education as higher educational institutions. (A. O. P.)

Points of View. — Though welcomed by many, and accepted by most. the horizontal expansion of higher education was not without opponents. Dissenters insisted that, whatever else they might be, courses in beauty culture, manipulation of the adding machine and preparation of an evening meal were not valid parts of higher education. They damned the uncontrolled impetus toward specialized fragmentation and the introduction of triviality into the college curriculum and called for a re-examination and reorientation of educational theory. Advanced training in academic areas and preparation for "successful" careers, these people asserted. are not proper objectives of undergraduate college curriculums

From the debate which followed, a debate largely forced on the educational world by the articulate voices of the dissenters. emerged the concept of general education. As used in its most common currency, the term was understood to embrace the broad views of those who sought to preserve certain common elements of liberal education in the college curriculum and to restore the unity of purpose that had characterized the best colleges of the 18th and 19th centuries. Despite a number of specific successes, the supporters of general education would be the last to assert the victory of their position and many of them would, indeed, insist that the situation may have become worse than when the debate began; that, like a large cafeteria, the college program seems designed to offer the largest number of students the widest variety of insubstantial snacks to be eaten with the least amount of effort.

Most hopeful — and. perhaps. most enduring — of the many experiments sponsored by the supporters of general education were various efforts to plan education around a standardized program of reading in what came generally to be called Great Books The idea that true education begins best with the reading of great works by great minds, rather than in the analysis of what later textbook authors have written about those works, was not new. It may have been implicit in the Bibliotheca *curiosa,* a formal eclectic reading list prepared by Johann Hallervord of Königsberg in 1676, or in the reading-discussion program of Benjamin Franklin's Junto association of the 18th century, in Sir John Lubbock's list of the *Hundred* Best Books (1891) or in any of the many bound home-library collections of "classics" published throughout the late 19th and early 20th centuries

In 1916 John Erskine at Columbia university made what is believed to have been the first attempt to persuade a major U.S. college to offer a credit course based on the reading and discussion of great books. He was not to succeed in his plan until the end of World War I, when he first offered his general honours course in great writings from Homer to William James. Fifteen students were enrolled in the initial course; they read a book a week and met once a week in the evening for a two- or three-hour discussion of the material covered Unlike later offerings of the same type. the Erskine course did not constitute the entire curriculum followed by the students enrolled in it, and the 53 works on the reading list were drawn entirely from the humanities. The goal of Erskine and his assistant instructor, Mark Van Doren, was relatively modest — to repair the failure of contemporary scholarship to reward effort with "either pleasure or wisdom."

The general honours course continued in existence at Columbia

until 1932, when it was replaced by a colloquium, or seminar, limited to selected members of the junior and senior classes.

Early in the 1930s Robert M. Hutchins, then president of The University of Chicago, with Mortimer Adler, who had been an Erskine student in the first year of the course at Columbia. offered a great books class for 25–30 selected freshmen at the university. Convinced that the great books approach offered a sound corrective to the educational trends of his day, trends which "confused science with information, ideas with facts and knowledge with miscellaneous data," and determined that the primary obligation of the college student was "to think," Hutchins in 1936 established at Chicago a committee on the liberal arts. The committee, whose members included Stringfellow Barr and Scott Buchanan, was directed to study the whole concept of a liberal education. Hutchins in 1937 dropped high school credits as a basis for admission to the college and instituted a four-year liberal arts program starting in what would have been the junior year of high school. In 1942 the university decided to award the bachelor's degree for the program. Three years earlier. in 1939, the university college had begun a great books curriculum, which by 1944 had become firmly established.

Meanwhile, in 1937, St. John's college in Annapolis, Md., reinstituted the liberal arts program that it had earlier abandoned. Under the direction of Barr as president and Buchanan as dean, it became the first U.S. college to offer a full four-year liberal arts program consisting of the study of great books. Like The University of Chicago list before it. the St. John's course was based on a modified version of the Erskine reading list with science as a notable addition. Seventy-five authors were represented on the list which formed the nucleus of a program consisting of four years of seminars on the books, one lecture each week on the great ideas, special tutorials in Greek. Latin, French, German and mathematics, and laboratory work in science. The course has remained without substantial revision.

Significantly, the great books program has perhaps been more influential in the field of adult, nonformal education than it has in academic collegiate studies. In New York. under the influence of the Columbia program, Adler. Buchanan and Everett Dean Martin in 1927 began a series of adult courses with the support of the Carnegie Corporation of New York. Similar courses had been offered two years earlier by the New York Public library and the Peoples' institute and were to be offered later by Alexander Meiklejohn's School of Social Studies in San Francisco, Calif. (1933); the Chicago Public library (1945) and the District of Columbia Public library (1945) ; and by adult education programs in Annapolis, Washington. D.C.. and Baltimore, Md., beginning in 1938 and 1939. In 1945–46 The University of Chicago accepted an incitation to conduct what is believed to have been the first course in classical readings for industrial employees in the United States. and in the same period offered a similar program for supervisory personnel of the Marshall-Field department store in Chicago.

By 1947 the movement had resulted in the creation of the Great Books foundation to promote "reading and discussion of Great Books as a program of free, universal adult liberal education." The foundation assisted in the organization of groups, the training of group leaders and the publication of editions of the works to be read. Discussion groups were conducted in the manner of Platonic dialogues. Growth of the movement was spectacular. In 1948 there were 36.000 enrollees in groups in 222 cities throughout the United States; in 1949 the number had grown to 60,000 and by the beginning of the 1960s, organized groups were active in well over 1.000 communities.

Perhaps the most spectacular manifestation of the movement was recorded in 1952 when, after seven years of preparation, a 54-volume set of the "Great Books of the Western World" was published by Encyclopædia Rritannica. Inc , under the direction of William Benton and the editorship of Hutchins. Included in the 54 volumes were 32.000 pages and 25.000.000 words comprising 443 full works by 74 authors. A feature of the set was the *Syntopicon,* edited by Adler, which indexed the entire set in relation to 102 great ideas and 3,000 subordinate ones. Within a decade, the set had become, despite the early skepticism of many, a publishing success which attested to the vigour of the great books idea as a method of liberal education. (W. E. Pr.)

GROWTH IN ENROLLMENTS

Not only was the curriculum of higher education expanding, but enrollments also increased. Follo ing World War II the "G.I. Bill of Rights" (public law 346, 78th congress) in the United States and the Further Education and Training scheme in Great Britain released a flood of students upon the educational institutions in both countries. The effect was not only to fill the gaps created by the war years but also to give new impetus to the demand for higher education on the part of persons who othernise would not have considered applying for work beyond the secondary-school level. What happened can be illustrated by the experience in the United States. In 1946, when higher education first felt the full impact of World War II veterans, the enrollment climbed to 2,078,000. The highest enrollment ever before reached was in 1939, when 1,365.000 students were registered. By the late 1950s enrollments exceeded 3,000 000 In 1930 just over 21% of U.S. youth aged 18 to 21 attended higher educational institutions. By the second half of the 20th century the ratio between persons aged 18 to 21 years and persons enrolled in higher educational institutions had climbed beyond 32%. Similar advances were recorded in Great Britain.

Calibre **of** Students. — In the midst of these exploding enrollments, questions were raised about the intellectual calibre of the young people entering colleges. Some persons were convinced that opening the doors to more and more students could only result in the progressive deterioration of higher education. On the other hand. the United States president's commission on higher education in 1946 argued that only a portion of those qualified for higher education were actually enrolled. The commission said that 49% of the population had the mental ability to complete 14 years of schooling with a curriculum of general and vocational studies and that 32% had the ability to complete advanced liberal or specialized professional education.

In Great Britain the Barlow committee earlier concluded, on the basis of an analysis of test experiments, that only about one in five of the boys and girls with intelligence equal to that of the best half of the university students actually reached the university. The committee stated that it would be possible to double enrollments in British higher educational institutions while still raising standards. In both the U S. and Great Britain the respective reports met with mixed reactions They were as roundly condemned as they were loudly applauded, but conclusive evidence either substantiating or repudiating their conclusions was lacking.

Faculties. — Increased enrollments were accompanied by problems in staffing and financing Among U S colleges and universities one of the most persistent concerns was how to obtain and hold competent teachers in the numbers needed to serve the steadily expanding enrollment A study conducted by the research division of the National Education association showed that over a four-year span holders of the doctor's degree comprised a steadily decreasing per cent of the successive groups of newly employed full-time college teachers. The decrease appeared to be only in small part due to the short supply of qualified personnel. To fill the gaps institutions were turning to new instructional methods and. among other things, some introduced closed-circuit television in various ways.

Among British institutions, the expanding enrollments also brought significant changes. The traditional residential college pattern was disrupted by the tremendous growth in enrollments in the nonresidential "red-brick" or civic universities.

Finance. — The financing of higher education in the United States represents a complex balance of eight different sources of income: student fees. government grants (federal. state. local), endowment earnings. private gifts. sales and services, auxiliary enterprises scholarships and a general catchall category labeled "other." The proportion of income from each of these sources varies nith the institution and with the type of institution. The most striking variation is between public and private institutions.

Private institutions in the second half of the 20th century derived over 30% of total income from student fees, while public institutions received about 10% from the same source. (In the United States "public" institutions are tax-supported institutions.) Private institutions received about 15%–17% of their total income from government sources, while public institutions received over 60% of their income from these sources.

Private colleges and universities earlier depended heavily upon endowment income. In the 1960s endowment funds produced less than 10% of the income. These institutions became more dependent upon student fees and private gifts. The most significant development in the financing of private higher education was the growth in contributions from industry. In 1960 business and industry gave an estimated $100.000.000 to higher education in the United States. This was an increase of $60.000.000 over 1950. In large part the funds went to private institutions. Public higher educational institutions. enrolling almost 60% of. the resident students, depended for their major income upon tax monies from state governments. State governments contributed more than 40% of the total income for these institutions. Education had become one of the major items in state budgets.

In Great Britain. except for the University of London, none of the institutions had an endowment comparable with Oxford or Cambridge; but even those relatively wealthy universities were becoming more and more dependent upon government grants. Endowment was unable to carry the burdens imposed by postwar expansion, rising costs and new facilities. In the 1950s government grants constituted 70% of the total income for British higher educational institutions. See also ADULT EDUCATION; TECHNICAL EDUCATION; UNIVERSITY EXTENSION.

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HIGH-FIDELITY SOUND SYSTEMS. The reproduction of music in the home has been of sufficient importance that two large industries are built upon it—recording and radio broadcasting. With the popularization of alternating-current–operated amplifiers in the late 1920s, it became possible to provide enough power to approximate the acoustic volume of the original performance with loud-speakers, which have been improved continuously ever since. High fidelity became a hobby of thousands of music lovers. and many developments in the art appeared during the succeeding 30 years. The introduction of the long-playing phonograph record in 1948 made it possible to widen the over-all frequency range of recorded music so that a reasonable facsimile of the original could finally be attained. Improvements in broadcasting equipment and the introduction of frequency-modulation (FM) broadcasting provided still higher quality, and by the early 1950s the general public began to develop an interest in high fidelity.

The term high fidelity, in its original meaning, referred to an assembly of equipment—more often than not built by the hobbyist himself—designed for reproduction of music with as great a faithfulness to the original as possible. In general, a high-fidelity or "hi-fi" system contains a source of music, an amplifier and a loud-speaker. The source may be any means for reproducing phonograph records, a radio tuner or a tape recorder; the sound signals from a television set may also be used. The signals produced by any of these devices are fed into the amplifier where they are increased in strength so that they have enough energy to actuate one or more loud-speakers, a combination of several mounted in an enclosure commonly being known as a loud-speaker system. Early systems usually consisted of loud-speakers originally intended for use in motion-picture theatres, since speakers of good quality were rarely used in conventional radio receivers. Amplifiers designed for public-address systems were adapted for home use, but in many ways early systems were makeshift. Sufficient demand was recognized by 1950 to warrant the production of amplifiers, record-playing equipment and high-quality loud-speakers intended for home use. Within five years the industry had some zoo manufacturers engaged in building components.

With no industry standards of quality and no restrictions on what could be called high fidelity, it was not long before the term was applied to any and all equipment that would reproduce a sound. While the original concept of high fidelity referred exclusively to an assembly of individual components—each being produced by a specialist in that particular equipment—by 1954 many complete systems, already housed in a cabinet by the manufacturer, appeared on the market. Economies of manufacture resulted in more impressive equipment at lower cost, but complete packaged hi-fi systems seldom compared in reproduction quality with those assembled from components, even though the latter might have been assembled by a dealer and sold as a complete unit. In general, sound quality is better when the loud-speaker is in a separate cabinet, particularly if a record player or turntable is part of the system.

Sound Sources.—The source of sound for the usual hi-fi system is the phonograph record, although many listeners find adequate programing from radio broadcasts. Record-playing equipment chosen for such a system is most often of highest quality, especially in the case of the serious music lover, who is likely to use a transcription turntable, a less-expensive. modification of the extremely fine machines used in broadcasting stations and recording studios. This type of turntable produces a minimum of flutter and wow, and the lowest possible rumble. "Wow" is the name given to low-frequency variation in rotational speed of the record which causes a sound well described by the name. "Flutter" refers to speed variations of higher frequency, and while not so readily detected by the untrained ear, it is usually manifested by a roughness in violin and soprano voice tones. "Rumble" is a continuous low frequency which is fairly constant and which interferes with good reproduction of bass tones; intentional reduction of low-frequency response of the amplifier and loud-speaker equipment reduces the effect of rumble but sacrifices bass.

The phonograph pickup is the device which converts the mechanical vibrations caused by variations in the record groove into an electrical signal. Two general types are in use, with the magnetic group—including variable-reluctance, moving-coil and moving-magnet constructions—favoured for best quality. Piezoelectric types. which include crystal and ceramic pickups, are less expensive and require less critical amplifier circuits, hut their output is not as uniform for all frequencies nor do they cover as wide a frequency range. Output signals from the magnetic types range from 1 or 2 mv. up to about 50 mv. for average recorded volume; ceramic and crystal types have outputs in the vicinity of 0.j v. Stereophonic pickups of either type are actuated simultaneously by variations in both walls of the record groove and provide the two separate signals necessary for stereophonic reproduction. (See also PHONOGRAPH.)

Another source of program material is the tape recorder, which came into common use in the early 1950s. These machines record on narrow bands of thin plastic upon which a coating of magnetic oxide has been deposited. The recording process is simple and necessitates little skill. reproduction quality being dependent almost entirely on the quality of the recorder itself. Program material may be recorded from broadcasts or from live performances. and prerecorded tapes have been introduced that offer a wide selection of music. (See TAPE RECORDING, MAGNETIC.)

For reception of radio broadcasts, the tuner is employed. The

hi-fi tuner is simply a refined version of a radio receiver, but without audio amplifier or loud-speaker. Best reproduction comes from frequency-modulation stations, but since the range of FM signals is limited to about 50 mi. for reliable reception, amplitude-modulated (AM) stations can provide a usable signal for greater distances. The usual tuner for hi-fi use combines both AM and FM in the same unit, with circuitry often being arranged to permit reception of both types of signal at the same time for stereophonic reproduction. Frequency response of FM tuners meets highest broadcasting standards. and reception is almost entirely free from atmospheric or man-made static or noise.

FM stations are inherently capable of transmitting two or more programs over one channel at the same time by a process known as multiplexing, and thus can transmit both portions of a stereo program at once. FM stations also can provide additional program services by multiplex without the knowledge of listeners who are receiving the main channel only; such transmissions are usually subscribed for by hotels, restaurants and the like for background music entertainment.

The sound portion of TV programs is often fed into a high-fidelity system for improved reproduction. In most TV sets, the amplifier and speaker offer minimal sound quality, although the transmitted sound is almost equal to the best of FM quality. In built-in hi-fi systems, careful placement of TV picture tube and loud-speaker can give increased realism and greater enjoyment.

Amplifiers. — Since the output signals from phonograph pick-ups may be as low as 0.000001 v. during quiet passages, amplifiers are required to build these minute signals up to the volt or so necessary to actuate a loud-speaker. Controls are necessary to adjust frequency response to suit the listener's desires, the acoustic environment in the home and deficiencies in equipment or recordings. Phonograph records are not cut with a uniform frequency response because at low frequencies a loud signal would require a aide groove spacing which would reduce playing time. Noise and "needle scratch" can be reduced by accenting the high frequencies during recording and attenuating them during playback. Beginning at 500 cycles per second (c.p.s.), about one octave above middle C, the recording level is reduced progressively as frequency is lowered, decreasing in strength by one-half for each octave. High frequencies are increased or pre-emphasized beginning at 2,120 c.p.s., doubling in strength with each octave. To play back properly, a complementary correction must be introduced in the amplifier so that the resultant output is uniform over the entire frequency range. The frequency at which the lows begin to be reduced is known as the turnover, and was standardized in 1954 by the Record Industry Association of America (R.I.A.A.) at 500 c.p.s. for long-playing records. Prior to that time various other turnover points were used, resulting in lack of uniformity of records and necessitating greater complication in the amplifier. Similarly, the amount of pre-emphasis was standardized at 13.75 decibels (db.) at 10,000 c.p.s., which requires the complementary "roll-off" in the amplifier. For records made after 1954, only the one compensating characteristic, known as the R.I.A.A. curve, is required, but for records made prior to that date a number of compensations must be provided in the amplifier. These compensations, along nith bass and treble tone controls, volume and loudness controls and source selector switches, form the preamplifier section, which may or may not be a separate unit. Tone controls must be arranged to provide boosts and attenuations of approximately 1 j db. at both the bass and treble ends of the sound spectrum, with the reference frequencies usually specified as 50 c.p.s. in the bass and 10,000 c.p.s. in the treble. Loudness controls (sometimes designated "contour") are intended to compensate for reduced sensitivity of the human ear to low tones at volumes lower than the original performance. As the loudness control is turned so as to reduce volume, it reduces middle and high frequencies more rapidly than it reduces lows, giving the effect of increasing bass. Preamplifiers for stereophonic reproduction are equipped with two complete sets of controls, usually arranged so that one knob will control the same function in both amplifiers simultaneously.

The preamplifier may be combined with the basic or power amplifier, which furnishes sufficient electrical energy to drive the loud-speaker to room volume, although separate units for both give greater flexibility in use as well as in physical placement. When each component of a system is a separate unit, improvements in any one do not make the entire system obsolete, since the outdated'unit may be replaced independently of the remainder of the equipment.

Amplifiers for home use should be capable of furnishing at least 10 w. of power to the speaker. Two separate amplifiers are required for stereophonic reproduction, and each should be rated at not less than 10 w. Distortion in high-fidelity amplifiers should not exceed 2% at rated output, and many amplifiers are even better. Certain types of loud-speakers are of low efficiency and consequently require 30 w. of power or more to perform satisfactorily, and it is not unusual for home systems to employ 60-, 70- or 80-w. amplifiers. Because of their greater physical size, it is not usual for these high-power amplifiers to be built on the same chassis with the preamplifiers. Lower-powered amplifiers are usually combined with the preamplifier sections, and in many instances with a radio tuner, making a complete system in one unit. (*See* also AMPLIFIER, ELECTRONIC.)

Loud-speakers and Speaker Systems. — For use in the home, loud-speakers must be housed in cabinets which combine proper acoustic design with aesthetically compatible appearance. By the late 1930s, the dynamic or moving-coil loud-speaker was established as the most efficient form of reproducer, and more powerful magnets and design improvements subsequently brought it to a high degree of performance. The typical high-fidelity loud-speaker is basically a modification of heavy-duty theatre types, and different sizes — each intended for optimum performance over a limited range of frequencies — are often combined into a loud-speaker system. The larger models of direct-radiator cone speakers are generally employed for low frequencies because of the need to move large volumes of air for good performance. Middle frequencies may be reproduced well by eight-inch cones, but some designers prefer small driver units coupled to horns for the intermediate range. Still smaller cones or horn-type loud-speakers are preferred for the very high frequencies. Reasonably uniform sound pressures may be created by such complete systems from as low as 25 or 30 c.p s. up to about 18,000 c p.s.

Electrostatic loud-speakers met with some acceptance, particularly for handling the upper frequency range, and some even were offered as "full-range" models. Most types have exceptionally good tone quality, but for acceptable reproduction down to 50 c.p.s. or below, the electrostatic speaker must be made excessively large, usually with an area of at least 12 sq.ft. Smaller units designed especially for high frequencies were favoured by some listeners, but not universally.

The performance of a loud-speaker depends more upon the enclosure than upon the mechanism itself, and a aide variety of enclosure designs appeared. each with its own claims to superior performance. Since all loud-speakers are presumed to possess the best sound-reproducing characteristics their designers can build into them, and since all do not sound alike by any means, the potential buyer should listen to the products of several reputable manufacturers and then choose the one that sounds best to him. (*See* also LOUD-SPEAKER)

Public-Address Systems. — Sound coverage of large groups of people comprises two classifications: public-address systems, in which the principal requirement is to provide intelligible speech over large areas, usually outdoors; and sound reinforcement systems. which must reproduce both speech and music with sufficient faithfulness that the sound system is unobtrusive. The latter are generally employed indoors, and aim for greatest realism. Equipment differs considerably between the two types, and the acoustic problems are entirely dissimilar.

For large outdoor gatherings. directional horns are usually employed to concentrate the sound over the occupied areas, thus utilizing the available power most efficiently. Since low frequencies contribute little to intelligibility of speech, response is decreased below about 300 c.p.s., and the upper limit is around 5,000 c.p.s. This permits the use of sturdy driver units and horns of reasonable

sizes.

These units, used with directional horns, have high efficiencies—of the order of 40%–50%—and about 2 w. of electrical power will be required for each 1,000 sq.ft. of floor or seating area for a suitable sound level of 20 dynes per square centimetre, uhich is 100 db. above the threshold of audibility. Reflections from adjacent structures, such as buildings, grandstands and high fences, may reduce the required power, but such reflections may result in echoes which decrease rather than increase intelligibility, and their effect must be considered carefully. Amplifiers must be duplicated sufficiently so that failure of any one will not put the entire system out of commission, and output lines should feed the loud-speakers alternately so that partial coverage will be possible even in the event of some equipment failure.

Because of the high powers required, loud-speaker lines should be fed from a 70.7-ohm distribution system to reduce losses in the wiring, rather than at the lower impedances of the speaker units. This also permits ease of adjustment of the power consumed by each speaker to equalize sound distribution over the affected area. Switching of loud-speakers and sound sources and control of volume should be concentrated at one point so that a single operator can control the system.

Sound reinforcement systems for indoor use require less acoustic power because of reflections from walls and ceiling, but since wide-range loud-speakers are less efficient than directional horn units. a minimum of 50 w. should be provided for seating capacities up to 500, with an additional 50 w. being necessary for each additional 500 seats. The entire system must be capable of a wide frequency range for high-fidelity reproduction of music. It is important that the operator be stationed not in a separate control studio but uhere he can hear the sound in the auditorium if he is to maintain levels that are not too loud for realism, yet still adequate to override audience noises.

Theatrical performances are best reinforced by groups of loud-speakers at the sides and above the proscenium, but in many other applications the use of a "low-level" system which employs numerous small speakers at low volume is more satisfactory. Acoustic treatment to avoid undesirable echoes or reflections is likely to be required in most auditoriums, and the use of nonparallel surfaces often simplifies the sound reinforcement problem. See also ACOUSTICS OF BUILDINGS.

See J. H. Newitt, *High Fidelity Techniques* (1953); H. Pender and K. McIlwain, *Electrical Engineers' Handbook*, vol. 2 (1950)

(C. G. McP.)

HIGH-FREQUENCY HEATING is that form of industrial heating which derives its energy source from an alternating electric field. The field may be magnetic. as in induction heating. or electric, as in dielectric heating. In both cases, the energy transfer as heat into the material being processed increases with the frequency of the alternating polarity. Therefore, frequencies greater than those normally encountered in electrical energy supplies are generally used. These heating methods are sometimes misleadingly referred to as "r-f" (radio-frequency) heating or "electronic" heating.

Induction heating is applicable to materials that are nominally electrical conductors, usually metals. The required magnetic field is produced by circulating high-frequency current through a work coil, or inductor, that acts as the primary winding of a simple transformer in which the work to be heated may be thought of as a single-turn secondary or susceptor. By shaping the coil properly, the heat can be localized or spread throughout the work as required, and heat distribution patterns can be obtained which are not possible using conventional forms of heating. The work coil may consist of a single turn or of many turns, depending upon the desired heat pattern.

Appreciable heat losses occur in the work coil from the relatively high currents and the high effective resistance due to the increased frequency. Because of these losses, the work coil is generally water-cooled.

Induction heating has a number of salient features. For example, it is possible to localize the heat at the surface of the work, resulting in surface hardening. such as is required for bearings. This phenomenon becomes more pronounced at higher frequencies.

With induction heating it also is practical to localize the heat longitudinally on the work within the confines of the work coil. Many desirable heat-treating and metal-joining applications are made possible by this feature.

No electrical connections are made to the work to accomplish the heating. and the surrounding atmosphere remains cool. Induction heating has no temperature limitations, since the heat energy is generated within the work itself, and as long as the energy input is in excess of the heat losses the work temperature will increase. With proper thermal insulation, extremely high temperatures can be attained, an especially important factor in the metallurgy of the refractory metals. In addition, heat energy can be introduced into the work at extremely rapid rates. many times those possible by conventional means.

Combination of one or more of these features makes induction heating a widely accepted metal-working tool. It is used for metal melting and refining. sintering, surface hardening, annealing, soldering, brazing. welding, and in vacuum furnace operations. In broad terms, induction heating finds application in practically any metal-working process requiring heat. It has been utilized in the processing of nuclear fuels and components, and also has been used in specialized heating applications for materials that are electrically conducting though nonmetallic; ionized solutions, glass at elevated temperature and molten salts are examples.

Three types of frequency conversion equipment are used as energy sources for induction heating. The motor-generator set is the most common. and standard units of this type supply frequencies of 960, 1.920, 3,000 and 9,600 cycles per second (c.p.s.) at power ratings of 7.5 to 1.500 kw. Since the power factor of the work coil is very low, large banks of capacitors are used to bring the load circuit power factor to unity or slightly leading, thus permitting optimum utilization of the generator.

Spark-gap convertors are also used for induction heating, employing both the mercury-vapour gap and the air gap principle. These units are inherently of low output, not exceeding 40 kw., and their frequency is limited to the 40 kc. to 300 kc. range. Vacuum-tube oscillators are employed where the higher frequencies at higher output power ratings are desired, and equipment of this type is available at frequencies of 300 kc. and higher at power outputs of 200 kw. or greater in single units.

The choice of frequency in induction heating depends upon the particular application. In many cases, it is not critical, and any frequency may suffice. The degree to uhich the induced current, and in turn the heat losses. penetrate the work is an inverse function of the frequency. Therefore. for deep-heating applications, such as forging, melting, brazing and through-hardening, the lower frequency range of 1,000 to 10,000 c.p.s. finds application. For case hardening, or any other surface heating application, the higher frequencies of 10,000 to 500,000 c.p.s. are used. Diameter of the work being heated also affects the choice of frequency, since the smaller diameters require higher frequencies for a given rate of energy transfer. As a rule. it can be said that the range of frequencies for induction heating is from 1,000 to 500,000 c.p.s., with very few applications requiring higher frequencies. Large melting installations and low-temperature heating of large masses employ 60-cycle energy for induction heating, and the principles of operation are the same as those which apply to high-frequency induction heating.

The induction heating effect also is dependent upon the magnetic properties of the material being heated. and in general magnetic materials heat more readily than nonmagnetic. However, all magnetic materials lose their magnetic properties at the Curie point (1,330° F. for iron). Since most metallurgical operations on steel require temperatures in excess of this value, the problems of heating must be considered as those of nonmagnetic materials. Since induction heating can be considered as resistance heating, the resistivity of the material directly affects its reaction to the induction-heating field. Hence, good electrical conductors, such as copper, silver and aluminum, heat less readily than poorer conductors such as nickel, iron, steel and the refractory metals.

Dielectric heating is the counterpart in the field of industrial

heating of electrical nonconductors to induction heating in the metal-working field. Materials that are poor electrical conductors because of their molecular behaviour are also poor thermal conductors, and when they are heated by conventional means the transfer of heat through the surface to the inner sections of the mass is difficult and time-consuming. Since a large proportion of these materials are subject to damage at elevated temperatures, the rate of heating conventionally is sloaed considerably by the damage temperature. which cannot be exceeded.

Dielectric heating is achieved by placing the material to be processed in the influence of a high-frequency electric field It is a voltage phenomenon, whereas induction heating is a current phenomenon. but it is also directly affected by the frequency of the alternating field. The electrodes which produce the heating field are. in industrial practice, flat plates separated so that the work can be placed between them. Since one side of the output circuit can be operated at ground potential. the electrode assembly reduces itself to a single high-voltage electrode. suspended on electrical insulators above the grounded platen of the work-handling equipment. Other electrode configurations are employed, such as cylindrical, finger and cuff shapes.

If a mass of material relatively uniform and homogeneous in cross section is placed in a high-frequency electric field, each unit mass of that material absorbs energy. The rate of energy absorption is proportional to (1) the square of the voltage gradient across the unit mass; (2) the frequency of the alternating field; (3) the dielectric constant of the material at the operating frequency and (4) the power factor of the material at the operating frequency. The latter two factors are often combined and their product referred to as the loss factor of the material. Consequently, for maximum heating rate, the frequency and voltage should be as high as can be practically attained. In general, dielectric-heating electrodes are energized at potentials of the order of 5,000 to 15,000 v.. and the frequency ranges from 5 to 50 mc. For many materials. the specific frequency is relatively unimportant, and effective heating can be accomplished anywhere within the above limits. Other materials show radical change in their loss factor at different frequencies, and the frequency for such materials must be chosen to give the maximum loss factor.

Since dielectric heating is a voltage phenomenon, the currents involved in the electrode circuit are relatively small and no water cooling is required. On the other hand, the high voltages encountered impose a severe electrical insulation problem.

Dielectric heating finds application in practically all fields where heat must be introduced uniformly throughout electrically nonconducting materials. Moisture removal is one of its most important functions, since much of the industrial heating done on such materials is for this purpose. Water heats much more rapidly than any other material nhen exposed to the dielectric-heating field, since it has a dielectric constant of 80 over practically the entire frequency range, whereas other materials have dielectric constants from 1.0 to 8.0. Typical examples of dielectric heating as applied to moisture removal are the heating of packages of yarn, the baking of foundry cores and the curing of wood and tobacco. Other curing operations do not involve the removal of moisture but are truly molecular transformations brought about by heat. Thermosetting plastics are typical examples and dielectric heating is used extensively in processing them. The heat may be applied to a thermosetting glue in the woodnorking field, or to plastic for heating prior to molding. Foundry cores. already mentioned as an application for moisture removal, are also an example of plastic processing since a thermosetting binder is used in aqueous solution Other fields of application of dielectric heating include the production of pharmaceuticals, food processing and sterilization.

The great advantage of dielectric heating is speed. For example, foundry cores that previously required 8 to 12 hr. in an oven can be baked in 90 sec., and textile packages which formerly required 72 hr. in heated, circulated air for proper drying can be dried dielectrically in 15 min. The vacuum-tube oscillator provides the high-frequency electrical energy source for dielectric heating, since it is the only type of apparatus which will produce sizable amounts of electrical energy in the high-frequency ranges. Terminal output voltages range from 5,000 v. on small equipment to 15,000 and even 20,000 v. on large units. Power output ratings range from a fraction of a kilowatt to 200 kw. Although the large majority of units operate in the frequency range from 1 to 50 mc., some equipment is built which has an output frequency of the order of 2,500 mc. These units are self-contained equipment of the resonant cavity type, with the oscillator and heating section mounted adjacent to each other in the same cabinet. They have found application in cooking and defrosting foods.

See J. Wesley Cable, *Induction and Dielectric Heating* (1954).

(J. WY. CE.)

HIGHGATE, a district in northern London and Middlesex, England, in the boroughs of St. Pancras, Islington and Hornsey (Middlesex). Area 1.2 sq.mi. Pop. (1951) 14,994. The Great North road passes through Highgate and leaves it at the top of the hill (413 ft.) where a tollgate was erected by the bishop of London in the 14th century. Highgate school was founded by Sir Roger Cholmley in 1565. In the Grove S. T. Coleridge died after living there for 18 years. There too, in Arundel house (now Old hall), Bacon died in 1626. On the other side of the hill lies Waterlow park (26 ac.) containing Lauderdale house, the seat of the duke of Lauderdale, one of the "Cabal" of Charles II. To the west lies Parliament Hill fields (containing Highgate ponds) and Ken wood, (see ST. PANCRAS) and in the north are Highgate woods.

HIGHLAND PARK, a residential city of Lake county, Ill., U.S., 23 mi. N.N.W. of Chicago, situated on a bluff 100 ft. above Lake Michigan. Originally the site of two Potawatomi villages, white settlement began in 1834 with a tavern, Green Bay house, on the Chicago-Milwaukee post road. For a short time it served as a small lake port (Port Clinton), and was named Highland Park by the Chicago and Northwestern railroad in 1854 when it became a station. The town was incorporated in 1867, became a popular wealthy residential and health resort area in the late 19th century, and owes its growth to its proximity to Chicago. It adopted a city-manager form of government in 1955. Ravinia park within the city is one of the oldest outdoor summer music and cultural centres in the United States; the U.S. army's Fort Sheridan adjoins Highland Park on the north. For comparative population figures see table in ILLINOIS: *Population.* (RI. S. H.)

HIGHLAND PARK, a city in Wayne county: Mich., U.S., is a residential and industrial suburb surrounded by the city of Detroit (*q.v.*). The site, originally the English settlement of Nabors, was renamed Whitewood after the American Civil War.

Judge Augustus B. Woodward in 1824, purchased 320 ac. in what is now the centre of the city and laid plans for developing a village which he named Woodwardville. Three years later the Judge died and his property was sold.

In the early 1880s Capt. William Stevens settled in Whitewood, which by 1889 was incorporated as a village. A ridge or highland (at Highland and Woodward avenues) leveled to make way for the electric railway became the namesake of the community. City status was attained in 1918.

Henry Ford purchased the old race track along Woodward avenue and opened his automobile plant Jan. 1, 1910. Three years later he introduced the system of mass production. After the Model T was discontinued in 1927, the Ford assembly operations moved to Dearborn. In 1959 the famous Ford stacks mere torn down to make way for a modernization program, completed the following year. Paints, chemicals. interior trim sets for cars and tractors are manufactured in the Highland Park Ford plant. Another major industrial establishment is the Chrysler corporation plant with its institute of engineering.

The school district of Highland Park, established in 1889, offers an educational program from kindergarten through junior college to all residents. For comparative population figures see table in MICHIGAN: *Population.* (E. C. HA.)

HIGHLAND PARK, an independent town within the city of Dallas. Tex., U.S. was one of the first planned residential towns in the southwestern United States. In 1889 a Philadelphia syndicate acquired the wooded, creekside site north of Dallas for an exclusive residential section, but the panic of 1893 killed the project. In 1906 John S. Armstrong. a retired packer. bought the land. The town was incorporated in 1913. He and his son-in-law, Hugh E. Prather, went to California to see the town of Beverly Hills laid out by a planning expert and brought him to Texas

to design Highland Park. With its sister suburb, University Park (*q.v.*) at its north boundary, Highland Park shares one of the better public school systems of the nation. Of its high school graduates 98% go to college. For comparative population figures *see* table in TEXAS: *Population.* (E. P. CR.)

HIGHLANDS, THE, that part of Scotland northwest of a line drawn from Dumbarton to Stonehaven, sometimes including the Inner and Outer Hebrides and the county of Bute, but excluding the Orkneys and Shetlands, Caithness, the flat coastal land of the shires of Nairn, Elgin and Banff, and all east Aberdeenshire (*see* SCOTLAND). The town of Inverness is usually regarded as the capital of the Highlands.

HIGHMORE, JOSEPH (1692–1780), English portrait painter, was born in London, June 13, 1692. About 1714 he entered Sir Godfrey Kneller's academy where he was influenced, according to George Vertue, by the French painter Louis Cheron. In Highmore's early work, he adapted Kneller's style to a more unvarnished if less masterful rendering. Observation of individual resemblance and a discreet grace are evident in later portraits.

Although Highmore visited France and the Low Countries in 1732 and again in 1734, his style was perhaps affected more by French Rococo artists such as Philippe Mercier and Hubert Gravelot, who were established in London during the 1730s and 1740s. But their influence is traceable less in Highmore's portraits than in his genre illustrations. In 1744 he painted a series of 12 for Richardson's *Pamela,* which suggest comparison with William Hogarth's "Marriage *à la* mode." Highmore is less boisterous, less satirical and more refined, although his juxtaposition of characters is quite vivacious, as in the British museum drawing called "The Enraged Husband." But Highmore's genre belongs to a larger context which includes John Vanderbank's illustrations for *Don Quixote* and Francis Hayman's compositions for Vauxhall. Highmore retired from practice in 1761 and moved to Cambridge in 1762. (F. H. D.)

HIGH PLACE is the usual translation of the Hebrew *bamah,* a word of uncertain etymology, meaning "height." The rendering of "high place" is, however, accurate enough, as appears from the poetical use of the plural, but in prose *bamah* is always a place of worship. It has been surmised that it acquired this meaning because places of worship were originally upon hilltops, or that the *bamah* was an artificial platform or mound, but neither view is historically demonstrable. The word was probably adopted from the Canaanites, along with some of the holy places themselves.

In old Israel every town and village had its own place of sacrifice, often on the hill above the town as at Ramah (I Sam. ix, 12–14). On the *bamah* stood a stone altar on which offerings were burned; and near the altar there was a cistern for water, and perhaps low stone tables for dressing the victims; sometimes also a hall (*lishkah*) for the sacrificial feasts. At times there was also a stele (*massebah*) marking the place as sacred, and a wooden post or pole (*asherah*) which, among the Canaanites, was itself an object of worship. Around these places the religion of the ancient Israelite centred; at festival seasons, or to make or fulfill a vow, he might journey to more famous sanctuaries, but ordinarily the offerings were paid at the *bamah* of his own town. While the *massebah* and *asherah* were condemned from an early date, the use of the banzah was permissible as long as there was no central sanctuary in existence; yet the practice had been of such long-standing that it continued even after the building of Solomon's temple.

The religious reformers of the 8th century assailed the worship at "high places" because of their heathenish associations, though they equally condemned the worship at the temple in Jerusalem when divorced from inner piety and moral conduct. (I. E.)

HIGH POINT, an industrial city of Guilford county, in north central North Carolina. U.S., in the Piedmont region, 18 mi. S.W. of Greensboro, 99 mi. N.W. of Raleigh. The area was originally settled by Quakers about 1750, but the town was not laid out until 1853 when it was so named because it was the highest point between Goldsboro and Charlotte on the state built North Carolina railroad. Incorporated in 1859, it developed from a small trading centre in the 1880s into a modern, sprawling industrial city. Furniture manufacturers, attracted by the abundance of hardwood timber, caused it to become "the Grand Rapids" of the south. The Southern Furniture exposition is held every January and July in a block-size building where national manufacturers bring their new lines for inspection and sale. More recently the hosiery industry outstripped the furniture business in volume. Other manufactures include paint, chemicals and machinery.

High Point college, a Methodist, coeducational institution, chartered in 1920 and opened in 1924, has about 1,000 students, one half of whom are day students.

The city adopted a commission-manager form of government in 1916. The population, which almost trebled between 1900 and 1920, was 62.063 in 1960. (B. P. R.)

HIGH SCHOOL: see SECONDARY EDUCATION.

HIGH SEAS, also known as the open seas, consist of all parts of the mass of salt water surrounding the globe which are not territorial waters and which are accessible by navigable salt-water lanes open to the shipping of all countries. For a period of several hundred years beginning in the middle ages attempts were made by a number of states with varying degrees of success to assert claims of sovereignty over certain areas of the high seas. The importance of free communication and commerce brought realization that such claims were untenable. (P. W. T.)

HIGH-SPEED STEEL, a tungsten-chromium-vanadium tool steel, so called because of its ability to machine metals at speeds many times those possible with carbon tool steels.

It was developed almost simultaneously by European and U.S. metallurgists during the latter years of the 19th century. The research of F. W. Taylor and Maunsel White on proper heat-treating methods led to the full realization of the unusual qualities of these high-alloy steels. The Taylor-White heat treatment, which applies substantially to all high-speed steels, consists of two essential parts: heating the tool to a temperature just below its melting point, usually in the range of 2,200°–2,350° F. (1,204°–1,288° C.), the exact temperature depending upon the type of high-speed steel, and quenching in oil, molten salt or a blast of air; reheating to approximately 1,050° F. (565° C.) and cooling in air. Subsequent research showed that a second reheating (tempering treatment) at 1,050° F. develops the optimum in hardness, resistance to wear and toughness which are essential for good cutting tools. Such a treatment induces the quality of red-hardness in these alloys, whereby the tool retains its useful hardness even when cutting so fast that the tip is heated red-hot by friction with the chip. The presence of numerous small particles of tungsten and vanadium carbides in the steel plays a significant role in attaining these properties. The most important feature of the Taylor-White treatment is the unusually high quenching temperature to which the steel is heated. Ordinarily carbon or low-alloy steels would be seriously damaged by heat treating at such temperatures.

Up to 5% cobalt has been usefully added to high-speed steel to improve its hardness and wear resistance for special machining requirements. Other innovations include an increase in the vanadium content to 2%–3%, which permits higher carbon contents and provides greater wear resistance without decreasing the toughness. A more important innovation consists of replacing half or more of the tungsten with molybdenum, an element analogous chemically, but cheaper and much more readily available. However, the molybdenum-type steels are more prone to suffer a loss of carbon from their surface because of reaction with oxygen of the air at the high heating temperatures, thus decreasing the cutting efficiency of the tools. Coating the tools with borax or copper paint or using neutral molten salt baths for a heating medium successfully combats this problem.

The varieties of high-speed steel can be reduced to the three important classes indicated in the table. Three additional classes are made possible by the addition of cobalt to each of these types.

Approximate Analysis of High-Speed Steel

Metal		High tungsten	Molybdenum	Tungsten-molybdenum
Carbon	per cent	0.50–0.80	0.75	0.80–1.20
Tungsten	per cent	18.0	1.5	5.75
Chromium	per cent	4.0	4.0	4.0
Vanadium	per cent	1.0	1.0	1.0–4.0
Molybdenum	per cent	—	8.5	4.5

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HIGH WYCOMBE, a municipal borough in the Wycombe parliamentary division of Buckinghamshire, Eng., 29 mi. N.W. of London by road, on the edge of the Chiltern hills. Pop. (1951) 40,702. Area 11.1 sq.mi. The town stretches for more than 4 mi. along the narrow valley of the Wye stream (the Wye combe of the name) and it also spreads over the steep hills on either side. The valley is one of the main passes of the Chilterns and through it run the railway and the London-Oxford road. High Wycombe has long been noted for furniture, especially Windsor chairs, manufactured from the beeches that grow on the Chiltern hills; to the sheer woodwork have been added ancillary industries in metal, etc., and the manufacture of precision instruments. During World War II a number of clothing factories were opened. There are also paper mills and

printing works. Wycombe appears to have been settled from early times. There are various British remains, including an encampment, and many indications of an important Roman settlement. In Domesday the manor only is mentioned, but the borough existed in the time of Henry II, though it was not chartered until 1558.

All Saints' church replaced in 1273 a church dedicated in 1070 to All Hallows. It was in great part rebuilt in the 16th century. Wycombe abbey, now a public school for girls, is a modern rebuilding. In and around the main street are other interesting buildings, including the 18th-century Market house and guildhall and the Red Lion hotel with its memories of Benjamin Disraeli. Hughenden manor, where Disracli lived and where he was buried, lies on the northern outskirts oi the town. Since 1947 it has been national property—a rebuilt Tudor house in a fine park and a rebuilt church incorporating 14th-century ieatures.

West Wycombe is a beautiful 15th- to 18th-century village lining the main road west of Hish Wycombe. Threatened with destruction. it was bought by the Royal Societv of Arts in 1929 and transferred to the National Trust in 1934.

The Trust also owns West Wycombe park (300 ac. and an 18th-century mansion) and the hill above the village. This is crowned by an extraordinary church and mausoleum erected in 1763 by the eccentric Sir Francis Dashwood, who also built West Wycombe park and founded the so-called "Hell Fire club."

HILARIUS (HILARUS, HILARY). **SAINT** (d. 468). pope from 461 to 468, succeeded Leo **I.** He was of Sardinian origin. As legate to the "robber" synod of Ephesus in 449 he opposed the condemnation of Flavian, patriarch of Constantinople, whose dying appeal to Rome he brought to Leo. His letters as pope show him as a wise and zealous administrator, correcting abuses and solving disputes submitted to him from southern Gaul and Spain His synod of 46 j is the oldest Roman synod of which the acts survive. He died on Feb 29. 468, and his feast day is Feb. 28/9.

See his letters in A Thiel, *Epistolae Romanorum pontificum genuinae,* vol i (1868); *see* also *E.* Caspar, *Geschichte des Papsttums,* vol ii (1933) (ME. BT.)

HILARIUS (fl. A.D. 1125), medieval poet and wandering scholar, was a pupil of Abelard and seems to have been associated with Angers, France. He wrote light verse of great charm in Latin, including a poem addressed to Abelard and several dedicated to English persons—which has led to the otherwise unsupported theory that he was English himself. His fame rests on his three Latin religious plays, two of which. like two of his poems, have French refrains. Those on the raising of Lazarus and on Daniel were written to be performed at matins or vespers. Both follow the biblical narrative fairly closely. In the latter, surprising elaboration of décor is required for a performance within the liturgy. The third play, nhich bears no trace of liturgical performance, is on a non-biblical subject: the legend of the image of St Nicholas. All three plays show variety of metre, great liveliness and dramatic power. The French refrains (lacking in the play on Daniel), nhich are a lyrical addition, not an interpretation of the Latin. give an impression of directness and freshness.

See editions of his norks by J.-J. Champollion-Figeac (1838) and J. B. Fuller (1929). The plays are quoted in full in K. Young, *The Dranza of the Medieval Church,* vol 1 (1933).

HILARY (HILARIUS). **SAINT** (c. 315–367), bishop of Poitiers. his native city. was a champion of orthodoxy who. after the Arianizing councils of Ariminum and Seleucia (j59), resisted almost alone both imperial pressure and the maneuvers or unintelligent subservience of his fellow bishops, and then consolidated the faith of his colleagues in Gaul, thus earning the title of "Athanasius of the west" He was exiled from his see by the emperor Constantius to Phrygia (356–360), where his contact with the Greek mind enabled him to discern the real issues of the Trinitarian controversies. There he wrote De tvinitate, the first work in Latin to deal with them comprehensively. In De *synodis seu* de *fide orientalium* he explained the history of the controversy to his Gallic colleagues, and convincingly showed the easterns that those who held the Son to be like the Father in substance and those who held him to be consubstantial should rally against those who called him unlike the Father. His appeals to the emperor were in vain, and he was turned out of the east as a trouble maker. Returning to Poitiers he spent his last years in confirming the faith in Gaul and in writing his commentary on the Psalms and *Tractatus mysteriorum* on typology. In these too he served as channel for Greek thought to the west, writing in a very personal style, which is difficult but free from ambiguity or uncertainty of thought. Besides minor works he also wrote hymns and (before his exile) a commentary on St. Matthew. His feast day is Jan. 14. He was declared a doctor of the church in 1851.

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HILARY (HILARIUS), **SAINT** (c. 400–449), bishop of Arles, is often regarded as having provided the occasion for an extension of papal authority in Gaul. Born probably in northern Gaul, in early youth he entered the abbey of Lérins, presided over by his kinsman Honoratus, who became bishop of Arles in 426. In 429 Hilary succeeded him and vigorously promoted reforms through several local councils. But his zeal led him to interfere with provinces outside his metropolitan jurisdiction and to overstep even the personal privileges bestowed on Patroclus, one of his predecessors, by Pope Zosimus in 417. He deposed Chelidonius, bishop of Besançon, and replaced another bishop (Projectus) regardless of canonical procedure. An appeal was made to Rome (444), and Pope Leo I quashed Hilary's irregular appointments, but while depriving him of all metropolitan rights he did not remove him from his see. These measures, to which Hilary submitted, were endorsed by an imperial decree of Valentinian III reinforcing Gratian's recognition of papal authority in 378. Besides minor works, Hilary wrote a memorial sermon on St. Honoratus. His feast day is bfay 5.

BIBLIOGRAPHY.—Works in J. P. Migne, *Patrologia Latina,* vol. 1 (1846). *See* also O. Bardenhewer, *Geschichte der altkirchlichen Literatur,* vol. iv, pp. 571–572 (1924); T. G. Jalland, *Life and Times of St. Leo the Great,* pp. 113–136, 159–164 (1941). (ME. BT.)

HILBERSEIMER, LUDWIG (188 j–), German-American city planner, was born at Karlsruhe, Ger., on Sept. 14, 1885. In Germany he devoted as much time to architecture as to planning and in 1930 founded the department of city planning at the Bauhaus. Dessau. An original and logical thinker, his first project for a new city was, to some extent, two cities on top of one another, dwelling houses for workers being vertically above the offices and workshops. Later he developed a linear form of city with housing and industrial units related horizontally.

In 1938 Hilberseimer came to the United States as professor of city planning at the Illinois Institute of Technology, Chicago, and there demonstrated further the implications of the decentralization of cities with a plan for Chicago and in regional planning studies showing the possibilities for integrating agriculture, industry and transportation.

His writings include *The New City* (1944); *The New Regional Pattern* (1952); *The Nature of Cities* (1956). (R. F. MN.)

HILBERT, DAVID (1862–1943), German mathematician who exerted a great influence on modern mathematics. He was born on Jan. 23, 1862, in Konigsberg, where he studied under H. Weber and F. Lindemann. receiving his Ph.D. in 1885. During this period began the close personal and scientific ties with H. Minkowski and A. Hurwitz that had a lasting effect on his mathematical interests. He taught in Konigsberg as *Privatdozent* (1886–92) and professor (1893) until he became professor at Gottingen (1895), a post he held to his retirement in 1930. He died in Göttingen on Feb. 14, 1943.

Hilbert became a member of the academy at Gottingen in 1895, editor of the *Mathematische Annalen* in 1902, and later received many honours. His lectures were rich in ideas and stimulated his students who came from all parts of the world.

His main achievements, all of great importance, included work on the theory of algebraic invariants (1885–92); the theory of algebraic numbers (1893–99); the foundations of geometry, initiating his work in axiomatics (1898–99); a new approach to Dirichlet's problem and other contributions to the calculus of variations (1900–05); integral equations and the theory of infinitely many variables including spectral theory and the concept of

Hilbert space (1901–12). Then followed his work in mathematical physics with contributions in such fields as the kinetic theory of gases, the theory of relativity, etc., and, finally, his critical studies on the foundations of mathematical logic.

He helped establish many modern trends with his famous "mathematical problems" formulated at the International Mathematical congress in Paris (1900). Noteworthy among his extensive accomplishments is his proof, in 1909, of the famous conjecture of E. Waring (1782) on the representation of integers as sums of powers.

Hilbert's work, and in particular his collaboration with H. Minkowski and F. Klein, was most fruitful and led to a new vigour within the field of mathematics in Gottingen and all over Germany, interrupted only by the unhappy political developments of the 1930s. *See* also MATHEMATICS, HISTORY OF: *19th* and *20th Centuries*.

See the collection of his papers, 3 vol., with a warm and accurate biography by O. Blumenthal, one of his first pupils, *Gesammelte Abhandlungen* (1933–35). (*G*. So.)

HILDA, ST., strictly HILD (614–680), was the daughter of Hereric, a nephew of Edwin, king of Northumbria. She was converted to Christianity before 633 by Paulinus. About 650 she became abbess of Hartlepool, where she remained several years. From Hartlepool Hilda moved to Whitby, and in 657 founded the famous double monastery which in her time included among its members five future bishops, Bosa, Aetta, Oftfor, John and Wilfrid II, as well as the poet Caedmon. Hilda exercised great influence in Northumbria, and ecclesiastics from all over England and from Strathclyde and Dalriada visited her monastery. In 6j5 after the battle of Winwaed, Oswio, king of Northumbria, entrusted his daughter Aelfled to Hilda, with whom she went to Whitby. At the synod of Whitby in 664 Hilda sided with Colman and Cedd against Wilfrid, and in spite of the defeat of the Celtic party, remained hostile to Wilfrid until about 679. Hilda died in 680.

See Bede, *Hist. eccl.,* ed. by *C*. Plummer (1869) ; Eddius, *Vita Wilfridi* in Raine's *Historians of Church of York,* Rolls series, vol. i, c. liv. (1879).

HILDEBRAND, ADOLF VON (1847–1921), German sculptor, who was a powerful exponent of classical Greek principles in modern sculpture, was born in Marburg on Oct. 6, 1847. He studied in Nurnberg, Munich, Berlin and Rome, and in 1874 settled in the neighbourhood of Florence. In 1897 he built himself a house in Munich, where he died on Jan. 1, 1921.

Hildebrand's work combined lifelike realism with classic conception of form. He modeled many portrait busts, among which may be mentioned those of Clara Schumann, Hermann von Helmholtz, Max von Pettenkofer, Wilhelm von Bode and Henriette Hertz. For the market place in Jena he designed the Bismarck fountain (1894); for Munich the Wittelsbach fountain (1895) and the Hubertus fountain (1907); for Strasbourg a fountain with the bronze figure of Father Rhine (1903), the architectural part of which was destroyed in 1919 and the figure placed in a park; for Meiningen a monument of Brahms (1898) and one of the poet Otto Ludwig (1898); for Bremen a monument of Bismarck (1910); and for Nurnberg a monument of Schiller (1911). His small book entitled *Das Problem der Form* (1893), in which he analyzed the optical laws underlying the artistic representation of form, exercised a revolutionary influence on art criticism. It was widely read, and many theorists in art founded their writings on it.

HILDEGARD, SAINT (1098–1179), German abbess and mystic, called the "Sibyl of the Rhine," was born of noble parents at Bockelheim, near Spanheim, and was educated at the Benedictine cloister of Disibodenberg by Jutta, sister of the count of Spanheim, whom she succeeded as prioress in 1136. From childhood she experienced visions, and in her 43rd year she consulted her confessor, who in turn consulted the abbot and the archbishop of Mainz, who gave a favourable verdict. He appointed a monk, Volmar, to aid in preparing a manuscript record of Hildegard's visions, and the principal writing, *Scivias,* was taken down in the years 1141–50. This consists of 26 visions, prophetic, apocalyptic, symbolic in form. About 1147 she went with 18 of her nuns to a new convent on the Rupertsberg near Bingen, where she continued to exercise the gift of prophecy and to record her visions in writing. She died on Sept. 17, 1179, and though she has never been canonized, her name is in the Roman martyrology. Her feast day, Sept. 17, is observed in a number of German dioceses.

In addition to the *Scivias* there is an extensive correspondence, in which are to be found further prophecies and allegorical treatises. Those addressed range from popes and emperors to simple nuns and laymen. There are also two treatises dealing with medicine and science, reflecting a quality of scientific observation rare at that period.

See *Butler's Lives of the Saints,* ed. *by* H. Thurston, S.J., and D. Attwater (1956). (Fs. P. C.)

HILDEN, a town in North Rhine-Westphalia on the Itter, 9 mi. S.E. of Dusseldorf by rail. Pop. (1950) 27,304. Its manufactures include silks, calico-printing, tanning, machinery and brickmaking.

HILDESHEIM, a town and episcopal see in Lower Saxony, Germany, at the north foot of the Harz mountains, on the right bank of the Innerste, 18 mi. S.E. of Hanover by railway, and on the main line from Berlin, via Magdeburg, to Cologne. Pop. (1950) 72,292.

Hildesheim owes its rise and prosperity to the fact that in 822 it was made the seat of the bishopric which Charlemagne had founded at Elze a few years before. St. Bernward, bishop from 993 to 1022, walled the town, and stimulated the art of working in metals. In the 13th century Hildesheim became a free city of the empire; in 1249 it received municipal rights and about the same time it joined the Hanseatic league. Its bishops gradually became practically independent, and carried on wars with neighbouring princes, especially with the house of Brunswick-Liineburg, under' whose protection Hildesheim placed itself several times. The extent of their lands depended on the fortune of war, but at the beginning of the 19th century the extent of the prince bishopric was 682 sq.mi. In 1801 the bishopric was secularized and in 1813 it was transferred to Hanover. In 1866, along with Hanover, it was annexed by Prussia. In 1803 a new bishopric of Hildesheim, a spiritual organization only, was established, and this had jurisdiction over all the Roman Catholic churches in the centre of north Germany.

The town consists of an old and a new part, and is surrounded by ramparts. Its streets contain many old houses with overhanging upper stories and adorned wooden facades. The Roman Catholic cathedral (mid-11th century) occupies the site of a building of the early 9th century. The Romanesque church of St. Godehard was built in the 12th century and restored in the 19th. The church of St. Michael, founded by Bishop Bernward early in the 11th century and restored after damage by fire in 1186, contains a unique painted ceiling of the 12th century, the sarcophagus and monument of Bishop Bernward and a bronze font; it is now a Protestant parish church, but the crypt is used by the Roman Catholics. The church of the Magdalene possesses two candelabra, a gold cross and various other works in metal by Bishop Bernward; and the Lutheran church of St. Andrew has a choir dating from 1389. In the suburb of Moritzberg there is an abbey church founded in 1040, the only pure columnar basilica in north Germany.

The chief secular buildings are the town hall (Rathaus), which dates from the 1 jth century and was restored in 1883–92, adorned with frescoes illustrating the history of the city; the Tempelherrenhaus, in Late Gothic, erroneously said to have been built by the Knights Templars; the Knochenhaueramthaus, formerly the guildhouse of the butchers, restored after a fire in 1884 and probably the finest specimen of a wooden building in Germany; the Michaelis monastery, used as a lunatic asylum; and the old Carthusian monastery. The buildings of Trinity hospital, partly dating from the 14th century, became a factory; and the Wedekindhaus (1598) became a savings bank. Hildesheim is the seat of considerable industry. Its chief productions are sugar, tobacco and cigars, stoves, machines, vehicles, rubber and gutta percha, paper. oil, agricultural implements and bricks. Other trades are brewing and tanning.

HILFERDING, RUDOLF (1877–1941), German statesman, was born on Aug. 10, 1877, at Vienna. He took his degree in

medicine in Vienna university. In 1907 he joined the staff of *Vorwarts* in Berlin as political director, and became one of the most important publicists of the Social Democratic party. Opposing his party's majority decision to vote war credits in 1914, after the outbreak of World War I, he conducted pacifist propaganda and joined the group that formed the Independent Social Democratic party in 1917. At the end of the war he acquired German (instead of Austrian) citizenship and was editor of *Freiheit* (1918–22), the organ of the Independents. He resisted Communism, however, and when the left wing of the Independents split off as "New Communists," he led the other to reunion with the Majority Socialists (1922). He was one of the German experts at the Genoa conference (April–May **1922**) and from August to October 1923 finance minister in the Stresemann cabinet. In **1928** he was given the same portfolio in the Mueller cabinet. He fled to France in 1933 when Hitler became chancellor and was arrested by German military police during the invasion of France in 1940. Berlin dispatches of Sept. **17,** 1941, reported that he had committed suicide in his prison cell. Hilferding's principal work was *Das Finanzkapital* (1910, 2nd ed. 1920).

HILL, AARON (1685–1750), English miscellaneous writer, whose adaptations of Voltaire's plays *Zaïre (Zara)* **(1736)** and *Mérope* (1749) enjoyed considerable success, was born in London on Feb. 10, **1685.** On leaving Westminster school he traveled in the near east, and published *A Full Account of the Present State of the Ottoman Empire* (1709). He was an optimistic speculator and, though kindly, bored his friends and irritated them with gratuitous advice. He married an heiress, produced Handel's *Rinaldo* at the Haymarket theatre (having himself translated the Italian libretto) and engaged in various ambitious commercial ventures, all without success. Peter the Great acknowledged his poem *The Northern Star* **(1718)** by ordering a gold medal for him which, however, never arrived. In 1730 he wrote *The Progress of Wit* as a retort to Pope who had satirized him in *The Dunciad.* He also published periodical essays, and his letters to Pope and others were published in 1751. Hill died in London on Feb. **8,** 1750, and was buried in Westminster abbey.

See H. Ludwig, *The Life and Works of Aaron Hill* (1911); *D.* **Brewster,** *Aaron Hill, Poet, Dramatist, Projector* (1913).

HILL, AMBROSE POWELL (1825–1865), American Confederate soldier, was born in Culpeper county, Va., on Nov. **9, 1825.** and graduated at West Point in **1847,** being appointed to the 1st U.S. artillery. He served in the Mexican and Seminole Wars, was promoted first lieutenant in Sept. **1851,** and in 1855–**1860** was employed on the U.S. coast survey. In March **1861.** just before the outbreak of the Civil War, he resigned his commission. and when his State seceded he was made colonel of a Virginian infantry regiment, winning promotion to the rank of brigadier general on the field of Bull Run. In the Peninsular campaign of **1862** he gained further promotion. and as a major general was one of the most prominent and successful divisional commanders of Lee's army in the Seven Days', Second Bull Run, Antietam and Fredericksburg campaigns. His division formed part of "Stonewall" Jackson's corps. and he was severely wounded in the flank attack of Chancellorsville in May **1863.** After Jackson's death Hill was made a lieutenant general and placed in command of a corps of Lee's army, which he led in the Gettysburg campaign of **1863,** the autumn campaign of the same year and the Wilderness and Petersburg operations of 1864–65. He was killed in front of the Petersburg lines on April 2, 1865. His reputation as a troop leader in battle was one of the highest among the generals of both sides.

HILL, ARCHIBALD VIVIAN (1886-), British physiologist, was awarded the **1922** Nobel prize for medicine and physiology jointly with Otto Meyerhof "for his discovery relating to the production of heat in muscles." Born at Bristol on Sept. **26, 1886,** he was educated at Blundell's school and at Trinity college, Cambridge, where he distinguished himself as a mathematician, being third wrangler in 1907 and a fellow of his college from 1910 to **1916.** He became a physiologist at the suggestion of Sir Walter Fletcher. one of his teachers. and his researches on the physiology of muscular activity were undertaken at the suggestion of J. N. Langley. After study in Germany in 1910–11, he continued to work at Cambridge until the outbreak of World War I, in which he served from 1914 to 1919. In **1920** he was appointed Brackenbury professor of physiology at Manchester university, and from 1923 to 1925 he was Jodrell professor of physiology at University college. London. Hill was elected fellow of the Royal society in **1918** and he was the society's Foulerton research professor (1926–51), secretary (1935–45), foreign secretary (1945-46) and Copley medalist **(1948).** As an Independent Conservative he represented Cambridge university in parliament from 1940 to 1945. During World War II he served on many commissions and committees concerned with defense problems and with scientific research. He was awarded the Order of the British Empire in **1918** and was made a Companion of Honour in **1946.**

In addition to his work on muscular activity, Hill studied heat production in nerves following their stimulation. These researches involved the use of apparatus capable of measuring rises of temperature of not more than 0.003° C. during only a few hundredths of a second. Hill's principal researches are summarized in his books *Muscular Activity* (1926), and *Muscular Movement in Man* (1927). (W. J. Bp.)

HILL, DANIEL HARVEY (1821–1889), U.S. Confederate soldier, was born in York district. South Carolina. July **12. 1821.** He graduated at the United States military academy in **1842** and became a major in the Mexican War. From **1849** until the outbreak of the Civil War he was professor of mathematics at Washington college (Washington and Lee university), at Davidson college, North Carolina. and superintendent of the North Carolina military institute. As colonel of a Confederate infantry regiment he won the action of Big Bethel. June 10, **1561.** As major general he led a division with great distinction in the battle of Fair Oaks and the Seven Days. in the second Bull Run campaign. In the Antietam campaign the resistance of his division enabled Lee to concentrate for battle. It was conspicuous in the battles of the Antietam and Fredericksburg. In **1863** he commanded one of Bragg's corps in the victory of Chickamauga. In 1866–69 he edited *The Land We Love,* at Charlotte (N.C.). He became president of the University of Arkansas in 1877 and in 1885 of the Military and Agricultural College of Georgia. He died at Charlotte on Sept. **24, 1889.**

HILL, DAVID JAYNE (1850–1932), U.S. diplomat, was born at Plainfield, N.J., on June 10, 1850. After graduating in **1874** from the Cniversity of Lewisburg, Pa.—later known as Bucknell university—he became instructor in Greek and Latin there and from **1877** professor of rhetoric. In **1879** he was elected president of Bucknell, and in **1888** of the University of Rochester. In **1896** he resigned and went abroad to study public law. In 1898 he was appointed assistant secretary of state by President McKinley. While in Washington he was also professor of European diplomacy in the school of comparative jurisprudence and diplomacy. In 1903 he was appointed minister to Switzerland and in 1905 was transferred to Holland. He was a delegate to the Second Peace conference at The Hague in 1907. From 1908–11 he was ambassador to Germany.

Hill's best-known work is his *History of Diplomacy in the International Development of Europe,* embracing *The Struggle for Universal Empire* (1905), *The Establishment of Territorial Sovereignty* **(1906)** and *The Diplomacy of the Age of Absolutism* (1914).

HILL, GEORGE BIRKBECK NORMAN (1835–1903), English author. editor of Boswell and commentator on Samuel Johnson, was born at Tottenham. Middlesex. the son of Arthur Hill. head master of Bruce Castle school. He was educated in his father's school and at Pembroke college. Oxford. In 1858 he began to teach at Bruce Castle school and from **1868** to **1877** was head master. In **1869** he became a regular contributor to the *Saturday Review.* He settled at Oxford in 1887, but from **1891** onwards his winters were usually spent abroad He died at Hampstead. London, on Feb 27, 1903. His works include: *Dr. Johnson, his Friends and his Critics* **(1878);** an edition of Boswell's *Correspondence* **(1879);** a laborious edition of *Boswell's Life of Johnson, including Boswell's Journal of a Tour to the Hebrides, and Johnson's Diary of a Journey into North Wales* **(6** vols , 1887);

Wit and Wisdom of Samuel Johnson (1888); *Select Essays of Dr. Johnson* (1889); *Footsteps of Dr. Johnson in Scotland* (1890); *Letters of Johnson* (1892); *Johnsonian Miscellanies* (2 vol., 1897); an edition (1900) of Edward Gibbon's *Autobiography;* Johnson's *Lives of the Poets* (3 vol., 1905); and other works on the 18th-century topics. Dr. Birkbeck Hill's elaborate edition of Boswell's *Life* is a monumental work, invaluable to the student.

HILL, JAMES JEROME (1838–1916), U.S. capitalist and one of the great U.S. railroad magnates, was born near Guelph, Ont., Can., Sept. 16, 1838. After settling in St. Paul, Minn.. about 1870 he established transportation lines on the Mississippi and Red rivers and effected a traffic arrangement with the St. Paul and Pacific railroad. When the railway failed in 1873 Hill interested Canadian capitalists in the road, reorganized it as the St. Paul, Minneapolis and Manitoba Railway Co., and in 1882 became its president, becoming president of the Great Northern railway, which absorbed the St. Paul line in 1890 (1893–1907), and board chairman (1907–1912). The Hill interests obtained control of the Northern Pacific and the Chicago, Burlington and Quincy railroads. Hill was president of the Northern Securities Co., which in 1904 mas declared to be in conflict with the Sherman Anti-Trust law. In 1912, he secured control of and merged the First and Second National banks of St. Paul. He wrote *Highways of Progress* (1910).

Hill died in St. Paul, Minn., May 29, 1916. (W. H. D.)

HILL, JOHN (*c.* 1716–1775), English miscellaneous writer and botanist who compiled from his wide firsthand knowledge the earliest British flora to use Linnaean nomenclature. Born, possibly in Peterborough, about 1716, he opened an apothecary's shop in Westminster. He studied botany and was employed by the Duke of Richmond and Lord Petre to arrange their botanical specimens, traveling all over the country to collect rare plants for them. A versatile man, of pugnacious temperament and extravagant tastes, he attempted to make money in a variety of ways: writing plays, novels and treatises on acting, natural history, medicine, astronomy and geology; editing the monthly *British Magazine* (1746–50) and contributing a daily letter of society gossip to the *London Advertiser and Literary Gazette* (1751–53); selling herbal medicines and practising medicine, in which he had a diploma from St. Andrews. He was involved in many literary quarrels: his scurrilous attack on Christopher Smart provoked Smart's mock epic, *The Hilliad* (1752), and his failure to persuade John Rich and David Garrick to produce his plays led to fierce denunciation of them, and to Garrick's epigram.

> For physic and farces, his equal there scarce is,
> His farces are physic, his physic a farce is.

Hill's most lasting work was as a botanist. Although critical of Linnaeus' work on classification, he accepted and used his system of binomial nomenclature and thus made it more widely known. In 1756 he published a *British Herbal* and between 1759 and 1775, under the patronage of Lord Bute, produced *The Vegetable System,* in 26 folio volumes with 1,600 copperplate engravings of 26,000 plants. For this, his most important work, he received the order of Vasa from the king of Sweden and thereafter called himself "Sir" John Hill. He died on Nov. 21. 1775, in London.

HILL, MATTHEW DAVENPORT (1792–1872), English lawyer and penologist and the originator of the *Penny Magazine,* was born on Aug. 6, 1792, at Birmingham. He was a brother of Sir Rowland Hill. In 1819 he was called to the bar by Lincoln's inn. In 1832 he was elected one of the Liberal members for Hull, but he lost his seat at the next election in 1835. He took silk in 1834, and was recorder of Birmingham from its incorporation in 1839 until 1865. He was also commissioner in bankruptcy for the Bristol district from 1851 until 1869. In his charges to the grand juries, as well as in special pamphlets, he advocated many important reforms in the methods of dealing with crime. He was supported by his brother Frederic Hill (1803–96), whose *Crime: its Amount, Causes, and Remedies,* the result of his experience as inspector of prisons for Scotland, marked an era in the methods of prison discipline. Hill mas a promoter of the Society for the Diffusion of Useful Knowledge. He died at Stapleton, near Bristol, on June 7, 1872.

His principal works are *Practical Suggestions to the Founders of Reformatory Schools* (1855); *Suggestions for the Repression of Crinze* (1857), consisting of charges addressed to the grand juries of Birmingham; *Mettray* (1855); *Papers on the Penal Servitude Acts* (1864); *Journal of a Third Visit to the Convict Gaols, Refuges and Reformatories of Dublin* (1865). See *The Recorder of Birmingham: Memoir of M. D. H.* by his daughters R. and F. Hill (1878).

HILL, OCTAVIA (1838–1912), English housing reformer, whose work led to the founding of the Society of Women Housing Managers in England and of similar societies in Europe and in the United States, was also a pioneer of the open space movement, one of the principal founders of the National Trust and organizer of the first cadet corps for lads. Eighth daughter of James Hill, a merchant and banker, and maternal granddaughter of Thomas Southwood Smith (1788–1861), pioneer of sanitary reform, she was born at Wisbech, Cambridgeshire, on Dec. 3, 1838. John Ruskin greatly influenced her. He offered to teach her drawing, and out of her visits to his home grew the first of her housing projects in a slum court in Marylebone, London (1864). Ruskin lent the money; Octavia managed the property. The novelty of her system was the substitution of a personal visitor for a slum rent collector; its success depended on the property's paying its way. The experiment succeeded and the scope of her work spread widely. In 1884 she was entrusted by the Ecclesiastical Commissioners with the management of their property in Southwark, London; she trained other women managers and her work became known abroad.

Knowledge of the life of the town poor led her to a crusade for open spaces, which resulted in the foundation of the National Trust (1895). and the preservation of such open spaces as Parliament hill in London. She died in London on Aug. 13, 1912.

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HILL, ROWLAND (1744–1833), English preacher, sixth son of Sir Rowland Hill, Bart. (d. 1783), was born at Hawkstone, Shropshire, on Aug. 23, 1744. He was educated at Shrewsbury, Eton and St. John's college, Cambridge. Having inherited considerable property, he built for his own use Surrey chapel, in the Blackfriars road, London (1783). Hill conducted his services in accordance with the forms of the Church of England, in whose communion he always remained. Both at Surrey chapel and in his provincial "gospel tours" he had great success. He possessed a voice of great power, and according to Southey "his manner" was "that of a performer as great in his own line as Kean or Kemble." He helped to found the Religious Tract society, the British and Foreign Bible society and the London Missionary society, and was a stout advocate of vaccination. His best-known work is the *Village Dialogues,* which first appeared in 1810. He died on April 11, 1833.

HILL, SIR ROWLAND (1795–1879), English administrator and educator, originator of the penny postage system, was principally known for his development of the modem postal service subsequently adopted throughout the world *(see* POSTAL SERVICES: *Great Britain: History).* Born Dec. 3, 1795, at Kidderminster, the son of an English schoolmaster, he early turned his attention to problems of teaching, developing the Hazelwood system of instruction with emphasis on student democracy, rigid self-discipline and intensive teaching methods. Hill possessed wide-ranging interests, exploring the fields of printing, astronomy, mathematics and transportation. An analysis of taxation led him to the conclusion that those levies mere best the productiveness of which kept pace with the growing prosperity of the nation. The postal revenues of his time were, he felt, an example of the failure to meet that requirement. His proposals for reform were based on the following: a lower rate would increase the revenues of the state by increasing the volume of mail: all postage rates should be the same without regard to distance; and all mail should be prepaid. In connection nith the last principle he suggested a device which subsequently became known as a postage stamp. He managed to put his program into effect in 1840 in spite of the opposition of an

entrenched bureaucracy.

He died at Hampstead on Aug. 27, 1879, and was buried in Westminster abbey.

See G. **Birkbeck Hill,** *Life of Sir Rowland Hill* (1880). (L. N.)

HILL, ROWLAND HILL, 1ST VISCOUNT (1772–1842), British general, one of the best of the duke of Wellington's officers, was born on Aug. 11, 1772, the second son of Sir John Hill. of Hawkstone. Shropshire. Entering the army in 1790, he took a course at Strasbourg military school, did well at Toulon (1793) and was secured by Thomas Graham (his future colleague in Spain, later Baron Lynedoch) as major of the 90th foot. Wounded in the first fight in Egypt (1801), he was promoted brigadier in 1803 and won credit in Ireland. A brigade command in Portugal (1808) brought him to Vimieiro, Corunna and Oporto; he led a division at Talavera. In 1810 Hill covered the southern flank with a corps and stood out as Wellington's ablest general, entirely trustworthy in a wing command and respected by his men. His absence on sick leave in 1811 was deeply felt at La Albuera; he came back a week later and faced J. B. Drouet d'Erlon in Estremadura; in October a well-calculated march and surprise broke J. B. Girard's division near Arroyomolinos de Montánchez. He was along the Tagus during the siege of Badajoz and led Wellington's right wing with prudence, enterprise and success for the rest of the war. He stormed the works of Almaraz at the Tagus bridge May 19, 1812, advanced to Madrid after Salamanca, was the pivot at Vitoria, invested Pamplona, drove Drouet d'Erlon from the Pyrenees, broke the lines on the Nive river and, at Bayonne on Dec. 13, 1813, defeated Marshal Soult before Wellington could join him. Orthez and Toulouse added to his renown. (See PENINSULAR WAR.)

Knight of the Bath and member of parliament for Shrewsbury in 1812, he was created Baron Hill of Almaraz and Hawkstone Salop, May 17, 1814. In 1815 he commanded one of Wellington's two corps. On the right at Waterloo he led the charge of Sir Frederick Adam's brigade against the imperial guard; his horse was shot down and for a time he was lost in the confusion. When Wellington became prime minister in 1828, Hill replaced him as general commander in chief.

Hill resigned in 1842 and was created a viscount, but died on Dec. 10, 1842.

See E. Sidney, *Life of Lord Hill, G.C.B.* (1845). (I. D. E.)

HILLAH, a town in Iraq, about 60 mi. S. of Baghdad, in 32° 28' N. and 44° 48' E. It lies on the Hillah branch of the Euphrates, 11 mi. below the fork at Hindieh. Population (1957) 54,005, mostly Shicah Arabs, but including a number of Jews. The town lies on the Baghdad-Basra railway line, and on the land routds along the river. There is also a certain amount of river traffic. There is a telegraph and post office and a small garrison. Saddlery and similar industries are carried on in the town but the principal trade is in grain—wheat, barley and rice—and there are a large number of grain stores. The two halves of the town are connected by a bridge of boats. Along the river there are flourishing palm groves although these have been threatened by periodic bursting of the Hindieh barrage and the drying up of the channel.

The country around Hillah, which is essentially agricultural, improved in production after renovation of the ancient canals. To the north lie the ruins of Babylon, which have been looted to build the town, while 14 mi. E. is Tell Oheimer, the ancient Rish. The bazaars of Hillah are large.

HILLARY, SIR EDMUND PERCIVAL (1919–), New Zealand mountaineer and explorer, was the first man, with Tenzing Norgay, to reach the summit of Everest (29.028 ft.). He was also the first man after Captain R. F. Scott to reach the south pole overland. Born on July 20, 1919, at Auckland, and by profession an apiarist, Hillary started climbing in the New Zealand Alps. In 1951 he joined a New Zealand party to the central Himalaya, and went on to take part in Eric Shipton's successful reconnaissance of a route up the southern flank of Everest. During the British Everest expedition of 1953 his outstanding qualities were persistence and boundless energy, as well as great strength on ice. He and Tenzing Norgay formed the second summit pair, and on May 29, from a tent at 27,900 ft., reached the summit at 11:30 a m. This and his earlier journeys he described in *High Adventure* (1955).

He was appointed leader of the New Zealand section of the British Commonwealth Transantarctic expedition. With the "Theron" party he reconnoitred the Weddell sea base (Nov. 1955–March 1956). During the main crossing by Vivian (later Sir Vivian) Fuchs's party (Nov. 1957–March 1958), his job was to support from the Ross sea and establish Depot 700. He reached the pole himself in a Weasel tractor on Jan. 4, 1958, and was flown out from the American South Pole station. (C. W. F. N.)

HILLEBRAND, KARL (1829–1884), German author, born at Giessen on Sept 17, 1829, was a student at Heidelberg when he was caught in the revolutionary movement in Baden and had to leave Germany. He was for some months secretary to Heine in Paris. and finally settled in Florence, where he died on Oct. 19, 1884. He wrote in English and French, as well as German, and was a good cosmopolitan critic of European literature. His best known work is *Zeiten, Völker und Menschen* (7 vol., 1874–85), being collections of essays on different subjects.

See H **Homberger,** *Karl Hillebrand* (1884).

HILLEGOM, a toun of the Netherlands, 5 mi. S. of Haarlem. Pop. (1957 est.) 14,362 (mun.). It is the centre of the bulb-growing activities in Holland.

HILLEL (c. 70 B.C.–*c.* AD. 10), Jewish rabbi, was of Babylonian origin and descended from the family of David. When about 40, he went to study at Jerusalem. There he became numbered among the leaders of the Pharisaic scribes, and tradition assigns him the highest dignity of the Sanhedrin, under the title of nasi ("prince"), about 30 B.C. Hillel is said to have laid down seven rules for the interpretation of the scriptures, which became the foundation of rabbinical hermeneutics. He founded a more lenient school in opposition to that of his colleague Shammai (*q.v.*), and introduced the well-known institution of the Prosbol, which was intended to avert the evil consequences of the scriptural law of release in the seventh year (see Deut. xv, I).

Hillel lived in the memory of posterity as the great teacher who enjoined and practised the virtues of charity, humility, patience and true piety.

Of the sayings ascribed to him, many of which bear a remarkable resemblance to the teaching of Jesus, the following are typical: "My abasement is my exaltation"; "What is unpleasant to thyself that do not to thy neighbour; this is the whole Law. all else is but its exposition"; "If I am not for myself, nho is for me? And if I am for myself alone, what then am I? And if not now, then when?" "Separate not thyself from the congregation"; "Judge not thy neighbour until thou art in his place"; "He who wishes to make a name for himself loses his name; he who does not increase [his knowledge] decreases it; he who does not learn is worthy of death; he who works for the sake of a crown is lost"; "He who has acquired the words of doctrine has acquired the life of the world to come."

It is noteworthy that no miraculous legends are connected with Hillel's life. A scholastic tradition, however, tells of a voice from heaven which made itself heard when the wise men had assembled in Jericho, saying: "Among those here present is one who would have deserved the Holy Spirit to rest upon him, if his time had been worthy of it." And all eyes turned toward Hillel. He was lamented after his death as "the humble, the pious, the disciple of Ezra."

HILLEL II, one of the patriarchs belonging to the family of Hillel I, lived in Tiberias about the middle of the 4th century, and introduced the arrangement of the calendar through which the Jews of the Diaspora became independent of Palestine in the uniform fixation of the new moons and feasts.

The Rabbi HILLEL, who in the 4th century made the remarkable declaration that Israel need not expect a Messiah, because the promise of a Messiah had already been fulfilled in the days of King Hezekiah, is probably Hillel, the son of Samuel ben Nahman, a well-known expounder of the scriptures.

The university student clubs established by the B'nai B'rith (*q.v.*) order were named after Hillel, the ideal student and sage.

HILLER, FERDINAND (1811–1885), German composer, was born at Frankfort-on-blain, on Oct. 24, 1811, and studied first under Aloys Schmitt and then under Johann Hummel in Weimar. There he devoted himself to composition, among his work being the entr'actes to *Maria Stuart*, through which he made Johann Goethe's acquaintance. With Hummel he went in 1827 to Vienna, where he met Ludwig van Beethoven and produced his pianoforte quartet. Later he went to Paris where he spent seven years and did much to make the works of Beethoven and Johann Sebastian Bach known in French musical circles. Subsequently he joined his friend Jakob Ludwig Mendelssohn-Bartholdy in Leipzig. where in 1843–1844 he conducted a number of the Gewandhaus concerts and produced his oratorio. *Die Zerstörung Jerusalems*, one of his best works. Later at Cologne he was conductor of the Gürzenich concerts and head of the conservatory. He retired in 1884, and died May 12, 1885.

Hiller frequently visited England. He composed a work for the opening of the Royal Albert hall, his *Nala and Damayanti* was performed at Birmingham, and he gave a series of pianoforte recitals of his own compositions at the Hanover Square Rooms in 1871. His compositions, numbering about 200, include six operas. two oratorios, six or seven cantatas, much chamber music and a once-popular pianoforte concerto.

HILLER, JOHANN ADAM (1728–1804), German composer. n-as born near Görlitz,' in Silesia, on Dec. 25. 1728. He studied law at Leipzig. but adopted music as a profession. In 1789 he became cantor of the Thomasschule, and died at Leipzig, where the most of his life was spent. on June 16, 1804. Hiller played an important part in the German musical life of his day. To him was due the foundation of the famous Gewandhaus concerts in Leipzig. He had much to do with the re-establishment in favour of the *Singspiel* and the general popularization and development of light opera. while he helped materially also in the cultivation and development of the German *Lied* as against the Italian operatic aria. He did propagandist work for Handel also. and the *Messiah* was first given in Berlin (more than 40 years after it was composed) under his bâton. He was a prolific author as well as a copious composer, his literary works including an autobiography.

HILLIARD, LAWRENCE (1582?–1640), English miniaturist, was baptized on March 5, 1582, in St. Vedast's, Foster Lane, London. He was a pupil of his father, Nicholas Hilliard (*q.v.*), whose profession he followed. In 1606 he was working for James I and the queen, in limning and medals; in 1608 he was granted a patent as king's limner, to take effect at his father's death. He succeeded his father in 1619, and in 1624 was paid for five pictures, presumably painted for the king. Lawrence Hilliard is reputed to have had three sons, and one daughter named Laurence. His portraits, signed L. H. in roman capitals, are rare. His style is stiffer than his father's; two examples in the Beauchamp collection, signed and dated 1636 and 1638, bear florid inscriptions. like those found in Nicholas' work.

The colour scheme adopted by Lawrence is fuller and more varied than his father's, and to some extent his light and shade and modeling were influenced by the oil painters of the early Stuart period. (C. H. C. B.)

HILLIARD, NICHOLAS (1547–1619), the first true English miniature painter, is said to have been the son of Richard Hilliard of Exeter. He was appointed goldsmith, carver and portrait painter to Elizabeth I, and engraved the Great Seal of England in 1586. He was in high favour with James I as well as with Elizabeth, and from the king received a patent of appointment (May 5, 1617), which granted him a sole licence for the royal work for 12 years.

Hilliard is believed to have been the author of an important treatise on miniature painting, preserved in the Bodleian library, but it seems more probable that the author of that treatise was John de Critz. It is probable, however, that the treatise was taken down from the instructions of Hilliard, for the benefit of one of his pupils, perhaps Isaac Oliver.

John Donne, in a poem called "The Storm" (1597), praises Hilliard's work. He painted a self portrait at the age of 13, and is. said to have executed one of Mary, queen of Scots, when he was 18. He died Jan. 7, 1619, and was buried in St. Martin's-in-the-Fields, Westminster.

It seems to be fairly certain that he visited France, and that he is the artist alluded to in the papers of the duc d'Alençon under the name of "Nicholas Belliart, peintre anglois" who was painter to this prince in 1577.

HILLMAN, SIDNEY (1887–1946), U.S. labour leadernoted for his aggressive organization of industrial workers and extension of union functions to include social services and political action. He was born March 23, 1887, at Zagare, Lithuania, and received a rabbinical education. At the age of 19, while employed in a chemical laboratory in Kovno, he was jailed by the government for advocating labour reforms. Released, he went to England and then in 1907 to the United States where he soon became active in labour unions.

In 1914 he became president of the Amalgamated Clothing Workers of America, a position he held for the rest of his life. Under his leadership the union increased its membership and provided two banks, a housing development and unemployment insurance for its members. With John L. Lewis (*q.v.*) and others, Hillman formed the Congress of Industrial Organizations in the 1935–38 period and broke away from the American Federation of Labor. (See AMERICAN FEDERATION OF LABOR-CONGRESS OF INDUSTRIAL ORGANIZATIONS.)

Pres. Franklin D. Roosevelt appointed him to several labour advisory posts and in 1541 made him associate director-general of the Office of Production Management and in 1942 director of the labour division of the War Production Board.

Hillman left his government positions in 1943 to become chairman of the C.I.O. political action committee! which played an active role in the election of 1544. After World War II he attended labour union meetings in Europe and served as vice-president of the World Federation of Trade unions.

Hillman died at Point Lookout, N.Y., July 10, 1946.

See Matthew Josephson, *Sidney Hillman: Statesman* of *American Labor* (1952). (B. MI.)

HILL TIPPERA: *see* TRIPURA.

HILTON, JOHN (1804–1878), British surgeon, was born at Castle Hedingham, in Essex, in 1804. He entered Guy's hospital in 1824, and was connected with the hospital all his life. In 1867 he was president of the Royal College of Surgeons. As Arris and Gale professor (1859–62) he delivered a course of lectures on "Rest and Pain" (published 1863, with several revised editions later), which became classics. He was surgeon-extraordinary to Queen Victoria.

His anatomical knowledge is indicated by the method for opening deep abscesses which is known by his name, and he was the first to reduce a case of obturator hernia by abdominal section, and one of the first to practise lumbar colostomy. He died at Clapham on Sept. 14, 1878.

HILVERSUM, a town in the province of North Holland, Neth., 18 mi. by rail S.E. of Amsterdam. Pop. (1957 est.) 97,312 (mun.). It is in the middle of the Gooi, a stretch of hilly country extending from the IJsselmeer (Zuider Zee) to about 5 mi. south of Hilversum.

Hilversum is a summer resort and manufactures large quantities of carpets and is the centre of the Dutch radio activities. The A.V.R.O. and the V.A.R.A. stations are in this town. Two miles from Hilversum is the village of 's Graveland (the count's country), seat of a number of 17th century Dutch Renaissance country homes, most famous of these being the Trompenberg.

HIMACHAL PRADESH, a former constituent state of India, now a Union Territory. It was formed on April 15, 1948, of the 21 former Punjab Hill princely states and their 9 tributaries. Bilaspur (*q.v.*) was merged into it on July 1, 1954. Area of Himachal Pradesh 10,922 sq.mi.; pop. (1951) 1,109,466. The capital is Simla (*q.v.*). Himachal Pradesh was administered under part C of the first schedule of the Indian constitution of 1950; *i.e.*, it mas the direct responsibility of the central government in New Delhi, which controlled it through a lieutenant governor (equivalent to a chief commissioner in other part C states). There was, how-

ever. a state legislature with powers somewhat more limited than those of governors' and rajpramukhs' states, and a ministry comprising a chief minister and two others. The former state was composed of five districts, four of which, Sirmoor, Mahasu, Mandi and Bilaspur formed a continuous tract while the fiith, Chamba, to the northwest, was separated by a wedge of Punjab state.

Potatoes and fruit (apples, peaches, pomegranates, etc.) are the main products; almonds and other nuts are cultivated. There are considerable salt deposits, and forests yield coniferous timber? firewood and charcoal. Wool of good quality is available and the shawls woven there are exported to all parts of the country. There is a large hydro-electric plant at Jogindarnagar and a rosin and turpentine iactory at Nahan (pop. 9,431).

The forests. besides being the main source of revenue for the Gnion Territory (about Rs. 6,000,000 a year), ensure the safety of the catchment areas oi the Jumna, Sutlej, Beas, Ravi and Chenab rivers. The steady and constant flow of water in these rivers and the success of irrigation and engineering yrojects in the plains depend on the proper protection of these catchment areas. (S. GL.)

HIMALAYA, that portion of the mountain region between India and Tibet enclosed within the arms of the Indus and the Brahmaputra, having, therefore, a length of 1,500 mi., and a width from 100 to 150 miles. North-west of the Indus the region of mountain ranges which stretches to a junction with the Hindu Kush, south of the Pamirs, is usually known as Trans-Himalaya. Thus the Himalaya represents the southern face of the great central elevated region — the plateau of Tibet — the northern face of which is buttressed by the huen Lun.

Geographical Classification of the Himalaya. — For this purpose the Himalayan mountain system is divided into three parallel longitudinal zones which have marked differences in orographical features.

(1) *The* Great *Himalaya.*—The main ranges, which lie in the north, rise above the snow line and have an average elevation of 20.000 ft. above the sea. Here occur the highest peaks, *e.g.,* Everest, K_2 (Godwin-Austen). hanchenjunga, etc.

(2) *The* Lesser *Himalaya.*—The middle ranges, which are closely related to and lie south of the Great Himalaya. They form an intricate mountain system, with an average height of 12.000 to 15,000 ft. above the sea.

(3) *The Outer Himalaya.*—These comprise the Siwalik ranges, lie between the Lesser Himalaya and the plains, and have an average height of 3,000 to 4,000 ft. above the sea.

The Great Northern Watershed. — On the north and north-west of Kashmir, the great water-divide which separates the Indus drainage area from that of the Yarkand and other rivers of Chinese Turkestan, is the Mustagh range which, with the Karakoram, trends south-eastwards. forming a continuous mountain barrier and the true water-divide west of the Tibetan plateau. Shutting off the sources of the Indus affluents from those of the Central Asian system of hydrography, this great water-parting is distinguished by a group of peaks of which the altitude is hardly less than that of the Eastern Himalaya. Mount Godwin-Austen (K_2) (28,250 ft. high), only 778 ft. lower than Everest, affords an excellent example of a dominating. peak-crowned water-parting or divide. From Kailas on the far west to the extreme north-eastern sources of the Brahmaputra, little is known of the great northern water-parting of the Indo-Tibetan highlands. For some 500 or 600 mi. E. of Kailas it appears to he lost in the mazes of the minor ranges and ridges of the Tibetan plateau. Nor can it be said to be well defined to the east of Lhasa.

Eastern Tibet. — The Tibetan plateau, or Chang, breaks up about the meridian of 92° E., to the east of which the affluents of the Tsanpo (the same river as the Dihang and subsequently as the Brahmaputra) drain no longer from the elevated plateau, but from wild, rugged mountain slopes. In this region are hidden the sources of all the great rivers of Burma and China. Neither immediately beyond the great bend of the Brahmaputra nor in the Himalayan regions lying north of Assam and east of Bhutan, have scientific investigations yet been systematically carried out; but it is known that the largest of the Himalayan affluents of the Brahmaputra west of the bend derive their sources from the Tibetan plateau. and break down through the containing bands of hills, carrying deposits of gold from their sources to the plains, as do ail the rivers of Tibet.

Although the northern limits of the Tsanpo basin are not sufficiently well knonn to locate the Indo-Tibetan watershed even approximately, there exists some evidence of the nature of that strip of Northern Himalaya on the Tibeto-Nepalese border which lies between the line of greatest elevation and the trough of the Tsanpo. Recent investigations show that all the chief rivers of Nepal flowing southwards to the Tarai take their rise north of the line of highest crests, the "Great Himalaya." and that some of them drain long lateral high-level valleys enclosed between minor ridges nhose trend is parallel to that of the Himalaya and, occasionally, almost at right angles to the course of the main drainage channels breaking down to the plains. This formation brings the southern edge of the Tsanpo basin to the immediate neighbourhood of the banks of that river, which runs at its foot like a drain flanking a wall. North of Bhutan, between the Himalayan crest and Lhasa, this formation is approximately maintained; farther east, although the same natural forces first resulted in the same effect of extensive curves of ridge and furrow, the abundant rainfall and the totally distinct climatic conditions which govern the processes of denudation subsequently led to the erosion of deeper valleys enclosed between forest-covered ranges which rise steeply from the river banks.

Height of Himalayan Peaks. — It is now proved that Mount Everest, which appears from the Tibetan plateau as a single dominating peak, has no rival amongst Himalayan altitudes. The main features of Nepalese topography are now fairly well defined. So much controversy has been aroused on the subject of Himalayan altitudes that the present position of scientific analysis in relation to them may be shortly stated. The heights of peaks determined by exact processes of trigonometrical observation are bound to be more or less in error for at least three reasons: (1) the extraordinary geoidal deformation of the level surface at the observing stations in submontane regions; (2) ignorance of the laws of refraction when rays traverse rarefied air in snow-covered regions; (3) ignorance of the variations in the actual height of peaks due to the increase, or decrease, of snow.

Geology. — The Himalaya have been formed by violent crumpling of the earth's crust along the southern margin of the great tableland of Central Asia. Outside the arc of the mountain chain no sign of this crumpling is to be detected except in the Salt Range; and the Peninsula of India has been entirely free from folding of any importance since early Palaeozoic times, if not since the Archaean period itself. But the contrast between the Himalaya and the Peninsula is not confined to their structure: the difference in the rocks themselves is equally striking. In the Himalaya the geological sequence (Cambrian to Eocene) is almost entirely marine; there are occasional breaks in the series, but during nesrly the whole of this long period the Himalayan region, or at least its northern part, must have been beneath the sea — the Central Mediterranean Sea of Neumayr or Tethys of Suess. In the peninsula, however, no marine fossils have yet been found of earlier date than Jurassic and Cretaceous, and these are confined to the neighbourhood of the coast; there can be no doubt that; at least since the Carboniferous period. nearly the whole of the peninsula has been land. Between the folded marine beds of the Himalaya and the nearly horizontal strata of the peninsula lies the Indo-Gangetic plain: covered by an enormous thickness of alluvial and wind-blown deposits of recent date. Deep borings here have failed to reach the rocky bottom, or even to indicate the approach of the base of the alluvium. It is clear. then, that in front of the Himalaya there is a great depression, but there is no indication that this depression was ever beneath the sea.

Geologically, the Himalaya may be divided into three zones. The northern (Tibetan zone), in which fossiliferous beds of the Palaeozoic and Mesozoic age are largely developed — excepting in the north- vest, no such rocks are known on the southern flanks. The second (Himalayan zone) comprises most of the Lesser and Great Himalaya, and is composed chiefly of crystalline and metamorphic rocks, together with unfossiliferous sedimentary beds supposed to be of Palaeozoic age. The southern (*sub*-Himalayan zone) consists entirely of Tertiary beds, and especially of the Upper Tertiaries. The oldest beds which have yielded

fossils occur in the Spiti valley and belong to the Cambrian system (the "Haimanta" system). These are underlain by Archaean gneisses. There appears to be no break in the Lower Palaeozoic beds in the Spiti region but in other parts of the Central Himalayas the conglomerate at the base of the Permian rests unconformably upon older formations. This conglomerate forms an important datum line. From the Permian to the Lias the sequence in the central Himalaya shows no sign of a break. The Spiti shales follow, and although they contain Middle and Upper Jurassic fossils no break has yet been proved at their base. The Spiti shales are succeeded conformably by Cretaceous beds (Giumal sandstone below and Chikkim limestone above), and these are followed without a break by h'ummulitic beds of Eocene age. The beginning of the Tertiary period was marked by violent igneous activity, in which intrusion and extrusion occurred. The next succeeding deposit is a sandstone, often highly inclined, which rests unconformably upon the Nummulitic beds and resembles the Lower Siwaliks of the sub-Himalaya (Pliocene) but which as yet has yielded no fossils of any kind. The whole is overlaid unconformably by the younger Tertiaries of Hundes, which are perfectly horizontal and have been folded.

It is evident that in the northern part of the Himalayan belt, at least in the Spiti area, there can have been no post-Archaean folding of any magnitude until after the deposition of the Nummulitic beds, and that the folding was completed before the later Tertiaries of Hundes were laid down. It was, therefore, during the Miocene period that the elevation of this part of the chain began, while the disturbance of the Siwalik-like sandstone indicates that the folding continued into the Pliocene period. Along the southern flanks of the Himalaya the history of the chain is still more clearly shown. The sub-Himalaya are formed of Tertiary beds, chiefly Siwalik or Upper Tertiary, while the Lower Himalaya proper consist mainly of pre-Tertiary rocks without fossils. Throughout the whole length of the chain, wherever the junction of the Siwaliks with the pre-Tertiary rocks has been seen, it is a great reversed fault (the "Main Boundary Fault"). The hade of the fault is constantly inwards, towards the centre of the chain, and the older rocks, which form the Himalaya proper, have been pushed forward over the younger beds of the sub-Himalaya. Moreover, nearly everywhere the fault formed the northern boundary of deposition of the Siwalik beds, and only in a few instances do any of these deposits extend even to a short distance beyond it. The fault, in fact, was being formed by the deposition of the Siwalik beds, and as they were laid down, the Himalaya were pushed forward over them, so that they were folded and upturned during the process. The Siwaliks are fluviatile and torrential deposits similar to those which are now being formed at the foot of the mountains in the Indo-Gangetic plain. The "Main Boundary Fault" is really one of a series of approximately parallel faults, all of which formed the northern boundary of deposition of the deposits immediately south of them. The Himalaya grew southwards in a series of stages. A reversed fault was formed at the foot of the chain, and upon this fault the mountains were pushed forward over the beds deposited at their base, crumpling and folding them in the process, and forming a sub-Himalayan ridge in front of the main chain. This process was repeated several times and the earthquakes of to-day in this region can be traced to the fault lines and show that crustal equilibrium has not yet been reached.

Topographical Results sf Evolution. — The uplift of the Himalayas was a gradual process protracted over a very long period and the process had a very marked effect upon the scenery, the topography and the river system. The latter is not consequent upon the structure, but the principal rivers were of an age anterior to the Tertiary earth-movements and the drainage is spoken of as "antecedent." During the slow process of uplift, folding and faulting the rivers were able to keep, for the most part, to their original courses, although their erosive power was increased owing to increased gradients. Thus we find the rivers cutting through the main chains in deep transverse gorges after flowing for long distances parallel to the trend of the chain. Examples of this are the Indus and the Brahmaputra.

In the outer valleys of the Himalaya the sides are generally steep, so steep that landslides frequently occur, whilst the streams are still cutting down the river beds and have not yet reached their base level. Here and there a valley has become filled with alluvium, owing to some local obstruction, and when this occurs there is usually to be found a fertile and productive field for agriculture. The straits of the Jhelum, below Baramula, probably account for the lovely vale of Kashmir, which is in form (if not in principles of construction) a repetition on a grand scale of the Maidan of the Afridi Tirah, where the drainage from the slopes of a great amphitheatre of hills is collected and then arrested by the gorge which marks the outlet to the Bara.

Other rivers besides the Indus and the Brahmaputra begin by draining a considerable area north of the snowy range — the Sutlej, the Kosi, the Gandak and the Subansiri, for example. All these rivers break through the main snowy range ere they twist their way through the southern hills to the plains of India. Here the "antecedent" theory will not suffice, for there is no sufficient catchment area north of the snows to support it. Their formation is explained by a process of "cutting back," by which the heads of these streams are gradually eating their way northwards owing to the greater rainfall on the southern than on the northern slopes. The result of this process is well exhibited in the relative steepness of slope on the Indian and Tibetan sides of the passes to the Indus plateau. On the southern or Indian side the routes to Tibet and Ladakh follow the levels of Himalayan valleys with no remarkably steep gradients till they near the approach to the water-divide. The slope then steepens with the ascending curve to the summit of the pass, from which point it falls with a comparatively gentle gradient to the general level of the plateau. The Zoji La, the Kashmir water-divide between the Jhelum and the Indus, is a prominent case in point, and all the passes from the Kumaon and Garhwal hills into Tibet exhibit this formation. Taking the average elevation of the central axial line of snowy peaks as 19,000 ft., the average height of the passes is not more than 10,000 owing to this process of cutting down by erosion and gradual encroachment into the northern basin. (See also TIBET; LEH.)

Climate. — Independently of the enormous variety of topography the vast altitude of the mountains alone is sufficient to cause very great modifications of climate. One-half of the total mass of the atmosphere and three-fourths of the water suspended in it in the form of vapour lie below the average altitude of the Himalaya; and of the residue, one-half of the air and virtually almost all the vapour come within the influence of the highest peaks. The mean winter temperature at 7,000 ft. (which is about the average height of Himalayan "hill stations") is 44° F and the summer mean about 65" F, but in the valleys a temperature of go to 100° F may be felt during the day in May and June. At 9,000 ft. the mean temperature of the coldest month is 32" F. At 12,000 ft. the thermometer remains above freezing-point from the end of May to the middle of October, but at 15,000 ft. is seldom above that point even in the height of summer. It should be noted that the thermometrical conditions of Tibet vary considerably from those of the Himalaya. At 12,000 ft. in Tibet the mean of the hottest month is about 60° F and of the coldest about 10° F, while at 15,000 ft. the frost is only permanent from Nov. 1 to May 1. In Tibet the daily range may be 60" and often reaches 50°. The temperature of the sandy surface varies even more and records of 2° and 96" have been taken within 24 hours by the Everest expedition. The soil beneath the surface is far more constant in temperature. The difference of temperature between forest-clad ranges and the Indian plains is twice as much in April and May as in December or January; and the difference between the temperature of a well-wooded hill top and the open valley below may vary from 9° to 24° within twenty-four hours. The general relations of temperature to altitude as determined by Himalayan observations are as follows: (1) The decrease of temperature with altitude is most rapid in summer. (2) The annual range diminishes with the elevation. (3) The diurnal range diminishes with the elevation.

Rainfall is chiefly related to the monsoonal rainfall of India of which the Himalayas catch a large portion. There is more

rain, and rain for a longer season, in the east than in the west. The east may have 50 to 80 in. of rain against southward hill slopes and in certain spots even higher totals are reached, for example Darjeeling gets 120 inches. The rainfall diminishes westward to 40 inches near the place where the Ganges leaves the mountains and falls to 30 towards the emergence of the Indus from the mountains, while in places in a rain-shadow the fall may be only 15 in. though they are in a zone that on the whole averages 30 or more. In the arid zone protected from the rainy winds the rainfall goes below 15 in. and in Tibet for the most part well below 10 inches.

In Tibet the rapid heating of the plains by the morning sun brings a fierce wind down daily from the eternal snows and some air may thus drift through such partial gaps as there are in the great range from India to the Tibetan table-land.

In the eastern Himalaya the ordinary winter limit of snow is 6,000 ft. and it never lies for many days even at 7,000 ft. In Kumaon, on the west, it usually reaches down to the 5,000 ft. level and occasionally to 2,500 feet. Snow has been known to fall at Peshawar. At Leh, in western Tibet, hardly 2 ft. of snow are usually registered and the fall on the passes between 17,000 and 19,000 ft. is not generally more than 3 ft., but on the Himalayan passes farther east the falls are much heavier. Even in September these passes may be quite blocked and they are not usually open till the middle of June. The snow-line, or the level to which snow recedes in the course of the year, ranges from 15,000 to 16,000 ft. on the southern exposures of the Himalaya that carry perpetual snow, along all that part of the system that lies between Sikkim and the Indus. It is not till December that the snow begins to descend for the winter, although after September light falls occur which cover the mountain sides down to 12,000 ft., but these soon disappear. On the snowy range the snow-line is not lower than 18,500 ft. and on the summit of the table-land it reaches to 20,000 ft. On all the passes into Tibet vegetation reaches to about 17,500 ft., and in August they may be crossed in ordinary years up to 18,400 ft. without finding any snow upon them; and it is as impossible to find snow in the summer in Tibet at 15,500 ft. above the sea as on the plains of India.

The glaciers of the Himalayas seem to be in retreat. On the north side of Everest the Rongbuk glacier ends at about 16,500 ft. and the Kyetrak glacier at 15,400 feet. In the Kinchinjunga group the glaciers may come down to 13,000 ft. while in Kumaon they reach 12,000 ft. and in Kashmir, in special situations, they may come as low as 8,000 feet. The level reached is, as in Europe, 3,000–5,000 ft. below the limit of perpetual snow. The air temperatures at the ends of the glaciers are about as in Europe, namely, nearly 60° in July and diminishing slowly until the end of September. Several glaciers are 11–16 m. long, the higher figure being attained in the Kinchinjunga series. Italian geologists have investigated the moraines of the Karakoram Mts. and have given evidence of the great ice sheets of the Pleistocene glaciation, ice sheets which may have been one continuous mass over the whole of central Asia. They have further shown that there is evidence of phases of variation during the Pleistocene Ice Age which seem to correspond with those observed in Europe.

Plants. — A valuable study of the ecology of the Himalayan forests of Osmaston (*Journ.* Ecology, Cambridge, England, 1922, vol. x., p. 129), and the observations taken by the Everest expeditions have added considerably to knowledge of the plants of this region.

The European flora of the Mediterranean reaches the Himalaya, but very few of its members attain the eastern end of the chain. Some Japano-Chinese forms such as *Aucuba, Helwingia, Skimmia,* Adamia, *Goughia* reach the east of the chain, but do not spread far to the west. It is naturally at fairly high levels that the European forms are found, but *Tilia, Fagus,* Arbutus, Erica, Azalea and the *Cistaceae* are absent. An African element is claimed to reach the western Himalayas.

The eastern section is very warm and damp and intertropical plants live even at 7,000 ft. above sea, while the forest reaches up to nearly 13,000 ft. in places. In the west the corresponding levels are 5,000 and under 12,000 ft., the dry season being more marked and the variation of temperature greater.

Using Osmaston's general classification of the forests we have: (1) The Shorea (-Sal) *Anogeissus-Pinus* formation in the warm moist valleys, and up to about 6,500 ft. in places. The warm temperature implies heavy evaporation and rapid decomposition of humus. This forest may be called warm subtropical, the trees form an open canopy and belong to species that either shed their leaves in the warm weather before the rains, or are needle-leaved conifers. *Pinus* longifolia is specially able to survive fires and Anogeissus has special powers of coppicing so that it survives grazing and lopping. *Anogeissus* lives up to a 4,000-ft. level in large groups and reaches west as far as the neighbourhood of Srinagar (Kashmir). (2) The Quercus-Abies formation on the moist hill sides from 5,000 ft. to 11,500 ft., where the rainfall is typically 50–80 in. per annum, and some of it is snow. The parts which face south are apt to get dry in November and December and from April to June and in the latter season there are often forest fires. The heat and rainfall prevent accumulation of much humus on the south side except under special circumstances, but the north side has humus, and there forest fires are rare. The general covering is dense on the north, but less so on the south; evergreen oaks are the commonest trees, epiphytic ferns abound and on higher levels mosses and lichens encrust the tree-trunks. (3) The *Pinus-Cedrus* formation on the drier mountain flanks from 9,000 ft. to 12,000 ft. with a rainfall of 10 to 40 in., but in winter the precipitation is mainly snowfall and the temperature is low. Slopes facing the sun are apt to be very dry and suffer from fires. Trees and grass often occur together, both giving place to shrubs in some areas with long dry periods. *Cedrus* itself reaches the 8,000-ft. level in the moist zone, but the 10,000-ft. level in the dry one, it grades into cypress below and blue-pine above. The cypress suffers specially from fires and perhaps for this reason is rarely found near grassland in the Himalayas; it favours rather the steep rocky hill sides. (4) The *Betula-Rhododendron* formation has a general distribution between the 9,000- and the 13,500-ft. contours with vegetative activity chiefly during the monsoon rains. The cold soil makes absorption by the roots slow even if there be abundant moisture, as there is in some parts. The rainfall varies very much and a large proportion is really snowfall, and the formation generally occurs where insolation is low because of a north aspect, or cloudiness. The formation makes a dense covering, but there are no large trees and the branches often bend down and are flexible. It is sometimes quite absent in the moist zone in which oak forest may be succeeded above by grass; much has to be allowed in this matter for the depredations of grazing animals. Sometimes one finds a Rhododendron-Lonicera shrubby group, sometimes a *Betula-Abies* tree-group, but it is difficult to distinguish different conditions for them. Lonicera oboaata is restricted to the higher part of the zone. (5) The Caragana-Lonicera-Artemisia formation in the arid Tibetan zone 9,000 ft. to 15,000 ft. above sea with extremely dry conditions during the short period in which vegetative activity is possible. The sun is strong and the dry atmosphere gives it unusual power. The strong daily wind down from the peaks transports sand and dust. Trees and shallow rooted grasses are almost absent, shrubs have branches bent down and very flexible and the leaves are deciduous. *Salix* and *Myricaria* form associations related to No. 5, but choosing moister spots near streams. Only a few plants, save willows and junipers, grow taller than 2 ft. or so. The small amount of grass, and shoots of shrubs are a precious resource to yaks and other animals of the heights and water weeds of the cold lakes are also useful to them. The mouse-hares lay up stores of seeds in their burrows for the winter and perhaps on the whole help in this way to maintain some species of plants.

Animals. — On the outer fringes the Himalayan fauna grades into that of the surrounding regions. Towards India, for example, the langur (Semnopithecus sp., a monkey) elephant, rhinoceros, tiger, leopard, civet, mongoose (*Herpestes*), toddy cat (Paradoxurus), cat-bear (*Aelurus*), *Helictis* (an aberrant badger), linsang (an aberrant civet), the last two of Malayan affinities, and the bamboo-rat (Rhizomys) of the base of eastern Himalayas. The Himalayan fauna in the stricter sense, especially on the Tibetan

side, is, however, mainly northern in its affinities. The fossils of the Siwalik beds include remains of 84 species of mammals akin to those of Miocene and Pliocene Europe. The langur reaches as high as the 12,000-ft. level and bears, martens and related forms and several cats are features of the forests, while moles abound, though they are unknown in India; foxes and wolves are unknown in the forest area, but both, and also the lynx, ounce, marten, ermine and wild ass occur on the Tibetan side, also musk-deer, antelope (2 species) and sheep. The wild dog (Cuon) is found in the forest area, so is the wild pig, a form of which reaches very high levels, but the gaur or wild ox is confined to the lower lands; two species of the scaly anteater (*Manis*) reach the eastern Himalayas, but the chevrotain, another southeast Asiatic form, is absent. Goat-like animals called the serow (Nemorhaedus), goral (*Cemas*), and tahr (Hemitragus) are found, and the tahr ranges up to great heights. The yak and other animals of the great altitudes will be discussed below.

The bird life of the Himalayas is wonderfully rich. Eagles, vultures and many birds of prey soar to great heights. Gorgeous colouring occurs among sun-birds, trogons, kingfishers, etc., but of the parrot family only parrakeets and a small lory are known. The peacock occurs in the forests borderin'g the plains on the Indian side, and pheasants and partridges include varieties adapted to life on the snow at great altitudes. Waders and waterfowl are not very important features.

Among the snakes the python is found on the Indian side and the cobra penetrates as high as some 8,000 ft. above sea. Lizards and frogs abound and reach remarkable elevations, the lizard, Phrynocephalus, and a frog being found even in Tibet. Of the fishes only two Acanthopterygii enter the mountains, most of the fish of the region belonging either to the catfish family (*Siluridae*) or the carp family (*Cyprinidae*), a few of the former and a number of the latter live in Tibetan waters. Most of the fishes of high mountain-torrents have suckers with which to hold on to rocks. The salmon family is absent from the region.

The butterflies are renowned for their magnificence and include among others Papilionidae, *Nymphalidae, Morphidae,* and *Danaidae*. Insect life of all kinds is very rich and locust-swarms are carried up by the winds even to the perpetual snow.

Major Hingston of the Indian Medical Service has given valuable accounts of the natural history of animals at great altitudes in the Himalayas. Protective colouring, usually in browns and greys akin to those of the desert-like surface of Tibet, is almost universal. The mouse-hare (Ochotona) is common and even the sheep and gazelles are coloured like the soil. Most of the birds are protectively coloured, though some show bright colours when on the wing. Unlike the large mammals, the large birds are not protected in colour, and the eagles, kites, ravens and choughs abound. It is said that the birds living among the villages are not protectively coloured. That type of coloration is common among insects, spiders, etc.

The intense cold of the great heights is made still more trying by the fierce winds that rush down from the snows to the plateau as the latter warms up in the morning sun. As a protection most mammals have thick hair and the dogs have wool as well; even the pig is thickly covered with hair. The yak has a coat of wool over which is the long hair that forms a protective skirt under the belly, while the tail may be described as a unique windscreen. The hair under the belly is thought by Major Hingston to keep the animal's legs warm when it is resting. The yak stands with its hindquarters to the wind. The smaller animals and the birds mostly shelter among the rocks and stones when the wind becomes strong, but many of them illustrate its power of damaging fur and feathers. The birds generally face the wind and the great vultures are able to some extent to make use of it. The butterflies may protect themselves by pressing their wings against a stone in as sheltered a nook as can be found. Major Hingston found *Parnassius* sp. as high as 17,000 ft. above sea-level.

The sharp changes of temperature within a few hours, known in all mountain regions, are accentuated here and may be very trying in winter. Many animals of the high mountains are protected from this by the habit of hibernation in burrows where, a little beneath the snow and the surface soil, the temperature is much more uniform. The mouse-hare was seen by Major Hingston as high as 17,000 ft. above sea and he thinks it may reach 20,000 ft. as a stray. Several birds go up to 20,000 ft. and more on the mountain side, and choughs followed the Everest climbers as high as 27,000 ft.; they seem least incommoded by the great heights. The habits of mammals and birds have been noticed to change on the great heights; thus birds which elsewhere are of the wild, live there on and around the villagers' houses, while communities (even some of birds and mammals) are a characteristic development with mutual aid in view.

See D. N. Wadia, Geology of India (1919); G. Dainelli, *Relazione Scientifiche della* Spedizione *Italiana* De *Filippi* nell' *Himalaia, Caracorum* e *Turchestan* Cinese (1913–14) Serie II. Resultati Geologici e Geografici, 10 vols.; E. Argand, La Tectonique de *l'Asie* (Liége, 1924); A. E. Osmaston, "Forest Communities of the Garhwal Himalayas," Journ. Ecology (Cambridge, 1922); E. Trinkler, "Tibet" Mitt. Geogr. Ges. *München* Bd. 15, 1922 and the literature of the Everest Expeditions.

HIMERA, an ancient city on the north coast of Sicily, on a hill above the west bank of the Himeras Septentrionalis, south of the present railway station of Buonforello 6 mi. east of Termini Imerese. It was founded c. 649 B.C. by Chalcidian inhabitants of Zancle and Syracusan exiles. Early in the 5th century the tyrant Terillus, son-in-law of Anaxilas of Rhegium and Zancle, appealed to the Carthaginians, who came to his assistance, but were utterly defeated by Gelon of Syracuse in 480 B.C., on the same day, it is said, as the battle of Salamis. Thrasydaeus, son of Theron of Agrigentum, seems to have ruled the city oppressively, but an appeal made to Hieron of Syracuse, Gelon's brother, was betrayed by him to Theron; the latter massacred all his enemies and in the following year resettled the town. In 408 Hannibal, after capturing Selinus, destroyed Himera, founding a new town close to the hot springs (Thermae Himeraeae), 8 m. to the west, which, however, soon became a Greek city. The only relic of the ancient town now visible above ground is a small portion (four columns, lower diameter 7 ft.) of a Doric temple, the date of which (whether before or after 480 B.C.) is uncertain.

HIMERIUS (c. A.D. 315–386), Greek sophist and rhetorician, was born at Prusa in Bithynia. He completed his education at Athens, whence he was summoned to Antioch in 362 by the emperor Julian to act as his private secretary. After the death of Julian in the following year Himerius returned to Athens, where he established a school of rhetoric, to which pupils came from all over the world; among them were Gregory of Nazianzus and Basil the Great, bishop of Caesarea; in his later years he became blind and he died of epilepsy. Although a heathen, who had been initiated into the mysteries of Mithra by Julian, he shows no prejudice against the Christians. Himerius is a typical representative of the later rhetorical schools. Photius (cod. 165, 243 Bekker) had read 71 speeches by him, of 36 of which he has given an epitome; 24 have come down to us complete and fragments of 10 or 12 others. They consist of epideictic or "display" speeches after the style of Aristides, the majority of them having been delivered on special occasions, such as the arrival of a new governor, visits to different cities (Thessalonica, Constantinople), or the death of friends or well-known personages.

The *Polemarchicus* is a panegyric of those who had given their lives for their country. Other declamations, only known from the excerpts in Photius, were imaginary orations put into the mouth of famous persons — Demosthenes advocating the recall of Aeschines from banishment, or Themistocles inveighing against the king of Persia. Himerius is more of a poet than a rhetorician, and his declamations are valuable as giving prose versions or even the actual words of lost poems by Greek lyric writers. The prose poem on the marriage of Severus and his greeting to Basil at the beginning of spring are quite in the spirit of the old lyric. Himerius possesses vigour of language and descriptive powers, though his productions are spoilt by too frequent use of imagery, allegorical and metaphorical obscurities, mannerism and ostentatious learning But they are valuable for the history and social conditions of the time, although lacking the sincerity characteristic of Libanius.

See Eunapius, *Vitae sophistarum;* Suidas, *s.v.:* editions by G. Wernsdorf (1790), with valuable introduction and commentaries, and by F. Dübner (1849) in the Didot series; C. Teuber, *Quaestiones Himerianae* (Breslau, 1882); on the style, E. Norden, *Die antike Kunstprosa* (1898)

HIMLY, LOUIS-AUGUSTE (1823–1906), French historian and geographer, was born at Strasbourg on March 28, 1823. After studying in his native town and taking the university course in Berlin, 1842–43, he went to Paris, and passed first in the examination for fellowship *(agre'gation)* of the lycées (1845), first in the examinations on leaving the École des Chartes and first in the examination for fellowship of the faculties (1849).

In 1849 he took the degree of doctor of letters with two theses, one of which, *Wala et Louis le Débonnaire* (Paris, 1849), placed him in the front rank of French scholars in Carolingian history. Soon, however, he turned his attention to the study of geography. In 1858 he obtained an appointment as teacher of geography at the Sorbonne, and henceforth devoted himself to that subject. In 1876 he published, in two volumes, his *Histoire de la formation territoriale des états de l'Europe centrale,* in which he discussed the reciprocal influence exerted by geography and history. The work was written in the form of a student's manual, but it was based on original research.

Himly was head of the Faculté des lettres de Paris, 1881–98, and became a member of the Institute (Académie des sciences morales et politiques).

HIMMEL, FREDERICK HENRY (1765–1814), German composer, was born on Nov. 20, 1765, at Treuenbrietzen, Brandenburg.

During a temporary stay at Potsdam, he had an opportunity to show his self-acquired skill as a pianist before King Frederick William II, who made him a yearly allowance to enable him to complete his musical studies. He studied under Johann Gottlieb Naumann, a German composer of the Italian school, and Himmel adopted the style of that school in his serious operas. The first of these, a pastoral opera, *Il Primo Navigatore,* was produced at Venice in 1794 with great success.

The production of his oratorio *Isaaco* (1792) procured his appointment as court Kapellmeister to the king of Prussia. His Italian operas, successively composed for Stockholm, St. Petersburg and Berlin, were all received with great favour in their day. Of greater importance than these, however, is an operetta to German words by Kotzebue, called *Fanchon,* a good specimen of the German *Singspiel.* Himmel's gift of melody is shown in the still popular anthem "Incline thine ear." He died in Berlin on June 8, 1814.

HIMMLER, HEINRICH (1900–1945), German police official, was born Nov. 7, 1900, at Munich. He studied agriculture at the University of Munich and later became a member of the Academy of German Law.

In 1927 he became deputy leader of the *Schutzstaffel* (known as the S.S., Black Shirt or Elite Guard troops), and he was appointed leader in 1929. Himmler was reich director of propaganda, 1926–30, a member of the *Reichstag* and Prussian state council, 1933, commander of the united German police forces, 1936, and deputy head of the reich administration, 1939. He was empowered by Adolf Hitler to suppress antinazi resistance at home and in the occupied countries, and his methods were brutal and ruthless.

Hitler made Himmler interior minister on Aug. 24, 1943, and by Nov. 1944 it appeared that the gestapo chieftain had assumed executive control over Germany, replacing Hermann Goering as the second nazi. After the Karl Doenitz government was formed on May 1, 1945, following Hitler's death, Himmler went into hiding. He adopted a disguise which might have proved effective, but his identity papers, made out in the name of Hitzinger, aroused suspicion of British soldiers at Bremervoerde, and Himmler was arrested on May 21. He revealed his identity and was placed under strict custody. On May 23, 1945, the gestapo chief was able, however, to swallow a vial of poison carried under his tongue, and he died within a few minutes.

HIMYARITES: *see* ARABIA: *History.*

HINCKLEY, a market town and urban district in the Bosworth parliamentary division of Leicestershire, Eng., 13 mi. S.W. of Leicester by road. Pop. (1951) 39,094. Area 18.6 sq.mi. The ditch of a castle erected in the time of William Rufus is still to be traced; the site is a garden of remembrance. In the 19th century Hinckley was a spa and health resort. A weekly market has been held since 1311; the grammar school dates from the 16th century and there is a technical college. Hinckley's main and oldest industry is that of hosiery, footwear is made and there are dye and engineering works. The battle site of Bosworth field (*q.v.*) is 5 mi. N.

HINCKS, EDWARD (1792–1866), British Assyriologist, was born at Cork, Ire., and educated at Trinity college, Dublin. He took orders in the Protestant Church of Ireland and was rector of Killyleagh, Down, from 1825 till his death on Dec. 3, 1866. Hincks devoted his spare time to the study of hieroglyphics and to the deciphering of the cuneiform script, working out contemporaneously with and independently of Sir Henry Creswicke Rawlinson the ancient Persian vowel system. He published a number of papers on Assyriological questions, chiefly in the *Transactions* of the Royal Irish academy.

HINCKS, SIR FRANCIS (1807–1885), Canadian statesman, was born at Cork, Ire., and migrated to Canada, where he settled in business at Toronto. After ten years of political life he became premier of Canada (1851–54), and co-operated with Lord Elgin in negotiating the reciprocity treaty of 1854 with the United States. In 1855 he was chosen governor of Barbados and the Windward Islands, and subsequently governor of British Guiana. He was finance minister (1869–73) in the cabinet of Sir John Macdonald. In 1879 the failure of the Consolidated Bank of Canada, of which he was president, led to his being tried for issuing false statements. Though found guilty on a technicality (see *Journal* of the Canadian Bankers' Association, April 1906), judgment was suspended and his personal credit remained unimpaired. He died on Aug. 18, 1885.

His writings include: *The Political History* of *Canada between 1840 and 1855* (1877); *The Political Destiny of Canada* (1878), and his *Reminiscences* (1884).

HINCMAR (c. 805–882), archbishop of Reims, was born of noble parents and received his education at St. Denis under the direction of abbot Hilduin who brought him in 822 to the court of the emperor Louis the Pious. When Hilduin was disgraced in 830 for supporting Lothair, Hincmar accompanied him into exile at Corvey, but returned with him when the abbot was reconciled with the emperor. Through the influence of Charles the Bald, he received the abbacies of Notre Dame at Compiègne and St. Germer de Fly, and in 845, the archbishopric of Reims. Archbishop Ebbo had been deposed in 835 at the synod of Thionville (Diedenhofen) for having broken his oath of fidelity to the emperor Louis, but on the death of Louis, he regained possession of his see for some years (840–844), until in 844 Pope Sergius II confirmed his deposition.

From the beginning of his episcopate Hincmar was in conflict with the clerks who had been ordained by Ebbo during his reappearance. His view that their ordination was invalid was confirmed in 853 at the council of Soissons, and in 855 by Pope Benedict III. This conflict, however, bred an antagonism of which Hincmar was later to feel the effects. During the next 30 years the archbishop of Reims played a very prominent part in political and religious affairs. In the latter sphere, his first encounter was with Gottschalk (*q.v.*), whose predestinarian doctrines were claimed to be drawn from St. Augustine. Hincmar secured the condemnation of these doctrines at Quierzy (853) and Valence (855), and the decisions of these two synods were confirmed at the synods of Langres and Savonnières, near Toul (859). To refute the predestinarian heresy he composed his *De praedestinatione Dei et libero arbitrio,* and against certain propositions advanced by Gottschalk on the Trinity he wrote his *De una et non trina deitate.* The question of the divorce of Lothair II, king of Lorraine, who had repudiated his wife Theutberga to marry his concubine Waldrada, engaged Hincmar's literary activities in another direction.

In the middle of the 9th century there appeared in Gaul the

collection of false decretals known as the Pseudo-Isidorian Decretals. Rothad, bishop of Soissons, one of those who favoured the pseudo-Isidorian theories, came into collision with his archbishop. Deposed in 863 at the council of Soissons, presided over by Hincmar, Rothad appealed to Rome. Pope Nicholas I supported him, and in 865, in spite of the protests of the archbishop of Reims, Arsenius, bishop of Orta and legate of the Holy See, was instructed to restore Rothad to his episcopal see. Hincmar experienced another check when he endeavoured to prevent Wulfad, one of the clerks deposed with Ebbo, from obtaining the archbishopric of Bourges. Nicholas I pronounced in favour of the deposed clerks, and Hincmar had to submit. He was more successful in his contest with his nephew Hincmar, bishop of Laon. who refused to recognize the authority of his metropolitan. Hincmar exposed his errors in a treatise *Opusculum* LV. *capitulorum,* and procured his deposition at the synod of Douzy (871). A more serious conflict arose between Hincmar on the one side and Charles and the pope on the other in 876, when Pope John VIII, at the king's request, entrusted Ansegisus, archbishop of Sens, with the primacy of the Gauls and of Germany, and created him vicar apostolic. Hincmar regarded this as an encroachment on the jurisdiction of the archbishops, and published his *De jure metropolitanorum.* At the same time he wrote a life of St. Remigius to prove the supremacy of the church of Reims over the other churches. Charles the Bald, however, upheld the rights of Ansegisus at the synod of Ponthion. On Charles's death, he helped to secure the submission of the nobles to Louis the Stammerer, whom he crowned at Compiègne (Dec. 8, 877).

To Carloman, on his accession in 882, Hincmar addressed his *De ordine palatii,* partly based on a treatise (now lost) by Adalard, abbot of Corbie *(c.* 814), in which he set forth his system of government and his opinion of the duties of a sovereign, a subject he had already touched in his *De regis persona et regio ministerio,* and in his *Instructio ad Ludovicum regem.* In 882 an irruption of the Normans forced him to take refuge at Epemay, where he died on Dec. 21, 882.

Hincmar's works, which besides the above include many theological tracts and a continuation from 861 of the *Annales Bertiniani,* written by Prudentius, bishop of Troyes, were printed in Paris (1645) and in Migne, *Patrol. Latina,* vol. cxxv and cxxvi. *See* J. C. Prichard, *Life of Hincmar* (1849); *C.* von Noorden, *Hinknzar, Erzbischof von Reims* (Bonn, 1863); H Schrors, *Hinkmar, Erzbischof von Reims* (Freiburg-i-B., 1884); Abbé Lesne, *La Hiérarchie épiscopale en Gaule et en Germanie* (1905); Hefele, *Konziliengeschichte IV* (Freiburg-i-B., 1879).

HIND, the female of the red deer, usually taken as being three years old and over, the male being known as a "hart." It is sometimes applied to the female of other deer.

In Scotland the hind is a farm servant, with a cottage on the farm, and duties and responsibilities that make him superior to the rest of the labourers. Similarly hind is used in certain parts of northern England as equivalent to bailiff.

HINDEMITH, PAUL (1895–), German composer, was born at Hanau on Nov. 16, 1895, and studied at the Hoch conservatorium in Frankfurt. For eight years (1915–23) he was first leader and then conductor of the opera there. In 1923 he joined the Amar quartet as viola player. Among much which is frankly experimental he produced a good deal also which secured the genuine approbation of even conservatively inclined musicians. His works include the operas *Cardillac* (1926), *Neues vom Tage* (1929) and *Mathis der Maler* (1934); the puppet-play *Das Nusch-Nuschi* (1921); one symphony, songs and choral music and much chamber music including works for chamber orchestra with one solo instrument.

His works were banned by the nazis in 1933. He emigrated to the U.S. in 1939 and joined the faculty of the Yale university school of music in 1941.

See F. Wilms, "Paul Hindemith," in *Von neuer Musik* (1925); Heinrich Strobel, *Paul Hindentith* (1928).

HINDENBURG, PAUL VON (1847–1934), German soldier, second president of the German reich. Paul Ludwig Hans von Beneckendorf und von Hindenburg was born in Posen Oct. 2, 1847, the son of a Prussian officer whose family traced its military record to the 13th century. In 1858 he entered the cadet school at Wahlstatt in Silesia, later joining the chief cadet academy in Berlin. He entered the 3rd foot guards at Danzig as a second lieutenant in 1866. At the battle of Koniggratz, he was wounded while storming an Austrian battery for which he received the order of the Red Eagle. In the Franco-German war of 1870–71, he received the Iron cross for bravery at St. Privat, and was chosen to represent his regiment at the proclamation of the German empire at Versailles.

During the next 40 years Hindenburg rose from captain to general, being promoted not for outstanding achievement but in the regular advancement of a conscientious officer. In 1903 he was appointed to command the 4th army corps at Magdeburg, and in this capacity participated in the imperial manoeuvres of 1908, when he committed the mistake of allowing the corps commanded by the kaiser to lose the battle. In 1911, he was allowed to retire at his own request, because "there was no prospect of a war." He settled down in Hanover, where he was able to indulge his passion for shooting. He had married the daughter of a general, and his son Oskar was a second lieutenant in his old regiment.

When war broke out on Aug. 1, 1914, Hindenburg chafed in a fever of inactivity. On Aug. 22 he received a telegram appointing him to command the 8th army in East Prussia and at 3:00 A.M. on the 23rd boarded a train at Hanover on which he found Major Gen. Erich Ludendorff, an officer who had distinguished himself at the siege of Liège and had now been made chief of staff to Hindenburg. Ten days later Hindenburg leaped from obscurity into world-wide fame as the victor of Tannenberg.

Legend long had it that Hindenburg had been appointed because of his familiarity with the region of the Masurian lakes (a brother lived at Neudeck, the family home) and that he had worked out plans for a battle years before; but he himself declared that he had never seen the battlefield until Aug. 24, 1914. Two Russian armies, under Gen. Alexander Samsonov and Gen. Paul Rennenkampf, were advancing into East Prussia and driving back the numerically inferior Germans whose commander, Gen. Max von Prittwitz, became somewhat panicky. By the time Hindenburg and Ludendorff arrived on the scene, the chief of staff,Lt. Col. Max Hoffmann,had devised a plan for stopping the Russians, which was to beat Samsonov first and then turn on Rennenkampf. The two generals agreed. On Aug. 26, Ludendorff, upset by a hitch, wished to modify the plan, but was overruled by Hindenburg, who remained calm and resolute. By Aug. 31, Samsonov's army had been surrounded and beaten, 100,000 being killed, including Samsonov, and an equal number taken prisoner. In the following week, Rennenkampf's army was dispersed and defeated and East Prussia was cleared of enemy troops. It was Hoffmann's idea to report the victory from Tannenberg, where the Teutonic Knights had been defeated by the Poles in 1410, and thus even the score in the struggle of *Germanentum* and *Slaventum,* which was a leitmotiv of the war. Because of his official position, however, Hindenburg could and did claim credit for the victory, and he almost immediately became the most popular man in Germany; he himself gradually realized this and cultivated his position until he became a legend, against which all other factors in the state, including the emperor, were powerless. A monster wooden statue of Hindenburg was erected in Berlin, into which his admirers drove thousands of nails.

For the next four years Hindenburg and Ludendorff were inseparable. Hindenburg later described their relations as those prevailing in "a happy marriage." Ludendorff, with the assistance of Hoffmann and others, formulated plans for the conduct of operations and submitted them to his chief, who "invariably" (says Ludendorff) approved them. Hindenburg's tranquillity enabled him to restrain the impetuous Ludendorff—"no one ever saw Hindenburg out of temper and nobody ever saw Ludendorff laugh," remarks one biographer. There is no doubt that the pair functioned together admirably, and as the war advenced they became the practical rulers of Germany.

Hindenburg was unable to follow up his victories in East Prussia by advancing across the lower Narev, for the Austro-Hungarian armies had been badly defeated in Galicia and German forces had

to be sent to their assistance. The Germans in southern Poland then advanced toward the Vistula and the Austrians toward the San. The Russians counterattacked from Warsaw. Much confused fighting followed, in the course of which Hindenburg regrouped his forces on a line from Posen to Thorn and then moved against Lodz. He captured the city on Dec. 6, but did not have enough troops to crush the Russians, who retired behind the Bzura and Rawka rivers.

Meanwhile Hindenburg had been promoted to field marshal and appointed commander in chief of all German forces in the east. Since the German armies in the west had not been too successful and trench warfare had in fact been introduced, Hindenburg and Ludendorff clamoured for huge reinforcements with which to follow up their victories against the Russians, but Gen. Erich von Falkenhayn, who had succeeded Gen. Helmuth von Moltke as chief of the general staff after the defeat at the Marne, refused, for he believed that the war had to be won in the west. Hindenburg appealed to the emperor, who was thus forced to choose between his chief of staff and his most popular and successful general. A compromise was reached by which an offensive in the east was approved, but only with the troops already available; the Austro-Hungarian armies were to strike in the south, and it was hoped to catch the Russians in a vast encircling movement. Hindenburg opened his attack in Masuria on Feb. 7, 1915, but was unable to cross the Narev to Bialystok. When the general eastern campaign, directed by Falkenhayn, began with the break-through at Gorlice on May 2, Hindenburg's armies, stretching from the upper Vistula to Courland, remained stationary, except for local offensives. The Russians withdrew steadily, but their armies were not destroyed. Hindenburg was convinced that victory for the Central Powers depended upon the destruction of the Russian colossus and proposed a super-Tannenberg, an outflanking movement to cut off the Russians behind Warsaw, by striking towards Kovno and Vilna. Falkenhayn, on the other hand, held that it would be sufficient by means of a "campaign with limited objectives" to keep the Russian army at bay and thus cripple its offensive power; the chief of staff, being responsible for the western front as well, could not bring himself to take the troops from France necessary for the execution of Hindenburg's plan. With the support of the emperor, he rejected the large strategy in favour of an advance across the lower Narev, which was to be carried out in conjunction with an attack by Gen. August von Mackensen and the Austrians in the south. The relations between Hindenburg and Falkenhayn became very cool.

At first Falkenhayn's scheme seemed to work out well, for the Russians withdrew from Warsaw on Aug. 5, from Kovno on Aug. 17, and from the fortress of Novo-Georgievsk on Aug. 18. Nevertheless their armies under the grand duke Nicholas escaped annihilation. So Hindenburg and Ludendorff once more pressed their idea by proposing to surround the Russian centre at the Pripet marshes, and once more Falkenhayn refused. In September he ostensibly gave way, but without placing at Hindenburg's disposal the necessary forces, and an attack on Vilna petered out. At the end of the campaign, Hindenburg celebrated the 50th anniversary of his entry into the Prussian army.

From the autumn of 1915, Falkenhayn treated the Russian front as subsidiary and in Feb. 1916 launched a mighty attack on Verdun, in the hope of putting France out of the war. In spite of a sharp protest, Hindenburg had been forced to surrender divisions, and could not do more than defeat a Russian offensive on the Narev in March 1916. In June and July the Russians under Brussilov broke through the Austro-Hungarian front at Luck and created such havoc that Hindenburg had to be placed in command of the entire eastern front from Riga to Galicia, with headquarters at Brest-Litovsk. He was able to stabilize the new line and restore order. Meanwhile, Falkenhayn's offensive against Verdun had obviously failed, the British and French were pushing ahead on the Somme, the Italians captured Gorizia, and on Aug. 27, Rumania declared war against the Central Powers. This last event sealed Falkenhayn's fate. Hindenburg was appointed chief of staff, with Ludendorff as first quartermaster general, and they repaired to Pless, the German headquarters.

Thanks to the Hindenburg myth, his appointment restored German morale, at least for a time, and a supreme war command was established which the field marshal exercised in the name of the emperor. But more than ever Ludendorff became the directing spirit, especially in the negotiations with the government and the *Reichstag*. Thus it was Ludendorff who insisted on the proclamation of the kingdom of Poland in Nov. 1916 and on the resumption of submarine warfare in Jan. 1917, which was to involve the United States in the war; Hjndenburg's role was to lend the support of his prestige to the proposals of his nominal subordinate. Likewise the tightening-up of the economic effort, the so-called "Hindenburg program," was inspired by the first quartermaster general.

From a military point of view, Hindenburg's visit to the western front made him for the first time conscious of the danger there. So the offensive against Verdun was abandoned, and in March 1917 the German lines were withdrawn somewhat to the east, being re-established from Arras through St. Quentin to Vailly-sur-Aisnes on what was officially called the *Siegfried-Stellung* but is known to history as the "Hindenburg line." Against this the Allied offensive organized by Gen. Robert Georges Nivelle spent itself in vain, and for the rest of 1917 the Germans were not seriously disturbed, for the Passchendaele "push" cost the British more than it did the Germans.

So secure did Hindenburg and Ludendorff feel that in July 1917 they brought about the resignation of the chancellor, Theobald von Bethmann Hollweg, whom they regarded almost as a defeatist, and imposed on William II an unknown politician named Georg Michaelis, who could be counted on to do their bidding. The new chancellor soon repudiated a peace resolution adopted by the *Reichstag* on July 19 which asked for peace without annexation or indemnities on either side. Henceforth the supreme command exercised dictatorial power. It rebuffed a suggestion for peace negotiations made by Pope Benedict XV by refusing to make a declaration concerning the restoration of Belgium, and it took its own line in dealing with the Russian situation.

Shortly after the Russian revolution broke out, Ludendorff—without the knowledge of Hindenburg—arranged for the passage through Germany of Lenin, the Bolshevist agitator, then living in Switzerland, but anxious to return to Russia. Lenin reached Petrograd in April and at once launched a campaign for peace. The morale of the Russian armies was rapidly affected, and although Alexander Kerensky, the minister of war, was able to restore it sufficiently for an offensive in July, its fighting spirit was definitely broken. When the Bolshevists mounted to power in November, they promptly proposed an armistice, and the Central Powers accepted. In the peace negotiations Hindenburg stood out for the establishment of a "protective belt" on the Prussian front—whereas Hoffmann, usually in full agreement with his superiors, objected to the inclusion of more Poles in Germany. Hindenburg and Ludendorff protested strongly against Hoffmann's intrusion, and the emperor yielded. The two generals then formulated harsh terms and forced them on Russia by threatening to resume military operations. The treaty of Brest-Litovsk of March 3, 1918, was one of the severest in history, for it took from Russia 301,000 sq.mi. of territory and 56,000,000 inhabitants. A supplementary and severe treaty with Rumania followed in May 1918.

Hindenburg's greatest task, however, remained: to defeat Great Britain and France before the United States could intervene in force, for Ludendorff had decided, and Hindenburg had accepted his view, that the favourable military situation in the east was not to be used for offering peace on reasonable terms in the west. Hindenburg forced this policy on the unhappy William II by the threat that he and Ludendorff would resign. Later the two generals brought about the resignation of the chief of the emperor's civil cabinet, Rudolf von Valentini, who favoured a negotiated peace. It was Ludendorff, rather than Hindenburg, who decided that the German attack should be directed primarily against the British, near their junction with the French, in order to drive a wedge between the two armies.

The battle which opened on March 21, 1918, the "Kaiser's battle," and lasted till Nov. 11, was the greatest in history (up to that

time). From a tactical point of view the first blow in the direction of Amiens was a brilliant success, for the British front reeled badly — without, however, breaking. A second attack on the Lys had the same result. Nevertheless, Hindenburg clung to his resolve to deal the decisive blow against the British in Flanders. In order, however, to divert the French reserves, he attacked along the Chemin-des-Dames and threw the French back to the Marne, where, for the first time. German troops came into real contact with the U.S. army. Despite large gains of territory, the Germans failed to break through the Allied lines at any point, and men like Prince Max of Baden and the crown prince of Bavaria urged the necessity of trying to obtain peace. But when Richard von Kuhlmann. the foreign minister, spoke in the *Reichstag* in this sense, the generals forced the emperor to dismiss him on July 8. A week later, they opened the last German offensive at Rheims.

This was the beginning of the end, for not only were the Germans stopped with frightful losses but Marshal Ferdinand Foch immediately replied with an Allied counteroffensive from Villers-Cotterêts, in which U.S. troops assumed a large role. Henceforth the initiative rested with the Allies. On Aug. 8, which Ludendorff called "the black day of the German army," the British struck east of Amiens so savagely that the Germans were unable to counterattack and large numbers of them were captured. From that time until November the German armies were forced from one position to another, although they fought bravely and stubbornly.

At a conference of the highest military and civilian officials held under the presidency of William on Aug. 14. Ludendorff let his opinion be known that the war could no longer be won by military operations. Hindenburg, on the other hand, assured the emperor that it would be possible to "maintain our troops on French territory and thereby in the end to enforce our will on the enemy." Chancellor Georg von Hertling passed these assurances on to the *Reichstag* and the political leaders. and no negotiations for peace were started. By the end of September, however, Bulgaria had withdrawn from the war and the Hindenburg line in the west had been pierced, while discontent was seething at home. On Sept. 28 Ludendorff. losing his nerve, concluded that an immediate armistice was imperative and communicated this to Hindenburg, and the next day the two generals informed the emperor, who accepted the situation calmly and announced the establishment of a parliamentary regime in Germany, with Prince Max of Baden as chancellor. In spite of Max's protests, the generals insisted on an armistice, and he appealed to Pres. Woodrow Wilson on Oct. 4.

As the month passed. the military situation of the German army was found to be less desperate than had been supposed, but the negotiations for an armistice could no longer be halted. On Oct. 24 Hindenburg telegraphed to all army group commanders denouncing the terms demanded by Wilson and ordering a fight to a finish. Such an act could not be tolerated by the new government, and Prince Max protested. This time the emperor yielded, not to the supreme command, but to the civilian chancellor, and Ludendorff resigned—while Hindenburg stayed, although it was he who had signed the telegram. Gen. Wilhelm Groener was appointed to succeed Ludendorff. By this time Austria-Hungary and Turkey were also ready to withdraw from the war. Also, the negotiations with Wilson had raised the question of the emperor's abdication. The emperor, incidentally, had left Berlin and gone to general headquarters at Spa, where he was out of touch with political realities. The chancellor urged William to abdicate in favour of his grandson, but in vain. The emperor wished to place himself at the head of troops and march against the revolution, but Groener was forced by Hindenburg to tell him that the army would not follow him. William then proposed to abdicate as emperor but remain king of Prussia. On Nov. 9 the revolution occurred in Berlin by which a republic was proclaimed and Friedrich Ebert, the Social Democratic leader, named chancellor. Hindenburg had then to advise the emperor to abdicate and to proceed to Holland, adding "Would to God, Sire, it were otherwise." William II never forgave Hindenburg for his exile.

With the signing of the armistice on Nov. 11, Hindenburg's role changed completely. He was no longer a victorious general but a beaten commander who had to lead his armies home as best he could. Thanks to his reputation, the armies marched back with good discipline. Hindenburg deeply resented the terms of the Versailles treaty, but when asked by the government if there was any chance of successful resistance, he evaded the issue and once more forced Groener to take the responsibility for the decision. The field marshal then retired for the second time to Hanover.

Hindenburg offered to place himself at the disposal of the Allies, in place of William II, who was accused in the treaty of Versailles of "a supreme offense against international morality and the sanctity of treaties," but no reply came. He then prepared his memoirs, *Out* of My *Life* (1920), in which he declared that the German army had not been truly beaten but had been betrayed by the revolution, thus creating the legend of the "stab in the back." He also appeared before a committee of the national assembly which was investigating the causes of the war and of the German defeat; he treated it with scant respect and made it look ridiculous. In 1923 Frau von Hindenburg died. Seemingly the old marshal having rounded out his second life, had nothing more to live for.

When President Ebert died in Feb. 1925, the Nationalists remembered Hindenburg and persuaded him to accept a nomination for the presidency. On April 26, 1925, he was elected by 14,600,000 votes, as against 13,800,000 for Wilhelm Marx, the candidate of the Catholics, Liberals and Socialists, and thus began a third life, this time in a civilian capacity. Though a monarchist by tradition and conviction, Hindenburg made no effort to restore the Hohenzollerns and allowed the republican regime to function without much interference. Perhaps his chief service was to restore the confidence of the German people in themselves. He was much influenced by Otto Meissner, secretary of state to the president, who had risen to power under Ebert, and by a camarilla of generals and conservative politicians which gradually formed around him.

In 1930 he appointed as chancellor the Catholic leader Heinrich Bruening, to whom he took a great liking. In order to deal with the economic difficulties which were becoming increasingly serious, the president, practically violating his oath, allowed the chancellor to rule more and more by decree under article 48 of the constitution. In the confused state of German politics and the multiplicity of parties, this sabotaging of the *Reichstag* seemed to have its advantages; but in 1932 Hindenburg was persuaded that Bruening was planning legislation to the disadvantage of the *junker* landlords of East Prussia and dismissed him out of hand—and the chancellor could not defend himself by appealing to the *Reichstag*. Inasmuch as Hindenburg had been re-elected president only two months before, defeating Adolf Hitler, largely through Bruening's efforts, the treachery was hardly deserved.

As successor to Bruening, the president appointed Franz von Papen, a close friend but a deep intriguer. Papen was succeeded by General von Schleicher, another favourite, only to be in turn ousted in Jan. 1933. Adolf Hitler's National Socialists were now the strongest party in Germany, and Hitler had made a bid for power in the summer of 1932. Hindenburg refused to appoint "that Bohemian corporal," but in Jan. 1933 he was persuaded to do so by Papen, who thought that he and the other experienced politicians of the right could manipulate the upstart Viennese paperhanger. It should be said that the old marshal had become somewhat senile and in all probability did not understand the machinations of those around him, including his own son Oskar, who had allowed the estate of Neudeck, East Prussia, presented to Hindenburg by admiring *junkers*, to be registered in his own name in order to escape the payment of inheritance taxes when his father should die. The calculations of Papen were quickly and completely frustrated by Hitler, who was soon able to possess himself of complete power. Hindenburg's career was now practically ended, although Hitler treated him with marked respect, and he spent more and more time at Neudeck. When Hitler carried through his purge on June 30, 1934, a telegram was sent from Neudeck congratulating him on having "nipped treason in the bud and saved the German nation from serious danger." It bore Hindenburg's signature; whether it was actually signed by him

remains uncertain. On Aug. 2, 1934, he died at Neudeck. In 1935 his body was moved to Tannenberg.

Hindenburg was Germany's greatest hero of World War I, and even in other countries he was long regarded as one who had served the state honestly and well. After his death opinion became more critical. Certainly he took credit for much which others did, while he tried to evade responsibility at critical moments, and it was a misfortune that he continued to hold the highest office in Germany after his faculties had begun to fail. Perhaps the best description of this massive personality is in the title of an English biography, "Wooden Titan."

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(B. E. S.)

HINDENBURG (ZABRZE), a town of Germany. in the extreme southeast of Prussian Silesia, on the railway between Gleiwitz and Konigshiitte. Pop. (1939) 126.402. Like other towns in this region, it is an important manufacturing centre, having coal mines, iron, wire, glass, chemical works, breweries, etc.

HPNDENBURG LINE, BATTLES OF 1918. On Aug. 26, 1918. began the third stage of the series of offensive operations which formed the British share of the Allied advance to victory. This stage culminated on Oct. 5 in the capture of the last and strongest system of German defence, known as the Hindenburg Line. The first stage had been the attack by Rawlinson's IV. Army, assisted by the French I. Army under Debeney, eastwards and southeastwards from Amiens with the object of freeing the Paris-Amiens railway. In the second phase the British III. Army under Byng had extended the front of the attack northwards by a successful thrust towards Bapaume. The British I. Army under Horne was now to broaden the front of attack by driving eastwards from Arras with the object of turning the German positions on the Somme battlefields.

Hindenburg Line Described.—The Hindenburg Line consisted of a heavily wired system of trenches which ran northwards from St. Quentin to the village of Bantouzelle approximately parallel to the Schelde Canal. This portion was known to the Germans as the Siegfried Line. From Bantouzelle the main line of trenches ran northwest to Havrincourt, whence it turned north and followed the line of the Canal du Nord to Moeuvres. From Moeuvres it ran northwest past Quéant and Bullecourt to the original German front line east of Arras. Within this northern bend in the system, and covering the approaches to Cambrai, lay several snitch lines and defensive positions, the most formidable of which were the Drocourt-Quéant Line, which ran in a northerly direction from the Hindenburg Line at Quéant, and the Canal du Nord, which passed by Moeuvres to the Sensée.

On the night of Aug. 25–6 the British line extended from a point northwest of Chaulnes, where the right of the British IV. Army joined the left of the French I. Army, east of Bray, nest of Bapaume to Croisilles, and thence northwest to the old British line, southeast of Arras. The IV. Army had the Australian and III. Corps in line; the III. Army, which extended northwards from a point east of Albert, had the V., IV., VI. and XVII. Corps. The I. Army front was held by the Canadian Corps and the VIII. and I. Corps, of which only the Canadian Corps, astride the Scarpe, was involved in the operations to be described. The German troops who were to bear the brunt of the impending blow were the left wing of Bulow's XVII. Army, the II. Army under Marwitz and the right wing of Hutier's XVIII. Army.

The Offensive Launched.——At 3:00 A.M. on Aug 26 the Canadian Corps under Sir A. Currie attacked the German positions astride the Scarpe on a front of 53 miles. The attack was carried out by the 2nd and 3rd Canadian Divs. and the 51st Highland Div. supported by 45 tanks and some 600 guns. The XYII. Corps of the III. Army co-operated on the right. The attack was a complete success. The Bavarian II. Corps and Bavarian I. Res. Corps were driven back through Wancourt. Guémappe, Monchy and Roeux. and by evening, in spite of strong counter-attacks, the Canadian Corps had established itself well to the east of those villages. On Aug. 27 the attack was continued by the same divisions, and Chérisy, Vis-en-Artois and Gavrelle fell into their hands. On the following day the Canadian 3rd Div. made further progress, and that night both divisions were relieved, the Canadian 2nd Div. by the Canadian 1st. while the British 4th Div. relieved the Canadian 3rd. During the next few days considerable progress was made. This advance brought the British to within assaulting distance of the formidable trench system known to the Allies as the Drocourt-Quéant Line, and to the Germans as the Wotan Line. The capture of this system, would, it was anticipated, turn the whole of the German organized positions for some distance southwards. Preparations were put in hand to launch the attack on Sept. 2. The XXII. Corps took over the front north of the Scarpe held by the 51st Div. and relieved that division by the 11th.

The Drocourt-Quéant Line Attacked.—By the evening of Sept. 1 all preparations for the attack of the Drocourt-Quéant Line were complete. The main attack was to be carried out by the Canadian Corps, whose principal task was to break through the defences between Hendecourt and Sailly. The XXII. Corps, also of the I. Army astride the Scarpe, mas to secure the Canadian left, while the XVII. Corps of the III. Army, advancing on the right of the Canadians, was to capture the maze of trenches at the junction of the Drocourt-Quéant and Hindenburg lines, and turn the last named defensive position from the north. The XVII. and Canadian Corps were then to push on up to and if possible beyond the Canal du Nord.

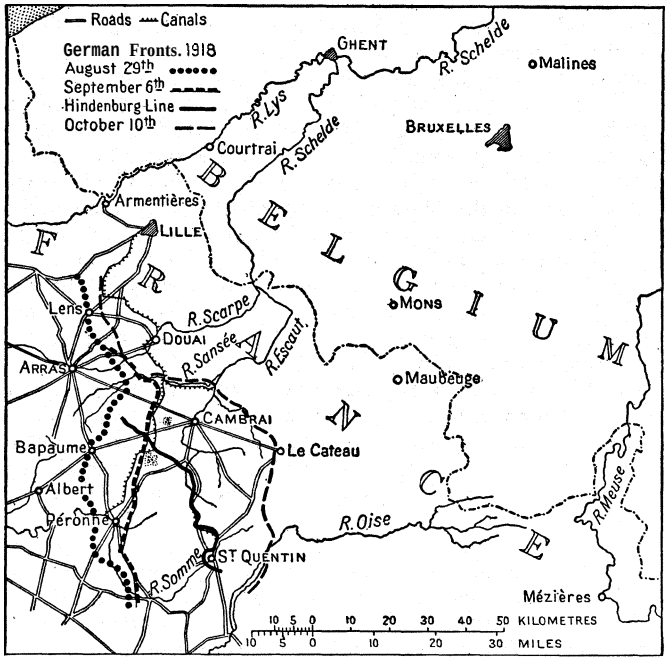
The attack of the Canadian Corps was launched at 5:00 A.M. by the Canadian 1st and 4th and the British 4th Divs., supported by some 500 guns and 40 tanks, on a front of $4\frac{1}{2}$ miles. All resistance on the first objective was speedily overcome, and by 9:15 A.M. the whole system of trenches on the front of the Canadian Corps was in the hands of the assaulting troops. On the XVII. Corps front, the attack was launched at the same hour and met with equal success. The 52nd Div. stormed the network of trenches at the junction of the two systems, and after heavy fighting succeeded in overcoming all resistance. The 57th Div., attacking north of the 52nd, pressed forward south of the Canadians, and by nightfall had swung round to the right and were threatening the villages of Quéant and Pronville from the north. The 63rd Div. had heavy fighting during the afternoon, but by dark had reached the railway east of Quéant.

During the afternoon the Canadian Corps met with increased opposition, particularly from machine guns on the British 4th Div. front, but by the evening an advance of some 3 mi. had been made and British troops had captured Cagnicourt, Villers and Dury, and were approaching the outskirts of Buissy. Eight thousand prisoners and many guns were captured, bringing the total captures on the I. Army front alone since Aug. 26 to 16.000 prisoners and 200 guns. In eight days the 10 British and Canadian divisions employed by the I. Army had defeated 13 German divisions and driven them back 10 mi., out of all their organized positions in front of Cambrai. Troops of the III. and IV. Armies prolonged the attack southward on Sept. 2, and substantial progress was made, though the fighting was severe.

The results of this most successful operation became obvious at once, as on the night of Sept. 2–3 the Germans fell back to the line of the Canal du Nord from Pkronne to Hermies. The following day they commenced to withdraw from the Somme, south of Péronne, and by the night of Sept. 8 they were back on a line Yermand (6 mi. west of St. Quentin)-Epehy-Havrincourt and thence along the east bank of the Canal du Nord to the Sensée.

Preparatory Operations Continued.—The Canal du Nord. behind which the German forces facing the I. Army and left of the III. Army had now established themselves, was far too

strong a natural position to warrant attack without very careful preparation. The next three weeks were therefore devoted by the British forces on this front to the organization of an operation which eventually took place on Sept. 27. South of Havrincourt the German main line of resistance was the Hindenburg Line, but strong forces were still occupying advanced positions in the trenches which formed the old British and German lines



MAP SHOWING SUCCESSIVE GERMAN FRONTS BETWEEN AUG 29 TO OCT. 10, 1918 AND THE GENERAL TREND OF THE HINDENBURG LINE

prior to the German offensive in March 1918. These had to be captured before the Hindenburg Line itself could be assaulted, and to this end operations were undertaken by the British III. and IV. Armies.

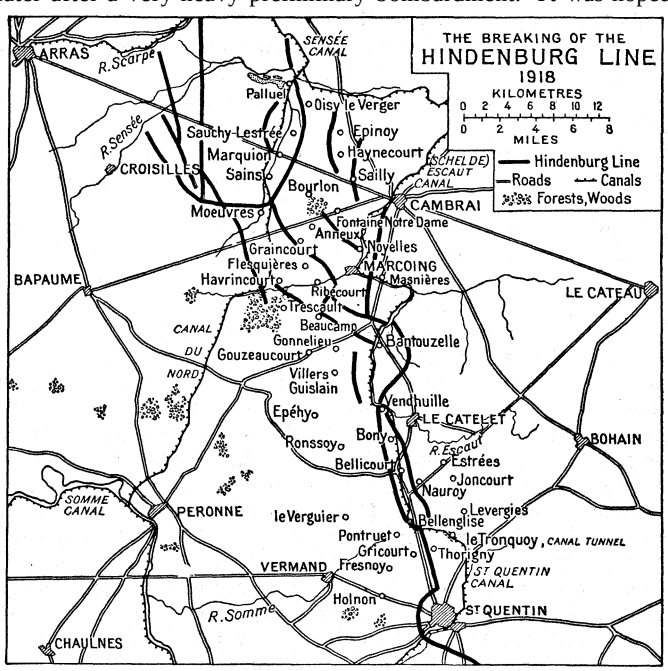
On Sept. 12 the III. Army attacked with the IV. Corps and the VI. Corps on a 5m. front in the neighbourhood of Havrincourt Wood. A considerable advance was made and the villages of Trescault and Havrincourt were captured. Meantime the IV. Army had continued to press the German withdrawal, and between Sept. 11 and 17 the line had been pushed forward at several points. On Sept. 18 a much more extensive operation was undertaken, in which the IV. Army in conjunction with the III. Army attacked the German forces on a 17m. front from Holnon to Gouzeaucourt. The French I. Army co-operated on the right. The final objective of the main attack was the old British outpost line running past Pont Ruet, west of Bellicourt, Bony and Vendhuille. It was not intended that this final objective must necessarily be reached on the first day—and in fact it was not reached until after several days of very severe fighting.

At 7:00 A.M. on Sept. 18 the IV. and III. Armies attacked in heavy rain. The attack was supported by 23 tanks and 978 guns, and in some sectors dummy tanks were used with considerable success. The IX. Corps advanced on the right with the 6th and 1st Divisions. The first objectives were taken at 9:00 A.M., but the 6th Div. was checked at Holnon and west of Fresnoy. The 1st Div. was more successful, but was unable to reach Pont Ruet, and both divisions suffered severe casualties. The Australian Corps had very heavy fighting, particularly in and about Le Verguier, and was held up in front of its final objective till dusk. During the night a successful attack was made which completed the operation on the Australian front.

North of the Australians the III. Corps attacked with the 74th, 18th, 12th and 58th Divs., and met with very stubborn resistance. Ronssoy was captured by the 18th Div. and Epéhy by the 12th and 58th Divs., but little progress was made beyond these places. The V. Corps of the III. Army continued the front of attack to the north and all divisions made considerable progress, though it was not found possible to take Gouzeaucourt on this day. Minor operations were undertaken during the succeeding week, which resulted in the capture of Gricourt and Pontruet by the IX. Corps, and by Sept. 26 the British line had been advanced to a position from which the attack on the main Hindenburg system could be launched. In this last series of operations 15 divisions of the British III. and IV. Armies had driven back 29 divisions of the German II. and XVII. Armies into the Hindenburg defences, and inflicted on them a loss of 12,000 prisoners and 100 guns.

The Storming of the Hindenburg Line.—All was now ready for the great effort to break through the Hindenburg Line. The strategic plan decided on by Marshal Foch and the Allied Commanders-in-Chief involved the launching of four convergent and practically simultaneous offensive operations. The Americans were to attack west of the Meuse in the direction of Mézières. The French offensive, also against Mézières, was to be launched west of the Argonne. The British were to break through the Hindenburg Line between St. Quentin and the river Sensée and advance on Maubeuge, while an Allied force (British, French and Belgian) under the King of the Belgians, was to attack in Flanders in the direction of Ghent. The results to be obtained from these offensive operations depended in no small degree on the success of the British attack in the centre, where a threat to the German vital systems of lateral communication would re-act on their defences elsewhere. It was here, too, that the German system of defence was most highly organized.

In accordance with the above general strategic plan the French and Americans attacked on Sept. 26; the British offensive commenced on the 27th, and the Allied attack in Flanders was launched on the 28th. Haig's plan was to strike first with his left wing in the direction of Cambrai, while the right wing, which was faced by the more formidable defences, was to attack later after a very heavy preliminary bombardment. It was hoped



DETAIL MAP SHOWING THE HINDENBURG LINE. WHICH WAS A SERIES OF STRONGLY FORTIFIED WORKS—NOT A SINGLE OR CONTINUOUS LINE

that any success obtained by the left wing would draw off the German reserves, and deceive their higher command as to the point where the main blow was to fall.

A very heavy bombardment was opened on the night of Sept. 26–27 on the front of the British I., III. and IV. Armies, and at 5:20 A.M. on the 27th four corps-attacked on a front of 13m. from Gouzeaucourt to the neighbourhood of Sauchy Lestrée. On the northern flank the Canal du Nord was too formidable an obstacle to be carried in face of opposition, and consequently the plan was conceived of crossing on a comparatively narrow front,

and then of turning the line of the canal farther north by a divergent attack from the point of crossing. This difficult manoeuvre was most successfully carried out. On the right the 5th and 42nd Divs. of the IV. Corps established and held a strong flank between Beaucamp and Ribecourt. On their left the VI. Corps advanced with the 3rd and Guards Divs., and captured Ribecourt and Flesquieres, while the 62nd and 2nd Divs., passing through, continued the advance in the direction of Marcoing. Farther north the 52nd and 63rd Divs. of the XVII. Corps forced the passage of the canal and, after heavy fighting, established themselves in Graincourt, and the 57th Div., in close co-operation with the Canadians, reached Anneux.

On the I. Army front the Canadian Corps attacked with the Canadian 4th and 1st Divs., and in the half light of dawn stormed the canal on the line Moeuvres-Sains-Marquion. With irresistible impetus the Canadian 4th Div. pushed on to Bourlon village and wood where the Canadian 3rd Div., taking up the attack, advanced towards Fontaine Notre Dame and Sailly. On the left the Canadian 1st Div. was equally successful, and, having captured Sains and Marquion, advanced rapidly towards Haynecourt and Sauchy Lestrée, while the British 11th Div. passed through and captured Epinoy and Oisy-le-Verger. Meanwhile the 56th Div. of the XXII. Corps crossed the canal, west of Sauchy Lestrée, cleared that village and advanced on Palleul. By the evening of Sept. 27 over 10,000 prisoners and 200 guns had been taken. As soon as the crossings of the canal were secured the British and Canadian engineers began to construct the necessary bridges, and in spite of heavy artillery fire completed their task with remarkable speed, and contributed in no small degree to the success of the operation.

On Sept. 28 the advance was continued and Gouzeaucourt, Marçoing, Noyelles, Fontaine Notre Dame, Sailly and Palleul were taken, and a footing was obtained on the east bank of the Schelde Canal at Marcoing. At 5:50 A.M. on the morning of Sept. 29, after a preliminary bombardment lasting over two days, in which some 1,600 guns were employed, the British IV. Army advanced to the attack, covered by an intense artillery barrage. The front of attack extended from Holnon to Vendhuile, a distance of about 12 miles. On the right the IX. Corps met with complete success. The 1st Div., advancing south of the bend in the canal at Bellenglise, established a flank facing southeast from Gricourt to the Le Tronquoy tunnel. The 46th Div., which was faced by a most formidable task, advanced with the greatest gallantry, and with the assistance of rafts, mats and even life-belts, stormed the canal at and north of Bellenglise and rushed the German trench system west of the canal. The German defences here faced south, and the British troops swung to the right and took them in flank and rear, capturing many prisoners and guns. By 3:00 P.M. the 46th Div. had broken through the Hindenburg Line to a depth of 3 miles, routed four German divisions, and taken over 4,000 prisoners and 70 guns at the small cost of 800 casualties. The 32nd Div., passing through, completed the capture of the Hindenburg Reserve Line, and by nightfall had taken 800 more prisoners and 20 guns.

Work **of** the American **Corps.**—On the left of the IX. Corps the American II. Corps had been superimposed on the Australian Corps. The task of the American troops was to break through the Hindenburg Line at and north of Bellicourt, where the St. Quentin Canal passes through a tunnel. The Australian 5th and 3rd Divs. were then to take up the attack and advance on more distant objectives. The Americans advanced with the greatest gallantry, but owing to the uncertain issue of a preliminary attack that had been made to secure a good starting line, their left division (the 27th) started half a mile behind the barrage—which the Army Command were reluctant to bring back. Without this protection its attack was quickly shattered with great loss. The Australian 3rd Div., following it up, could make but little headway and was finally checked in front of Bony. The American 30th Div. on the right was more successful, but also suffered heavily from German reserves who came up from their shelter in the tunnel, and it was only after very heavy fighting that the Australian 5th Div., passing through, finally succeeded in reaching the Hindenburg Reserve Line about Nauroy.

On the left the III. Corps carried out their task of securing the left flank of the IV. Army. On the same day the III. Army achieved an important success by securing the canal crossings at Masnières and northward as far as Cambrai, while the I. Army front was advanced northwest of that town. On Sept. 30 the break in the Hindenburg system was widened by the capture by the IX. Corps of Thorigny and Le Tronquoy, and on the same day the Germans abandoned Villers Guislain and Gonnelieu. On Oct. 1, in co-operation with the French I. Army who occupied St. Quentin, the IX. Corps took Levergies and the Australians captured Joncourt, Estrées and Bony. The III. and I. Armies also achieved important successes. During the first week in Oct. the XIII. Corps relieved the III. Corps north of the Australians and a series of successful minor operations were carried out on the fronts of all three armies, and by Oct. 5 the whole of the rearward lines of the Hindenburg system were in British hands.

Results **of** the Offensive.—During this nine days' battle 30 British and two American divisions had broken through the last and most powerfully organized system of German defences, had overwhelmed 39 German divisions and captured 36,000 prisoners and 380 guns. The effect of the British victory was decisive on the subsequent course of the campaign, and though there was still to be hard and bitter fighting before the termination of hostilities on Nov. 11, only natural obstacles such as woods, rivers and villages now lay between the British Armies and their objective at Maubeuge.

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HINDĪ is the national language of India. The 1951 census of India failed to ascertain the number of people using Hindi as their mother tongue; instead it computed returns from, Hindi, Urdū and Hindustani. Of the total 149,944,311, over 90,500,000 gave Hindi and 13,500,000 Urdū as their mother tongues; the remainder gave Hindustani (*q.v.*), the lingua franca of northern India.

Hindi or High Hindi developed as a standard language through the language program offered to British civil servants at the College of Fort William, Calcutta, in the 19th century. It was fashioned on a vernacular spoken near Delhi and in the upper Gangetic Doab, and spread as the language used by government officials. Later it was used for literary purposes and eventually it became the vehicle of prose composition—previously rare in any of the modern Indo-Aryan languages (*q.v.*). (For a sketch of Western Hindi see *Linguistic Survey* of *India,* vol. ix, pt. i, pp. 50–57, 1916.)

The term "Hindi" is applied to two groups of dialects, viz. Western and Eastern. Western Hindi, *i.e.*, the Indo-Aryan dialects of the middle and upper Gangetic Doab, and the country to the north and south, has as one of its standard dialects Braj Bhāshā (Braj Bhāṣā or Braj Bhākhā), spoken near Muttra (Mathura), with extensive literature directed to the worship of Krishna. Another is Hindustani, from which High Hindi was derived. Western Hindi represents the language of the Madhyadēśa (Midland), as distinct from the Intermediate and Outer Indo-Aryan languages in the classification devised by Sir George A. Grierson. Western Hindi has four main dialects: Bundēlī of Bundelkhand, Braj Bhasha, Kanauji of the central Doab and the country north and vernacular Hindustani of Delhi and the upper Doab. West of the upper Doab, across the Jumna, is another dialect, Bāngarū. Kanauji is closely related to Braj Bhāshā, and these two were with Awadhi the great literary vehicles of northern India until about 1850. Nearly all the classical literature of India is religious, Braj Bhāshā being concerned with Krishna, Awadhi with the Rāma cult and associated epic poetry.

Eastern Hindi, an Intermediate Indo-Aryan language spoken in Oudh, Baghelkhand and Chattisgarh, has a large and important literature. Its most famous writer is Tulsi Dās, poet and reformer,

who died early in the 17th century; since his time it has been the north-Indian language of epic poetry. Eastern Hindi has Bihārī to its east and Marāthī to the south, both being Outer languages. Awadhi (Avadhi), spoken in Oudh, is the most important dialect of Eastern Hindi. The other dialects, Chattisgarhi and Baghēlī, have little recorded literature. (For a sketch of Eastern Hindi see vol. vi of the *Linguistic* Survey *of India,* 1904.)

Modern Hindi literature: like other Indian literatures under British influence in the early 19th century, developed away from the conventions and themes of indigenous verse, and towards a standard language suitable for western prose forms—the novel, short story, essay, newspaper article, biography, history, literary criticism, tragedy and the one-act play. New themes reflect dynamic changes—social, political, intellectual and material—which entered the Indian social structure through contact with the west. Secular and popular themes were preferred to religious and esoteric themes; *e.g.,* daily life, society in transition, the need for social reform.

Of the first two great Hindi writers, Bharatendu Harischandra (1850–1883) and Mahavirprasad Dwivedi (1868–1938), the latter is considered the founder of modern Hindi prose through his influence as editor of the monthly *Saraswati* (first quarter of the 20th century). The period roughly from 1920 to 1937 was characterized by two movements. Limited to poetry, the first, the Chāyāvāda, was romanticist with a strongly theistic undercurrent. Its pioneers were the poets "Nirala" (Suryakant Tripathi, 1896–) and Sumitranandan Pant (1900–). The second movement, Pragativāda ("Progressivism"), was a blend of late romanticism and Marxian dialectic. At first it had common interests with the progressive-liberal outlook found in the most distinguished of Hindi writers, Prem Chand (1880–1936), but later it identified itself with the doctrinaire communist movement. These movements gave way in the post World War II period to the Nayī Kavitā ("New Poetry") or Prayogavāda ("Experimentalism") and, in prose, to the search for authenticity which has interested some writers in special segments of society and produced a regional fiction.

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(ET. B.)

HINDI AND URDU LITERATURE. The literatures of Hindi and Urdu are here grouped together because they are two forms of what is basically a single language, possessing a common grammatical structure and a largely common vocabulary of those words which relate to the elementary needs of daily life (see HINDUSTANI LANGUAGE). At the literary level they are widely divergent and constitute for all practical purposes two separate languages. Hindi is written in the Devanagari script, draws upon Sanskrit for its literary vocabulary, and exhibits in many works the influence of Sanskrit literary traditions. Urdu is written in the Persian script, draws upon Persian and Arabic for its literary vocabulary, and is influenced by Persian literature. (RH. R.)

HINDI LITERATURE

Of the different forms of Hindi the most important from a literary point of view are Braj Bhasha and Kanauji and Eastern Hindi (see HINDI). High Hindi is a modern literary development of that dialect of Western Hindi originally spoken about Delhi and northward to the Himalayas.

The Rajasthani dialects of Marwari and Jaipuri, west of the main Hindi areas, and Bihari, to the east, are now not customarily classed as Hindi tongues. But their literary importance is mentioned here because of their contribution to the formation of the literature of central north India between the upper Jumna and eastern Rohilkhand that may securely be labelled "Hindi." (See BIHARI LANGUAGE; RAJASTHANI LANGUAGE.)

Hindi as a literary language intruded upon the ground occupied by Sanskrit and represents mainly a revolt against Brahmin monopoly of Sanskrit. During the early period (approximately A.D. 1100–1500) the language was being fashioned as a literary medium out of the ancient Prakrits *(see* PRAKRIT LANGUAGES).

Early Hindi **Literature.**—Knowledge of the ancient metrical chronicles of Rajasthan is still imperfect and is chiefly derived from James Tod's *Annals and Antiquities of Rajasthan* (1829–32), which is founded on them. It is in the nature of compositions of this character—products of the family bards of the dynasties whose fortunes they record—that they should be constantly added to and their languages modified. Around a historical nucleus legends accumulate; later redactors try to systematize and to assign dates. but the mass has the character of ballad literature. The materials used by Tod are nearly all still unprinted. and his important manuscripts are in the library of the Royal Asiatic society. London.

The first known chronicle of this bardic era is the *Khumman Raso* of the 10th century. This relates the deeds of the rulers of Chitor. In 1016 was first written the *Bisaldev Raso,* in four cantos, about a ruler of Ajmer. But the earliest author of whose works any part had been published in the original text by the mid-20th century is Chand Bardai, court poet of Prithvi-raj, the last Hindu sovereign of Delhi. His poem, *Prithi-Raj Raso,* is a vast chronicle in 69 cantos, comprising a general history of his period. Of this a small part has been printed by the Asiatic Society of Bengal; but the difficult nature of the task prevented much progress. A fresh critical edition of the text was completed in 1913 under the auspices of the Nagari Pracharini Sabha (Banaras). Chand was a native of Lahore, which for nearly 170 years (since 1023) had been under Moslem rule when he flourished. and the poem contains many Persian words. In its present form the work is a redaction made by Amar Singh of Mewar (early 17th century), more than 400 years after Chand's death. The detailed dates contained in the c ronicle are in every case about go years astray: and the Mongols (Book XV) are brought on to the stage more than 30 years before they actually set foot in India and are said to have been vanquished by the redoubtable Prithviraj. But undoubtedly the chronicle contains in it much of Chand's original composition. "We have certainly in his writings some of the oldest known specimens of Gaudian literature, abounding in pure Xpabhramsa Sauraseni Prakrit forms" (Grierson, see *Bibliography*).

It is difficult to form a just estimate of the poem as literature. The language, essentially transitional in character, consists largely of obsolete and obscure words. Chand appears to exhibit the merits and defects of ballad chroniclers. There is much that is spirited in his descriptions of the battles, marriages and hunting expeditions of Prithivi Raj; and the characters of the Rajput warriors are often sketched with skill and animation. But the poem is too long and tends to be tedious.

Chand may be taken as a representative of a long line of successors. still continued in Rajasthan. Many of their compositions are still popular as ballad literature but are known only in the oral versions of professional singers. One of the most famous is the *Alha-khand,* reputed to be the work of a contemporary of Chand called Jagnik or Jagnayak, of Mahoba in Bundelkhand, who sang the praises of Raja-Parmal, a ruler whose wars with Prithviraj are recorded in the "Mahoba-Khand" section of Chand's work. Alha and Udal, the heroes of the poem, are famous warriors in popular legend. and the stories connected with them exist in an eastern recension current in Bihar, as well as in the Bundelkhandi or western form which is best known. Another celebrated bard was Sarangdhar of Rantambhor, who flourished about 1363, and sang the praises of Hammir Deo, the Chauhan chief of Rantambhor, who fell in a heroic struggle against Sultan Alauddin Khilji in 1300. He wrote the *Hammir Kavya* and *Hammir Raso,* of which an account is given by Tod. The *Hammir Raso* is the last epic of the bardic era. A much later work is the long chroni-

cle, *Chattra-Prakas*, or the history of Raja Chattarsal, the Bundela raja of Panna, who was killed fighting for Prince Dara-Shukoh in the battle of Dholpur won by Aurangzeb in 1658. The author, Lal Kabi, has given in this work a history of the valiant Bundela nation.

Mention may be made here of a remarkable composition, a poem entitled the *Padmawat* (1540), the materials of which are likewise derived from the heroic legends of Rajasthan. The author, Malik Mahomed of Ja'is in Oudh, was a Moslem devotee to whom the Hindu raja of Amethi was greatly attached. The poem is composed in pure vernacular Awadhi, with no admixture of traditional Hindu learning, and is generally found written in the Persian character, though the metres and language are thoroughly Indian. It professes to tell the tale of Padmawati or Padmini, a princess celebrated for her beauty, who was the wife of the Chauhan raja of Chitor in Mewar, Rajasthan. The story turns upon the attempts of Alauddin Khilji to gain possession of her person. Malik Mahomed takes great liberties with the history, and explains at the end of the poem that all is an allegory.

With the dispersal of scholars and destruction of temples which followed the Moslem invasions the Hindus of the north were driven back on their religion. The literature of the *bhagats* or Vaishnava saints who propagated the doctrine of *bhakti* or faith in Vishnu has exercised a powerful influence upon the national speech and poetic literature. Nearly the whole of subsequent Hindi poetry is impressed with Vaishnava doctrine. This Vaishnava revival in the north had its source in the south, in the teachings of Ramanuja, a Brahmin born about the end of the 11th century at Perambur near the modern Madras. His works, which are in Sanskrit and consist of commentaries on the *Vedanta Sutras,* are devoted to establishing "the personal existence of a Supreme Deity, possessing every gracious attribute, full of love and pity for the sinful beings who adore him, and granting the released soul a home of eternal bliss near him." The Hindus regard the Deity as having become incarnate on several occasions for the benefit of mankind; but of these incarnations two, Ramachandra, the prince of Ayodhya, and Krishna, the chief of the Yadava clan, are pre-eminently the objects of *bhakti*. The cult of Kama is founded on the virtues of family life, while that of Krishna employs the language of erotic passion to express the longings of the soul for God.

Because Ramanuja's doctrine was too abstruse, and in Sanskrit, it did not reach the people. But it appears to have been set forth in the vernacular about 1250 by Jaideo, a Brahmin of Bengal, author of the Sanskrit *Gita Govinda,* and about 1300 by Namdeo, or Nama, a tailor of blaharashtra, of both of whom verses are preserved in the *Adi Granth,* the sacred book of the Sikh gurus or fathers. But it was not until the 15th century that the Brahmin Ramanand, a follower of Ramanuja, wandered in the north as an itinerant preacher and made Vaishnavism the popular faith of Hindustan. One short Hindi poem by him is contained in the *Adi Granth* and Sir George Grierson collected hymns (bhajans) attributed to him and still current in Mithila or Tirhut.

Among Ramanand's 12 disciples was a Moslem weaver, the celebrated Kabir. Sixty-one works, containing about 20,000 verses, are ascribed to him, but of these at least four were the works of his disciples. Though he described his dialect as Awadhi, it was in fact an amalgam. His style makes up in power what it lacks in polish, and it is suffused by mysticism. Both Ramanand and Kabir were devoted to the cult of Rama; a contemporary of Ramanand. Yidyapati Thakur, is celebrated as the author of numerous lyrics in the Maithili dialect of Bihari, expressive of the other side of Vaishnavism, Krishna worship. Vidyapati's stanzas afterward inspired the Vaishnava literature of Bengal, whose most celebrated exponent was Chaitanya (b. 1484). Mira Bai, "the one great poetess of northern India" (Grierson), was the daughter of Raja Katiya Rana, a Rathor of Merta in Rajasthan, and was married in 1413 to Raja Kumbhkaran of Mewar. She was devoted to Krishna, and her songs have a wide currency in India.

An important compilation of the utterances of the early Vaishnava *bhagats* is contained in the Sikh *Adi Grunth*. Nanak (1469–1538), the founder of Sikhism, took his doctrine from the *bhagats;* and each of the 31 *rags,* forming the body of the *Granth,* is followed by texts from the utterances of Vaishnava saints, chiefly of Kabir, while the book's *bhag* or conclusion contains more verses by the same authors. These extracts are a precious store of the work of authors some of whom have left no other record.

Middle Hindi Literature. — The second period, that of middle Hindi, begins with the reign of the emperor Akbar; and it is not improbable that his sympathy with his Hindi subjects, and the peace which his organization of the empire secured had an important effect on the great development of Hindi poetry which then set in. Akbar's court was itself a centre of poetical composition. Akbar's favourite minister and companion, Raja Birbal, was a musician and a poet, and held the title of *kabi-ray* or poet laureate; his verses and witty sayings are still popular.

By this time worship of Krishna as the lover of Radha (*Radhavallabh*) had been systematized, with its chief habitation at Gokul, near Muttra, by Vallabhacharya, a Brahmin from Madras. Born in 1478, he chose Braj as his headquarters in 1497, thence making missionary tours throughout India. He wrote chiefly in Sanskrit; but among his immediate followers, and those of his son Bitthalnath (who succeeded him in 1530), were some of the most eminent poets in Hindi. Four disciples of Vallabhacharya and four of Bitthalnath, who flourished between 15jo and 15jo, are known as the Asht Chhap, or "Eight Seals," and are the acknowledged masters of the literature of Braj Bhasha. Their names are Krishna Das Pay-ahari, Sur Das (the Bhat), Parmanand Das, Kumbhan Das, Chaturbhuj Das, Chhit Swami, Nand Das and Gobind Das. Of these the most celebrated is Sur Das, who was descended, as he claimed, from the bard Chand Bardai. The traditional dates of his birth (1483) and death (1573) seem to be placed too early. His many hymns to Krishna have been collected in the *Sur Sugar,* said to contain 60,000 verses. This work is considered the high-water mark of Braj devotional poetry. The great glory of this age (coinciding with the Elizabethan age of English literature) is Tulsi Das (*q.v.*). He and Sur Das between them are held to have exhausted the possibilities of poetic art.

A period of artifice and reflection followed, when many works were composed dealing with the rules of poetry and the analysis and the appropriate language of sentiment. Especially famous is Kesab Das, a Brahmin of Bundelkhand. who flourished in the reigns of Akbar and Jahangir. His works are the *Rasik-priya,* on composition (1591), the *Kuvipriya,* on the laws of poetry (1601), the *Ramachandrika,* dealing with the history of Rama (1610), and the *Vigyan-gita* (1610). This elaboration of the poetic art reached its highest point in Bihari Lal, whose *Sat-sai,* or "seven centuries" (1662), is the most remarkable example in Hindi of the rhetorical style in poetry.

Side by side with this literary cultivation of the themes of Rama and Krishna, there grew up a class of composition dealing with the lives of the holy men who guided the development of the popular religion. The most famous is the *Bhakta-mala,* or "Roll of the Bhagats," by Naryan Das. Nabha Das, or Nabhaji, a member of the menial Dom tribe of the Deccan, who had in his youth seen Tulsi Das. His work consists of 108 stanzas, each setting forth the characteristics of some holy personage. and expressed in a brief and obscure style. Its date falls between 1j8j and 1623. The book was furnished with an *ika* (supplement or gloss) in a different metre by Priya Das in 1713, gathering up in an allusive and disjointed fashion the stories related of each saint. This again was expanded about a century later by Lachhman into a work called the *Bhakta-sindhu.* From these nearly all our knowledge of the lives of the Vaishnava authors is derived, and much of it is of a dubious character. Another work. dated 1j51, named the *Chaurasi Varta,* is devoted to stories of the followers of Vallabhacharya. It is attributed to Gokulnath, grandson of Vallabhacharya.

The themes of the many authors who succeeded the great period of Hindi poetical composition which extended through the reigns of Akbar. Jahangir and Shah Jahan exhibit no novelty. (*See* list of Hindi authors by Sir George Grierson, in *J. Asiatic Soc.* of *Bengal,* 1889.) The courts of Chhatar Sal, raja of Panna, who died in 1658, and of several rajas of Bandho were famous for their

patronage of poets; and the Mogul court itself kept up the office of poet laureate even during the fanatical reign of Aurangzeb.

Modern Period.—At the beginning of the 19th century John Gilchrist was head of the Fort William college at Calcutta and he gathered together the leading vernacular scholars to prepare suitable books in their languages. Under Gilchrist's guidance Lallu Lal created "High Hindi" as a literary language. His Prem *Sagar* and Rajniti—the former a version in pure Hindi of the 10th chapter of the Bhagavata Purana, detailing the history of Krishna, and founded on a previous Braj Bhasha version by Chaturbhuj Mise; and the latter an adaptation in Braj Bhasha prose of the *Hitopadesa* and part of the Pancha-tantra—are unquestionably the most important works in Hindi prose. The Prem *Sagar*, begun in 1804 and completed in 1810, enjoys immense popularity in northern India. The *Rajniti* (1809) is much admired for its sententious brevity and the purity of its language. Lallu Lal was also the author of a collection of 100 anecdotes in Hindi and Urdu entitled *Lataif-i-Hindi*, an anthology of Hindi verse called the *Sabhabilas*, a *Sat-sai* in the style of Bihari Lal called *Saptasatika* and several other works.

The most noticeable authors in Hindi after the middle of the 19th century were Babu Harishchandra and Raja Siva Prasad, both of Benares. The former (1850–85) was an enthusiastic cultivator of the old (dialect) poetic art. He published the *Sundari* Tiiak, an anthology of Hindi poetry, and a quantity of old texts, with much added matter. He also wrote biographies and critical studies. In history especially he cleared up many problems. In his Kashmir *Kusum*, or history of Kashmir, a list is given of about a hundred works by him. He was also the real founder of the modern Hindi drama. Raja Siva Prasad (1823–95) published many educational works which greatly contributed to the formation of a form of Hindi not excessively Sanskritized, and not rejecting current Persian forms. The first novel in Hindi, Rani Ketaki *Ki Kahani*, had been written about 1800 by Insha Allah, a Kashmiri Moslem settled in Lucknow; but thereafter there was no creative prose writing till Deoki Nandan (1861–1913) wrote a series of fantasies. His contemporary Gopal Ram Gahamari introduced some realism into fiction, while Kishori Lal Goswami (1865–1932) drew inspiration from the Bengali novel. But the greatest Hindi novelist was Prem Chand (1880–1936). His plots were thin and his characters somewhat unreal; but he had a vigorous style and a keen sense of description. Hindi drama, however, went through a lean period after Harishchandra.

Hindi poetry after the mid-19th century was inspired by nationalism and the desire for social reform. The most outstanding poet, Mithili Saran Gupta (b. 1886) voiced these sentiments while standing squarely in the classical tradition. (C. J. L.; S. GL.)

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URDU LITERATURE

Notwithstanding that the earliest Urdu works date from the 14th century, that a work of Urdu prose so outstanding as Mulla Vajhi's allegory *Sab* Ras was written in 1634 and that a school of poetry flourished in the Deccan in the 17th century—reaching the height of its development with Vali (?1667–?1741)—it was about 1730 in Delhi, the imperial capital, that some of the greatest Urdu poets began to establish their name. From then until the early years of the 19th century three great names dominate the scene. Sauda (1713–80), Mir (1724–1810) and Mir Hasan (1727–86).

The first great age of Urdu poetry is also the age of the rapid dissolution of the Mogul empire, when the faithlessness, cruelty, corruption and general moral depravity of the ruling nobility became notorious. On this nobility the poets depended for their livelihood; but it should not be thought either that their poetry reached only a limited court circle or that it expressed the decadent values of their patrons. The people of Delhi were accustomed to hear the great poets reciting their verses in public gatherings known as mushairas, and poetry of considerable refinement and subtlety was widely understood and appreciated. Mir indeed explicitly avowed that it was for the ordinary people that his poetry was primarily intended. That the poets did not flatter the nobility the example of Sauda clearly shows. He is pre-eminent as a satirist, and his work is a fuil-blooded attack on the decadence of his age. A stranger to the modern conventions of literary polemic, he assails the objects of his wrath, as did Aristophanes and Milton, with every weapon at hand. The emperor himself is attacked for his spinelessness, his armies for their cowardice and inefficiency, the nobles for their incompetence in state affairs, administrators and officials for their corruption, and scholars for their failure to master and develop their heritage of learning. A healthy, boisterous humour pervades his work, which not only, reveals a remarkable invective power, but also an astonishing mastery of the whole range of learning of his day. Like that of all great satirists, his indignation arises from a deep and genuine sorrow, and he sincerely laments the decline of Delhi, which only a generation or so earlier had been the largest and most famous city between Constantinople and Canton.

This same deep sorrow for the fall of Delhi and the misfortune of its people finds frequent and poignant expression in the poetry of Mir. Mir, however, is primarily a love poet, unsurpassed in the beautiful and moving portrayal of all the situations of love as it manifests itself in Indian Moslem society, where love and marriage are two wholly separate phenomena, where purdah ensures the complete segregation of the sexes from an early age, where all love is therefore illicit love, persecuted as dangerous to society, and when in consequence almost all love affairs end in tragedy. Mir's poetry is the finest expression of the values which to a greater or less extent are those of all the great writers of the *ghazal*, or lyric. For him it is fidelity to the ideals of love in the face of all adversity which makes a man a real man, and love in a much wider sense than that of the love of man for woman (though comprehending that also) is the force which should govern all human relationships. In his poetry the love of man as man, without regard to social status, religious creed or nationality, is particularly prominent.

Mir Hasan's fame rests mainly upon a single work, his masnavi (verse romance) of the love of Badr-i-Munir and Benazir. Its popularity is still unrivalled. Within the conventional framework already established for the masnavi before his day, he describes with great delicacy and beauty the first meetings of the lovers, the subsequent grief of separation and their final happy reunion. The story is set amid scenes of splendour which, vividly and with realistic detail, recall Mogul India at the height of its glory. The characterization is masterly and the language of crystal and overwhelmingly effective simplicity.

Of the same age is Nazir Akbarabadi (1740–1830), but he differs significantly from his contemporaries in that he alone turned his back on the courts and passed his life among the ordinary people. His poetry reflects this fact: for the most part he abandons the strict classical forms for those which allow him more freedom, uses metres more varied and closer to folk rhythms, and employs without any refinement the language of popular speech. Most significant of all, however, are his themes. These describe the revelry of popular festivals, both Moslem and Hindu, the seasons, various animals and their young, everyday recreations and scenes, and many other subjects which had not hitherto been made the central themes of independent poems. A zest for the material pleasures of life, including sexual pleasures, finds frank expression in his poetry. He is a great poet, though not of the greatest. Of all Urdu poets he is perhaps the one who makes the most immediate appeal to the western reader.

No long period of time divides Ghalib (1797–1869) from the age of Mir and Sauda, but his outlook is radically different from theirs. He is unmistakably the first of the moderns, living in the present, and seeking the solution to the ills of the time not, as they did, in the re-establishment of the best values of the old society, hut in the development of the potentialities of his own age. A shrewd, humorous and deep observer of men and their institutions, sceptical about religion, jealous fo'r his honour and self-respect, un-

failing in fortitude and humour, able to look at himself, as it were, through others' eyes, critical both of the old order and of the new, and unwilling to fall down and worship the values of either—such is the picture of him which emerges from his works. It is significant that his popularity rapidly increased in the 20th century.

Anis (1802–74), though younger than Ghalib, belongs spiritually to the old world. He is the undisputed master of the *marsia*, or elegy. a long poem composed for recitation in assemblies gathered to mourn the martyrdom of Husain and his 71 companions at Karbala; and it is his complete mastery of this particular form which singles Xnis out from the other great poets. who in depth of feeling and skill in composition are not inferior to him. What the *marsia* particularly demands is that the poet never lose the sense of what will make it effective in recitation, and in all Anis's prolific work this sense rarely seems to desert him.

Urdu Prose.—In 1800 the Fort William college was established and within a few years a number of romances in simple. colloquial Urdu made their appearance. Commissioned as test books for the instruction of British officials in Urdu. many of them nevertheless possess considerable literary merit. Their atmosphere is that of the *Arabian Nights.* Outstanding among them is Mir Amman's *Bagh o Bahar,* which is still widely read. There is an English translation by D. Forbes (London. 1862). Others available in English include Sayyid Haidar Bakhsh's *Tota Kahani* (tr. G. Small. London. 1875) and Ikram Xli's *Ikhvan us Safa* (tr. J. T. Platts, London, 1875). These works did much to weaken the hold of the traditional style of Urdu prose. ornate and abounding in elaborate verbal artifices. which had hitherto alone been considered a fit vehicle for literary work. It continued to dispute the field, however. until it received its death blow at the hands of Ghalib. The graceful. easy. almost conversational style of his letters. collections of which were published during his lifetime, set a new standard which completely superseded the old.

After the 1857 mutiny new trends developed in Urdu literature. The first of these was the fruit of the life work of Sir Sayyid Ahmad Khan (1817–98), who strove to convince the Indian Moslems that they must identify themselves with the aims of British rule, and worked indefatigably for the introduction of western education and western ideas as the most potent means of achieving this end. His movement. the "Aligarh movement." is so called because it centred around the Aligarh Mohammedan Anglo-Oriental college founded by him in 187;. His own voluminous writings are less important than those of the younger men associated with him. Noteworthy among these are Zaka Ullah (1832–1910), who performed single-handed an enormous task in preparing more than 100 instructional books in Urdu. Nazir Ahmad (1831–1912), one of the best of all Urdu prose stylists and ,a writer of great. realistic power and, above all. Hali (1837–1914). As a poet. Hali is best known as the author of the *Musaddas,* a long poem contrasting the past glories of Islam with the present fallen state of the Indian Moslems and calling on them to work for national regeneration. It evoked a truly overwhelming response. His best poetry, however. is to be found in his *ghazals.* As a biographer his most voluminous work is his life of Sir Sayyid. his best that of Ghalib. As a critic. his major work is *Poetry and Poetics,* in which he discusses the nature of poetry and then proceeds to a comprehensive survey of the main branches of Urdu poetry in the light of the conclusions reached. The work reveals all the limitations of a narrowly Victorian outlook. but also shows a wide knowledge and deep appreciation of classical Urdu poetry.

In a sense complementary to Hali's work is *Ab i Hayat,* by Muhammad Husain Xzad (1827–1910), the first considerable work on the history of Urdu poetry. It is most valuable for the largely traditional stories of the great poets. which Xzad tells extremely well and which often bring into relief significant aspects of their character of which Xzad himself seems unaware.

The opposition to Sir Sayyid was centred in Lucknow. but not all Lucknow writers were hostile. With Aligarh in spirit were Sarshar (1846–1902), whose enormous book *The Adventures of Azad* is full of vivid pictures of the Lucknow of his day, and Rusva (1858–1931), the setting of whose *Cmrao Jan Ada,* technically the most perfect novel in Urdu, is Oudh in the middle decades of the 19th century.

The organ of the opposition was the humorous journal *Oudh Punch* (1877–1913), and its most effective weapon the witty satirical verse of Akbar (1846–1921). *Oudh Punch* did not share Aligarh's enthusiasm for British rule. and assailed it for trying to turn Indians into Englishmen. While not opposed to modern education as such. it insisted on the need to preserve and take a pride in the traditions of Indian cultural and social life. including the tradition of Hindu-Moslem unity. and was from the outset sympathetic to the Indian national congress.

Shibii (1857–1914) is the author of many works on Islamic history. Originally a partisan of Sir Sayyid, he later became increasingly sympathetic to pan-Islamism and to Indian nationalism, and a tendency to idealize the past impairs the value of his historical work. It is as a critic that he excels. His monumental *Sher ul Ajam* is an excellent study of the whole range of Persian poetry. and his *Comparison of Anis and Dabir* was in the mid-century still the best study of the Urdu *marsia.*

Literature of the 20th century.—The main political ideas of the age—nationalism. pan-Islainism, Moslem communalism and finally. after 1917, Socialism and Communism—all influenced Grdu literature. which after 1goo, and more especially 1918, enormously extended its range. From 1y18 to about 193j poetry. both in the classical and in the more modern forms. and prose of every kind—journalism. essays. criticism. history. biography, travel writing, short stories. novels, humorous writing—all developed on a scale which renders an adequate survey impossible. Among the *ghazal* writers the major names are those of Hasrat. Fani. Asghar, Yas-Yagana, Riaz and Firaq. Those writing mainly in other forms include Iqbal. Josh and Akhtar Shirani. In journalism. which developed particularly rapidly in the years which culminated in the first non-co-operation movement and the allied *khilafat* movement, some of the great names are those of Abul Kalam Xzad, Muhammad Ali. Zafar Ali Khan. and finally Qazi Abdul Ghaffar. also a novelist and biographer. In criticism. Abdul Haq is the leading figure; in the essay. which in the 1920s was the most developed form in Crdu prose. Hasan Nizami. Mahdi Ifadi. Sajjad Xnsari and Sajjad Haidar Yaldaram; in the short story. Prem Chand and Sudarshan; in the novel. Prem Chand again; in humorous writing, Farhat Ullah Beg. Azim Beg Chughtai, and Patras. Space allows detailed mention of only two—Iqbal and Prem Chand.

No poet of this period exercised so wide an influence as Sir Muhammad Iqbal (1875–1938), for nationalists. Moslem communalists and communists all derive inspiration from his poems. Iqbal stresses the need for man to develop to the full all the latent powers within him, so that he may become "the vice-regent of God on earth" and set out to make his own future. guided not only by reason but also by a passionate and all-consuming zeal for the realization of his ideals. He believes that this doctrine constitutes the essence of true Islam. and conversely that only he who is inspired by sincere devotion to Islam can hope to achieve the tasks which Iqbal sets before mankind. *Poems from Iqbal* (translated by Victor Kiernan, London. 19jj) gives an excellent translation of some of his main poems. *The Ardent Pilgrim,* by Iqbal Singh (London. 1951), is a good short study.

The work of Prem Chand (d. 1936), who wrote both in Urdu and Hindi, mainly depicts the life and struggles of the Indian peasants of his own day. Prem Chand knew his subject intimately; he deeply loved the peasants, and from the outset strove to use his art in their service and to inspire in his readers the same indignant anger that he himself felt for their oppressors—the landlords. moneylenders. capitalists and officials of the foreign government. His numerous short stories contain his artistically most perfect work, and his novels would be equally good were it not for faults in construction and for the negative influence of Gandhian preconceptions which in parts impair their essential realism. A steady weakening of this influence is evident as his work matures, and his last novel *Gaodan* (1936) is his best, *A Handful* of *Wheat* (Delhi, 19jj) gives a good selection of his stories in English.

After 1935 the major trend to develop was that represented by the Progressive Writers' association, founded in 1936, in which writers of socialist and communist sympathies came to predomi-

nate. In fiction its forerunner was Prem Chand, who indeed actively associated himself with the new movement. In poetry. many of its writers continued the trend established by Josh (1894–), the "poet of revolution," an accomplished and versatile poet who had already made his name in the 1920s. Noteworthy among writers who were associated with this trend are the poets Ali Sardar Jafri, Majaz, Jazbi, Makhdum and Faiz; the critics Majnun, Ihtisham Husain. Firaq and Ale Ahmad Sarur; and the short story writers Krishan Chandar. Minto, Bedi. Hayat Ullah Ansari and Ismat Chughtai. The further perfection of the short story was the progressives' main achievement. Some of Krishan Chandar's appear in English (Flame and the Flower, Bombay, 1951).

BIBLIOGRAPHY.—There are no satisfactory general histories. The most readable is R: B. Saxena's *History of Urdu Literature* (Allahabad, 1927); *see* also *T*. Grahame Bailey, *History of Urdu Literature* (London, 1932) ; S. A. B. Suhrawardy, *Critical Survey of the Development of the Urdu Novel and Short Story* (London, 1945). (RH. R.)

HINDLEY, an urban district (1894) in the Westhoughton parliamentary division of Lancashire, Eng., 18 mi. W.N.W. of Manchester by road. Pop. (1961) 19,395. The first grammar school was built in 1632 and the church in 1641. Now purely industrial, cotton milling, light engineering and the making of asbestos, paints and clothing are the chief works.

HINDOSTAN is a Persian word. and in modern Persian is pronounced "Hindūstān." It means the country of the Hindūs. In mediaeval Persian the word was "Hindōstān," with an 6, but in the modern language the distinctions between *ē* and i and between 6 and *ū* have been lost. Indian languages borrowed Persian words in their mediaeval form. The word "Hindu" is in mediaeval Persian "Hindō," representing the ancient Avesta *hendava* (Sanskrit, *saindhava*), a dweller on the *Sindhu* or Indus. Because of the influence of scholars in modern Persian the word "Hindū" is now established in English and, through English, in the Indian literary languages; but "Hindo" is also often heard in India. "Hindostan" with o is much more common both in English and in Indian languages, although "Hindustan" is also employed. Up to the days of Persian supremacy inaugurated in Calcutta by John B. Gilchrist and his friends, every traveller in India spoke of "Indostan" or some such word, thus bearing the testimony to the current pronunciation. Gilchrist introduced "Hindoostan." which became "Hindustan" in modern spelling. The word is not an Indian one, and both pronunciations, with *ō* and with *ū*, are current in India at the present day. but that with *ō* is unquestionably the one demanded by the history of the word and of the form which other Persian words take on Indian soil. On the other hand, "Hindu" is firmly established in English. The word "Hindi" has another derivation, being formed from the Persian Hind, India (Avesta *hindu*, Sanskrit *sindhu*, the Indus). "Hindi" means "of or belonging to India," while "Hindu" now means "a person of the Hindu religion." See Sir Charles James Lyall, *A* Sketch of the Hindustani Language, p. 1. (1880).

HINDUISM. A precise definition of Hinduism is hard to formulate since the beliefs and practices of the Hindus vary widely both regionally and, within a given region, from class to class. It is a favourite dictum that Hinduism is not a religion but a whole way of life, whose precepts cover a vast range of human activity outside the scope of most modern religions. A distinction must be drawn, however, between the orthodox Hindu and the modern educated Indian of Hindu origin who still respects much of his ancient religion and calls himself a Hindu but breaks so many of the ancient precepts that, strictly, he can scarcely be classed as such. In its traditional form the chief distinguishing features of Hinduism are the doctrine of the transmigration of souls, with its corollary that all living beings are the same in essence; a complex polytheism, subsumed in a fundamental monotheism by the doctrine that all lesser divinities are subsidiary aspects of the one God; a deep-rooted tendency to mysticism and monistic philosophy; a stratified system of social classes, generally called castes, which is given religious sanction; and a propensity to assimilate rather than to exclude. This last feature divides Hinduism sharply from the religions of the west, based on Judaism. The latter, at least in their earlier forms, generally reject as false all other religious beliefs and practices; Hinduism, on the other hand, concedes some validity to them all. The western attitude is expressed by the words of Yahweh on Sinai, "You shall have no other gods before me" (Ex. xx, 3); in the Bhagavad Gita, the incarnate god Krishna says, "Whatever god a man worships, it is I who answer the prayer."

Hinduism as it is known today has developed slowly from the synthesis of sacrificial cults brought in by the Aryan invaders of c. 1500 B.C. with the religions of the various indigenous peoples they conquered. These included the highly civilized peoples of the Harappa culture of the Indus valley and the nameless savage tribes of the hillier parts of the hinterland of India. There are thus distinctive differences in the Hinduism of every main region of India, partly due to the local genius and partly to the survival of prehistoric chthonic cults and practices. To these must be added external factors. Zoroastrianism, Islam, Christianity, the tribal religions of central Asian nomads and perhaps even Chinese Taoism have all influenced the complex of religious belief, custom and practice.

HISTORY AND LITERATURE

Vedic Period. — The earliest phase of Hinduism is rooted in the religion of the Vedas — four collections (*samhita*) of hymns, incantations and sacrificial formulas, known as the Rigveda, the Samaveda, the Yajurveda and the Atharvaveda. Of the four, the Rigveda is the earliest and most important, being probably composed over a period of several centuries and collected in its present form early in the 1st millennium B.C. To each Veda is attached a body of prose writings of later date called Brahmanas (c. 800–600 B C), intended to explain the ceremonial application of the texts and the origin and import of the sacrificial rites for which they were supposed to have been composed. Further appendixes, the Aranyakas (c. 600 B.C.) and Upanishads (c. 600–300 B.C.), respectively expound the symbolism of the more recondite rites and speculate on the nature of the universe and man's relation to it. (See also VEDIC RELIGION; SANSKRIT LANGUAGE AND LITERATURE.) When Vedic religion gradually evolved into Hinduism between the 6th and 2nd centuries B.C., these texts taken collectively became the most sacred literature of Hinduism. They were known as shruti (that which was "heard" or divinely revealed to ancient sages), as opposed to the later strata of religious literature, known as smriti (that which is "remembered," or is traditional). But in modern Hinduism the shruti, with the exception of a few hymns of the Rigveda and the more important Upanishads, is little known, while some of the *smriti* texts, notably the Bhagavad Gita, are extremely influential.

The Rigveda reflects in general a polytheistic sacrificial religion very different from that of later India. It involved the worship of numerous divinities, most of whom were conceived of as male, and were connected with the sky and natural phenomena. The complex ceremonial, for which the hymns were composed, centred in sacrifice connected with the ritual slaughter of animals and the pressing and drinking of a sacred inebriating liquor called Soma, and it was afterward abandoned in favour of rituals of a different kind.

In some of the more recent hymns of the Rigveda, however, there are speculations on the source and fundamental nature of the cosmos, and already its origin is attributed to a single being or principle. It is suggested that the world is the product of a creator god, to whom various names, such as Prajapati (Lord of Creatures) and Vishvakarman (All-worker), are given. In one very important hymn (x, 90) creation takes place after the gods have offered a primeval being, identified with Prajapati, as a sacrifice to himself. From his body the whole universe is created, including the four great classes of Indian society, each being made from a different member of the victim. Alternatively it was suggested that the universe developed out of a watery chaos, or from an impersonal entity such as the Hiranyagarbha or Golden Embryo (Rigveda x, 121). These speculative tendencies, coupled with the development of asceticism, led to the mysticism and monism which have been always characteristic of Hinduism.

C. 600 **B.C.–A.D.** 650. — The Aryans who composed the Rigveda

do not appear to have believed in transmigration or the reincarnation of the soul; apparently they thought that the righteous dead passed to a heaven resembling the Valhalla of the Nordic peoples. while sinners were relegated to a dark and shadowy land similar to the Semitic Sheol. By perhaps 600 B.C., the new doctrine of the continual process of reincarnation (samsara) was known to comparatively small circles of ascetics and was coupled with the idea of karma (*q.v.*), the fundamental law of cause and effect by which the evildoer is reborn in unhappy conditions It spread very rapidly, and seems to have been accepted almost universally in the time of the Buddha (6th century B.C.). Its origin and rapid diffusion are not yet satisfactorily explained, but it may have been derived from cruder doctrines of metempsychosis held by some of the indigenous non-Aryan inhabitants of the Ganges valley. It was accompanied by a desire to escape from the round of birth and death, and this urge produced the splendid mystical literature of the Upanishads and led to the emergence of a number of heterodox sects, some of which, notably Buddhism and Jainism, became distinct religions.

Thereafter Hinduism. at least in its higher manifestations was concerned not with propitiating the gods but with obtaining release from *samsara.* This mas the main aim of the philosophical schools which arose between about 300 B.C. and A.D. 300. Sacrifices were by this time less frequently performed, partly because of a strong feeling against the unnecessary destruction of life but largely because it was felt that they were ineffectual as a means to salvation Morality and religious observance were thought to be conducive to favourable rebirths on the lower stages of spiritual progress. but for complete emancipation asceticism and mystical gnosis were necessary.

Also in the second half of the 1st millennium B.C., the older gods of the Rigveda began to lose ground before Vishnu and Shiva, the first a minor divinity in earlier times, the second a fertility god. perhaps inherited from the pre-Vedic Harappa culture with whom the Vedic god Rudra was identified. Local divinities in the areas gradually occupied by Aryan culture were assimilated to one or other of these, and the doctrine of *avataras* or divine incarnations made it possible for theriomorphic gods (gods worshiped in the form of a beast) and divinized heroes to become incarnations of Vishnu. The religion of this period is reflected in the two great epics, the Mahabharata and the Ramayana, and in the texts on law and human conduct generally called Dharma Sutras and Dharma Shastras. The religious attitude usually known in Indian contexts as *bhakti,* or devotion to a personal deity. also developed The new gods were normally worshiped with prayer, offerings of flowers and food, incense or music; the rite of worship (*puja*) had replaced that of sacrifice (*yajna*). The most important text of early *bhakti* is the Bhagavad Gita, inserted into the Mahabharata epic as a discourse addressed to the hero Arjuna by the incarnate god Krishna.

Until just before the beginning of the Christian era it seems that the Indians generally worshiped without the aid of images. The oldest extant icons, other than those of the Harappa culture, are large figures of yakshas, or local chthonic divinities. not much more than 2.000 years old. This indicates that iconolatry began among lower levels of the people devoted to deities not fully assimilated into the Hinduism of the time. Similarly, there are no remains of Vedic temples; sacrifices normally took place in the open air. though small shrines housing sacred objects may have existed. Sacred places (*chaityas*), usually groves or mounds, were the centres of popular religion, but they were outside the ambit of orthodoxy. By the Gupta period (*c.* A.D. 300–650) the worship of images in stone temples was fully established, possibly through the influence of the successive invaders of northwestern India about the beginning of the Christian era.

By A D 650 a new feature of later Hinduism. the worship of feminine divinities, was also fully established. The Mother Goddess. in various forms and under various names. became an important object of reverence and though the Tantras, the sacred texts of the cult of the Mother. are of later composition, it is evident from inscriptions that her temples existed from the 5th century A.D. onward. Animal and sometimes even human sacrifices were revived. and certain other barbaric practices, such as sati burning and religious suicide, seem to have increased in prevalence. This marked the close of the formative period of Hinduism.

Period of the Later Hindu Dynasties. — The 9th–12th centuries saw the work of great philosophers and theologians, such as Shankara (*q.v.*), Ramanuja and Madhva (*q.v.*). Later, an enormous quantity of religious literature was composed in the regional languages, chiefly devotional hymns whose various authors today command respect and reverence second only to that accorded to the great gods themselves. The earliest collections are in Tamil, the songs of the Nayanars or devotees of Shiva. and the Alvars, the devotees of Vishnu, which were written from the 7th century onward. The composition of such hymns in the Indo-Aryan languages began only some centuries later. Among the most important hymnodists are Kabir (*q.v.*) in the 15th century and Tulsi Das (*q.v.*) in the 16th century, who both wrote in Hindi; various singers of the school of Chaitanya (15th–16th century) in Bengali; and Namdev (13th century) and Tukaram (17th century) in Marathi. Noteworthy also is Mira Bai, the 16th-century poetess of Rajasthan. These teachers, and many others like them in all parts of India, encouraged simple faith and devotion to a personal deity: disparaged exaggerated ritualism and caste pretensions and stressed brotherly love and fellowship. Though all these elements can be found in the early Tamil devotional poetry it is generally thought that Islamic ideas, mediated by *sufi* preachers, had some influence on this development. Kabir knew something of Islam, and according to tradition he was brought up as a Muslim. Nanak owes his insistence on the unity of God and his opposition to iconolatry to Islam, and the religion of Sikhism which he founded is clearly syncretistic.

By the end of the 17th century the inspiration of the devotional hymnodists had ceased and there was no advance in Hindu thought or practice during the 18th century. The first European rulers of India found a sterile religion whose chief aim was the preservation of a rigid social order by means of a very complex system of ritual observances and tabus. It was widely expected that India would soon become Christian, but contact with the west tended instead to revitalize Hinduism through the work of a number of reformers (see *Modern* Developments below).

COSMOLOGY

Indian religion contrasts sharply with the religions of the west in its conception of the size and duration of the universe. In place of the comparatively small, transient cosmos of traditional Judaism, Christianity and Islam. Hinduism postulates a universe immense in size and immensely long in duration. passing through a continuous process of development and decline. The fundamental cosmic cycle is the "day of Brahma." a period of 4 320,000,000 years known as a kalpa. At the beginning of this day Vishnu lies asleep upon the cobra Shesha, symbolizing endless time. who in turn floats on the cosmic ocean, the primeval chaos. From Vishnu's navel there grows a lotus. and from its bud is born the god Brahma who creates the universe on behalf of Vishnu, who then awakes and controls the cosmos throughout the day. At its end the world is destroyed, according to some accounts by Shiva. and is once more absorbed into Vishnu's body. The god sleeps for a further kalpa, the "night of Brahma," after which the process is repeated more or less indefinitely.

According to some sources. Vishnu has a life of 100 "years of Brahma," each of which consists of 360 days of Brahma. He is now 50 years old, and when he reaches his 100th year his personality will be lost in the one real and eternal impersonal entity, the Brahman. After a tremendously long period when nothing but the one Absolute World Spirit exists, a new Vishnu will appear and the process will begin once more This scheme is to be found with modifications in various early texts. such as the Puranas, long collections of legendary and mythological stories which date from the 4th century A.D. It is evidently an attempt to find room for devotional theism in a scheme which is essentially idealist and monist.

The later devotional sects insist on the fundamental nature of Vishnu, who will always retain his character of a personal god in

whom and through whom universes have their being and are again destroyed. The Shaivites have different legends. In south India some maintain that Shiva created the universe by a process analogous to dancing, preserves it by his divine ascesis and destroys it at the end of time by a similar process. This myth has produced one of the most beautiful figures of Hindu iconography, the image of the Dancing Shiva (Nataraja). The Shaktas hold that the Mother Goddess gave birth to the universe after a sort of cosmic coitus with her transcendent spouse, Shiva, who plays little or no direct part in the universal process. The educated Hindu believes that all these legends bear some symbolic relationship to the actual evolution of the cosmos, but prefers the version maintained by his own sect.

Within the *kalpa* are 1.000 smaller cycles, the *maha* yugas or "great aeons." These are divided into four *yugas,* or aeons, each of which is progressively shorter and less blissful than that which preceded it. The world is at present in the fourth aeon, the kali yuga, which began in 3102 B.C. and will continue for over 400,000 years, until Vishnu in the form of the Kalki destroys its evil elements and a new age of gold begins.

PHILOSOPHICAL AND THEOLOGICAL SCHOOLS

Philosophical Schools.—The traditional account of the immense duration of the universe led to a general vie that life is essentially unsatisfactory, since man is enmeshed in this universal scheme by the process of samsara, continued reincarnation. In theory, the Hindu finds existence a vale of tears, and his long-term aim is to achieve salvation or "release" (*mukti*, moksha) from the round of birth, death and rebirth. Its achievement may involve a series of many lives and demands a long course of spiritual discipline, meditation and devotion. All the six philosophical schools, the Nyaya, the Vaisheshika, the Samkhya, the Yoga, the Purva Mimamsa and the Vedanta, are theoretically directed to this end, though different schools emphasize varying factors as the chief means of attaining it (see INDIAN PHILOSOPHY).

Theological Schools.—The theological schools, most of which are branches of the Vedanta school of philosophy, are differentiated by the degree of ultimate reality which they concede to personality, and the degree of identity which they admit between the naked soul of the individual and the Absolute. The school of strict monism (advaita) maintains that the ultimate reality is the impersonal world spirit, Brahman, and that the inmost soul of the individual is mystically identical with it. The phenomenal universe, including the gods themselves and all individualized beings, evolves from this Absolute and is fundamentally illusory.

This concept of Brahman is based on the gnosis of the Upanishads, where the term is sometimes used to describe the world spirit. with which the individual soul is essentially one. Originally, in the Rigveda, Brahman implied supernatural power—the magical force. inherent in impressive beings or objects, widely believed in by primitive peoples and known to anthropologists as mana. In later Hindu literature Brahman is always used with a mystical but impersonal connotation. It is grammatically neuter, and must not be confused with the Brahman priest (brahmana, literally the possessor of brahman in its primitive sense), or the male god Brahma. Brahman, according to the school of strict monism, is characterized by the three attributes of being, consciousness and bliss (*sachchidananda*).

The advaita school, looking back to the great 9th-century philosopher Shankara (*q.v.*), has perhaps been the most influential in forming the character of intellectual Hinduism. But it is possible that the school of qualified monism (*vishishtadvaita*), based on the teaching of Ramanuja, has had greater effect on the religion of the masses. This school maintains that the ultimate reality has in some sense a personality, and is in fact a God; moreover the soul, though essentially a part of God and intimately joined to him in the state of salvation, never completely loses its sense of individuality. The school of qualified monism holds that the soul can reach salvation more easily through sincere devotion (bhakti) to God. and by patiently awaiting his grace in the attitude of mind known as *prapatti* (passive surrender), than through meditation. The way of devotion (Bhakti Marga) has probably at all times been more popular than the way of knowledge (Jnana Marga). Though most Hindus honour Shankara and pay theoretical respect to his teachings, in its practical manifestations Hinduism is a theistic religion demanding deep devotion of its adherents and, as all who have visited Hindu temples and attended festivals will realize, its main expression is simple piety.

GODS

Most of the great gods of the Rigveda, such as Indra, Agni and Varuna, are of secondary importance in later Hinduism, and have yielded pride of place to other divinities who either play a minor part in Vedic religion or are not mentioned in the Vedas at all. Another god who has lost a great deal of his importance is Brahma (masculine, not to be confused with the neuter Brahman). This name seems to have evolved as an epithet applied to the creator god of the later Vedas, Prajapati, which eclipsed the latter name in popularity. At the time of the Buddha, Brahma was looked on as the high god in eastern India, and he is often referred to in the older parts of the Mahabharata as the creator of all things. But in the Vaishnava cosmology he becomes a mere demiurge. Some attempt to rehabilitate Brahma was made in the medieval doctrine of the trimurti or Trinity, postulating three gods of equal importance as the primary manifestations of the ultimate reality—Brahma, the creator; Vishnu, the preserver; and Shiva, the destroyer. This syncretistic system, however, was at no time important and plays a much bigger part in some older textbooks on Hinduism written in Europe than in any ancient Hindu text. At present Brahma is little regarded, and it is said that only one temple of Brahma (at Lake Pushkar, near Ajmer) exists in the whole of India.

Shiva, Vishnu and the Mother Goddess.—Classical Hinduism is centred in these three great divinities and, though many other deities are worshiped, nearly all Hindus look on one or other of the triad as the ultimate being. the disposer of human destiny and of the destiny of the cosmos itself. Thus with few exceptions Hindus may be broadly divided into followers of Shiva, Vishnu or Shakti ("Power," godhead in its active feminine form), whichever is by family tradition their main object of worship. Each group, while reverencing the Vedas, has its own scriptures. In general each has respected the faiths of the other two, though occasional cases of mild religious persecution have been attested, especially on the part of the Shaivites of south India. Certain scriptures. such as the Bhagavad Gita, which is Vaishnava in origin and glorifies Vishnu as the chief god and Krishna as his incarnation, are highly respected by all sects. A man may occasionally worship in a temple, or take part in a festival, connected with a divinity other than his own, since behind the superficial polytheism of Hinduism is a general realization that the various gods severally worshiped are essentially one.

Vishnu, who probably receives rather more widespread worship than Shiva, is generally reverenced in the form of one of his incarnations, of which at present only two, Rama and Krishna, are given much attention. The cult of Rama is comparatively recent; though he was known as a great hero much earlier, he appears not to have been generally worshiped as a god until medieval times. He is depicted as the ideal ruler, the embodiment of grace and justice toward men, and significantly is chiefly honoured in those parts of India which came earliest and most completely under Muslim domination. His spouse Sita is the ideal of Hindu womanhood, the perfect wife and mother, entirely devoted to her lord. The cult of Rama is particularly strong in Uttar Pradesh and Bihar, and has been wholly beneficent. Ramaite literature, especially the beautiful Hindi Ramayan of Tulsi Das, which is virtually the bible of millions of simple Hindus of northern India, has very high ethical value.

Krishna (*q.v.*) is a more complex figure, and his worship is even more widespread than that of Rama. Long and involved legends show him to be a combination of disparate elements. He appears in such archetypal forms as the wonder-working child, the divine lover, the charismatic leader and the dying god. Some Rrishnaite religious literature contains rich erotic imagery, notably Jayadeva's mellifluous Gita-Govinda; probably he is worshiped most widely

as the divine flute player, luring the wives and daughters of the cowherds of Vrindavana (Brindaban) to dance with him in the moonlight, a symbol of God calling the human soul. He appears as the teacher in the Bhagavad Gita.

Shiva, unlike Vishnu, is not believed to incarnate himself for the salvation of the world, but only to afford occasional theophanies to his more devout worshipers. Thus he is a rather remoter figure than Vishnu, and more calculated to excite awe. He sits on the peak of Mt. Kailas in the Himalayas, in a state of perpetual meditation, generating an immense spiritual force which maintains the cosmos. He is most commonly worshiped in the form of the *linga*, an upright rounded post usually of stone, which is a formalized phallic emblem. This proves his origin as a fertility god, an element of his character which has largely vanished, for he is generally thought of by his worshipers as a very austere divinity. His cult is strongest in the south, but it is also prevalent among Kashmiri Hindus, and he has numerous devotees all over India. The millions of Hindu ascetics are mostly his followers.

The Mother Goddess is an ambivalent divinity. The gentler aspects of her character appear in her manifestations as Parvati, Uma or Annapurna, the bestower of blessings. the personification of a beneficent nature, in which form she is depicted as a beautiful woman in early middle age. In her fierce form as Kali, Chandi, Durga or Chamunda she is usually thought of as a terrible giantess with black skin, an enormous blood-red tongue and fierce tusks protruding from her mouth, an assortment of weapons in her many hands and a garland of skulls or human heads round her neck. Thus the Mother Goddess stands for nature in all its aspects, and her worship is in part designed to avert evil. Frequent animal sacrifices are still performed in her honour, kids being offered throughout the year and buffaloes at the Dasahra festival (see below, Festivals). Her cult is most prevalent in Bengal and Assam. The Shaktas, who look on the Mother as the chief object of worship, have produced their great teachers; Ramakrishna Paramahamsa, who did so much for the regeneration of Hinduism, began his career as a devotee of Kali in the famous Shakta temple of Dakshineshvari, outside Calcutta. Nevertheless the cult of the Mother has obtained a rather bad reputation on account of some sects of Shaktas whose initiates, in certain ceremonies, partake of the pancha-makara, ritually breaking some of the major tabus of orthodoxy, eating meat, drinking alcoholic liquor and having illicit sexual intercourse. These Tantric sects (so called from the Tantras, their sacred texts) evolved a theory that salvation was to be obtained most easily not by knowledge, meditation or devotion but by the utterance of mystical syllables, words and phrases (mantras), and by ritual acts of a magical character, among which the pancha-makara rite was included. Both animal sacrifice and the practice of pancha-makara are repugnant to the trend of modern Hinduism, and both practices are disappearing, though animals are still sacrificed by the uneducated and semieducated, especially at certain famous Shakta temples; such as Kalighat in Calcutta and Kamakhya, near Gauhati, Assam.

As well as the three great gods there are many others who have considerable importance and who are worshiped on special occasions. Of these the best known is probably Ganesha, the elephant-headed son of Shiva and Parvati, petitioned for success before all enterprises. Skanda or Karttikeya, the war god, also the son of Shiva and Parvati, is of 'some importance in south India; Lakshmi. the spouse of Vishnu, is the patroness of wealth and fortune; Sarasvati, the beautiful goddess of learning and the arts, is worshiped annually at festivals throughout India, especially by students; Hanuman, the monkey god associated with the exploits of the divine hero Rama, appears as a personification of the active power of God upon earth, and is a popular object of worship especially in the north and west; in Bengal and Assam, Manasa, the goddess of snakes, is much worshiped by peasants, not only to prevent snake bite but also for general prosperity; another divinity revered in order to propitiate her is Sitala, the goddess of smallpox.

Many animals, plants and natural objects are sacred in varying degrees, the most noteworthy being the cow. The bull is specially sacred because of his connection with the god Shiva, but the cow is divine in her own right and is generally revered as the representative of Mother Earth. Thus all cattle are inviolate and even among those castes where vegetarianism is not the rule. beef is never eaten. Among other sacred animals are monkeys and Indian tree squirrels (*gileri*), especially associated with Rama, and snakes, associated with Shiva. The many-rooted banyan and the pipal, two of the largest trees of India, are sacred; also the tulsi, a wild basil sacred to Vishnu, which is grown on a pedestal in the courtyard of the orthodox Vaishnava home. All rivers and hills are more or less divine, and the extreme holiness of the Ganges, believed to flow from the head of Shiva, needs no emphasis.

A qualified or limited divinity inheres in other beings and objects also. Thus parents are divinities to their children and should be treated as such; similarly a husband is for his wife a divine incarnation, and texts can be found giving the same position to a wife in respect of her husband, though this is not stressed in a predominantly masculine civilization. Teachers are gods on earth to their students. All Brahmans and earnest ascetics possess a degree of divinity, as do very aged people. At regular festivals a workman will worship the godhead inherent in his tools, and it is even laid down that a man's food is a god and he should worship it before he eats it. The evident animistic origin of Hinduism does not detract from its value, and much of the dignity of Hindu culture may be attributed to this belief in the immanence of divinity.

SOCIAL AND ETHICAL ASPECTS OF HINDUISM

For nearly 3,000 years Hinduism has believed in a stratified social system as a divinely ordained feature of the cosmos, and its teachers have given full religious sanction to the four classes (varna) and the innumerable castes (jati). The doctrine of the four classes goes back to the hymn of the Rigveda describing the primeval sacrifice from which the world was created. From the head of the primeval man appeared the Brahman, from his arms the warrior (Kshatriya), from his trunk the class of merchants and craftsmen (Vaishya) and from his feet the menial (Shudra). Thus the fourfold society is an essential part of the structure of the world, and it must be preserved in order that as many people as possible may achieve salvation.

As there is a fourfold order of society, so there are four stages in the life of each man in the three higher classes who has undergone the ceremony of initiation (upanayanu). After initiation, which takes place at or just before puberty, he should become a celibate student (*brahmachari*); next he is a householder (grihastha). producing sons and fulfilling his family duties; in later middle age, when he has seen his children's children, he retires as a vanuprastha, ideally to a hut in the forest, and devotes his life to the things of the spirit; finally as an old man he becomes a homeless religious beggar (sannyasi) giving up all earthly ties. This scheme of the four *ashramas*, though laid down in many texts, could obviously never be enforced by law as was possible to some extent in the case of the segregation of the four classes. Though it was never taken literally by more than a comparatively small fraction of the Hindu population, it formed an ideal which set the pattern of Hindu life.

The two fourfold systems, of class and stage of life, are often referred to together as *varnashrama;* the dharma or system of conduct appropriate to each class and stage, taken collectively, is known as *varnashrama-dharma,* a term which recurs again and again in earlier religious literature as the fundamental principle of social ethics. It was said that in the earlier stages of the world's development, when men were closer to perfection, *varnashrama*-dharma was practised more or less automatically. With the decline of the cosmos the rules were increasingly broken, and men suffered at one another's hands in a state of terrible anarchy; so Vishnu appointed a divine king to enforce dharma by coercion. The state is thus subordinate to society and exists to preserve it.

Within each of the four orders are numerous castes (jati) and clans or families (kula), and each of these units has its own dharma, or standard norm of conduct. Each must be preserved intact, its traditions and way of life unvitiated by miicegenation or innovations. Thus the traditional Hindu social system is thor-

oughly conservative in principle, although in fact at all times old practices have lapsed into disuse and new ones have been adopted. The change has never been more rapid than in the 20th century. (See also CASTE [INDIAN].)

Second only to the preservation of the social order as a whole, Hindu ethics aim at the preservation of the family. The traditional family is a joint one. the paterfamilias being the steward of the family property. Solidarity is maintained by the rite of shraddha at which offerings are made for the welfare of the ancestors, who are believed to enter into spiritual communion with the surviving kinsfolk. The utmost respect for the elder members of the family is inculcated and the paterfamilias has authority over the younger members, even when they are full grown. Marriage is indissoluble, even before consummation. and widows may not remarry. The practice of the immolation of the widow on her husband's funeral pyre, wrongly called sati (a word meaning a "true wife"), which aroused so much disapprobation and was ultimately forbidden by law in 1829, was. however, never obligatory from the point of view of the sacred texts, though in many families it became virtually so in practice. Polygamy is permitted but not looked on with favour in most castes, except when the first marriage does not produce living male children. Successive Indian governments have modified traditional Hindu marriage law by legislation, forbidding the marriage of children, legitimizing widow remarriage and even, in 1955, forbidding polygamy and allowing divorce. However, feeling against some of these innovations remains strong in many Hindu families, and divorce and widow remarriage are rare.

Personal ethics are not neglected in the Hindu texts and there is much sacred literature of high ethical value. notably the Bhagavad Gita, the Tamil *Kural* and many of the poems of the medieval hymnodists. For the layman the norm of personal conduct was contained in the traditional formulation of the three aims of man (*purushartha*): righteousness or religious merit (*dharma*), profit and material advantage (*artha*) and pleasure (kama). All three were regarded as worthy of pursuit, but the claims of the first overrode those of the second, and those of the second overrode those of the third. All three aims were theoretically subservient to the fourth long-term aim of salvation (moksha), which was only pursued directly by ascetics. Thus the traditional ideal of the layman's life was one of a balanced via media. Modern Hindu teachers, however, appear to have largely forgotten the doctrine of the three aims, and the layman is often told to follow the ascetic's way of life as far as possible.

Everyday Religious Life.—Religious activity is chiefly centred in the home. Every orthodox home has at least one sacred image, picture or emblem, before which *puja* in the form of prayers, hymn singing, the offering of flowers and the burning of incense is performed, especially by the women of the house. In richer houses there is usually a family shrine room or chapel. Every meal is a religious rite and daily rituals. of a sacrificial character but not involving the killing of animals. surviving almost without change from the Vedic period, are still performed by some of the more orthodox Brahmans. Much time is spent in listening to religious literature, read aloud or recited. Rites requiring the help of a trained brahman are performed by a *purohita,* or chaplain, serving a family or group of families.

The personal ceremonies begin from the conception of the child; rites are performed with the participation of the pregnant mother, to ensure the safe arrival of a male child. The birth ceremony (*jatakarma*) should take place before the cutting of the umbilical cord. Ten days after birth the ritual impurity of mother and child is removed and the child is named. L7arious minor rites take place in infancy; more important is the rite of upanayana, originally performed among the three higher classes but now largely confined to Brahmans, celebrated about the time of puberty. At this ceremony a boy is invested with the sacred thread (*upavita* or *yajnopavita*), which he should wear throughout his life over his right shoulder. He is taught the *Savitri* or Gayatri verse of the Rigveda, which is repeated at all religious rites and ceremonies, and he is then qualified to study the Vedas, and has the status of an Aryan. With this the stage of the *brahmachari* commences.

The Hindu marriage ceremony is lengthy and complicated. The kernel of the rite is the threefold circumamhulation of the sacred domestic fire by the couple, and their taking seven steps with their garments knotted together. Hindu funerals normally involve cremation. The corpse is burned as soon as possible after death, and the bones are thrown into a river, preferably the Ganges (Ganga) or another sacred stream. For ten or more days the family is ritually impure, and the relatives, with shaven heads, confine themselves as far as possible to the family home, performing antyeshti ceremonies for the welfare of the soul of the dead man; without these rites it will find it impossible to achieve a rebirth. They consist of pouring libations of water and offering rice balls (*pinda*) and milk to the departed spirit. On the tenth day the soul acquires a subtle body and reaps the fruits of its former deeds, whether good or evil. The shraddha ceremonies, repeated at periodic intervals for the continued welfare of the dead man and for the welfare of other dead members of the family, are of similar character.

Congregational worship hardly exists, though it has been introduced by some reformed sects, such as the Arya Samaj. The temple is the house of the god, as the palace is the house of the king. It is a meritorious act to do him homage, and thus Hindus visit the temple alone or in small family groups, reverence the image of the deity and depart. Although regular *pujas* or ceremonies of worship are performed by trained ministrants at intervals throughout the day in the larger temples, devoutly watched by the laity, there is no real parallel to the Christian religious service or the Muslim khutba. The larger temples, however, are centres of religious instruction, where sacred literature is read publicly, and at one time many of them also ran schools.

FESTIVALS

At least once a year each temple of any importance holds its festival. In south India these are marked by the procession of the god round the city or village, either in a very large cart with a towering superstructure (*ratha*), usually pulled by devotees, or on the back of an elephant. Dancing, singing and the recitation of religious stories take place in the temple. Even festivals in quite small villages attract worshipers from nearby and pilgrims come from all over India to the great festivals of such temples as that of Puri in Orissa, where the annual procession of the god Jagannath (a form of Vishnu) is famous throughout the world. The seven sacred cities of Hinduism and the chief centres of pilgrimage are: Varanasi (Benares). Hardwar. Ayodhya. Dwarka, Mathura, Kancheepuram and Ujjain. To these must be added hladurai, one of the most important centres of Dravidian Shaivism; Gaya, equally a centre of Buddhist pilgrimage; and Prayaga (Allahabad), where the religious fair (*mela*) at the confluence of the Jumna and Ganges attracts hundreds of thousands.

Pilgrims and visitors to temples often assume the so-called caste mark. This symbol. painted on the wearer's forehead and sometimes on other parts of his body, really indicates his sectarian affiliations Vaishnavas wear a mark ∪ and Shaivites wear three horizontal lines ≡. Variations of these marks indicate sects within the two main traditions. These and other religious emblems are often worn painted, tattooed or branded on various parts of the body by ascetics and extreme devotees.

All festivals are fixed according to the Hindu lunisolar calendar, and their occurrence according to the western calendar varies from year to year within a month, as does the Christian Easter. General days of festival are numerous. but lesser festivals and fasts are little regarded except by the more devout Hindus. Probably the most widely maintained are those occurring in the autumn. The first ten days of Ashvina (September–October) are particularly sacred to the Mother Goddess. For nine days she is worshiped in her fiercer forms, animals being sacrificed to her on the ninth day by Shaktas and some Shaivites. The tenth day (dasahra) is one of processions and merrymaking, celebrated even by Vaishnavas. Divali or *dipavali,* at the beginning of Karttika (October–November) is by origin a New Year festival, at which lamps are ceremonially lit, housefronts are illuminated and presents are exchanged. *Holi* is a spring festival, occurring at the

full moon of Phalguna (February–March); it is a sort of Hindu saturnalia, theoretically connected with the god Krishna but evidently originally a fertility ceremony; for townspeople at any rate it has now lost much of its original religious significance. *Vasanta-panchami,* usually falling in February, is the festival of Sarasvati, the patroness of art and learning; the goddess is worshiped in specially erected shrines and concerts are held in her honour. In the Tamil country the most famous festival is *Taipongal,* occurring in January or February, when newly cooked rice is offered to various divinities and domestic cattle are honoured to the accompaniment of many festivities. There are many other festivals of varying importance, and all Hindus, whatever their sectarian affiliations, are usually ready to take part in them. (See also FEAST AND FESTIVAL: *Hinduism.)*

ASCETICISM

Among westerners Hinduism is especially associated with asceticism, perhaps unjustly, because for the lay Hindu it is not essentially an ascetic religion. The practice of asceticism seems to have begun in a sort of shamanism, the performance of austerities in order to achieve supernatural powers. hints of which are to be found in the Rigveda. With the growth of the doctrine of transmigration it was thought that full release from the round of birth and death *(samsara)* could be gained only by giving up worldly life and concentrating on achieving mystical gnosis, and this has been the ostensible motive for a Hindu's taking to the life of asceticism down to the present day. The doctrine of the four *ashramas* put forward the ideal that every man should end his days in asceticism, but in fact many have not done so, while many others have taken to asceticism in youth.

The ascetic, on "leaving the world," attaches himself to a master *(guru),* who initiates him and trains him in his early career. The sincere ascetic usually learns the technique of breath control and control of the bodily functions known as Hatha Yoga, and from this goes on to rapt meditation, until he feels that he has fully realized the identity of his soul (Atman) with the Absolute (Brahman). He should own nothing, or only the barest necessities, and should depend on food offered to him by laymen.

Many ascetics at all times have achieved great respect, and some have been very powerful spiritual forces in the molding of Hinduism On the other hand there are innumerable men of a more dubious character who live very comfortably on the donations of credulous laymen. Others, of a psychopathic character, subject themselves to self-tortures — which are not, as some apologists assert, a feature of the degenerate Hinduism of recent times but are fully attested in the earliest Buddhist scriptures, and must have been practised centuries before the Christian era.

The organization of ascetics into disciplined fraternities probably began with the heterodox sects such as Buddhism and Jainism, but orthodox ascetic schools existed from around the beginning of the Christian era. A form of Hindu monasticism, probably owing much to Buddhist precedent, was established by the great teacher Shankara. and the foundation of similar monastic orders is attributed to Ramanuja and other medieval teachers. These ascetic foundations still survive. In the 19th and 20th centuries the celibate order of the *swamis* of the Ramakrishna Mission were and are one of the most vital forces of Hinduism. The many schools of Indian asceticism are distinguished by varying sectarian marks, uniforms and practices.

MODERN DEVELOPMENTS

The system of belief and conduct described above has prevailed in Hindu India for many centuries. In the 19th and 20th centuries the system has altered considerably, at least in the cities among literate people, because of the influence of western ideas, changing social conditions and the work of numerous reformers. The earliest of these was the Bengali brahman Ram Mohan Roy who founded a reformed Hindu church, the Brahmo Samaj (*q.v.*), which, though it is now almost extinct, had much influence in the 19th century and campaigned against many of the more objectionable aspects of Hinduism, such as widow-burning, child marriage and polygamy. The Arya Samaj (*q.v.*), founded by Dayananda Sarasvati in 1875. is more nationalist and is still an important force in Uttar Pradesh and the Punjab. The claim of its founder that all wisdom was to be found in the Vedas was accompanied by an attack on the worship of idols, an insistence on monotheism and social equality and much educational activity. The Theosophical society. originally gnostic or cabalistic in character, became virtually a reformed sect of Hinduism when its founder, Madame Blavatsky, moved her headquarters to India in 1879 (see THEOSOPHY). At the very end of the century the Ramakrishna Mission was founded, inspired by the teachings of the saintly Begali mystic Ramakrishna Paramahamsa. Its founder. the *swami* Vivekananda (*q.v.*) campaigned energetically in favour of Hinduism in Europe and America and was successful in making a number of western converts to his reformed Hindu movement. In the mid-20th century the west was also showing increasing interest in Yoga.

India's achievement of independence, and the significant part played by the Indian republic in international affairs, have added to the importance of Hinduism. Undoubtedly the greatest contribution has been that of Mahatma Gandhi (*q.v.*), whose unique synthesis of religion and politics provided an ideology for the civil disobedience movement which was instrumental in gaining India's independence. Appreciably influenced by Christian ideas, which he assimilated to the Hindu outlook, Gandhi gave a new sense of purpose to many Hindus of all classes and taught them to respect their traditional beliefs and practices but to adapt them to the needs of the times. Continuing the work of early reformers he encouraged the emancipation of Hinduism from the system of class and caste, and fostered a spirit of social service. His work has been continued in the agrarian reform movement led by Acharya Vinoba Bhave (*q.v.*) and in many smaller movements.

The great majority of Indians still support their traditional religion, but the educated among them may have their reservations, and unbelief in the form of agnosticism, humanism and materialism has made many inroads on the citadels of the faith. Though the development of industrialization, education and democracy will almost certainly condemn many traditional elements, the lack in Hinduism of an over-all organization, which superficially may seem a source of weakness, may prove a source of strength. Its continuance depends not on popes or high priests but on a multitude of independent brahmans who perform the domestic ceremonies of the laity, and on thousands of ascetics, of varying degrees of intelligence and saintliness, who give the layman spiritual help and advice and need no organization to carry on their work. See ASCETICISM; see also references under "Hinduism" in the Index volume.

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HINDU **KUSH,** a range of mountains in Central Asia. Throughout 500 mi. of its length, from the Pamir region to the Koh-i-Baba, west of Kabul, it forms the water divide between the Kabul and the Oxus basins, and, for the first 200 mi. is the

southern boundary of Afghanistan. Probably it branches from the head of the Taghdumbash Pamir, where it unites with the Sarikol stretching northward, and the impressive mountain barrier of Muztagh. the northern base of which separates China from Kanjut. The Wakhjir pass. crossing the head of the Taghdumbash Parnir into the river Hunza, almost marks the trijunction of the three great chains. As the Hindu Kush strikes westward. after first rounding the head of an Oxus tributary (the Ab-i-Panja), it closely overlooks the trough of that glacier-fed stream under its northern spurs, its crest at the nearest point being separated from the river by a distance of about 10 mi. As the river is here the northern boundary of Afghanistan, and the crest of the Hindu Kush the southern boundary, this distance represents the width of the Afghan kingdom at that point.

Physiography.— For the first roo mi. the Hindu Rush is a comparatively wide flat-backed range with small lakes on the crest, and possessing no considerable peaks. It is crossed by many passes, varying in height from 12,500 ft. to 17,500 ft., the lowest and the easiest being the group about Baroghil. As the Hindu Kush gradually recedes from the Ab-i-Panja and turns southwestward it pains in altitude. and prominent peaks rise to more than 24.000 ft. above sea level. The main central water divide is not the line of highest peaks. which is farther south, where Tirach Mir dominates Chitral from a southern spur. For some 40 or 50 mi. of this southwesterly bend, the crest is intersected by many passes, of which the most important is the Durah group (including the Minjan and the Mandal), which rise to about 15,000 ft.. and which are practicable links between the Oxus and Chitral basins.

From the Durah to the Khamak group of passes (11,000 and 12,000 ft. in altitude), the water divide overlooks Kafiristan and Badakshan. There, its exact position uncertain, it lies amid a wild, inaccessible region of snowbound crests: and is nowhere less than 15,000 it. above sea level. The Khawak, at the head of the Panjshir river, leading straight from Badakshan to Charikar and the city of Kabul: is now an excellent kafila route, and is available for traffic throughout the year. From the Khawak to the head of the Ghorband (a river which meets the Panjshir near Charikar), the Hindu Kush is interjected by passes at intervals. *e.g.,* the Kaoshan (the "Hindu Kush" pass *par excellence*), 14,340 ft.; the Chahardar (13.900 ft.), on the Afghanistan high road to Turkistan; and the Shibar (9,800 ft.).. There the southern extremity of the Hindu Kush commences the Koh-i-Baba system into which the Hindu Kush is merged.

The general structure of the Hindu Kush south of the Khawak, no less than such evidence as at present exists to the north. points to similar conditions of uplift and subsequent denudation as in the western Himalaya and the whole of the trans-lndus borderland. The uplift was later than the Himalayas and was marked by the overthrusting of Cretaceous limestones upon Recent shales and clays as on the Baluch frontier. The Hindu Kush is, in fact, but the face of a great plateau lying north of it. just as the Himalaya forms the southern face of the tableland of Tibet. and its general physiography, exhibiting long, narrow. lateral valleys and transverse lines of "antecedent" drainage. is similar. There are few passes across the southern section of the Hindu Kush which have not to surmount a succession of crests or ridges as they cross from Afghan Turkistan to Afghanistan. The exceptions are notable, and have played an important part in the military history of Asia. From a little icebound lake called Gaz Kul. which lies on the crest of the Hindu Kush near the Taghdumbash Pamir. two very important river systems (those of Chitral and Hunza') are believed to originate. The lake really lies on the watershed and is probably a glacial relic. Its contribution to either stream appears to depend on the blocking of ice masses towards one or other end. It marks the commencement of the water divide which separates the Gilgit basin from that of the Yashkun, and subsequently divides the drainage of Swat, and Bajour from that of the Chitral (or Kunar). The Yashkun-Chitral-Kunar river is the longest affluent of the Kabul, and it is in many respects a more important river than the Kabul. It is closely flanked on its left hank by this main water divide. It is this range. crowned by peaks of 22.000 ft. and of an average height of 10,000 it. throughout its length of 250 mi., that is the real barrier of the north—not the Hindu Kush itself. Across it are glacial passes (Darkot) which lead to the foot of the Baroghil. Those passes (the Kilik and Mintaka. both above 15,000 ft.) from the Pamir. which lead into the gorges of the upper affluents of the Hunza, east of Darkot, belong rather to the Muztagh system. Other passes are the Shandur (12,250 ft.), between Gilgit and Mastuj; the Lowarai (10,230 ft.), between the Panjkora and Chitral valleys; and farther south certain lower crossings, which formed part of the great highway between Kabul and India.

Facing Chitral, on the right bank of the river, and extending for 70 mi., is the lofty snowclad spur of the Hindu Kush known as Shawal, across which one or two difficult passes lead into the Bashgol valley of Kafiristan. This spur carries the boundary of Afghanistan. South of Arnamai the Kunar valley becomes a part of Afghanistan *(see* KUNAR). The Durah pass leads into the Chitral valley from the Oxus, as also the Mandal pass, a few miles south, is the connecting link between the Oxus and the Bashgol valley of Kafiristan; and the Bashgol valley leads directly to the Chitral valley at Arnawai, about 50 mi. below Chitral. Nor must we overlook the connection between north and south afforded by the long narrow valley of the Chitral (or Yashkun) itself, leading up to the Baroghil pass. This route was once used by the Chinese for purposes of pilgrimage, if not for invasion.

Access to Chitral from the north is therefore but a matter of practicable tracks; or passes, in two or three directions, and the measure of practicability under any given conditions can best be reckoned from Chitral itself.

Historical.— Hindu Kush is the Caucasus of Alexander's historians. It is also included in the Paropamisus, though the latter term embraces more. Caucasus being apparently used only when the alpine barrier is in question. It was no doubt regarded (and perhaps not altogether untruly) as a part of a great alpine zone believed to traverse Asia from west to east. whether called Taurus. Caucasus or Imaus. Arrian himself applies Caucasus distinctly to the Himalaya also. The application of the name Tanais to the Syr seems to indicate a real confusion with Colchian Caucasus.

Alexander. after building an Alexandria at its foot (probably at Hupian near Charikar), crossed into Bactria, first reaching Drapsaca, or Adrapsa. This has been interpreted as Anderab, in which case he probably crossed the Khawak pass. but the identity is uncertain. The ancient Zend name is, according to Rawlinson, Paresina, the essential part of Paropamisus; this accounts for the great Asiatic *Parnassus* of Aristotle, and the *Pho-lo-sin-a* of Hsiian Tsang.

The Hindu Kush. formidable as it seems, and often as it has been the limit between petty states, has hardly ever been the boundary of a considerable power. Greeks, White Huns, Samanidae of Bukhara. Ghaznevides, Mongols, Timur and Timuridae, down to Saddozais and Barakzais, have ruled both sides of this great alpine chain.

See also AFGHANISTAN; INDIA.

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HINDUR (modern official NALAGARH), a town and *tehsil* in the Patiala district of Punjab, India. The town (pop. in 1951, 2.517) is 25 mi. W. of Simla.

NALAGARH TEHSIL (272 sq.mi.; pop. in 1951. 52,042) was formerly one of the Punjab Hill states. It was merged with Pepsu on July 15, 1948.

HINDUSTANI LANGUAGE. Hindustani is the name used in English to refer to the lingua franca of modern India before its partition in 1947. Hindustani, like Bengali, Marathi, Gujarati and most other Indian languages except those of the

southeastern part of the peninsula. has its ancient origins in the Prakrits or "vernaculars" associated with Sanskrit. The widespread common language Hindustani is closely associated with two specialized literary languages, Hindi and Urdu.

Hindi, written from left to right in the Devanagari or Sanskrit script, borrows largely from Sanskrit. Urdu, written from right to left in an adapted form of the Perso-Arabic script brought by the Moslem invaders from over the northwest frontier, is naturally full of loan words from Persian and Arabic. Still, Urdu and Hindi are "of one language" mith Hindustani and the other Sanskritic languages of India. Through the well-known relationship of Sanskrit, Persian. Greek and Latin. they belong. with most of the languages of Europe, to the great linguistic family usually called Indo-European.

The everyday speech of well over 50,000,000 persons of all communities in the north of India and in West Pakistan is the expression of a common language. Hindustani. This language is shared at different levels and in varying degrees by about 50,000,000 more in the north, in Hyderabad (Deccan) and in all parts of India. This vast language community of close on 100,000,000 persons is the third largest in the world, coming next after Chinese and English. The basic common language of many millions of Indians and Pakistanis is a form of Khari Boli (*i.e.*, "standing" or current language).

There is convincing evidence of the existence and development of Khari Boli from the 13th century. The use of what can be recognized as Khari Boli in certain early writings indicates that it was being employed also as a spoken language. Hindustani, in this sense, was the natural language of the people in the wide neighbourhood of Delhi and ultimately became the lingua franca of the Mogul camp and was carried everywhere in India by the lieutenants of the empire, long before the publications issuing from Fort William. It has several recognized varieties. Dakhini, Urdu, Rekhta and Hindi. Dakhini is the name usually employed for Hindustani in south India. and was the first to be employed for literature. It contains many archaic expressions now extinct in the standard dialect. Urdu or Urdu zaban, "the language of the camp," is, with Bengali, the official language of Pakistan and the standard form of speech of the Moslems of India.

All the early Hindustani literature was in poetry, and this literary form of speech was named "Rekhta" or "scattered," from the way in nhich the words borrowed from Persian were scattered through it. The name was applied to the dialect used in poetry, Urdu being the dialect of prose and of conversation. The introduction of these borrowed words, which has been carried to an even greater extent in Urdu, was facilitated by the fact that Persian was the official language of the Mogul court. In this way, Persian (and, with Persian, Arabic) words came into current use and, though the language remained Indo-Aryan in its grammar and essential characteristics, it soon became unintelligible. in its elegant form, to anyone nho had not at least a moderate acquaintance with the vocabulary and literature of Iran. This extreme Persianization of Urdu in the earlier days m s probably the work of Hindu officials employed by the Mogul administration and acquainted with Persian, rather than by the Moslem elite who normally would prefer the Persian language itself. It is clear that in the days of the Mogul empire, Urdu began to develop and its use as a literary language followed a natural course. It exercised a strong influence on the development of spoken Hindustani, contributing a measure of standardization.

Hindi scholars are inclined to nullify the effects of Urdu upon the formation of Hindi through their labours on Sanskritization to replace Persian elements. Up to the 19th century, the only literary forms which arose from colloquial Khari Boli, and gave it some stability and prestige, must be described as Urdu.

The epoch of Akbar was the period of the formation of the language. But its final consolidation did not take place until the reign of Shah Jahan. Changes were comparatively immaterial until the time when European sources began to mingle mith those of the east. Like the greater part of those from Arabic and Persian, the contributions from these sources were chiefly in vocabulary.

The development of Hindustani as the lingua franca, with publication in it as well as in Persianized Urdu and Sanskritized Hindi, owes an enormous debt to Fort William college and the labours of John B. Gilchrist and his assistants, both Hindu and Moslem. Gilchrist was appointed head of the college upon its foundation in 1800. From the Hindustanee Press in Bengal there had already come his large *Grammar of the Hindoostanee Language* (1796). He had also written *A Dictionary, English and Hindoostanee* (1787–90) and is described by John Elphinstone as the "founder of Hindee philology."

Among those who worked with Gilchrist in the "Hindoostanee" department were William Hunter, Lallu Ji Lal and Sadal Misra. Gilchrist's early references to Khari Boli are of great interest. He described it as the "sterling tongue of India" . . . "distinguished by the general observance of Hindoostanee grammar and nearly a total exclusion of Arabic and Persian."

Inspired by Gilchrist, Lallu Ji Lal wrote the *Prem Sagar* in a form of Khari Boli. "the grand object" being to teach "our scholars the Hindoostanee in its most extended sense, and with proper advantages among the grand Hindoo mass of the people at large in British India."

People who speak what is called Khari Boli may read and write Grdu in the adapted Persian character or Hindi in the Devanagari, or both. To the cultural specialization of the two languages have now been added national and political forces since the separation of Pakistan from India. Since partition, Hindi has been declared the national language of India while Urdu is associated with Pakistan and, in particular, West Pakistan. Nevertheless Urdu remains one of the languages of India, which is its origin and home. It is interesting to note that after the conquest of the Punjab, the British government introduced not only hundreds of junior officials. referred to in the newly conquered province as "Hindostanees," from what is now Uttar Pradesh, but also their language, Urdu.

The Moslem gentry of the Punjab petitioned the government of India in favour of Persian, rejecting Urdu. Pakistan owes its Urdu to British policy in the early formative years after the annexation of the Punjab.

To sum up, Urdu may be described as the Persianized Hindustani of educated hfoslems, while Hindi is the Sanskritized Hindustani of educated Hindus. Hindustani is the great lingua franca of peninsular India understood both by Hindus and Moslems alike.

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(J. R. FH.; ET. B.)

HINES, JOHN LEONARD (1868–), U.S. soldier, was born at White Sulphur Springs, W. Va., on May 21, 1868. After graduating from the U.S. military academy in 1891 he was stationed for five years at Fort Omaha, Neb. He served as acting quartermaster in Cuba during the Spanish-American War, and afterward in the Philippines, 1900–01, 1903–05, 1911–12. He was assistant chief quartermaster 1908–09 in the department of Missouri and 1910–11 in Japan. In 1916–17 he served as adjutant of the punitive expedition into Mexico, and in June 1917 was sent to France as assistant adjutant-general of the American expeditionary forces.

In May 1918, he was appointed to the command of the 1st brigade of infantry, 1st division, A.E.F., which he commanded during the Cantigny operations and in the Montdidier and Aisne-Marne defensives. In August he was transferred to the 4th division. which he commanded at the Battle of St. Mihiel and in the earlier stages of the Meuse-Argonne offensive. He was appointed commander of the 3rd army corps Oct. 11, 1918 with a temporary

commission as major-general. He was made a major-general of the regular army on March 5, 1921, and in Dec. 1922, became deputy chief of staff.

Upon the retirement of Gen. John J. Pershing on Sept. 13. 1924, Hines succeeded as chief of staff. He retired from active service in 1932.

HPNES, WALKER DOWNER (1870–1934), U.S. lawyer, was born at Russellville, Ky., Feb. 2, 1870. He was educated at Ogden college and the University of Virginia. From 1893 to 1904 he was with the Louisville and Nashville railroad in the legal department and, after 1901, as first vice-president. He practised law in Louisville. Ky., 1904–06 and in New York city 1906–16. In 1906 he became general counsel for the Atchison, Topeka and Santa Fe railroad, later becoming chairman of the board of directors.

In Feb. 1918, after the U.S. government had assumed control of the railways as a war measure. Hines was appointed assistant director general. and in January of the following year director general. In May 1920 he was designated by Pres. Woodrow Wilson as arbitrator in the distribution of German, Austrian and Hungarian inland shipping under the peace treaties. In 1925 he made an investigation and report of navigation on the Rhine and Danube for the League of Nations. He wrote *The War History of the American Railroads* (1928).

HINNY, a hybrid between a horse and an ass in which the latter is the female parent. *See* MULE.

HINRICHS, HERMANN FRIEDRICH WILHELM (1794–1861), German Hegelian philosopher, was born on April 22, 1794, at Oldenburg.

He studied theology at Strassburg and philosophy at Heidelberg under Hegel, who wrote a preface to his *Religion im innern Verhältniss zur Wissenschaft* (1822) directed against Schleiermacher. Hinrichs held professorships at Breslau (1822) and at Halle (1824j. Among his philosophical works were *Grundlinien der Philosophie der logik* (1826) and *Genesis des Wissens* (1835). His writings on esthetics include *Vorlesungen über Goethes Faust* (1825); *Das Wesen der antiken Tragodie* (1827), and *Schillers Dichtungen* (1837); His *Geschichte der Rechts- und Staatsprinzipien seit der Reformation* (1848–52) and *Die Könige* (1832) were historical works.

Hinrichs died on Sept. 17, 1861.

HINSCHIUS, PAUL (1835–1898), German jurist, the son of Franz Sales August Hinschius (1807–77), was born in Berlin on Dec. 2j, 1835. His father was not only a scientific jurist. hut also a lawyer with a large practice in Berlin. After working under his father, Hinschius in 1852 began to study jurisprudence at Heidelberg and Berlin, the teacher who had most influence upon him being Aemilius Ludwig Richter (1808–64). to whom he afterward ascribed the great revival of the study of ecclesiastical law in Germany. In 185j Hinschius took the degree of *doctor utriusque iuris,* and in 1859 was admitted to the juridical faculty of Berlin. He lectured at Halle. Berlin and Kiel universities, and in 1870–71 represented Kiel in the I'russian upper house (1870–71). In 1872 he was appointed professor ordinarius of ecclesiastical law at Berlin. He took part in the conferences of the ministry of ecclesiastical affairs. which issued in the famous "Falk laws." In connection with the developments of the *Kulturkampf* which resulted from the "Falk laws." he wrote several important treatises. He sat in the *reichstag* as a National Liberal from 1872 to 1878, and again in 1881 and 1882, and from 1889 onward he represented the University of Berlin in the Prussian upper house. He died on Dec. 13, 1898. The two great works by which Hinschius established his fame are the *Decretales Pseudo-Isidorianae et capitula Angilramni* (2 parts, Leipzig, 1863) and *Das Kirchenrecht der Katholiken und Protestanten in Deutschland,* vol. i–vi (1869–77). The first of these, for which during 1860 and 1861 he had gathered materials in Italy. Spain. France. England, Scotland. Ireland. the Netherlands and Belgium. was the first critical edition of the False Decretals. The *Kirchenrecht* is an exhaustive historical and analytical study of the Roman Catholic hierarchy and its government of the church.

HINSHELWOOD, SIR CYRIL NORMAN (1897–), English chemist. was awarded, with Nikolai Semenov (*q.v.*), the 1956 Nobel prize for chemistry, for his work on chemical kinetics. Hinshelwood was horn in London on June 19, 1897. He was educated at Westminster City school and at Oxford university. where he held in succession fellowships at Balliol. Trinity and Exeter colleges. In 1937 he was elected Dr. Lee's professor of chemistry at Oxford. From the Royal society, of which he was elected a fellow in 1929 at the early age of 31, he received the Davy medal in 1943 and a Royal medal in 1947, and he was elected president in 1955. During 1946–48 he was president of the Chemical society. His early studies dealt with molecular kinetics and later he investigated chemical changes in the bacterial cell with physico-chemical explanations of the biological responses of bacteria to changes in environment. He claimed that changes. more or less permanent, in resistance to a drug could be induced in bacterial cells by prolonged exposure to the drug. as a result of a change in the enzyme patterns of the cell impressed on them by the drug, a conclusion of great significance with regard to the development of "resistance" in bacteria subjected to the action of chemotherapeutic agents and antibiotics. Hinshelwood was knighted in 1948. His publications include *The Kinetics of Chemical Change* (1926; 4th ed.. 1940) and *Tlze Chemical Kinetics of the Bacterial Cell* (1946). (*D.* McK.)

HINSLEY, ARTHUR (1865–1943), English cardinal. was born at Carlton. Selby, Yorkshire. Eng.. on Aug. 2j. 1865. Educated at Ushaw, near Durham, and at the English college in Rome, he was ordained at Rome in 1893. He was professor at Ushaw (1893–97), assistant priest at Keighley. Yorkshire. in 1898. and headmaster of St. Bede's grammar school. Bradford. Yorkshire (1899–1904). He was pastor of' Sutton Park. Surrey, from 1904 to 1911 and of Sydenham. Devonshire, from 1911 to 1917, when he returned to academic life as rector of the English college at Rome, a position he held until 1928. In 1926 he was consecrated titular bishop of Sebastopolis, and in 1930 titular archbishop of Sardis. He was Visitor Apostolic in Africa in 1927. He was Apostolic delegate in Africa from 1930 to 1934, and while there contracted paratyphoid. which seriously affected his hearing and vision. He was canon of the Patriarchal Basilica of St. Peter's in Rome during 1934–35, after which he retired.

The death of Francis Cardinal Bourne, archbishop of Westminster. on Jan. 1. 193j. left English Catholics without a ruling prelate for the jubilee of George V. and consequently Hinsley was called out of retirement and made archbishop of Westminster on March 25, 1935. On Dec. 13, 1937, he was made cardinal.

Outspoken on political matters, he had criticized the negative stand of Pope Pius XI at the time of the Ethiopian invasion in 1935. His experience in Africa had confirmed him as a staunch advocate of English imperialism. Though he had been long out of England, he became famous before and in the early years of World War II, not only to English Catholics but to the English people generally, for his forthright stands against totalitarianism. He despised Germany's national socialism. denounced the Hitler party as "pagan upstarts" and, although no friend of communism, paid frequent tribute to the Russian people for their defense against Germany.

Cardinal Hinsley died at Buntingford. Hertfordshire, on March 17, 1943.

HINTERLAND, the region lying behind a littoral country yet regarded as a part of it geographically and perhaps economically. The term, which may be translated as "hack country," is German in origin. first coming into prominence in 1883–85, when Germany insisted on the right to exercise jurisdiction in the territory behind those parts of the African coast that it had occupied. The doctrine of the hinterland was a revival of the U.S. theory of continuity and contiguity. set forth by secretaries of state John C. Calhoun and Daniel Webster. which had held that a state occupying a certain territory should have the right of preference in the future disposition of territory contiguous to it. Extensive regions in Africa were claimed after 1895 by Great Britain. Germany, France and Portugal on the basis of the hinterland doctrine. Neither the U.S. theory of contiguity nor the doctrine of the hinterland ever obtained wide support.

The weakness common to both of them was the lack of effective occupation and control over the areas claimed.

See M. F. Lindley, *The Acquisition and Government of Backward Territory in International Law (1926).* (N. L. HL.)

HINTON, SIR CHRISTOPHER (1901–), British engineer who played a leading part in developing the atomic industry in Great Britain, was born at Tisbury, Wilts., on May 12, 1901, and served an engineering apprenticeship in the Great Western railway shops at Swindon before going up to Cambridge to read for the mechanical sciences tripos. In 1926 Hinton joined the research department of Brunner Monds, which became the Alkali division of Imperial Chemical Industries Ltd. By 1931 he was chief engineer at I.C.I., Northwich. On the outbreak of World War II, Hinton went to the ministry of supply, being deputy director general of filling factories from 1942 to 1946. After the war he became director of the production division of the department of atomic energy, and subsequently a member of the Atomic Energy authority. 1956 saw the commissioning of the Calder Hall power station, the first in the British program for the peaceful development of nuclear power. In 1958 Hinton became chairman of the central electricity generating board. He was knighted in 1951 and was made a knight of the British empire in 1957. In 1954 he was elected a fellow of the Royal society and in 1957 an honorary fellow of Trinity college, Cambridge. (J. F. BR.)

HINTON, JAMES (1822–1875), English surgeon and author, son of John Howard Hinton (1791–1873), Baptist minister and author, was born at Reading in 1822. He was educated at his grandfather's school near Oxford, and at the Nonconformist school at Harpenden, and in 1838 was apprenticed to a woollen-draper in Whitechapel. After a year in this occupation he became a clerk in an insurance office, spending his evenings in intense study, and this, combined with his over-zealous interest in moral problems, endangered his health in his 19th year. On the advice of a physician he was then sent to St. Bartholomew's hospital to study for the medical profession. After receiving his diploma in 1847, he was for some time assistant surgeon at Newport, Essex, but the same year he went to Sierra Leone to take medical charge of free labourers on their voyage to Jamaica. He returned to England in 1850 and practised as a surgeon in London, where he became interested in aural surgery and physiology. He first appeared as an author in 1856 when he contributed papers on physiological and ethical subjects to the *Christian Spectator;* and in 1859 he published *Man and his Dwellingplace.* A series of papers entitled "Physiological Riddles," in the *Cornhill Magazine,* and another series entitled *Thoughts* on *Health* (1871), proved his aptitude for popular scientific exposition. He was appointed aural surgeon of Guy's hospital in 1863, and rapidly acquired a reputation as the most skilful aural surgeon of his day, which was fully borne out by his works, *An Atlas of Diseases of the membrana tympani* (1874) and *Questions of Aural Surgery* (1874). He gave up his practice in 1874 when his health broke down; and he died in the Azores on Dec. 16, 1875. Other works by him include *The Mystery of Pain* (1866) and *The Place of the Physician* (1874). His *Life and Letters,* with an introduction by Sir W. W. Gull, appeared in 1878.

HINTZE, PAUL VON (1864–1941), German admiral and diplomatist, was born at Schwedt-on-the-Oder on Feb. 13. 1864. He entered the navy. and became (1908) military plenipotentiary at the Russian court. where he was said to enjoy the tsar's confidence. From 1911–14 he was ambassador in Mexico, but was recalled at the end of 1914, was sent to Peking and accomplished the journey in spite of the vigilance of the Allies. Transferred to Christiania (Oslo) in 1915 he again succeeded in eluding the blockade. From July 9 to Oct. 3, 1918, he was state secretary at the foreign office in succession to Kiihlmann, representing it at German headquarters in the months preceding the Armistice in 1918. Tirpitz said in his *Erinnerungen* (1919) that war with Russia might have been averted in 1914 if the emperor had sent Hintze on a mission to the tsar. Hintze died Aug. 23, 1941.

HIP, the projecting part of the body formed by the top of the thighbone and the side of the pelvis, in quadrupeds generally known as the haunch. The hip joint is the connecting joint between the thighbone (femur) and the pelvis. *See* JOINTS AND LIGAMENTS; SKELETON, VERTEBRATE.

HIPPARCHUS (fl. 146–127 B.C.), was the greatest astronomical observer of antiquity and an able mathematician. He was born at Nicaea in Bithynia, which lies east of the sea of Marmara. The dates of his birth and death and the place of his death are not known. He carried out his observations in Bithynia, at Rhodes, where he spent much time, and also, it seems, at Alexandria. The year 127 B.C. is usually quoted as the latest date known for his actual work, and the French astronomer J. B. J. Delambre (1749–1822) clearly showed how some observations of Hipparchus on the star η Canis Majoris seem likely to have been carried out in that year.

Most of our knowledge of Hipparchus is contained in the writings of Strabo of Amasya (fl. A.D. 20) and in that great astronomical compendium, the *Almagest* of Ptolemy (fl. A.D. 127–151). Ptolemy often quotes Hipparchus verbally, and it is obvious that he thought very highly of him; indeed, as a result of the slow progress of early science, he speaks of him with the respect due to a distinguished contemporary, although almost three centuries separated the work of the two men. It is difficult always to determine to which of them credit is due.

It is certain, however, that in all his work Hipparchus showed a clear mind and a dislike for unnecessarily complex hypotheses. He rejected not only all astrological teaching, as might be expected, but also the heliocentric views of the universe which seem to have been proposed, according to Archimedes (287–212 B.C.), by Aristarchus of Samos (fl. c. 270 B.C.) and which were resuscitated by Seleucus the Babylonian, a contemporary of Hipparchus. It must be remembered that strong arguments had been advanced against the motion of the earth, and the general climate of opinion had never been favourable to following up the lead given by Aristarchus. Moreover, the movable eccentric and the epicyclic systems accounted well for most of the irregularities observed in the motions of the sun, the moon and the planets, and it was not until the 15th century A.D. that regular observations over very long periods showed the geocentric hypothesis to be too complex to be acceptable. It was, of course, the Ptolemaic geocentric system which was handed down to western European science, but it must be remembered that the views of Hipparchus had a profound influence on Ptolemy, as he himself acknowledged.

Few details are known of the instruments which Hipparchus used. However, it seems likely that he observed with the usual devices current in his day, although Ptolemy credits him with the invention of an improved type of theodolite. In all his instruments Hipparchus would, of course, have used open sights.

Precession of the Equinoxes and Length of the Year.— Hipparchus is best known for his discovery of the precession of the equinoxes; *i.e.,* of the alterations of the measured positions of the stars resulting from the movement of the points of intersection of the ecliptic and of the celestial equator. It appears that he had written a work bearing "precession of the equinoxes" in the title, and this term is still in current use although the phenomenon is more usually referred to merely as "precession." This notable discovery was the result of painstaking observations worked upon by an acute mind. Hipparchus observed the positions of the stars and then compared his results with those of Timocharis of Alexandria 150 years before. and with even earlier observations made in Babylonia. He discovered that the celestial longitudes were different, and that this difference was of a magnitude exceeding that attributable to errors of observation. Hipparchus therefore proposed precession to account for this, and gave a value of 45″ or 46" for the annual changes.

This is very close to the figure of 50″.26 accepted nowadays, and is a value much superior to the 36" which Ptolemy obtained. It strongly confirms the reputation of Hipparchus as an observer of outstanding precision.

His discovery of precession enabled Hipparchus to obtain more nearly correct values for the tropical year (the period of the sun's apparent rotation from an equinox to the same equinox again) and also for the sidereal year (the period of the sun's apparent rotation from a fixed star to the same fixed star). Again he was ex-

tremely accurate, so that his value for the tropical year was too great only by 63 minutes.

Star Catalogue. — Observations of star positions, measured in terms of celestial latitude and longitude. as was customary in antiquity, were carried out by Hipparchus and entered in a catalogue — the first star catalogue ever to be completed. Hipparchus measured the stellar positions with greater accuracy than any observer before him, and his observations were of use to Ptolemy and later to Edmund Halley. To catalogue the stars was thought by some of Hipparchus' contemporaries to be an impiety. but he persevered. He had been stimulated in 134 B.C. by observing a "new star" and. concluding that such a phenomenon indicated a lack of permanency in the number of "fixed" stars, he determined to catalogue them, and no criticism was able to deflect him from his purpose.

Hipparchus' catalogue was completed in 129 B.C. and listed about 850 stars (not 1,080 as is often stated), the apparent brightnesses of uhich were specified by a system of six magnitudes similar to that used today. For its period, this catalogue was a monumental achievement.

Lunar and Solar Work. — In his work on the sun and moon Hipparchus used the observations of others as well as his own. He showed that the movable eccentric and the deferent and epicycle systems were equivalent in the motions they gave for the sun and moon and, indeed, for the planets. Both methods gave the position of the sun correct to within 1', and Hipparchus rejected the peculiar notion, prevalent in his day. that the sun moved in an orbit inclined to the ecliptic. He also redetermined the inclination of the ecliptic and obtained a value correct to within 5' of the modern figure.

The motion of the moon is more complex than that of the sun, owing to the perturbations which the moon suffers from both earth and sun; in consequence, there are more irregularities to be taken into consideration. Hipparchus satisfactorily accounted for that inequality of the moon's motion which is due to the elliptical form of its orbit; he utilized circular motions but inclined the deferent at an angle of 5° to the ecliptic. His theory gave reasonably satisfactory results for the motion at full and new moon. Hipparchus was dissatisfied however, for, as he appreciated, the errors at quadrature were too great. He concluded that there was some further inequality in the moon's motion. but he uas unable to discover any means of solving this problem. With his scientific approach, he stated that he left the solution of this question to his successors.

Hipparchus also attacked the problem of the relative size and distance of the sun and moon. It had long been appreciated. of course, that the apparent diameter of each was the same, and various astronomers had attempted to measure the ratio of size and distance of the two bodies. Eudoxus obtained a value of 9:1; Phidias (father of Archimedes) 12:1; Archimedes himself 30:1, while Aristarchus believed 20:1 to be correct. The present-day value is, approximately, 393:1. Hipparchus followed the method used by Aristarchus, a procedure which depends upon measuring the breadth of the earth's shadow at the distance of the moon (the measurement being made by timing the transit of the shadow across the moon's disk during a lunar eclipse). This method really gives the parallax, and thus the distance, of the moon, the parallax for the sun being too small to give a significant result; moreover the accuracy obtainable for the distance even of the moon is poor. Hipparchus was dissatisfied with his results, so he attempted to find the limits within which the solar parallax must lie for observations and calculations of a solar eclipse to agree; he also hoped that differences betueen solar and lunar parallax might thus be revealed. He obtained no satisfactory result from his efforts. however, and concluded that the solar parallax was probably negligible. At least, then. he appreciated that the distance of the sun was very great indeed. But it must be mentioned that Cleomedes (fl. 2nd century A.D.) claimed that Hipparchus gave the sun's volume as 1,050 times that of the earth (modern value= 1,300,000); and Theon of Smyrna (fl. 2nd century A.D.) made him give it as 1,880 times.

Planetary Studies. — Hipparchus was unsuccessful in forming a satisfactory planetary theory, and, as has already been remarked, he was true scientist enough to avoid building hypotheses on insufficient evidence. Theon claims that Hipparchus preferred the mathematical device of the epicycle to that of the movable eccentric, but it seems clear that he looked upon such devices purely as mathematical conveniences, and was not concerned with the reality or otherwise of these combinations of circular motion. Ptolemy went further in his description of the planetary work of Hipparchus and wrote: "It was, I believe, for these reasons and especially because he had not received from his predecessors as many accurate observations as he has left to us, that Hipparchus, who loved truth above everything. only investigated the hypotheses of the sun and moon, proving that it was possible to account perfectly for their revolutions by combinations of circular and uniform motion, while for the five planets, at least in the writings which he has left, he has not even commenced the theory, and has contented himself nith collecting systematically the observations and showing that they did not agree with the hypotheses of the mathematicians of his time. He explained in fact not only that each planet has two kinds of inequalities but also that the retrogradations of each are variable in extent, while other mathematicians had only demonstrated geometrically a single inequality and a single arc of retrograde motion; and he believed that these phenomena could not be represented by eccentric circles nor by epicycles carried on concentric circles, but that, by Jove. it would be necessary to combine the two hypotheses." (J. L. E. Dreyer, *History of the Planetary Systems From Thales to Kepler,* Cambridge University Press, 1906.)

Those who studied this problem before the time of Hipparchus had but one main aim, to explain the irregularities which occurred when a planet was in opposition. No notice mas taken of those irregularities which occurred when a planet was in other parts of its orbit, doubtless because of the habit of observing only around times of opposition. Hipparchus advocated more frequent observing for longer periods, and he carried out such work himself with an accuracy unsurpassed in his time. The need for accurate and frequent observations made over a long period may be appreciated when it is recollected that Jupiter takes almost 12 years to complete an orbit round the sun and Saturn nearly 30 years, and that such sidereal periods must be carefully observed before any law can be formulated. Ptolemy used the older observations which Hipparchus had sifted and those which Hipparchus himself had made as well as his own, before he formulated the planetary views enshrined in the *Almagest.* In his own planetary work Hipparchus adopted the generally accepted order for the sun, moon and planets, namely (in order from the earth) the moon, Mercury, Venus. the sun, Mars, Jupiter and Saturn.

Mathematics. — It is to be expected that the astronomical work of Hipparchus should lead him to develop certain departments of mathematics. He made an early formulation of trigonometry and tabulated a table of chords (chord $\alpha = 2 \sin [\alpha/2]$); he is known to have had a method of solving spherical triangles. It is also generally agreed that the theorem in plane geometry known as "Ptolemy's theorem" was originally due to Hipparchus, and was later copied by Ptolemy. This theorem has implicit in it the trigonometrical addition formulas for $\sin (A \pm B)$ and $\cos (A \pm B)$, and Lazare Carnot (1753–1823) showed how the whole of plane trigonometry can be deduced from these formulas.

Hipparchus criticized severely the geographical work of Eratosthenes (*c.* 273–192 B.C.) and himself did some work in this field. His main contribution was to apply rigorous mathematical principles to the determination of places on the earth's surface, and he was the first to do so by specifying their longitude and latitude — the method used today. Hipparchus was, no doubt, led to this method by his work on the trigonometry of the sphere. He tried to measure latitude by utilizing the ratio of the longest to the shortest day at a particular place instead of following the customary method, due to the Babylonians, of measuring the difference in length of day as one travels northward. Hipparchus also divided the then known inhabited world into climatic zones, and suggested that the longitude of places could be determined by observing. from these places, the moments when a solar eclipse began and ended; but this bold scheme, while theoretically satis-

factory for a small area of the earth's surface, was not a practical proposition in his day.

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HIPPARION, an extinct horse that arose in North America and spread over Europe, Asia and Africa in the early Pliocene. Like its allies *Neohipparion* and *Nannippus,* which are known only from North America. *Hipparion* was persistently three-toed and was not ancestral to the modern horse *(Equus)* but was a lateral off-shoot derived from *Merychippus. (See* EQUIDAE.) (G. G. SI.)

HIPPASUS OF METAPONTUM (fl. *c.* 500 B.C.), Pythagorean philosopher. was probably of the first generation after Pythagoras. Tradition said that he was drowned after revealing a mathematical secret of the brotherhood. He may also have published a *mystikos logos* or work on the mysteries which for some reason was resented. He held the Heraclitean fire-doctrine. whereas the Pythagoreans maintained that number is the first principle, and seems to have regarded the soul as composed of igneous matter; so he approximates Pythagorean dualism of light and dark to the theories of Heraclitus.

See H. Diels and W. Kranz, *Fragmente der Vorsokratiker,* i, 7th ed. (Berlin, 1954). (A. C. LD.)

HIPPEASTRUM, formerly a genus of the Amaryllidaceae, now placed in the genus *Amaryllis* (*q.v.*).

HIPPED ROOF, in architecture, a roof which starts on all sides on the same level at the eaves and slopes up toward a ridge or point in the centre.. Hipped roofs were apparently common in the domestic work of the Mediterranean countries from the time of Greece, and are still the most common form for informal buildings throughout the near east and in Italy. southern France and Spain. With the coming of the Renaissance into northern Europe the hipped roof tended to supersede the gable, owing to the emphasis on the horizontal line of the cornice. Thus most of the Renaissance *châteaux* of France and many of the earlier Georgian manors of England have hipped roofs. A remarkable development of hipped roof design was made by the Chinese, particularly .in the north. where many of the great temple and palace halls have widely projecting and gently curved hipped roofs in which the hips (the intersections of the slopes) and the ridges are richly decorated with molded tiles and terminated by fantastic dragons or grotesque beasts. *See* ROOF.

HIPPEL, THEODOR GOTTLIEB VON (1741–1796), German satirical and humorous writer, was born on Jan. 31, 1741, at Cerdauen, East Prussia. the son of a schoolmaster. In 1770 he was appointed chief burgomaster in Konigsberg, and in 1786 president of the town. He died at Konigsberg on April 23, 1796. *Lebensläufe nach aufsteigender Linie* (1778–81) is an autobiography, in which persons well known to him are introduced, together with a mass of heterogeneous reflections on life and philosophy. *Kreuz- und Querzüge des Rifters A bis Z* (1793–94) is a satire levelled against the follies of the age—ancestral pride and the thirst for orders, decoration and the like. Hippel has some resemblance to Jean Paul Richter in his constant digressions and in the interweaving of scientific matter in his narrative. Like Richter he was strongly influenced by Laurence Sterne.

In 1827–38 a collected edition of Hippel's works in 14 vols., was issued at Berlin. *Über die Ehe* has been edited by E. Brenning (Leipzip, 1872), and the *Lebrnslaufe nach aufsteigender Linie* has in a modernized edition by A. von Öttingen (1878) gone through several editions. *See* J. Czerny, *Sterne, Hippel und Jean Paul* (Berlin, 1904).

HIPPIAS OF ELIS, Greek sophist who claimed to be at home in all the learning of his day. He was born before the middle of the 5th century B.C. and was alive in 399 B.C. He is depicted in Plato's *Protagoras* and in the *Hippias Major* and *Hippias Minor.* Hippias acquired great wealth and fame as a teacher throughout the Creek world. His vast literary output included elegies and tragedies as well as technical treatises in prose. He propounded an ideal of individual self-sufficiency and appealed from convention to nature. He was perhaps the first to preach cosmopolitanism. He made a significant contribution to mathematics by discovering the *quadratrix (see* CURVES, SPECIAL); and he developed a system of mnemonics (*q.v.*). His historical compilations and investigations, such as the list of Olympic victors, were used by later writers. His influence on contemporary thinkers was certainly considerable but cannot now be traced in detail.

For fragments and textimonia *see* H. Diels and W. Kranz, *Fragmente der Vorsokratiker,* ii. 7th ed. (Berlin, 1954). (G. B. KD.)

HIPPIUS, ZINAIDA (1869–1945), Russian poet and prose writer, was born on Nov. 8. 1869. at Belev. in the Tula province. She married Dmitri Merezhkovsky (*q.v.*) in 1889 and went to St. Petersburg (Leningrad). Later she settled in Paris. Hippius was one of the leading poets of the Russian symbolist movement of the '90s and her poetry bears the usual character of the movement: the cult of beauty. mysticism and individualism. The influence of Nietzsche's philosophy is also apparent as in the famous line "I love myself as I love God." which became the slogan of the Russian "decadents." Her later poetry shows the influence of the neo-Christian theories of Merezhkovsky. but at the same time reveals deep individual and emotional power. Her prose works were much inferior to her poetry, but under the pseudonym of "Anton Krainy" she was known as a trenchant literary critic. Among her works are *Revolution and Violence* (French trans.. 1907); *The Green Ring* (Eng. trans. *by* S. S. Koteliansky. 1920); *My Journal under the Terror* (French trans., 1921).

HIPPO (fl. *c.* 450 B.C.), Greek philosopher who revived the belief of Thales that the world originates from water or moisture, was born either in Samos or at Rhegium in southern Italy. He held that fire first originates from water and that these two, operating as contrary forces, produce the physical cosmos. But he was more especially concerned with problems of medicine and physiology: disease and death were due to the drying up of the natural moisture in the body. He was a critic of Empedocles. and his physiology resembled that of the Pythagoreans. He must have been well-known at Athens, either personally or through his writings, since Cratinus in a comedy attacked him as an "atheist:" and he was often so designated.

See E. Zeller, *Die Philosophie der Griechen,* rev. ed., vol. i (Leipzig, 1920); K. Freeman, *Companion to the Presocratic Philosophers* (Oxford, 1946; Cambridge, Mass., 1947). (U. J. A.)

HIPPOCRATES AND THE HIPPOCRATIC COLLECTION. The attitude of scholars toward Hippocrates and the Hippocratic problem has altered greatly since the beginning of the 20th century. Serious investigators now agree that we know next to nothing of the man and that few, if any, of the works to which his name is attached can be by him.

According to Soranus (fl. 2nd century A.D.), Hippocrates, the "Father of Medicine" was born on the island of Cos off the coast of Asia Minor at a date corresponding to 460 B.C. Both Soranus and Plato speak of him as a member of the sect, family, guild or society known as the Asclepiadae (*i.e.,* sons of Asclepios). Unfortunately we know nothing of the rights, duties or functions of these Asclepiadae, though highly conjectural statements about them have become current. It is said that Hippocrates was descended from Asclepios on his father's side and from Heracles on his mother's. Since Asclepios is a historical figure—being mentioned as a physician in the Iliad—the former is at least possible. It is said that Hippocrates prosecuted his early medical studies in the famous temple of Xsclepios at Cos, but neither the results of the excavations on that island nor the description by Herondas (fl. 3rd century B.C.) of the conduct of the place suggest any affinity with the spirit of the *Hippocratic Collection.* We shall: therefore, not occupy space with the mass of Hippocratic legend, centred on Cos and spreading also to other sites. It is said, and it is likely, that Hippocrates traveled widely. He is stated to have taught and practised in Thrace, Thessaly. Delos. Athens and elsewhere. He is said to have died at Larissa, at an age given variously, the extremes being 8 j and 110. His "floruit" may be safely placed about 400 B.C. Biographies of him were written by Soranus of Ephesus in the 2nd century A.D., by Suidas the lexicographer in the 11th and by Tzetzes the historian in the 12th centuries. None of them contains much concerning him.

The character and abilities of Hippocrates as a physician have been held in almost universal veneration by medical men in the ages which have followed. Nevertheless, early references to him are very scanty He is mentioned twice by Plato with respect (in the dialogues *Protagoras* and *Phaedrus*). When we reflect that Plato was his younger contemporary, it is surprising that he does not mention Hippocrates more often—especially in the *Timaeus*, which deals with physiological subjects. There are some passages in the Platonic dialogues which have been influenced by works now included in the *Hippocratic Collection.* Aristotle mentions the name of Hippocrates once only (in his *Politics)* but a number of parallels can be discovered between works of the Hippocratic *Collection* and those of Aristotle. These are most frequent in Aristotle's *Historia Animalium*. On the other hand, Hippocrates has had few detractors. Among them were the physician Andreas, who practised in Egypt at the end of the 3rd century B.C., and Asclepiades of Bithynia, who practised in Rome in the 1st century B.C. The works neither of Andreas nor of Asclepiades have survived. We shall make no attempt to entertain the reader by inventing a life of Hippocrates, but pass straight to the so-called *Hippocratic Collection.*

THE HIPPOCRATIC COLLECTION

Early in the history of the Alexandrian medical school—probably not long after 300 B.C.—there began to circulate a group of medical works that has become known as the *Hippocratic Collection.* The name of Hippocrates was already at that date held in high veneration. and into this collection was put everything that could be claimed as of Hippocratic origin. The genuineness of some of these works was suspected from an early date. Ancient scholars applied themselves to their critical study. Notable among these students was Galen (*q.v.*) who was working about 600 years after Hippocrates and wrote commentaries on a number of works of the *Collection.* But dubious in its origin as was the *Collection,* it had not remained intact even between the time when first put together and the time of Galen. On the contrary, during that interval it had suffered considerable alteration—both by accretion and by loss—to say nothing of confusion and error due to the mistakes, dishonesty, haste and ignorance of booksellers, scribes and editors. Further, the deterioration continued after Galen. Our earliest manuscript of the *Collection* is of the 9th century A.D.; our earliest manuscript of a translation is of the 7th century and is a Latin version of the obviously spurious *Dynamidia;* while the earliest documents of any part of the *Collection* are papyrus fragments, of the 3rd or 4th century. of the no less spurious *Epistolae.* Thus the *Hippocratic Collection* provides an ideal battleground for textual criticism and for the discussion of genuineness. The literature on it is vast. Here, we shall give only conclusions.

The works which make up the *Hippocratic Collection* are variously numbered and divided and can be regarded, according to taste, as between about 70 and about 100. Where and when were they written? Of later works, some of the more recent. dating from the time of the Roman empire. were probably mostly written in Rome and may be as late as the 3rd century A.D. The main interest of the *Collection* is, however, concentrated on the earlier works. Of these the earliest were composed in the 5th century B.C. and came from the shores of Asia Minor, one or two possibly from Sicily. In Asia Minor two schools of medicine were early organized. The older was associated with the peninsula of Cnidus. The younger has always been associated with the opposite island of Cos. though it would be safer to link it with Coan physicians rather than with Coan soil. in view of what is known of Cos itself. It is with the Coan school that the name of Hippocrates will he forever linked. The Coan and the Cnidian schools represented divergent views, and their differences affected the medical world of the 5th and 4th centuries B.C. The main differences between the two were that the Coan school was more concerned with disease in general and the Cnidian with particular manifestations of disease. There is also some evidence that the Cnidians paid more attention to gynecology.

The great merit of Hippocrates, however, is that it was he, as the encyclopaedist **A.** Cornelius Celsus (1st century A.D.) tells us, "who first separated medicine from philosophy"; *i.e.*, in the language of modern times, he observed and inferred without allowing his judgment to be biased by preconceived ideas. Now there is a small group of treatises in the *Collection* (books i and iii of the *Epidemics* being perhaps the most striking of the group) of which this can fairly be said. Is this the residuum of works by "the Father of Medicine" himself? We may say so, if we will, but in doing so we have no test of authenticity save excellence. If we examine even these "authentic" works closely we shall find them by no means as free from preconceived ideas as many have considered. Scientific thinkers of the 5th century B.C. were indeed much like those of the 20th century A.D., for all their work was conditioned and controlled by their past.

To speak of a "Hippocratic canon" would be misleading: the contents of the various manuscripts differ. and the date, style, length and subject matter of the treatises also vary greatly, though most of them exhibit the doctrines of the Coan school. Some treatises appear to be textbooks for the use of medical men, some are books intended for use by the nonmedical layman; some are collections of material, either the results of research or matter intended for use in research; some are lectures or essays, sometimes with a polemical or apologetic purpose; in others the chief interest is philosophical. A few treatises are collections of aphorisms. Thus nearly every treatise in the *Coblection* requires separate and individual discussion from the point of view of style, authorship, philosophical associations, language, sources, doctrines and interpretation. The works of the *Collection* can no more be treated in common than can the books of the Old Testament, which cover a comparable area of time. We may. however, make one general negative statement. The works of the *Collection* contain practically nothing of superstition. They are sometimes wearisomely sophistic; they are frequently ludicrously wrong; they often advance absurd hypotheses; they are not seldom obscure. But the attitude of their authors to the supernatural is the same throughout and none swerves in his loyalty to the idea of natural law. There is a work on *The Sacred Disease* (*i.e.*, epilepsy) which puts the point for us:

> As for this disease called divine, surely it too has its nature and causes whence it originates, just like other diseases, and is curable by means comparable to their cure. It arises—like other diseases—from things which enter and quit the body, such as cold, the sun and the winds, things which are ever changing and never at rest. Such things are divine or not—as you will, for the distinction matters not—and there is no need to make such division anywhere in nature, for all are alike divine or all are alike human. All have their antecedent causes which can be found by those who seek them. (Slightly paraphrased.)

Another work in the *Collection,* the *Airs, Waters, Places,* is perhaps by the same author, but there are few instances in the *Collection* in which several works can be ascribed to one hand.

Other treatises belonging to the chief medical section of the *Collection* are the *Epidemics,* of which books i and iii are the most famous, containing 42 clinical histories, with descriptions of climatic and other circumstances for each particular case; the scientific character of these is striking.

Among the surgical treatises may be mentioned *Wounds in the Head,* one of the greatest of the Hippocratic treatises, dating probably from the end of the jth century B.C. It contains a remarkable description of the method of trephining (perforating the skull) and discusses when this operation should be attempted. Another interesting treatise is *In the Surgery,* from which the following passages may be quoted:

> Operative requisites in the surgery; the patient, the operator, assistants, instruments, the light, where and how placed; the patient's person and apparatus. The operator, whether seated or standing, should be placed conveniently to the part being operated upon, and to the light. Each of the two kinds of light, ordinary and artificial, may be used in two ways, direct or oblique . . .
>
> The nails [of the operator] neither to exceed nor to come short of the finger tips. Practice using the finger ends . . . Practice all the operations with each hand and with both together, your object being to attain ability, grace, speed, painlessness, elegance and readiness . . .
>
> Let those who look after the patient present the part for operation as you want it and hold fast the rest of the body so as to be all steady, keeping silence and obeying their superior.

Among the more philosophical treatises is *Ancient Medicine,* in

which the approach to medicine by way of arbitrary hypotheses or postulates (as was done for instance by Empedocles) is condemned, and the traditional method of observation and research is defended and commended. This treatise is interesting also for its strong emphasis upon regimen (an emphasis not uncommon in Hippocratic times, because of the defective development of drugs) and for its acceptance of the doctrine of an immense number of constituents (called *dynameis,* "strong substances") both of the human body and of its foods, the "blend" *(kraszs,* whence ultimately "temper," "temperament," etc.) of which substances was necessary for health. In *The Nature of Man* a theory of four humours is adopted.

In *Airs, Waters, Places* (which. as stated above, may well be by the same author as *The Sacred Disease),* climate is treated as an important factor in prognosis. and the effect of climate upon human character is discussed—an early essay in topographical anthropology.

Regimen, a treatise in four books, is based on the theory that the human body, its foods and its activities can all be reduced to the terminology of fire and water and prescribes foods and exercises for maintaining and restoring health; in book iv the medical significance of certain kinds of dreams is dealt nith.

A few treatises are written in the so-called aphoristic style, in which conclusions of wide general import are compressed into short and easily remembered sentences; the best-known is the admirable treatise which bears the title *Aphorisms* and opens with the most famous sentence of the whole *Collection,* "Art is long and life is short."

As a rule common style is an argument for common authorship, but in the case of aphorisms imitation is so easy that confidence as to authorship is almost impossible.

Perhaps the most famous of all the treatises in the *Collection* is the so-called *Hippocratic Oath,* which is really an indenture to be executed between master and pupil, perhaps upon the latter's completion of his period of apprenticeship. *(See* also MEDICINE, HISTORY OF. *Ancient Medicine: The Hippocratic Oath.)* It has been cogently argued by Ludwig Edelstein that the *Oath* embodies Pythagorean beliefs and did not at the time of its composition express the views generally accepted in Greece. Edelstein dates it to the 4th century B.C.

A Christian adaptation of the *Oath* is found in some manuscripts.

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(C. SI.; A L. PK.)

HIPPOCRATES OF CHIOS *(c.* 460 B.C.), famous Greek geometer known for compiling a book of the elements of mathematics, thus being a precursor of Euclid (c. 300 B.C.); for finding the areas of certain lunes. *i.e.,* plane figures bounded by arcs of circles; and for reducing the problem of doubling the cube to that of finding two mean proportionals between two given numbers.

Tradition saps that Hippocrates was a merchant whose goods had been captured by pirates.

He went to Athens to prosecute them, stayed in that city for a long time, attended lectures on mathematics and added to his income by teaching that subject.

Aristotle's account of the story was that Hippocratcs had been cheated by customs officers in Byzantium. and that though he was a good geometer, he was a poor businessman.

The book of the elements of mathematics compiled by Hippocrates is said to have been the first of his achievements. It is known only through references in the work of later commentators, especially Proclus *(c.* 450) and Simplicius *(c.* 530). Hippocrates' quadratures of lunes were based upon the theorem that the areas of two circles have the same ratio as the squares on their diameters. A summary of these quadratures. written by Eudemus, with elaborate proofs, has been preserved by Simplicius.

The third of the achievements attributed to Hippocrates was the discovery that if two mean proportionals be inserted between a number and its double, the first of these mean proportionals is the edge of a cube whose volume is double that of the cube that has the first of the numbers as its edge *(see* CUBE).

See also SCIENCE: *Ancient Science.*

See Sir Thomas Little Heath, *A History of Greek Mathematics,* 2 vol. (1921); F Rudio, *Der Bericht des Simplicius über die Quadraturen der Antiphon und des Hippokrates* (1907); Oskar Becker, "Zur Textgestaltung des eudemischen Berichts uber die Quadratur der Möndchen durch Hippokrates von Chios," *Quellen und Studien z Geschichte der Mathematik* 3 411 (1936); B. L. v. D. Waerden, *Science Awakening* (1954)

(B. L. v. D. W.)

HIPPOCRATIC OATH, still taken at some universities by graduates in medicine, whereby they undertake not to divulge confidential information. For the text of the Hippocratic oath, *see* MEDICINE, HISTORY OF; *see* also HIPPOCRATES AND THE HIPPOCRATIC COLLECTION.

HIPPOCRENE, "the fountain of the horse," the spring on Mt. Helicon. in Boeotia, which like the other spring there. Aganippe, was sacred to the Muses and Apollo, and hence taken as the source of poetic inspiration. The spring, surrounded by an ancient wall, is now known as *Kryopegadi* or the cold spring.

According to the legend, it was produced by the stamping of the hoof of Pegasus. The same story accounts for the Hippocrene in Troezen and the spring Peirene at Corinth.

HIPPODAMUS of Miletus, Greek architect of the 5th century B.C., who introduced a tonn-planning system of a series of broad straight streets intersecting at right angles. He planned the harbour town of Athens. Piraeus, about the middle of the century, under Pericles, and was architect to the colony at Thurii in Italy in 443 B.C. His alleged superintendence of the building of the nen city of Rhodes in 408 B.C. is probably a fiction.

See R. *E* Wycherley, *How the Greeks Built Cities* (1949).

HIPPODROME, a Greek building for horse and chariot races, corresponding to the Roman *circus.* It was usually placed on a hill slope, so that the excavated material from one side could serve for an embankment for the other. One end was semicircular and the other square. The seats ran continuously around the semicircle and the two long sides, in rising tiers, and down the centre was a division. Because as many as ten chariots raced at a time, a width of about 400 ft. was necessary. The usual length varied from 600 to 700 ft. In the hippodrome at Constantinople much of the area was supported on tiers of great vaults instead of the more usual embankment. On the centre division, between an Egyptian obelisk and a memorial column, was placed the famous bronze serpent tripod from the oracle at Delphi.

Begun by Severus in 203, and completed by Constantine in 330, it was both the largest and the most splendid hippodrome of the ancient world. Among its decorations were the four Greek bronze horses that now stand on the facade of St. Mark's at Venice.

HIPPOLYTUS (d. *c.* 230), a writer of the early church, whose personality was enveloped in mystery before the discovery in 1851 of his chief nork. the *Philosophumena.* Assuming the

authenticity of this work, and correlating it with tradition, we get a tolerably clear picture. Hippolytus was born in the second half of the 2nd century, probably in Rome. He was learned and eloquent, and under Bishop Zephyrinus (199–217) was presbyter of the church at Rome. He accused Zephyrinus's successor, Calixtus I (*q.v.*), of favouring the Christological heresies of the Monarchians, and of subverting discipline by receiving back into the Church those guilty of gross offenses. The result was a schism, and for some ten years Hippolytus stood as bishop at the head of a separate church. During the persecution under Maximinus the Thracian, Hippolytus and Pontius, who was then bishop, were transported in 235 to Sardinia, where it would seem that both of them died, the former having been reconciled with the church.

Hippolytus's voluminous writings, some of which are listed in Eusebius, *Hist. Eccl.* vi and in Jerome, *De Viris Ill.* lxi, exist chiefly in fragments. They embrace the spheres of exegesis, apologetics and polemic, chronography and ecclesiastical law. Of his exegetical works the best preserved are the *Commentary on the Prophet Daniel* and the *Commentary on the Song of Songs*, both distinguished by sobriety and sense of proportion. Of his polemical treatises the chief is the *Refutation of all Heresies*, or *Philosophumena. Ek.* i was for a long time printed among the work of Origen; bks. iv–x were found in 1842 by the Greek Minoides Mynas, without the name of the author, in a ms. at Mount Athos, but it is now accepted as a work of Hippolytus; books ii and iii are lost. The work has been much over-rated, the exposition of the Gnostic system in particular being untrustworthy. Of the dogmatic works, that on *Christ and Antichrist* which survives in a complete state, gives a vivid account of the events of the beginning of the 3rd century. The chronicle of the world, from the creation to 234, formed a basis for many chronographical works both in the east and west. In the great compilations of ecclesiastical law which arose in the east after the 4th century *(see* CONSTITUTIONS, APOSTOLIC) much material was taken from Hippolytus.

BIBLIOGRAPHY.—The edition by J. A. Fabricius (2 vols., Hamburg, 1716–18, reprinted in Gallandi, *Bibliotheca veterum patrum* (vol. ii, 1766) and Migne, *patrol. graeca*, x) is out of date. The *Commentaries on Daniel* and on the *Song of Songs*, the treatise on *Antichrist*, and the *Lesser Exegetical* and *Homiletic Works* were edited by N. Bonwetsch and H. Achelis in 1897. The *Chronicle* has been published by A. Bauer (Leipzig, 1905) and the *Refutation* by Miller (Oxford, 1851), Duncker and Schneidewin (Göttingen, 1859) and Cruice (Paris, 1860). The *Philosophurnena* has been translated by F. Legge (1921).

See Bunsen, *Hippolytus and his Age* (1852, 2nd ed., 1854); Dollinger, *Hippolytus und Kallistus* (Regensb. 1853; Eng. transl., 1876); G. Ficker, *Studien zur Hippolytfrage* (Leipzig, 1893); H. Achelis, *Hippolytstudien* (Leipzig, 1897); K. J. Neumann, *Hippolytus von Rom in seiner Stellung zu Staat und Welt*, part i (Leipzig, 1902); Adhémar d'Alès, *La Théologie de Saint Hippolyte* (1906).

HIPPOLYTUS, in Greek legend, son of Theseus and Hippolyte, oueen of the Amazons (or of her sister Antiope), a famous hunter and charioteer and favourite of Artemis. His stepmother Phaedra became enamoured of him, but, finding her advances rejected, she hanged herself, leaving a letter in which she accused Hippolytus of an attempt upon her virtue. Theseus, to whom his father Poseidon had given three wishes, then prayed for the destruction of Hippolytus and banished him. While Hippolytus was driving along the shore at Troezen (the scene of the *Hippolytus* of Euripides), a sea-monster sent by Poseidon frightened his horses; Hippolytus was thrown out of the chariot, and was dragged along, entangled in the reins, until he died. According to a tradition of Epidaurus, Asclepius restored him to life at the request of Artemis; later, he was represented as having been removed to Aricia *(see* DIANA). At Troezen he had a cult, and girls used to dedicate a lock of hair to him before marriage (Eurip. Hipp. 1423; Paus. ii, 32, 1); a local cult-legend said he was not dead, but turned into the constellation Auriga (Paus. *ibid.*). Well-known classical parallels to the main theme are Bellerophon and Anrea (or Stheneboea) and Peleus and Astydamia. The story was the subject of two plays by Euripides (the later of which is extant), and a tragedy by Seneca. Trace of it has survived in the legendary death of the apocryphal martyr Hippolytus, a Roman officer who was torn to pieces by wild horses as a convert to Christianity.

See Roscher's *Lexikon*, art. "Hippolytus"; *L.* R. Farnell, *Greek Hero-Cults* (1921).

HIPPOLYTUS, THE CANONS OF. This book stands at the head of a series of church orders, which contains instructions in regard to the choice and ordination of Christian ministers, and regulations for baptism, the Eucharist, fasts and other observances. We possess the *Canons of Hippolytus* only in an Arabic version, itself made from a Coptic version of the original Greek. It was only in 1870 that it was edited by Haneberg, who added a Latin translation, and so made it generally accessible. In 1900 a German translation was made by H. Riedel, based on fresh mss. These showed that the book, as hitherto edited, had been thrown into disorder by the displacement of two pages near the end; they also removed other difficulties upon which the theory of interpolation had been based.

Contents **of the** Canons. — The book is attributed to "Hippolytus, the chief of the bishops of Rome," and is divided into 38 canons, to which short headings are prefixed. This division is certainly not original, but it is convenient for purposes of reference. Canon 1 is prefatory; it contains a brief confession of faith in the Trinity, and especially in the Word, the Son of God; and it speaks of the expulsion of heretics from the church. Canons 2–5 give regulations for the selection and ordination of bishops, presbyters and deacons. The bishop is chosen by the whole congregation: "one of the bishops and presbyters" is to lay hands upon him and say a prayer which follows (3); he is at once to proceed with "the offering," taking up the eucharistic service at the point where the *sursum corda* comes in. A presbyter (4) is to be ordained with the same prayer as a bishop, "with the exception of the word bishop"; but he is given no power of ordination (this appears to be inconsistent with c. 2). The duties of a deacon are described, and the prayer of his ordination follows (5). Canons 6–9 deal with various classes in the church. One who has suffered punishment for the faith (6) is to be counted a presbyter without ordination: "his confession is his ordination." Readers and subdeacons (7) are given the Gospel, but are not ordained by laying-on of hands. A claim to ordination on the ground of gifts of healing (8) is to be admitted, if the facts are clear and the healing is from God. Widows are not ordained (9): "ordination is for men only." Canons 10–15 describe conditions for the admission of converts. Certain occupations are incompatible with Christian life; only under compulsion may a Christian be a soldier. Canons 16–18 deal chiefly with regulations concerning women.

Canon 19 is a long one dealing with catechumens, preparation for baptism, administration of that sacrament and of the eucharist for the newly baptized. The candidate is twice anointed: first, with the oil of exorcism, after he has said, with his face westward, "I renounce thee, O devil, and all thy following"; and, again, immediately after the baptism. As he stands in the water, he declares his faith in response to an interrogatory creed; and after each of the three clauses he is immersed. After the second anointing the bishop gives thanks "for that Thou hast made them worthy that they should be born again, and hast poured out Thy Holy Ghost upon them, so that they may belong, each one of them, to the body of the Church"; he signs them with the cross on their foreheads, and kisses them. The eucharist then proceeds: "the bishop gives them of the body of Christ and says, This is the body of Christ, and they answer Amen": and similarly for the cup. Milk and honey are then given to them as being "born a second time as little children." A warning is added against eating anything before communicating. Canons 20–22 deal with fast-days, daily services in church and the fast of the passover-week. Canon 23 seems as if it closed the series, speaking, as it does, of "our brethren the bishops" who in their cities have made regulations "according to the commands of our fathers the apostles": "let none of our successors alter them; because it saith that the teaching is greater than the sea, and hath no end." We pass on, however, to regulations about the sick (24) who are to be visited by the bishop, "because it is a great thing for the sick that the high-priest should visit them (for the shadow of Peter

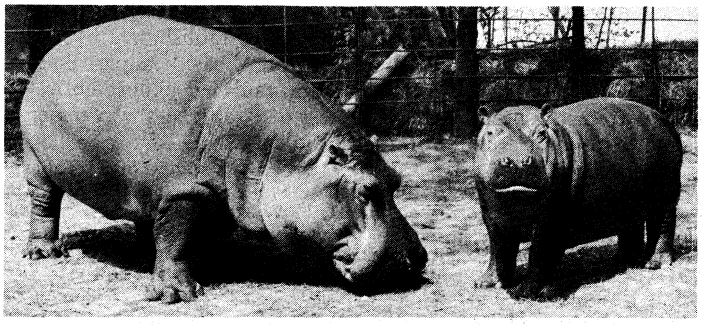
healed the sick)."

Canons 25–27 deal again with prayers and church-services. The "seven hours" are specified, with reasons for their observance (25); attendance at sermons is urged (26), "for the Lord is in the place where his lordship is proclaimed" (comp. *Didachè* 4, part of the Two Ways). When there are no prayers in church, reading at home is enjoined (27); "let the sun each morning see the book upon thy knees" (cornp. Ath. *Ad* virg., § 12, "Let the sun when he ariseth see the book in thy hands"). Prayer must be preceded by the washing of the hands. "No believer must take food before communicating, especially on fast-days"; only believers may communicate (28). The sacred elements must be guarded, "lest anything fall into the cup, and it be a sin unto death for the presbyters." No crumb must be dropped, "lest an evil spirit get possession of it." Canons 30–35 contain various rules, and specially deal with suppers for the poor (i.e., agapae) and memorial feasts. Then we have a prayer for the offering of first-fruits (36); a direction that ministers shall wear fair garments at "the mysteries" (37); and a command to watch during the night of the resurrection (38). The last canon hereupon passes into a general exhortation to right living, which forms a sixth part of the whole book. In Riedel's translation we read this for the first time as a connected whole. It falls into two parts, and describes, first, the true life of ordinary Christians, warning them' against an empty profession, and laying down many precepts of morality; and then it addresses itself to the "ascete" who "wishes to belong to the rank of the angels," and who lives a life of solitude and poverty. He is encouraged by an exposition, on somewhat strange lines, of the temptations of our Lord, and is specially warned against spiritual pride and contempt of other men. The book closes with an appeal for love and mutual service, based on the parables in St. Matthew xxv.

Authenticity of Authorship. — The Puritan severity of the canons well accords with the temper of the writer to whom the Arabic title attributes them; and it is to be noted that the exhortation at the close contains a quotation from 2 Peter actually attributed to the apostle, and Hippolytus is perhaps the earliest author who can with certainty be said to have used this epistle. But the general style of Hippolytus, which is simple. straightforward and strong, is in marked contrast with that of the closing passage of the canons; moreover, his mind, as presented to us in his extant writings, appears to be a much larger one than that of the writer of these canons; it is as difficult to think of Hippolytus as it would be to think of Origen in such a connection. How, then, are we to account for the attribution? There is evidence to show that Hippolytus was highly reverenced throughout the east; his writings, which were in Greek, were known, but his history was entirely unknown. He was supposed to be "a pupil (γνώριμος) of apostles" (Palladius, 4th century), and the Arabic title calls him "chief of the bishops of Rome," *i.e.,* archbishop of Rome. A whole group of books on church orders bears the name of Clement of Rome; and the attribution of our canons to Hippolytus may be only an example of the same tendency. The fact that Hippolytus wrote a treatise Concerning Spiritual Gifts, and that some such treatise is not only referred to in the Latin preface to the Egyptian Church order, but is actually found at the beginning of book viii of the Apostolic Constitutions, introduces an interesting complication. Dom Morin's ingenious attribution of the canons to Dionysius of Alexandria (on the ground of Eusebius, H.E. vi, 46, 5) cannot be accepted in view of the broader church policy which that writer represents.

HIPPONAX, of Ephesus, Greek iambic poet. Expelled from Ephesus in 540 B.C. by the tyrant Athenagoras, he took refuge in Clazomenae, where he spent the rest of his life in poverty. He was caricatured by the Chian sculptors Bupalus and Xthenis, upon whom he revenged himself by a series of satires. His coarseness, his rude vocabulary and his numerous allusions to local matters prevented his becoming a favourite in Attica. He was considered the inventor of parody and of a peculiar metre. the *scazon* or *choliambus,* which substitutes a spondee for the final iambus of an iambic senarius.

HIPPOPOTAMUS, the largest living nonruminating even-toed mammal (*see* ARTIODACTYLA).



W. SUSCHITZKY

FEMALE HIPPOPOTAMUS (HIPPOPOTAMUS AMPHIBIUS) **AND YOUNG**

The common hippopotamus (H. *amphibius*) inhabits the large rivers of Africa, though its range has non become much restricted. It is the type of the family Hippopotomidae, whose nearest relatives are the pigs.

In form the hippopotamus is huge and unnieldy, reaching a iength of 14 ft , a height of 3 ft. 10 in. at the shoulder and a weight of at least 3 tons. The ears are small but flexible, the body thick, the legs short. The eyes and nostrils protrude so as to be out of water when the animal is floating; the gape is enormous and the upper lip thick and bulging. Both canines and incisors are of continuous gronth and very large. The skin. which is two inches thick in places, is almost destitute of hair. Hippopotamuses live in herds of 20 to 40 on the banks and in the beds of rivers, feeding mainly at night and on aquatic plants groning in the nater. but they also come on shore to feed, frequently doing immense damage to crops.

Of a mild and inoffensive disposition, the hippopotamus can exhibit great ferocity nhen wounded or defending its young; its immense strength and agility, despite its unwieldy bulk, render it a formidable antagonist. As among elephants. old bulls may become "rogues" and will attack without provocation.

In the Pleistocene epoch, a hippopotamus inseparable from the living species inhabited the greater part of Europe, while dwarf species were found in Crete. Malta, Sicily, India, Burma and northern Africa. More recently a small species, H. *lemerlei,* lived in Madagascar.

The pygmy hippopotamus (Choeropsis liberiensis), the size of a pig, lives in the rain forest of west Africa. It is more primitive and less aquatic in habit than its large cousin.

HIRA, a ruined city, south of Kufa in Iraq. which played an important role in the history of the Arabs before Islam. As the word itself indicates (Syriac herta, "camp"), the town was originally a military encampment.

It was under the Lakhmids, the Arab vassals of Persia, that Hira attained its fame and importance. As their capital. it became, for at least two centuries before Islam, a centre of diplomatic, political and military activities nhich involved Persia. Byzantium and the Arabian peninsula. The Lakhmids adorned the town and its environs with palaces and castles, but twice during the 6th century A.D. it experienced the ravages of war at the hands of the Ghassanid Arabs, the vassals of Byzantium.

It is. however, in the history of Arab culture before Islam that Hira is most important. Various aspects of material culture flourished in it, and the Arabic script (according to tradition) was developed there. Especially significant was Hira's role in the development of Arabic poetry and Arab Christianity. Toward the Lakhmid court gravitated some of the best-known poets in pre-Islamic Arabia (*e.g.,* 'Abid, Tarafah and al-Nabighah), while in Hira itself flourished the famous poet 'Adi ibn Zayd. Even more significant was its role in the spread of Christianity. As the seat of a Nestorian bishopric, Hira exercised a strong influence over the religious life of the east, and through this influence Christian monotheism penetrated the Arabian peninsula.

Its fortunes closely linked to those of its Lakhmid rulers, Hira began to decline in the first decade of the 7th century after the Persians had brought the Lakhmid dynasty to an inglorious end.

In A.D. 633 the town capitulated to Moslem arms and agreed to pay tribute. Its decline was accelerated by the establishment of Kufa, which eclipsed it, and by the fact that the Abbasid caliphs did not make it their residence. Finally Hira vanished almost entirely, except from the literary consciousness of Arab poets who remembered it to point a moral or adorn a tale.

BIBLIOGRAPHY.—For Arabic sources *see* the *Annales* of al-Tabari, vol. i and iii, ed. by M. J. de Goeje (1879–1901), and the *Mu'jam al-Buldan* of Yaqut, vol. ii, ed. by H. F. Wiistenfeld (1866–73). *See* further G. Rothstein, *Die Dynastie der Lahmiden in al-Hira* (1899); *D.* Talbot Rice, "The Oxford Excavations at Hira, 1931," *Antiquity* (1932); *R. A.* Nicholson, *A Literary History* of *the Arabs* (1907; reprinted 1953). (I. A. K.)

HIRADO-SHIMA, an island lying off the west coast of Kyushu in Nagasaki prefecture, Japan. Area 66 sq.mi.; pop. (1955) 43,302. The town of Hirado was the first port open to foreign trade and is celebrated as the site of the original Dutch factory and the "English House" (17th century). It was frequented by Chinese ships, and during the period of Christian persecutions the port towns of Hirado and Nagasaki (*q.v.*) were the only ones open to foreign trade. It is the place where one of the finest blue and white porcelains of Japan (Hiradoyaki) was produced in the 17th and 18th centuries. (R. B. H.)

HIRE PURCHASE: see INSTALLMENT CREDIT.

HIRING, in law, a contract by which one man grants the use of a thing to another in return for a certain price. It corresponds to the locatio-conductio of Roman law. That contract was either a letting of a thing (locatio-conductio rei) or of labour (locatio operarum). The distinguishing feature of the contract was the price. In modern English law the term can scarcely be said to be used in a strictly technical sense. The contracts which the Roman law grouped together under the head of locatio-conductio —such as those of landlord and tenant, master and servant, etc.— are not in English law treated as cases of hiring but as independent varieties of contract, but hiring is generally applied to contracts in which the services of a man or the use of a thing are engaged for a short time.

Hiring fairs or statute fairs, still held in Wales and some parts of England, were formerly an annual fixture in every important country town. The men and maids seeking work stood in ro s, the males together and the females together, while masters and mistresses walked down the lines and selected those who suited them. Originally these hiring fairs were always held on Martinmas day (Nov. 11). Now they are held on different dates in different towns, usually in October or November. In Cumberland the men seeking work stood with straws in their mouths.. In Lincolnshire the bargain between employer and employee was closed by the giving of the "fasten-penny." the earnest money, usually a shilling, which "fastened" the contract for a twelvemonth. A few days after the statute fair it was customary to hold a second called a mop fair or runaway mop. "Mop" meant in Old English a tuft or tassel, and the fair was so called, it is suggested, in allusion to tufts or badges worn by those seeking employment. Thus the carter wore whipcord on his hat, the cowherd, a tuft of cow's hair, and so on. See EXHIBITIONS AND TRADE FAIRS; LABOUR LAW; MASTER AND SERVANT; WAGES.

HIROHITO (1901–), emperor of japan, was born on April 29, 1901, the son of the emperor Yoshihito (Taishō) (*q.v.*). After being educated at the Peers' school he .visited Europe in 1921, becoming the first crown prince to go abroad. Upon his return, he was named prince regent when his father retired because of mental illness. His marriage in 1924 to Princess Nagako stirred up controversy because the princess came from the Shimazu family instead of the Fujiwara family as decreed by tradition. The emperor and empress had two sons and four daughters; a fifth daughter died in 1928. The eldest son, Akihito, was born in 1933. Hirohito became emperor Dec. 25, 1926, and his reign, although designated Shōwa or "bright peace," was characterized by internal unrest and an aggressive foreign policy culminating in World War II. It appears that the emperor had grave misgivings about militarism and foreign expansion and tried to restrain the militarists. but in vain. In 1945, when Japan was near defeat, Hirohito threw his influence against the army and on the side of those favouring peace. He broke precedent on Aug. 15, 1945, when he spoke on the radio to announce Japan's surrender. When surrendering, the Japanese government sought a pledge from the Allies that the emperor would be retained; the U.S. reply was noncommittal, but eventually a policy of supporting a modified imperial system was adopted. To bring the throne closer to the people, Hirohito publicly repudiated the doctrine of the emperor's divinity in Jan. 1946; he later made numerous public appearances and permitted pictures and stories about his personal and family life to be published. The campaign to "humanize" the emperor increased his popularity and reduced the effect of Communist agitation to abolish the imperial system. When in 1959 he permitted Crown Prince Akihito to marry a commoner, Shoda Michiko, he again broke with tradition. (N. I.)

HIROSAKI, a town in Aomori prefecture in north Japan. Pop. (1955) 138,953. The fine isolated cone of Iwaki-yama, a mountain of pilgrimage, rises to the west. Hirosaki developed as a castle town, many traces of which are found in the old buildings and street names. It has failed to' develop modern industry. Local products include a distinctive green lacquer ware (*Tsugaru-nuri*), apples and processed apple products such as cider, jam and juice. (R. B. H.)

HIROSHIGE, ANDŌ (1797–1858), Japanese artist, was one of the last great masters of the Ukiyo-e or popular school of painting in Japan, a school which specialized in the making of colour prints. He was adopted into the And6 family but received his art name, Utagawa Hiroshige, from his tedcher Utagawa Toyohiro. Even as a child Hiroshige had shown considerable artistic promise, but it was not until he accompanied an embassy from the shogun in Edo (now Tokyo) to the emperor in Kyōto and traveled along the Tōkaidō road in 1832 that his great talent developed. On this trip Hiroshige stayed at the 53 overnight stations along the way and he made numerous sketches of everything he saw. Upon his return to Edo, he published in 1832 a series of 55 prints entitled the "Fifty-three Stages of the Tōkaidō"—one for each station plus the beginning of the highway and the arrival in Kyōto. The success of this series was immediate and made Hiroshige one of the most popular Ukiyo-e artists of all time.

Later Hiroshige made many other journeys within Japan and issued series of prints depicting the famous "Sixty-nine Stages of the Kisokaido," "Views of Edo," "Lake Biwa" and "Famous Places in Kyoto." Repeatedly new designs were executed of the 53 Tōkaidō views wherein he employed his unused sketches of previous years. He also designed some lovely bird and flower prints which are an interesting contrast to his landscapes. Hiroshige's work declined toward the end of his life, largely because of the demands of his publisher for new subjects and the artist's need for money. Various sources have estimated that Hiroshige created over 5,000 prints and that as many as 10,000 copies were made from some of his wood blocks. Hiroshige had assistants but not one of his pupils ever approached the talent of his master, although the names Hiroshige II and III were given to two of his successors. Possessing the ability to reduce the pictured scene to a few simple elements of a highly decorative character, Hiroshige captured the very essence of what he saw and turned it into a strikingly effective composition. Snow, rain, mist and moonlight scenes compose some of his most poetic masterpieces. These are the prints that so influenced the French painters of the late 19th century.

See Arthur Davidson Ficke, *Chats on Japanese Prints* (1915); James *A.* Michener, *The Floating World* (1954). (M. O. Gs.)

HIROSHIMA, a prefecture (ken) in southwest Honshu, Japan. with an area, including offshore islands, of 3,235 sq.mi. and a population (1955) of 2,149,044. The Chūgoku mountains run along the northern boundary, and delta plains are extensively developed along the Inland sea coast in the south. Agriculture supports most of the population, followed by manufacturing industry and retail trade. Important products are rice, oranges, rush (material for mats), cattle, oysters and salt. The majority of the factories are on the traditional small scale but large modern factories produce textile goods. There are shipyards at Kure, Innoshima. Onomichi and Hiroshima city, the prefectural capital. (R. B. H.)

HIROSHIMA, a seaport, capital of Hiroshima prefecture, in southwestern Japan. Population (1960) 431,336. The town of Hiroshima grew up on the delta of the Ota river, where the Mori clan built a castle in 1591 which survived until 1945. From the Meiji era (1868–1912) to World War II, the city was a military centre. On Aug. 6, 1945, Hiroshima was the first city to be struck by an atomic bomb dropped by the United States air force. The greater part of the city was destroyed, and about 200,000 people were killed. Reconstruction was commenced immediately after the end of the war. New permanent buildings were begun about 1950 under a city-planning scheme. Bridges are important as the city is split into five islets by the river delta, and recovery began with the rebuilding of the Inaribashi bridge. A wide road traversing the centre of Hiroshima from east to west is expected to become the main thoroughfare with the completion of the bridges. Being the largest city in the Chūgoku and Shikoku districts, Hiroshima has many administrative offices and public-utility centres. The chief modern industries include the Matsuda truck factory, the Mitsubishi shipbuilding and machinery factories and the Kirin brewery. The city produces 80% of the needles used in Japan.

From ancient days, Hiroshima was famous for its association with the neighbouring islet of Itsuku-shima which is dedicated to the goddess Benten; but now Hiroshima is thought of as a city dedicated to world peace. The Atomic Bomb Casualty commission was established there in 1947 to conduct long-range medical and biological research and to investigate the effects of radiation upon man. There are five public hospitals including the "A-Bomb hospital" and 40 private clinics which give free treatment to A-bomb sufferers. (R. B. H.)

HIRPINI, from an Oscan or Sabine stem hirpo-, "wolf." An inland Samnite tribe in the south of Italy, whose territory was bounded by that of the Lucani on the south, the Campani on the southwest, the Xppuli (Apuli) and Frentani on the east and northeast. On the north they were, politically speaking, identified with the Pentri and Caraceni, and with them constituted the Samnite alliance in the wars of the 4th century B.C. (See SAMNITES.) The Roman policy of separation cut them off from these allies by the foundation of Beneventum in 268 B.C., and henceforward they were a separate unit. They joined Hannibal in 216 B.C., and retained their independence until, after joining in the Social War (see ROME: The Republic: The Social War), which in their part of Italy could hardly be said to have ceased till the final defeat of the Samnites by Sulla in 83 B.C., they received the Roman franchise. Of their Oscan speech, besides the evidence of their place names, only a few fragments survive.

In the ethnology of Italy, the Hirpini appear from one point of view as the purest type of Safine stock, namely, that in which the proportion of names formed with the suffix *-ni-* is highest, 33 out of 36 tribal or municipal epithets being formed thereby (*e.g., Caudini, Compsani*) and only one with the suffix *-ti-* (*Abellinates*), where it is clearly secondary.

HIRSAU (formerly HIRSCHAU), a village of Germany, in Baden-Württemberg, 2 mi. N. of Calw. Pop. (1950) 1,576. Hirsau owes its origin and historical interest to its former Benedictine monastery, Monasterium Hirsaugiense, at one period one of the most famous in Europe. It was founded about 830 by Count Erlafried of Calw, at the instigation of his son, who enriched it with the body of St. Aurelius. Its first occupants (838) were a colony of 15 monks from Fulda, disciples of Hrabanus Maurus and Walafrid Strabo, headed by the abbot Liudebert. During about a century and a half, under the fostering care of the counts of Calw, it enjoyed great prosperity, and became an important seat of learning; but toward the end of the 10th century the ravages of the pestilence combined with the rapacity of its patrons and the selfishness and immorality of its inmates to bring it to the lowest ebb. After it had been desolate and in ruins for more than 60 years it was rebuilt in 1059, and under Abbot William —Wilhelm von Hirsau (abbot from 1069 to 1091)—it more than regained its former splendour. By his *Constitutiones* Hirsaugienses, a new religious order, the *Ordo* Hirsaugiensis, was formed, the rule of which was afterward adopted by many monastic establishments throughout Germany.

The friend and correspondent of Pope Gregory VII and of Anselm of Canterbury, Abbot William took active part in the politico-ecclesiastical controversies of his time; while a treatise from his pen, De *musica* et *tonis*, as well as the Philosophicarum et *astronomicarum institutionum libri* iii, bear witness to his interest in science and philosophy. About the end of the 12th century the material and moral welfare of Hirsau was again very perceptibly on the decline, and it never afterward rose into importance. It was secularized in 1558; in 1693 it was laid in ruins by the French. The *Chronicon* Hirsaugiense or, as it is called in the later edition, *Annales* Hirsaugienses of Abbot Trithemius (1559) is, although containing much that is merely legendary, an important source of information, both in the affairs of the monastery and on the early history of Germany. The Codex Hirsaugiensis, edited by A. F. Gfrorer, was printed in 1843.

HIRSCH, MAURICE, BARON DE (BARON MORITZ VON HIRSCH AUF GEREUTH) (1831–1896), German capitalist and philanthropist, was born at Munich on Dec. 9, 1831. His grandfather, the first Jewish landowner in Bavaria, was ennobled in 1818, and his father, who was banker to the Bavarian king, was created a baron in 1869. The family for generations occupied a prominent position in the German-Jewish community. At the age of 13 young Hirsch was sent to Brussels to school, but when 17 years old he went into business. In 1855 he became associated with the banking house of Bischoffsheim & Goldschmidt, of Brussels, London and Paris. He amassed a fortune, which he increased by purchasing and working railway concessions in Austria, Turkey and the Balkans and by speculations in sugar and copper.

While living in splendour, he devoted much time to schemes for the relief of his persecuted coreligionists, and took a deep interest in the educational work of the Alliance Israélite Universelle, on two occasions presenting the society with 1,000,000 fr. For several years he regularly paid the deficits of the alliance, amounting to several thousand pounds a year. In 1889 he capitalized his donations and presented the society with securities producing an annual income of £16,000.

On the 40th anniversary of Emperor Francis Joseph's accession to the Austrian throne Hirsch gave £500,000 for the establishment of schools in Galicia and the Bukovina. His greatest charitable enterprise was in connection with the persecution of the Jews in Russia. He gave £10,000 for the repatriation of the refugees in 1882 and offered the Russian government £2,000,000 for the endowment of a system of secular education in the Jewish pale of settlement. The Russian government, while willing to accept, declined to allow any foreigner to be concerned in its administration. Thereupon Baron de Hirsch devoted the money to a colonization scheme which should enable persecuted Jews to establish themselves in agricultural colonies outside Russia. He founded the Jewish Colonization association as an English society, with a capital of £2,000,000, and in 1892 presented to it a further £7,000,000. On the death of his wife, *née* Clara Bischoffsheim, in 1899 the capital was increased to £11,000,000, of which £1,250,000 went to the treasury in death duties. This fund became one of the largest charitable trusts in the world. The association, prohibited from working for profit, came to possess large colonies in South America. Canada and Asia Minor and adopted as its purpose the alleviation of Jewish distress, including emigration and distributing agencies, technical schools, co-operative factories, savings and loan banks and model dwellings in the congested Russian ghettos.

Hirsch also founded in 1891 the Baron de Hirsch fund in the Cnited States for the benefit of Jeaish immigrants, endowing it with £493,000. The activities of the trust involved helping newly arrived Jewish immigrants. educating them for U.S. citizenship, aiding them to move from the cities to smaller tonns and operating a trade school for Jewish boys, to name only a few. By mid-20th century the fund supported the Jewish Agricultural society. which aided farmers by means of loans and also helped to settle displaced persons on farms in the U.S. Baron de Hirsch's minor charities were on a princely scale. While in London he distributed over £100.000 among the local hospitals. In this manner he disposed of the whole gross proceeds derived from his successes on

the English turf. Baron de Hirsch died on April 21, 1896.
(L. W.; X.)

HIRSCH, SAMSON RAPHAEL (1808–1888), Jewish religious thinker, founder of Trennungs-Orthodoxie ("separatist Orthodoxy"). was born in Hamburg on June 20, 1808. He studied rabbinics at Mannheim and philosophy at Bonn university, and was rabbi in Oldenburg, Emden and Nikolsburg before being called to Frankfurt am Main (1851). There he became the leading spirit in the establishment of a modernized Orthodox Jewish congregation and school system which could withstand the challenge of enlightenment without abandoning the best in European civilization. "Torah combined with worldly wisdom" became the slogan of the growing "neo-Orthodox" group. Due to the efforts of Eduard Lasker (*q.v.*), Prussia adopted a law (July 28, 1876) permitting Jews to secede from the general Jewish community and establish separate religious societies. Thereupon, Hirsch led his congregation out of the community, which in his view was unfaithful to the Law. Hirsch wrote *Nineteen* Letters (1836; Eng. trans., 1899), Horeb (1837), commentaries on the Pentateuch (1867–78), Psalms (1882), the Hebrew prayer book (1890), and edited the monthly Jeshurun. Six volumes of his essays were published (1902–12). He died at Frankfurt on Dec. 31, 1888.

Hirsch presents Judaism as a community based on faith, aiming at the sanctification of life, the spiritualization of man and the attainment of an awareness of divine presence on earth. While searching for the symbolic meaning of the ritual and ceremonial laws, he steered clear of mysticism. In opposition to Abraham Geiger (*q.v.*) he rejected biblical criticism and the application of scientific methods to the study of Judaism. Though limited to a segment of Jewry, Hirsch's influence has been lasting and deep.

See I. Grunfeld (ed.), *S. R. Hirsch:* ***Judaism*** *Eternal* (1957).
(N. N. G.)

HIRT, HERMANN (1865–1936), German philologist, who was in his generation the most distinguished follower of Karl Brugmann and the neogrammarians (Junggrammatiker), was born at Magdeburg on Dec. 19, 1865. He was educated at Leipzig and Freiburg, and appointed professor of Indo-European philology and Sanskrit at the University of Giessen in 1912. His most original research was on accent and vowel gradation, published in Der indogermanische *Akzent* (1895), Der indogermanische Ablaut (1900) and many articles. From these studies he went on to a comprehensive *Indogermanische Grammatik* (7 vol., 1921–37), which no subsequent scholar has undertaken to revise or supersede. Hirt had less knowledge of ancient texts than Brugmann but he profited from the general advances in learning, particularly in the Celtic and Slavic fields, and he worked continually on the Germanic languages. He was intensely concerned with prehistory, not only of language but also of the Indo-European people and their culture, which he treated in Die Indogermanen (2 vol., 1905–07). He died on Sept. 12, 1936, at Giessen. (S. LN.)

HIRTIUS, AULUS (*c.* 90–43 B.C.), Roman historian and statesman. He was with Julius Caesar as legate in Gaul, but after the civil war broke out in 49 he seems to have remained in Rome to protect Caesar's interests. He was also a personal friend of Cicero. He was nominated with C. Vibius Pansa by Caesar for the consulship of 43; and after the dictator's assassination in March 44, he and his colleague supported the senatorial party against M. Antonius, with whom Hirtius had at first sided. The consuls set out for Mutina, where Antonius was besieging Decimus Brutus. On April 15 Pansa was attacked by Antonius at Forum Gallorum, about 8 mi. from Mutina, and killed. Hirtius, however, compelled Antonius to retire on Mutina, where another battle took place on April 21 (or 27) in which Hirtius was slain. Of the continuations of Caesar's Commentaries—the eighth book of the Gallic war, the history of the Alexandrian, African and Spanish wars—the first is generally allowed to be by Hirtius; the Alexandrian war is perhaps by him (or Oppius); the last two were supposedly written at his request by persons taking part in the events described, with a view to subsequent revision and incorporation in his proposed work on military commanders.

HIRUDINEA: see LEECH.

HIRUNDINIDAE: see SWALLOW; MARTIN.

HIS, WILHEEM (1831–1904), Swiss-German anatomist, one of the leading embryologists of his time and an authority in the embryology and anatomy of the brain, was born in Basel on July 9, 1831. As a medical student in Berlin. His received lasting impressions from the great anatomist and physiologist Johannes Peter Müller (*q.v.*) and from the embryologist Robert Remak. Afterward he studied in Wiirzburg under Rudolf Virchow and the histologist R. A. von Kölliker (*qq.v.*). Before taking his M.D. in Basel he visited Prague, Vienna and Paris and returned a few years later to Paris to attend the lectures of the neurologist C. E. Brown-Séquard. This background, and publications on the histology of the cornea of the eye and the lymphatic organs, gained him the professorship of anatomy and physiology in Basel at the age of 26. Fifteen years later he was called to Leipzig, where he established a new institute of anatomy, and where he remained until his death, on March 1, 1904. He and the physiologist Karl Ludwig were mainly responsible for the eminence of the Leipzig medical school in the late 19th century.

His's work in embryology covered the entire development from the early stages to the definite form of the organs, especially of the brain, and of the body as a whole. His discovery that the individual nerve fibre originates from a single nerve cell became the cornerstone of the neuron theory of the nervous system. Stressing mechanical factors as immediate causes of developmental changes, he stimulated later work in experimental embryology. His method of enlarged plastic reconstruction of embryonic organs from serial microscopic sections played an important part in the advancement of embryology. Asked for his opinion about the identity of a skeleton that was supposed to be that of Johann Sebastian Bach, he developed an anthropological method which has since been used repeatedly for the identification of a skull as that of a historical person.

His's son, also WILHELM HIS (1863–1934), professor of medicine in Berlin, is known for his contributions to the physiology and pathology of the heart and as the discoverer of the bundle of specific muscle fibres (bundle of His) in the septum of the heart which transmits the nervous impulse from the atria to the ventricles. (F. WN.)

HISHAM IBN AL-KALBI (ABU-AL-MUNDHIR HISHAM IBN MOHAMMED IBN AL-SA'IB AL-KALBI) (d. c. 819), Arab historian, who wrote a valuable account of the genealogies of the ancient pre-Islamic Arabs. He was born in Kufa but spent much of his life in Baghdad. Like his father. who was also his teacher, he devoted his energies to collecting information about the history and descent of the Arabs. He died in Kufa about 819. He is said to have written 140 works, most of which are lost. His account of the genealogies of the Arabs, which is continually quoted by Abu-al-Faraj (*q.v.*) in his Kitab al-Aghani, has been preserved only in part; one of his works has survived intact, Kitab al-Asnam (Eng. trans., The Book of Idols, with introduction and notes by N. A. Faris. 1952).

HISPANIOLA, the second largest island of the West Indies (*q.v.*), divided politically into the Republic of Haiti (République d'Haïti) and the Dominican Republic (República Dominicana). The island has been known by various names. Christopher Columbus, discoverer of the island in 1492, named it La Isla Espafiola, supposedly from which it was anglicized to Hispaniola. During Spanish colonial times it was commonly called Santo Domingo, after the capital city, and this name is still sometimes used. In English-speaking countries the form became San Domingo. The entire island has also been referred to as Haiti, supposed by some to be the precolonial name used by native aboriginal Indians (Arawaks) who also called it Quisqueya. Hispaniola is the name given to the island by the United States government.

The shape of the island can be described as resembling a lobster's claw with the western pincers open as though ready to grasp the island of Gonâve. Several large peninsulas extend from the main body of Hispaniola. The southwestern peninsula of Haiti reaches more than 120 mi, and the northwestern peninsula extends about 50 mi. The greatest length is nearly 400 mi. and the greatest width is 150 mi. The area is 29.296 sq.mi., of which nearly two-thirds (18,640 sq.mi.) is in the Dominican Republic and the re-

maining, western section (10,656 sq.mi.) is in Haiti.

Hispaniola's location is tropical. between latitude 17° 36' (Cape Beata) and 20° 04′ N. (Tortuga Island) and from longitude 68° 20′ (Cape Engaño) to 74° 29′ W. (Cape Irois). This location on the northern flank of the Caribbean sea furnished an excellent position for control of Spanish expansion to Cuba, Mexico, Panamb and South America during the early colonial period.

The rest of this article deals with the geography of the island. For its history, people, administration, social conditions and economy see DOMINICAN REPUBLIC and HAITI.

Geology and Structure. — The general structure of Hispaniola is geanticlinal, with the oldest rocks exposed in a broad belt through the centre of the island and the younger rocks flanking each side. The foundation is composed of igneous and metamorphic rocks, such as granite, schist and serpentine, of pre-Cretaceous age. The strata that were folded in Late Cretaceous time were also intruded by diorites. The ruggedness and irregularity of Hispaniola, however, are not primarily the result of folding, but of intense faulting. The Cordillera Central is much deformed, being faulted along several different axes. Faulting, accompanied by some folding, began in the Late Oligocene and continued during the Miocene and much of the Pliocene. The Late Cenozoic uplift resulted in the Cordillera Central being lifted considerably higher than it stands now and in the uplift of the Cordillera Septentrional. The Pliocene orogeny also probably produced the great faulted valleys of the Cibao and San Juan rivers and Lake Enriquillo, along with the Artibonite river, after which they received the deposition of great quantities of sediments from the mountains. Crustal movements are still in progress.

The alignment of features is dominantly east-west in the southern part, toward Jamaica, and in the eastern part, toward Puerto Rico. Northwest-southeast trends are predominant in the central, northern and northwestern sections of the island.

Physiography. — Hispaniola consists of alternate series of mountain ranges and long valleys and plains, with the mountains predominant. More than one-third of the island lies above 1,500 ft. elevation. The orientation of such land forms causes contrasts in climatic conditions and poses problems of transportation across the country from north to south.

Hispaniola has the highest relief of the West Indies, reaching to more than 10,400 ft. elevation in the Cordillera Central in the Dominican Republic with Monte Tina and Pico Trujillo as the loftiest peaks. The highest elevation in the northern cordillera is 3,992 ft. and in the southern mountains 5,350 ft. The southwestern peninsula is the most elevated part of Haiti, rising to 8,793 ft. about 15 mi. W. of the Dominican border. The island is unusual because the basin of Lake Enriquillo in southwestern Dominican Republic has land below sea level, the surface of the lake being about 150 ft. below sea level.

The main rivers draining Hispaniola are the Yaque del Norte (248 mi. in length) and the Camú in northern Dominican Republic and the Yaque del Sur in the south, and the Artibonite in Haiti. Hispaniola's coast line, though much indented, has relatively few deepwater, protected anchorages.

Climate. — The climate of Hispaniola can be described as modified tropical, resulting from the location of the island near the outer margin of the tropics and the somewhat complex mountain and valley structure. The influence of the steady trade winds, which blow from the northeast in winter and from the east and southeast in summer, is felt in both temperature and moisture conditions, which vary according to exposure and elevation.

Temperatures are constantly high near sea level, but freezing temperatures occur occasionally at moderate elevations near the centre of the island. Average temperatures range from 72° F. in January and February to 83° in July and August. Average extreme temperatures rarely go above 95° or below 50°.

Rainfall is abundant in much of the island, averaging about 55 in. annually over-all. Seasonal rainfall is highest in the southern sections during the months of May to November with a definite dry season. In the north the seasonal emphasis is reversed, with the wettest season occurring from December to April, though the summer is less rainy rather than really dry. The driest sections are the leeward plains, such as the lower Yaque del Norte and the basin of Enriquillo, where rainfall is less than 30 in. annually.

Hurricanes occasionally strike the island. sometimes causing serious damage. They may occur between August and November and generally cross from south to north.

Vegetation. — More than 60% of Hispaniola is covered by forests and woods and an additional 15% is classed as pasture land. The Dominican Republic has a higher proportion of its land still in forests than does Haiti. in part because of the lower density of population. Large tracts of land in the eastern plains of the Dominican Republic are still covered by forests, whereas much of even the steep mountain slopes of Haiti has been deforested because of the great population pressure for cultivated land.

The humid slopes of the mountains facing the trade winds are still clothed in dense forests. On the leeward, slopes and where the rainfall is distinctly seasonal are more open stands. In the higher elevations of the Cordillera Central and in the highest mountains of southeastern Haiti are extensive stands of pine. On the driest plains, as in western Dominican Republic and the Artibonite plain of Haiti, forests give way to scrubby growth and even desertic plants, except along the river courses. Scattered tree growth occurs in semiarid savanna grasslands. The stately royal palm (Roystonea *regia*) is widely distributed and is an extremely useful tree. Other than the valuable pine stands, the chief timber resources are mahogany, cedar, lignum vitae (*Guajacum officinale*) and logwood (Haematoxylon *campechianum*).

Mangrove swamps are common along the coast where tidal mud flats are formed. The largest areas are the head of Samanb bay, the northern coast east of Cap-Haitien and around Gonâve bay.

Animal Life. — There is a great variety and number of insects, but aside from some domestic animals which have been introduced, larger animal species are lacking. Before the arrival of the Spaniards land mammals were rare except for rodents and the mute dogs, which are now extinct. There is a great variety of birds and marine fishes, as well as mollusks, which are typical of the West Indian region. There are a few nonpoisonous snakes. Scorpions, centipedes and some large spiders are poisonous, but their bites are not usually fatal.

Land Use. — The major geographical features of Hispaniola are arranged in nearly parallel systems of mountains alternating with plains. Because of the existence of several distinct mountain systems and related plains. a large number of major regions could be delineated. In general, the mountains are forested and sparsely populated. Coffee growing is the chief agricultural activity and this enterprise is spread through most of the mountainous regions of Hispaniola in the humid areas.

The most populous plains region is the long and highly productive plain extending from Samaná bay northwestward to the northern coast of Haiti. In the humid eastern section, called the Vega Real (Royal plain), many crops are grown, the chief commercial one being cacao. Tobacco is dominant in the upper Yayue plain and irrigated rice in the semiarid lower plains, while sugar cane dominates the Plaine-du-Nord of Haiti. The southern plains of Hispaniola are also productive, though irrigation is necessary in many areas because of deficient rainfall. Sugar cane is by far the main crop and livestock grazing is also very signihcant. On the Haitian plains, cotton is also an important commercial crop and food crops assume great significance. (D. R. D.)

HISSAR. (1) A town in the Tadzhik S.S.R. of the U.S.S.R., in lat. 38" 30' N., long. 68° 39' E., at a strategic point at the head of the defile carved out by the Kafirnigan river, a tributary of the Amu-Darya. It is the ancient capital of a once independent region where principalities rose and fell, finally incorporated with the former emirate of Bukhara. The town was at one time famous for its damascene swords and silk goods. Before the revolution it was the winter residence of the beg of Hissar. The moist and oppressive heat leads to an abundance of reeds. (2) The Hissar mountains 7,000 to 13,000 ft. also in the Tadzhik S.S.R. form the snow-capped southern arm of the bifurcation in long. 67" 45′ E. of the Alai range, a western extension of the Tien-Shan. The Turkistan range forms its northern arm, and a long spur, the Zarafshan range branches off west of the Pakshif pass, from which

point the Hissar range turns off in a slightly southwest direction, with two deep curves on its northern slopes, and numerous spurs thrusting into the plain on the south. The valleys here are well wooded on their lower slopes, with clumps of poplar, ash, birch, willow, maple, juniper, pear, hawthorn and walnut interspersed with currant bushes and shrubs. From these southern slopes the Surkhan and Kafirnigan flow into the Amu-Darya. In the narrow parallel valley between the Turkistan range and the Zarafshan range the glacier-fed Zarafshan river flows westward, while between the Zarafshan range and the Hissar range, its tributary, the Yagnob, flows parallel to it.

See W. *R.* Rickmers, *The Duab of Turkestan* (1913).

HISSAR, a municipality and district in the Ambala division of Punjab, India. The town is on the Western Jumna canal, 97 mi. W.N.W. of Delhi. Pop. (1951) 35,297. It was founded in 1356 by the emperor Feroz Shah, who constructed a canal to supply it with water; but this fell into decay during the 18th century because of the constant inroads of marauders. Hissar was almost completely depopulated during the famine of 1783, but was afterward occupied by the Irish adventurer George Thomas, who built a fort and repopulated it. It is now chiefly known for its government cattle farm.

HISSAR DISTRICT comprises an area of 5,274 sq.mi. It lies along the northeastern border of the great Bikaner desert, and consists for the most part of sandy plains dotted with shrub and brushwood, and broken toward the south by undulations, which rise into hills of rock jutting up like islands out of a sea of sand. The Ghaggar is its only river, and its supply is uncertain. The Western Jumna canal crosses the district from east to west via Hansi and Hissar, irrigating many villages. Hissar produces a breed of large milk-white oxen, which are in great demand. The district's population is (1951) 877,945. The climate is very dry, hot westerly winds blowing from the middle of March till July. Cotton weaving, ginning and pressing are carried on. The chief trading centres are Bhiwani (pop. 52,183), Hansi (25,837), and Sirsa (24,980). Hansi was the capital of the Hariana tract and was also George Thomas' headquarters.

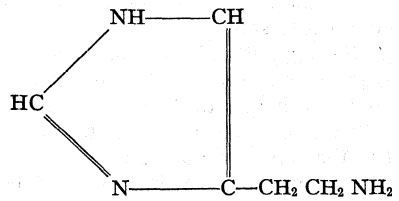
Before the Mohammedan conquest, the semidesert tract of which Hissar district forms a part was the retreat of Chauhan Rajputs. Toward the end of the 18th century the Bhattis of Bhattiana gained ascendancy after bloody struggles. Hissar passed nominally to the British in 1803, but they could not enforce order till 1810. Early in the mutiny of 1857 Hissar was wholly lost for a time to British rule, and all Europeans were either murdered or compelled to flee. The Bhattis rose under their hereditary chiefs, and the majority of the Mohammedan population followed their example. Before Delhi had been recovered, however, the rebels were utterly routed. Panjab university has a training college, a veterinary school and two general undergraduate colleges at Hissar and a training college and a textiles institute at Bhiwani.

HISTAMINE, a substance with varied and dramatic pharmacological effects, is found in extracts of all living cells, both animal and plant. Identified in 1910 by G. Barger and H. H. Dale, the compound itself, or a substance very similar to it, has been incriminated in certain types of headache, and in initiating the chain of events called triple response, reddening, flare and wheal, which is producible by heavy stroking of the skin. It is one of the irritating ingredients present in wasp venom, bee stings, heads of gnats and also in nettles. Above all, it is alleged to be the substance which is responsible for some of the symptoms of allergic and anaphylactic reactions such as asthma, hay fever, urticaria or hives (similar to the triple response) and serum sickness. Histamine is presumably always present in body tissues, but in an inactive, bound form which may be converted to the free, active compound in response to various stimulants. If all the histamine bound in the tissues of a human being were released at one time, the amount would be lethal. A quantity sufficient to kill an animal on injection is quite ineffective when given by mouth, however, since it is rapidly destroyed or inactivated in the intestine.

Histamine causes a contraction of the smooth musculature of some structures such as the lungs and the uterus. In asthma, the bronchioles of the lung are acutely obstructed because of exudate formation and muscular spasm caused by histamine. it also brings about capillary dilatation associated with an increased capillary permeability that leads to concentration of the blood. Intravenous injection in man of as little as 0.5 to 1 mg. produces headache, a marked dilatation of capillaries and arterioles, associated with the appearance of "blushing" and a lowering of blood pressure. These and still other responses may vary quantitatively and even qualitatively with different species of animals. The uterus responds to histamine (at term or immediately post partum) by contracting, but this action on the uterus is not employed clinically because of the many other and undesirable effects.

Some of the actions of histamine are put to practical use. Thus this remarkably versatile agent is the most potent known stimulant of the secretion of gastric juice, especially gastric hydrochloric acid. The doses which elicit this effect are smaller than those required to produce any of the other actions. Hence histamine is an important diagnostic tool in gastric function tests. Absence of an acid-secreting response may be associated with gastric carcinoma. Furthermore, observation of the separate components of the triple response produced on intradermal injection of histamine is used to ascertain the presence of a normal local arterial blood circulation and a functioning local peripheral nervous system.

Although a great deal of information has been uncovered concerning the responses to histamine, its precise role under normal physiological conditions and the exact mechanisms whereby it produces its various effects were, even 50 years after its discovery, only incompletely understood. It appears certain, however, that histamine is formed in the body from the amino acid histidine, a harmless and indeed essential component of dietary protein, by removal of carbon dioxide in an enzymatically catalyzed decarboxylation reaction. Histamine is destroyed in the body by oxidative deamination in the presence of the enzyme histaminase, or it may be inactivated by enzymatic acetylation. In solid form, histamine can be obtained as white deliquescent needles. It has the following chemical structure:



The ring component is known as imidazole, and histamine may be called β-aminoethyl imidazole.

The ill favour accorded to the word histamine is evidenced by the wide use made of the term antihistamine or antihistaminic. This denotes a group of substances that have a remote structural resemblance to histamine and block it in many but not all of its actions. The antihistaminics have been used with success clinically to give temporary relief in many allergic conditions.

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HISTIAEUS (d. 494 B.C.), tyrant of Miletus under the Persian king Darius Hystaspis. According to Herodotus he rendered great service to Darius while he was campaigning in Scythia by persuading his fellow despots not to destroy the bridge over the Danube by which the Persians must return. Choosing his own reward for this service, he became possessor of territory near Myrcinus (afterward Amphipolis), rich in timber and minerals. The success of his enterprise led to his being recalled to Susa, where in the midst of every kind of honour he was virtually a prisoner of Darius, who had reason to fear his growing power in Ionia. During this period the Greek cities were left under native despots supported by Persia, Aristagoras, son-in-law of Histiaeus, being ruler of Miletus in his stead. This prince, having failed against Naxos in a joint expedition with the satrap Artaphernes,

began to stir up the Ionians to revolt, and this result was brought to pass, according to Herodotus, by a secret message from Histiaeus. The revolt assumed a formidable character and Histiaeus persuaded Darius that he alone could quell it. He was allowed to leave Susa, but on his arrival at the coast found himself suspected hy the satrap, and was ultimately driven to establish himself (Herodotus says as a pirate, more probably in charge of the Bosporus route) at Byzantium. After the total failure of the revolt at the battle of Lade, he made various attempts to re-establish himself, but was captured by the Persian Harpagus and crucified by Artaphernes at Sardis. His head was embalmed and sent to Darius, who gave it honourable burial. The theory of Herodotus that the Ionian revolt was caused by the single message of Histiaeus is incredible; there is evidence to show that the Ionians had been meditating after about 512 a patriotic revolt against the Persian domination and the tyrants on whom it rested.

See *Cambridge Ancient History,* vol. iv (London, 1924); article IONIA; also S. Heinlein in *Klio,* pp. 341–351 (1909).

HISTOLOGY, the science or study of the tissues, is that branch of biology which deals with the microscopic structure of plants and animals in normal and abnormal states. This implies that histology is also concerned with those functions of living organisms which must be studied with the microscope. In the many-celled animals and plants, accumulations of cells of a common origin are grouped into the four major tissues. These in turn are grouped in various combinations to form the different organs. The distinction sometimes made between histology, which deals with the tissues, and microscopic anatomy, which deals with the organs, is falling into disuse. The major tissues are epithelium, connective tissue, muscular tissue and nervous tissue; they are considered below.

The histological constitution of the various organs is considered in the appropriate sections.

History.—As the history of the subject will be taken up under other headings, it will not be discussed here (see BIOLOGY: History; SWAMMERDAM, JAN; LEEUWENHOEK, ANTHONY VAN; MALPIGHI, MARCELLO; SCHWANN, THEODOR; VIRCHOW, RUDOLF.)

The Tissues.—The elementary tissues of the body may be more or less arbitrarily subdivided into: (1) epithelial (of various types and including such modifications as hair, nails, tooth enamel, glands, etc.); (2) nervous tissue; (3) connective tissue (including fibrous and elastic tissue, fat, tendon, bone, cartilage, dentine, blood and blood-forming tissues); (4) muscular tissue (voluntary, involuntary and cardiac).

These elementary tissues are derived from the three primary blastodermic layers of the embryo (with trifling exceptions) as follows: (1) from ectoderm, mesoderm or entoderm; (2) from ectoderm; and (3) and (4) from the mesoderm.

Tissues are composed of cells (see CYTOLOGY) and intercellular substances, the latter in most cases formed through cellular activity. In epithelial tissues there is a meagre "cement substance," the origin and nature of which is but poorly understood. In connective tissue, the intercellular substances (amorphous ground substance with its contained collagenous and elastic fibres) constitute the bulk of the material and the same is true of the cartilage matrix and the fibrous and calcareous substance of bone. In the nervous system, the glia fibres of the supporting neuroglia bear the same relation to the glia cells as the fibres of connective tissue to its cells.

Epithelial tissue serves chiefly as a protective covering and for absorption, secretion and excretion. According to shape, epithelial cells are called: flat or squamous (covering skin, adjacent mucous membranes, some kidney tubules, etc.); or columnar (lining the digestive tract, the ducts of glands, uterus and oviducts, forming the secreting cells of glands). They may occur in single (simple) layers or in many layers (stratified), and various modified forms are found, such as ciliated (bronchi, etc.), and greatly modified for special uses (as in the retina, ear, taste buds). The single-layered flat cells lining the vascular system and the large enclosed body spaces (pleura, etc.) are called endothelial and mesothelial cells respectively.

Connective *tissue* is found in such forms as the embryonal jelly of the umbilical cord, reticular, loose fibro-elastic or areolar, dense fibrous, elastic tissue, cartilage and bone (for details, see appropriate sections). It contains a variety of cells such as fibroblasts, macrophages and a few lymphocytes, plasma cells, eosinophiles, mast cells and pigment cells.

Muscle tissue (*i.e.,* a form of protoplasm in which the property of contractility predominates) is of three main types: (1) smooth or involuntary; (2) striated or voluntary; (3) cardiac. Some striped muscle, such as oesophagus and diaphragm, is only partly voluntary. Smooth muscle, consisting of elongated pointed cells with central oval nuclei, is found in the following systems: alimentary, respiratory, genito-urinary, vascular, and in glandular ducts, the capsule of the spleen, the skin and some eye muscles. Voluntary muscle, distinguished by definite longitudinal and cross striae, a complex system of lines and cross disks, and peripheral nuclei, is of obvious distribution through the body. Cardiac muscle (which also has characteristic cross striations) forms a close meshwork with loss of the original cell boundaries, and centrally placed nuclei. Its physiological properties differ somewhat from those of ordinary voluntary muscle.

Nervous tissue, receiving, originating and conducting nerve impulses, is made up of the neuron (or nerve cell in its broadest sense) and the supporting neuroglia. While details are to be found in the entry NERVOUS SYSTEM, a few examples of the many kinds of nerve cells may be given. The giant pyramidal cell of Betz in the cerebral cortex, the lesser ganglion cells of wide distribution (unipolar, bipolar and multipolar), the characteristic Purkinje cells of the cerebellum, the various types of Golgi cells, the ependymal cells and the various types of glial cells, will indicate the great variation of structure to be found, though unfortunately there is still a tremendous lack of correlation with function. While tigroid bodies, axone, dendrites, medullated sheath, neurolemma and terminal arborizations are common properties of most nerve cells, their infinite variety adds still further to the complexity of this subject. (*See* EPITHELIUM; ENDOTHELIUM; NERVOUS SYSTEM; CONNECTIVE AND SUPPORTING TISSUES, CYTOLOGY.)

Organs are formed from combinations of the various units of these tissues, sometimes of two units, usually of several. The separate subjects are to be found further described under appropriate headings.

Histological Methods.—The ideals of histological technique are to examine the tissues directly in the living condition and to compare them with methods which provide a minimum deviation from the condition in the living state and yet with a differentiation permitting a maximum recognition and study of the various component elements. Since neither of these desiderata has yet been attained, new methods are frequently being invented.

Among the many means of attack on histological problems are a variety of chemical procedures, including microincineration, and certain physical methods, such as the use of fluorescent dyes, polarized light and the electron microscope. These techniques form one of the bases of histochemistry.

Examination of **Living** Tissues under Normal Conditions.—Because of the thickness of most tissues arid organs it is difficult to examine them directly under the microscope in the living condition. There are a few exceptions to this by which it is possible to place thin living membranes under the microscope. The classic studies of Julius Cohnheim of the phenomena of inflammation in the living mesentery or tongue of the frog at once come to mind. Improved methods permit the examination of the tail of the tadpole for days and weeks and permanent transparent chambers have been inserted in the ears of rabbits. Normal growth or reaction to various tests or injuries may be thus studied in a way hitherto impossible. Many important problems, as the functions of the kidney, spleen, lung and liver may be studied in the living animal with the aid of modern methods of illumination.

Tissue Cultures.—The cell being the important unit of animal tissue, methods are constantly being sought by histologists to study it uader relatively normal conditions. The discovery by Ross Harrison in 1907 that nerve cells would survive, function and reproduce in suitable media outside the body ('(tissue cul-

ture" or "tissue growth in vitro") has been applied to practically every cell in the body. By this method Alexis Carrel kept strains of chicken cells alive for more than 20 years, far beyond the natural term of life. suggesting the potential immortality of animal tissue. Though this method can subject cells to microscopic examination while still alive. they exist under conditions that are far from normal. (See AKIMAL CELL [TISSUE] CULTURE.)

Smears or Spreads. — The cellular contents of the blood and various body fluids may be spread in thin films and examined either fresh or after fixation with a great variety of stains, designed to bring out diverse properties or pathological changes.

Vital Stains. — Methods of intra-, supra- and post-vital staining have developed a considerable technique for the study of living cells and tissues. Here dyes are used which enter but do not kill the cell. They usually select certain parts of the cell (vacuoles, mitochondria, etc.), and the cell only becomes diffusely stained after it has died. Such dyes may be injected in the living organism and the cells which have selected the stain studied, or may be applied to cells withdrawn from the body but still alive. Such procedures are comparatively free from the objection that death of the tissue may introduce artefacts in the form of the cell or tissue and also have the advantage of permitting the study of the differentiated components under varying experimental living conditions. It must be recognized, however, that even such stains are toxic to a greater or less degree, so that the cells being studied are to a corresponding degree abnormal.

Fixed Tissues. — For proper examination with the modern microscope (magnifying up to 1,500 diameters), tissues must be cut so thin that after appropriate staining they can be accurately examined by transmitted light and without the confusion of several superposed layers of cells. The vast majority of histological materials are prepared for microscopic examination by preliminary fixation, hardening, sectioning, staining and mounting. The purpose of the fixing fluid is to penetrate and kill the tissues quickly, so that the various tissue elements are preserved as life-like and undegenerated as possible. As hardening fluids, formalin and alcohol are preferred.

To get sufficiently even and thin sections (*e.g.*, 1/1000 mm.) with the microtome (introduced by J. E. Purkinje and W. His), the tissue must by gradual transitions be imbedded in paraffin wax or celloidin, the former having the advantage that ribbons of serial sections can be more easily obtained. The sections may be stained and counterstained in the greatest variety of ways (see EHRLICH, PAUL). The celloidin technique, used especially in the examination of the nervous system, is simpler yet more time-consuming, although yielding better results.

Morbid Histology. — The microscopic study of the structural changes produced in the tissues by disease is a subject of great importance (see PATHOLOGY). It will suffice here to say that the microscopic study of tissues removed at autopsy or at surgical operations not only serves to confirm the gross anatomical diagnosis or to give the necessary information where a gross diagnosis was impossible, but also gives an accurate picture of the condition at the time the organs were examined. An evaluation of the morbid process is thus constructed, which would otherwise be impossible. Morbid histology also performs a great practical service in the examination and diagnosis of "biopsy" material, *i.e.*, tissue removed from the living body (*e.g.*, in suspected neoplasms) in order to make a diagnosis.

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HISTORICAL ARTICLES. Under this head we give a general guide to the arrangement of these articles in the Encyclopedia *Britannica.*

ANCIENT HISTORY

In addition to the guide here given, see ARCHAEOLOGY (ARTICLES ox); PHILOSOPHY (ARTICLES ON); and RELIGION (AND THEOLOGY), ARTICLES ON.

Non-classical History. — For this see the articles BABYLONIA AND ASSYRIA, MESOPOTAMIA, EGYPT, PHOEKICIA, PALESTINE, PERSIA: and smaller articles such as PERSIS, MEDIA, PARTHIA, ELAM and EDESSA See also AEGEAN CIVILIZATION, CRETE and MYCENAE; ETRUSCANS and HITTITES; SCYTHIA; and the ancient history sections of such articles as GERMANY, IRELAND or WALES.

Greek History. — The main account of Greek history will be found under GREECE: History, Ancient. But this should be supplemented by reference to the special articles on constitutional and State questions, of which the chief are ARCHON, AREOPAGUS, BOULE, CONSTITUTION OF ATHENS, ECCLESIA. ORACLE. STRATEGUS, GREEK LAW. There are also articles on the most important towns, leagues. etc., such as ACHAEAN LEAGUE, AEGINA, ATHENS. BYZANTIUM, CORINTH, DELIAN LEAGUE, SICILY, SPARTA, SYRACUSE, THEBES, and tribes such as AMAZON, ACHAEANS, DORIANS, IONIANS and PELASGIANS.

HERODOTUS, ARISTOPHANES, DEMOSTHENES, THUCYDIDES, and all other ancient Greeks of importance have their biographies, nhich should be consulted; the history of the latest period of Greece should be also studied under the headings HELLENISM, MACEDONIAN EMPIRE and such biographies as that of ALEXANDER III THE GREAT.

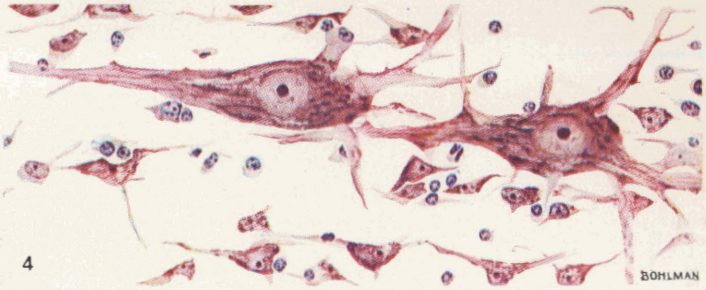
Roman History. — In Roman history the chief article is to be found under ROME. Under ITALY will be found pre-Roman history. All figures in Roman history or legend of any importance have biographical articles, from ROMULUS to ROMULUS AUGUSTULUS. The organization of the Roman State is systematically explored under the heads AERARIUM, CENSOR, COMITIA, CONSUL, EQUITES, MUNICIPIUM, PATRICIANS, PRAETOR, PREFECT (ROMAN), PROVINCE, QUAESTOR, SENATE, TRIBUNE, etc. There are other minor headings and the article ROMAN LAW should be consulted.

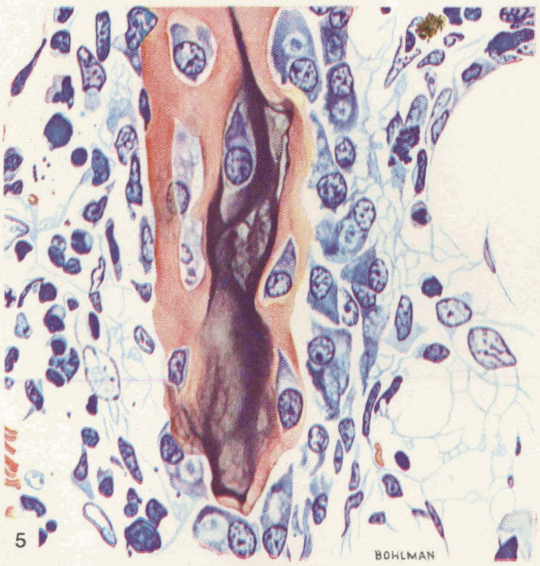
The chief tribes of the Roman world have each a separate article. We may mention HELVETII, HUNS and VOLSCI. Every province, etc., of the republic or empire has a separate article, in particular, AFRICA, ROMAN PROVINCE OF; BITHYNIA; BRITAIN: Roman Britain; CAPPADOCIA; CILICIA; DACIA; GALATIA; GAUL; ILLYRIA; LIMES GERMANICUS; LYCIA; LYDIA; MAURETANIA; PALMYRA; PANNONIA; PHRYGIA; PONTUS; SPAIN; SYRIA; THRACE; see also CARTHAGE.

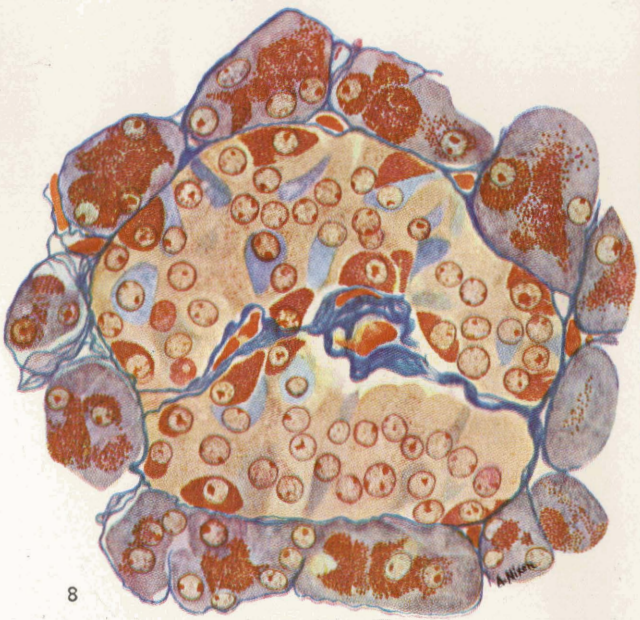
Military History. — The military history of the ancient world is dealt with in articles which, on the one hand, cover the outstanding military organizations and, on the other, the chief campaigns and battles. In the first class come the articles MACEDONIA-ARMY and ROMAN ARMY. The second class enables the reader not merely to study the course of the great conflicts but to trace the evolution of warfare and its methods. Beginning with the GRAECO-PERSIAN WARS, the thread passes through the PELOPONNESIAN WAR. then through such illustrative battles as CUNAXA, LEUCTRA, MANTINEA, and on by Alexander's battles, GRANICUS, ISSUS, GAUGAMELA and HYDASPES, as well as the biographical article on ALEXANDER III THE GREAT. The system of Alexander then declined, and the next stage is reached with the PUNIC WARS (see also HANNIBAL and SCIPIO). TRASIMENUS and CANNAE show Hannibal's art, as ILIPA and ZAMA show Scipio's. Thereafter come Caesar's battles and sieges. among them ALESIA, ILERDA, PHARSALUS and THAPSUS. and as CARRHAE reveals a weakness in the Roman legionary organization, so EDIRNE marks its fall from military supremacy.

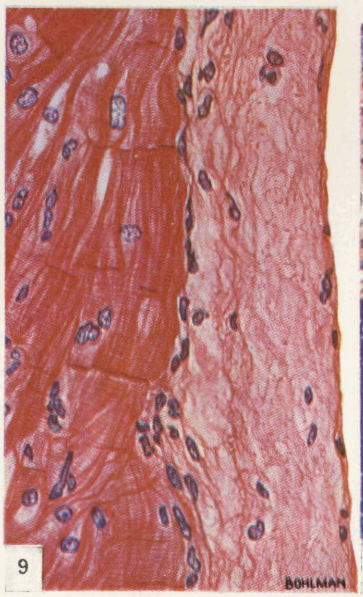
MEDIEVAL HISTORY

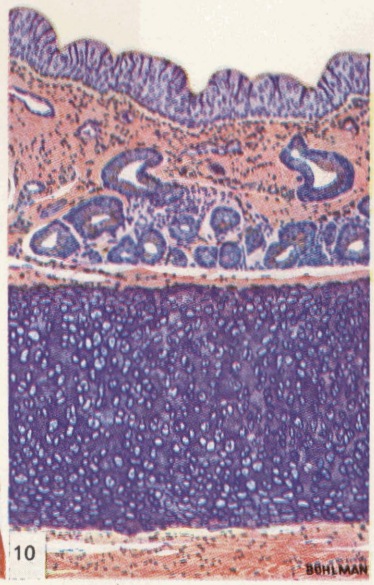
In addition to the guide here given reference should also be made to articles under the various biographical articles and to the headings connected with Archaeology, Church History, Economics, Law and Literature.











BY COURTESY OF W. BLOOM AND (8) W. BLOOM IN "THE ANATOMICAL RECORD," VOL. 49, PUBLISHED BY THE WISTAR INSTITUTE OF ANATOMY AND BIOLOGY AND (1-5, 7, 9) W. B. SAUNDERS COMPANY, FROM MAXIMOW AND BLOOM'S "TEXTBOOK OF HISTOLOGY" (4TH ED., 1942); ALL DRAWN BY ESTHER BOHLMAN, EXCEPT 8 BY AGNES NIXON

A VARIETY OF TISSUES AS THEY APPEAR IN ROUTINE MICROSCOPIC PREPARATIONS

1-3. Intestinal epithelial cells of guinea pig (magnification, **1440X**): **1,** living, unstained; 2, stained **supravitally** to show **mitochondria;** 3, sectioned and stained with **haematoxylin-eosin** (as in **4,** 6, 7, 9, **10**)

4. Nerve **cells** — large, several smaller — from monkey Brain **(about 275X)**

5. Bone **(pink** and purple), surface layer of bone-forming **cells** (blue) and bone marrow cells; stained, **haematoxylin-eosin-azure II** (710X)

6. Small intestine of man, composed of mucous membrane **with epithelium** (above), smooth **muscle** (light blue) and **connective** tissue (pink, below) **(27X)**

7. Thyroid gland of man, cuboidal epithelium surrounding masses of **colloid (pink)** containing vacuoles **(640X)**

8. **Pancreas** *of* man: glandular cells whioh **secrete** pancreatic juice border an islet of Langerhans **(orange-stained** cells are believed the **source** of insulin); stained, **Mallory-azan** method **(605X)**

9. Heart in man: cross-striated cardiac **muscle** (red) **with** darker **intercalated disks, connective** tissue (pink) and lining layer of **endothelium** (right) **(190X)**

10. Trachea **of** man, **lined** with ciliated epithelium (above), then a layer of **connective** tissue with glands, a thick **band of** cartilage (dark **purple)** and connective tissue **(pink) (27X)**

For Europe *see* DARK AGES; MIDDLE AGES; EUROPE. For articles on Europe generally, *see* also COMMUNE (MEDIEVAL); COMMUNE (OF PARIS, 1871); CRUSADES; FEUDALISM; GOTHS; GUILDS; LOMBARDS; PAPACY; BYZANTINE EMPIRE; SERFDOM; VANDALS; VIKING; VILLAGE COMMUNITIES; VILLEINAGE. For histories of individual countries and peoples of Medieval Europe, *see* articles under names of countries except England, which is under ENGLISH HISTORY.

For England, in addition to ENGLISH HISTORY, *see* ANGLO-SAXONS; BRITAIN; DANELAW; EAST ANGLIA; ESSEX; HWICCE; JUTES; KENT; NORTHUMBRIA; SUSSEX; STRATHCLYDE; WESSEX, etc. And also articles on constitutional problems and particular subjects, for example: BAYEUX TAPESTRY; CHURL; CLARENDON, CONSTITUTIONS OF; DOMESDAY BOOK; FRANKPLEDGE; FYRD; HIDE; JUSTICIAR; LOLLARDS; MAGNA CARTA; NORTHAMPTON, ASSIZE OF; OXFORD, PROVISIONS OF; PIPE ROLLS; PURVEYANCE; RAPE; SCUTAGE; TALLAGE; WAPENTAKE; WITAN; VASSAL.

In addition to article FRANCE, *see* articles on chief divisions of Medieval France, *e.g.,* ARTOIS; BRITTANY. *See* also ANTRUSTION; CAGOT; DAUPHIN; JACQUERIE, THE; CHATELAIN; PARLEMENT; PRAGUERIE; FRENCH LAW AND INSTITUTIONS; FRANKS; MAYOR OF THE PALACE; MEROVINGIANS; MISSI DOMINICI.

In addition to article GERMANY, *see* articles on EMPIRE; AULIC COUNCIL; DIET; FEHMIC COURTS; IMPERIAL CHAMBER; GOLDEN BULL; HANSEATIC LEAGUE; HUSSITES; SWABIAN LEAGUE; and articles on the principal divisions of GERMANY.

In addition to the article Italy, *see* CARROCCIO; GUELPHS AND GHIBELLINES: LOMBARD LEAGUE; FLORENCE; RAVENNA, EXARCHATE OF; ROME; PAPACY; VENICE; SICILY; VESPERS, SICILIAN.

In addition to articles SPAIN and PORTUGAL, see articles on the medieval divisions of Spain.

For Flanders (*q.v.*) *see* also BRABANT, DUCHY OF; FRISIANS; GELDERLAND; HAINAUT; HOLLAND, COUNTY AND PROVINCE OF; JOYEUSE ENTREE; NETHERLANDS.

For the Scandinavian countries, in addition to DENMARK, NORWAY, SWEDEN, *see* articles VIKING; VINLAND.

For the Near East, *see* AUSTRIA, EMPIRE OF; BULGARIA; CUMANS; PECHENEG; PERSIA; SLAVS; VLACHS, GREECE; TURKEY; ISLAM; ISLAMIC LAW; ISLAMIC INSTITUTIONS.

For the Jews, *see* EXILARCH, GHETTO, JEWS, RITUAL MURDER.

The development of the methods and means of warfare in Medievai history is covered in the historical parts of such general articles as ARMY; CAVALRY; FORTIFICATION; SMALL ARMS, MILITARY; INFANTRY; MILITIA; and TACTICS. For special light on certain periods and on certain military organizations which markedly influenced the course of medieval history *see* MONGOL CAMPAIGNS; HUNDRED YEARS' WAR; etc. The thread of evolution is also traced through the separate narrations of the more famous battles of each period, such as TRICAMERON; TAGINAE; MANZIKERT; COURTRAI; ACRE; ARSUF; BOUVINES, BATTLE OF; TAGLIACOZZO; BANNOCKBURN; DUPPLIN, BATTLE OF; HALIDON HILL; CRECY, BATTLE OF; POITIERS; AGINCOURT, BATTLE OF; ORLEANS; RAVENNA; and MARIGNAN.

More isolated but immortal incidents, for example the battles of Chalons, Tours and Hastings, also receive individual treatment in separate articles.

MODERN HISTORY

The history of the various countries will be found under their respective names with the following exceptions: the history of England is under the title ENGLISH HISTORY; the history of Ireland is to be found under IRELAND until the date 1921, but afterwards under IRELAND, NORTHERN, and IRELAND, REPUBLIC OF; the post-war history of "Iraq" is given under that title: for earlier history *see* MESOPOTAMIA. There is also a comprehensive article under the title of each continent. There are separate articles on all the British colonies and dominions as well as a long general article COMMONWEALTH OF NATIONS. The article SOUTH AFRICA, UNION OF, contains the complete history of the territory embraced by the republic; but there are also separate articles on its component parts, *e.g.,* CAPE OF GOOD HOPE, NATAL, TRANSVAAL, etc. The officially recognized names Nyasaland and French Equatorial Africa, are used in this edition in place of the older names British Central Africa and French Congo.

The events of World War I and its consequent problems are dealt with in such articles as SERBIA and DIMITRIJEVIC, DRAGUTIN, which discuss the Serajevo murder; WORLD WAR I; EUROPE, PARIS, CONFERENCE OF; VERSAILLES, TREATY OF; LEAGUE OF NATIONS; FOURTEEN POINTS; DISARMAMENT; REPARATIONS: MINORITIES; SAAR; RUHR; SANCTIONS AND GUARANTEES; LOCARNO, PACT OF, etc.

A great number of articles deal with questions of government and administration, *e.g.,* CABINET; PRIVY COUNCIL; PRIME MINISTER. BRITISH; STAR CHAMBER; GOVERNMENT; GOVERNMENT DEPARTMENTS; MINISTRY, GOVERNMENT; SPEAKER; ELECTORAL SYSTEMS; WOMEN'S SUFFRAGE.

Most important treaties, political documents, and congresses have entries of their own, *e.g.,* BERLIN, CONGRESS OF; BILL OF RIGHTS; NANTES, EDICT OF, etc. Political parties, etc., are dealt with under such headings as COMMUNISM; SOCIALISM; CHARTISM; FASCISM; MAFIA; CARBONARI; CONSERVATIVE PARTY (BRITISH); LIBERAL PARTY; LABOUR PARTY, THE (BRITISH); and under the titles of the principal parties of the French Revolution. Movements of historic importance have special articles of their own. *e.g.,* REFORMATION; RENAISSANCE; FRENCH REVOLUTION; REFORM MOVEMENT; EASTERN QUESTION; SCHLESWIG-HOLSTEIN QUESTION; PAN-GERMANISM; PANSLAVISM; CHURCH AND STATE. The Czech National Movement in Bohemia. Moravia, Silesia, and Slovakia, is included in the article BOHEMIA. There are also various articles on special subjects related to history such as DIPLOMACY; DIPLOMATIC; TRADE ROUTES.

The history of the Church will be found under PAPACY; ROMAN CATHOLIC CHURCH; INQUISITION, etc., and under the separate headings of denominations, *e.g.,* UNITARIANISM; BAPTISTS. etc., where the rise and development of each movement is traced. In some isolated articles, *e g ,* MONGOLS, a sketch of history is given as an essential indication of the influence of such peoples on surrounding nations. The Muslim religious world is treated in the article ISLAM, the history of Muslim Law is found under ISLAMIC LAW and the articles ISLAMIC INSTITUTIONS and CALIPHATE, give an indication of Mohammedan influence on Europe. The religious history of Further Asia is treated under BUDDHISM: SHINTO; TAOISM; HINDUISM; etc., and the individual biographical articles, *e.g.,* CONFUCIUS.

All the principal historical characters have their own biographical articles. There are also general family articles, *e.g.,* BOURBON; HABSBURG; HOHENZOLLERN DYNASTY; ROMANOV.

The great wars of modern history are all fully described and arranged in articles under their own headings—THIRTY YEARS' WAR; CIVIL WAR. ENGLISH; DUTCH WARS; GRAND ALLIANCE; SPANISH SUCCESSION; AUSTRIAN SUCCESSION; SEVEN YEARS' WAR; AMERICAN REVOLUTION; FRENCH REVOLUTIONARY WARS; NAPOLEONIC CAMPAIGNS; PENINSULAR WAR; WATERLOO CAMPAIGN, 1815; ITALIAN WARS; CRIMEAN WAR; AMERICAN CIVIL WAR; SEVEN WEEKS' WAR; FRANCO-GERMAN WAR; RUSSO-TURKISH WARS; RUSSO-JAPANESE WAR; BALKAN WARS; WORLD WAR I; WORLD WAR II.

The military history of Great Britain's overseas expansion and defense of her territories may be traced in such articles as QUEBEC; SIKH WARS; INDIAN MUTINY; EGYPT; and SOUTH AFRICAN WAR, 1899–1902.

Chief battles of these wars have special articles, which rise in scale as we approach the determinating military events of recent history. Thus ATLANTA, BATTLES AROUND; BULL RUN; FREDERICKSBURG; GETTYSBURG; the SEVEN DAYS and VICKSBURG, in the American Civil War have extensive treatment, as also such particular phases as the PETERSBURG, SHENANDOAH VALLEY, and WILDERNESS campaigns. Similarly with METZ and SEDAN in 1870. The events of World War I have been brought into historical perspective. the main battles of the Western, Eastern and Italian fronts, in particular MARNE, YPRES, SOMME, VERDUN, CAPORETTO, CAMBRAI, ST. QUENTIN, AMIENS and HINDENBURG LINE, having separate articles, in

which fresh light is shed on their origin and course, and their conduct is examined with frank and impartial regard for historical truth which documentary and personal evidence has made possible and the lapse of time has made suitable. The course of events in subsidiary theatres is described in such articles as DARDANELLES; PALESTINE; SALONIKA, and SERBIAN campaigns.

For more detailed information on the development of the instruments and methods of warfare during modern history, consult such articles as AIR WARFARE; AMMUNITION, ARTILLERY; ARMY; ARTILLERY; BRIDGING. MILITARY; CAMOUFLAGE; CHEMICAL WARFARE; CONSCRIPTION; FORTIFICATION; GUERRILLA WARFARE; INFANTRY; LOGISTICS; MEDICAL SERVICES, MILITARY; TRANSPORT, MILITARY; MOUNTAIN WARFARE; ORDNANCE; SMALL ARMS. MILITARY, SIGNAL COMMUNICATION; SMOKE: IN WARFARE; STAFF, MILITARY; STRATEGY; SUPPLY AND TRANSPORT, MILITARY; TACTICS; TANK; WAR.

HISTORY. The word history is used in two senses. It may mean either the record of events or events themselves. Originally limited to inquiry and statement, it was only in comparatively modern times that the meaning of the word was extended to include the phenomena which form or might form their subject. It was perhaps by a somewhat careless transference of ideas that this extension was brought about. Now indeed it is the commoner meaning. The "history of England" is used without reference to any literary narrative. Kings and statesmen are termed the "makers of history" and sometimes it is said that the historian only records the history which they make. History in this connection is obviously not the record, but the thing to be recorded.

History in the wider sense is all that has happened. not merely all the phenomena of human life, but those of the natural world as well. It includes everything that undergoes change; and as modern science has shown that there is nothing absolutely static, therefore the whole universe and every part of it has its history. This idea of universal activity has in a sense made physics itself a branch of history.

But the tendency to look at things historically is not merely the attitude of men of science. The present outlook upon life differs in just this particular from that of preceding ages. The unstable nature of our whole social fabric is recognized, and it is therefore more and more capable of being transformed. In short. the historical spirit of the age has invaded every field. The world picture presented in the *Encyclopedia Britannica* is that of a dynamic universe, of phenomena in process of ceaseless change. Because of this insistent change all things which happen. or seem to happen, are history in the broader sense of the word. The *Encyclopedia Britannica* itself is a history of them in the stricter sense—the description and record of this universal process. This narrower meaning is the subject of the rest of this article.

The earliest prose origins of history are the inscriptions. Their permanence, however, depends not upon their importance. but upon the durability of the substance on which they are inscribed; and as few know how to read them, they lie forgotten for centuries while oral tradition flourishes. Next to the inscriptions (sometimes identical with them) are the early chronicles frequently preserved in temples. These were of various kinds: simple religious annals. votive tablets recording miracles accomplished at a shrine, lists of priests and priestesses, accounts of benefactions. of prodigies and portents. In some cases. as in Rome, the pontiffs kept a kind of register of important political events; down to the time of the Gracchi (131 B.C.) the pontifex maximus inscribed the year's events upon annual tablets of wood which were preserved in his official residence and thus came to be a sort of civic history.

The first historians were the logographers of Ionian cities; men who carried their inquiry (*istorie*) beyond both written record and oral tradition to a study of the world around them. Their "saying" *(logos)* was gathered mostly from contemporaries; they made prose transcripts from folk memory, studying in particular the rise of Persia and the countermeasures of the Greek cities. They were the forerunners of the "father of history." Herodotus (*q.v.*). It is easy for the student now to show the inadequacy of his sources, yet the work of Herodotus remains a scientific achievement as remarkable for its approximation to truth as for its vastness of scope. It was his chief glory to have joined to this scientific spirit an artistic sense which enabled him to cast the material into the truest literary form. In Thucydides a higher art than Herodotus' was combined with a higher science. He scorned the storyteller "nho seeks to please the ear rather than to speak the truth." and yet his rhetoric is the culmination of Greek historical prose. He withdrew from vulgar applause. conscious that his narrative would be considered "disappointing to the ear." yet he recast the materials out of which he constructed it in order to lift that narrative into the realm of pure literature. Speeches, letters and documents are reworded to be in tone with the rest of the story. It was his art, in fact, which really created the Peloponnesian War out of its separate parts. And yet this art was merely the language of a scientist. His "laborious task" was that of consulting all possible evidence and weighing conflicting accounts. It is this which makes his rhetoric worthwhile, "an everlasting possession. not a prize competition which is heard and forgotten."

From the sublimity of Thucydides and Xenophon's straightforward story, history passed with Theopompus and Ephorus into the field of rhetoric. A revival of the scientific instinct of investigation is discernible in Timaeus the Sicilian at the end of the 4th century, but his attack upon his predecessors provoked a crushing counterattack by Polybius, who declares him lacking in critical insight and biased by passion. Polybius' comments upon Timaeus reach the dignity of a treatise upon history. He protests against its use for controversial pamphlets which distort the truth. "Directly a man assumes the moral attitude of an historian he ought to forget all considerations, such as love of one's friends. hatred of one's enemies. . . . He must sometimes praise enemies and blame friends. For, as a living creature is rendered useless if deprived of its eyes, so, if you take truth from History, what is left but an improfitable tale" (bk. xii, 14). Unfortunately Polybius. like most modern scientific historians, was no artist. His style is often only clear in the light of inscriptions, so closely does it keep to the sources; it thus found no imitator. and history passed from Greece to Rome in the guise of rhetoric. In Dionysius of Halicarnassus the rhetoric was combined with an extensive study of the sources. but the influence of the Greek rhetoricians upon Roman prose was deplorable from the standpoint of science. Cicero, although he said that the duty of the historian was to conceal nothing true, to say nothing false. would in practice have written the kind of history Polybius denounced. History for him was the mine from which to draw argument in oratory and example in education, not the subject of a scientific curiosity.

History writing in Rome (except for the Greek writers resident there) was until the first half of the 1st century B.C. in the form of annals. Then came rhetorical ornamentation—and the Ciceronian era. The first Roman historian who rose to the conception of a science and art combined was Sallust. the student of Thucydides. The Xugustan age produced in Livy a great popular historian and natural artist and a trained rhetorician (in the speeches). From Livy to Tacitus the gulf is greater than from Herodotus to Thucydides. Tacitus is at least a consummate artist. His style ranges from the brilliancy of his youth to the sternness and sombre gravity of age, passing almost to poetic expression in its epigrammatic terseness. Yet in spite of his searching study of authorities, his keen judgment of men and his perception of underlying principles of moral law, his view was warped by the heat of faction, which glows beneath his external objectivity. After him Roman history writing speedily degenerated. Suetonius' *Lives of the Caesars* is but a superior kind of journalism. But his gossip of the court became the model for historians, whose works, now lost. furnish the main source for the *Historia Augusta.* The importance of this uncritical collection of biographies is sufficient comment on the decline of history writing in the latter empire. though classical models could still inspire writers at the Byzantine court as late as Procopius in the 6th century. Finally, from the 4th century the epitomes of Eutropius and Festus served to satisfy the lessening curiosityin the past and became the handbooks for the middle ages. Ammianus Marcellinus stands out alone in this age like a belated disciple of Tacitus. But the world was

changing from antique to Christian ideals just as he was writing.

Early Christian History.— The 4th and 5th centuries saw a great revolution in the history of history. The pagan past slipped out of mind, and in its place was set, by the genius of Eusebius. the story of the world force which had superseded it, Christianity. and of that small fraction of antiquity from which it sprang — the Jews. Christianity from the first had forced thinking men to reconstruct their philosophy of history, but it was only after the church's triumph that its point of view became dominant in historiography. Three centuries more passed before the pagan models were quite lost to sight. But from the 7th century to the 17th (from Isidore of Seville and Bede for 1,000 years) mankind was to look back along the line of Jewish priests and kings to the Creation. Egypt was of interest only as it came into Israelite history, Babylon and Nineveh were to illustrate the judgments of Yahweh, Tyre and Sidon to reflect the glory of Solomon.

Christian history begins with the triumph of the church. With Eusebius of Caesarea the apologetic pamphlets of the age of persecutions gave way to a calm review of three centuries of Christian progress. Eusebius' biography of Constantine shows what distortion of fact the father of church history permitted himself, but the *Ecclesiastical History* was fortunately written for those who wanted to know what really happened and still remains an invaluable repository of Christian antiquities. With the continuations of Socrates, Sozomen and Theodoret and the Latin manual which Cassiodorus had woven from them (the *Historia tripartita*), it formed the body of church history during all the middle ages. An even greater influence, however, was exercised by Eusebius' *Chronica*. Through Jerome's translation and additions, the scheme of this world's chronology became the basis for all medieval world chronicles. It settled until modern times the succession of years from the Creation to the birth of Christ, fitting the Old Testament story into that of ancient history. Henceforth the Jewish past (that one path hack to the beginning of the world) mas marked by the absolute laws of mathematics and revelation.

From the first. Christianity had a philosophy of history. Its earliest apologists sought to show how the world had followed a divine plan in its long preparation for the life of Christ. From this central fact of all history, mankind should continue through war and suffering until the divine plan was completed at the judgment day. This idea received its classic statement in St. Augustine's *City of God*. The terrestrial city, whose eternity had been the theme of pagan history, had just fallen before Xlaric's Goths. Augustine's explanation of its fall not only passes in review the calamities of Roman history but carries the survey back to the origin of evil at the Creation. The Roman empire (the last general form of the earthly city) must at last yield to the heavenly. This is the main thread of Augustine's philosophy of history. The historical demonstration of its truth was left to his disciple Paulus Orosius. whose *Seven Books of Histories Against the Pagans*, written as a supplement to the *City of God*, was the first attempt at a Christian "world history."

Medieval and Renaissance History.— The commonest form of medieval historical writing was the chronicle. Often beginning merely as a series of memoranda of current events inserted in Easter tables, the chronicle might develop, either as a general history of Christendom or as a localized account of a monastic house—the individual historian was frequently a religious who wrote history from the standpoint of his own convent. Behind it might lie oral tradition, documentary collections and the testimony of contemporaries. If the monastic chronicle at times lacks perspective and tends to relate marvels, it is by no means uncritical. Among the English medieval chroniclers, William of Malmesbury and William of lieu-burgh were both men of remarkable ability, the one a stylist with a high sense of accuracy, the other an acute and penetrating intellect. The St. Albans school: from Roger of Wendover to Thomas Walsingham, showed itself keenly alive to the whole contemporary scene and began what might be termed a "Whig tradition" in historical writing through its support of and admiration for the baronial opposition to the crown. At the end of the middle ages, the development of vernacular chronicles, particularly town chronicles, prepared the way for the breakdown of general histories written to the medieval theological pattern.

The Renaissance marked the first great gain, in the historic sense, in the efforts of the humanists to realize the spirit of the antique world. If an Italian humanist in the 15th century had been asked to justify his writing of history, he might have replied that it was a form of literature highly regarded by the ancients and presenting admirable opportunities for the exercise of style; that it had great value for its inculcation of moral and political lessons; and finally that the history written by his contemporaries (*cf.* that of Leonardo Bruni) celebrated the past and present glories oi their native land or the city-state whose story they related. The political point of view and the patriotic purpose led to a new periodization of history into "ancient" (Creek and Roman) and "modern" (irom the age of Constantine onward). Some humanists, such as Petrarrh, regarded the modern age with disgust; but later Italians, such as Bruni and Flavio Biondo, found elements of hope in the emergence of the city-states from the commune; and Nicolaus Cusanus recognized the existence and the value of a middle age between classical times and the modern world. Nonetheless history had become the servant to literature, an adjunct to the classics. Rut if the literary side of humanism has been a barrier to the progress of scientific history, the discovery and elucidation of texts first made that progress possible. Laurentius Valla's brilliant attack on the "Donation of Constantine" (1440) and Ulrich von Hutten's rehabilitation of Henry IV from monastic tales mark the rise of the new science. For a while it remained but a phase of humanism. It mas north oi the .%lps that it parted company with the grammarians. Classical antiquity was an Italian past, the German scholars turned back to the sources of their national history. Aeneas Sylvius Piccolomini (Pius II) had discovered Otto of Freising and Jordanes. Maximilian I encouraged the search for manuscripts, and Vienna became a great humanistic centre. Conrad Celtes left his *Germania illustrata* unfinished, but he had found the works of Hrosvitha. Conrad Peutinger gathered all sorts of chronicles: publishing among them those of Gregory of Tours.

Influence of the Refowmation.— The Reformation. with its heated controversies, seems a strange starling point for science. yet it, even more than the Renaissance. brought out scientific methods of historical investigation. It not only sobered the humanist tendency to sacrifice truth for aesthetic effect. it called for the documents of the church and subjected them to the most hostile criticism. Martin Luther himself challenged them. Then in the *Magdeburg Centuries* (1559–74) Protestantism tried to make good its attack on the medieval church by a great collection of sources accompanied with much destructive criticism. This gigantic work is the first monument of modern historical research. The reply of Cardinal Baronius (*Annales ecclesiastici*, 1588–1607) was a still greater collection, drawn from archives which until then had not been used for scientific history.

The movement back to the sources in Germany until the Thirty Years' War was a notable one. Collections were made by Simon Schard (1535–73), Johannes Pistorius (1576–1608), Marquard Freher (1565–1614), Melchior Goldast (1576–1635) and others.

Leibniz began a new epoch, both by his philosophy, uith its lair. of continuity in phenomena, and by his systematic attempt to collect sources through an association (1670). His plan to have documents printed as they were, instead of "correcting" them, was a notable advance. But from Leibniz until the 19th century German national historiography made little progress—although church historians such as J. L. von Mosheim and J. A. W. Neander stand out among the greater historians of their country.

The 17th and 18th Centuries.— France had not paralleled the activity of Maximilian's Renaissance historians. The father of modern French history, or at least of historical research, was André Duchesne (1584–1640), whose splendid collections of sources are still in use. Jean Bodin wrote the first treatise on scientific history (*Methodus ad facilem historiarum cognitionem*, 1566), but he did not apply his own principles of criticism, and it was left for the Benedictine monks of the Congregation of St. Maur to establish definitely the new science. The place of this school in the history of history is entirely without a parallel. When Luc d'Achery turned irom exegetics to patristics anti the lives of the saints. as a sort of Christian humanist, he led the may to that vast work of collection and comparison oi texts which developed through Jean Mabillon, Bernard de Montfaucon. Thierry Ruinart, Edmond Martène, Martin Bouquet and their associates, into the indispensable implements of modern historians. Here, as in the Reformation, controversy called out the richest product. Mabillon's treatise! *De re diplomatica* (1681), was due to the criticisms of that group of Belgian Jesuits whose *Acta Sanctorum quotquot toto orbe coluntur* (1643, *et seq., see* BOLLANDISTS) was destined to grow into the greatest repository oi legend and biography the world has seen. In reply to D. Papebroch's criticisms of the chronicle of St. Denis, Mabillon prepared this manual ior the testing of medieval documents. Its canons are the basis, indeed, almost the whole, of the science of diplomatic (*q.v.*), the touchstone of truth for medieval research. Henceforth even the mediocre scholar had a body of technical rules by which to sort out the vast mass of apocrypha in medieval documentary sources. Scientific history depends upon implements. Without manuals. dictionaries or easy access to tests, the modern historian would go as far astray as any medieval chronicler. The France oi the Maurists supplied the most essential of these instruments. The great "glossary" of Charles du Fresne du Cange is still in enlarged editions the indispensable encyclopaedia of the middle ages. Chronology and paleography were placed on a new iooting by Montfaucon's *Palaeographia graeca* (1708), the monumental *Art de vérifier les dotes* (3rd ed., in 38 vol., 1818–31) and the *Nouveau Traité de diplomatique* (1750–65) of R. P.

Tassin and C. F. Toustain. The collections of texts which the Maurists published are too many to be enumerated here (see C. Langlois, *Manuel de bibliographie historique,* pp. 293 ff.). Bouquet's *Historiens* de la *Gaule* et de la France—the national repertory for French historians—is but one of a dozen tasks of similar magnitude. During the 18th century this deep underwork of scientific history continued to advance, though for the most part unseen by the brilliant writers whose untrustworthy generalities passed for history in the salons. Interrupted by the Revolution, it revived in the 19th century, and the roll of honour of the French École des Chartes has almost rivaled that of St. Germain-des-Prés.

The father of critical history in Italy was L. A. Muratori (1672–1750). His vast collection of sources (Rerunz *Italicarum scriptores*), prepared amid every discouragement, remains the national monument of Italian history; and it is but one of his collections. His output is perhaps the greatest of any isolated worker in the whole history of historiography. The same haste, but much less care, marked the work of J. D. Mansi (d. 1769), the compiler of the fullest collection of the councils. Spain, stifled by the Inquisition. produced no national collection of sources during the 17th and 18th centuries, although Nicolas Antonio (1617–84) produced a national literary history of the first rank.

England in the 16th century kept pace with continental historiography. Henry VIII's chaplain, John Leland, is the father of English antiquaries. Three of the most precious collections of medieval manuscripts still in existence were then begun by Thomas Bodley (the Bodleian, Oxford), Archbishop Matthew Parker (Corpus Christi, Cambridge) and Robert Cotton (the Cottonian collection, British museum). The end of Elizabeth's reign saw English historical scholarship concentrated on topographical description and upon the investigation of the beginnings of parliamentary and local government. In the first half of the 17th century a serious effort was made to study and exploit the national records which, until the end of the 18th century, were scattered in no less than 15 repositories. The characteristic English interest in local history and in family origins had now started; ecclesiastical and administrative history had begun to claim attention; and in the 17th and 18th centuries English scholarship was enriched by such monuments oi research as William Dugdale's *Monasticon,* Thomas Madox's History *of* the Exchequer, David Wilkins' *Concilia* and Thomas Rymer's Foedera. But these works, important as they were, gave but little idea of the wealth of historical sources which the 19th century was to reveal in England as a result of the concentration of English governmental records in the Public Record office (after 1838) and of the investigations undertaken by the Historical Manuscripts commission from 1870 onward. The picture was to be extended after World War II by the creation of the National Register of Archives (1947).

MODERN PRACTICE

History as a Science.—In the 19th century the science of history underwent a revolution. The machinery of research was periected. Groups of scholars grew into national or international associations, producing from archives collections of material to be worked up into the artistic form of history. These faithful workers, cataloguing, publishing and indexing make it possible for the student to master in a few hours sources which baffled the long years of research of a Martène or a Rymer.

Every science which deals with human phenomena is in a s-ay an implement in this great factory system in which the past is welded together again. But the real auxiliary sciences to history are those which deal with those traces of the past that still exist, the sciences of language (philology), of writing 'paleography), of documents (diplomatic), of seals (sphragistics), of coins (numismatics) and of weights and measures and archaeology in the widest sense of the word. These sciences underlie the whole development of scientific history. Dictionaries and manuals are the instruments of this industrial revolution. Without them the literary remains of the race would still be as useless as Egyptian inscriptions to the fellaheen. .Archaeology remained but a minor branch of art until the machinery was perfected which enabled it to classify and interpret the remains of the "prehistoric" age.

This is the most remarkable chapter in the whole history of history—the recovery of that past which had already been lost when our literary history began. The old "providential" scheme of history disintegrates before a new interest in the "gentile" nations to whose high culture Hebrew sources bore unwilling testimony. The scientific historian of antiquity works on the hills of Crete or in the uplands of Asia Minor rather than in the quiet of a library. His discoveries, co-ordinated and arranged in vast bodies of inscriptions, stand now beside Herodotus or Livy, furnishing a basis for their criticism.

The immense increase in available sources, archaeological and literary, has remade historical criticism. Leopold von Ranke's application of the principles of "higher criticism" to works written since the invention of printing (Rritik neuerer *Geschichtsschreiber*) was an epoch-making challenge of narrative sources. Now they are everywhere checked by contemporary evidence, and a clearer sense of what constitutes a primary source has discredited much of what had been currently accepted as true. Hardly an "old master" remains an authoritative book of reference. Old landmarks drop out of sight—*e.g.,* the fall of the western empire in 476, the coming of the Creeks to Italy in 1453, dates which once enclosed the middle ages. The perspective changes: humanism stretches back into the middle ages and the gap between the Renaissance and the middle ages dwindles; the Protestant Revolution becomes a complex of economics and politics and religion, the French Revolution a vast social reform, in which the Terror was an incident. The result has been a complete transformation of history since the middle of the 19th century. The history of the human spirit has also introduced itself as a new category, largely as a result of the work of Jakob Burckhardt. the Swiss historian of the Renaissance, who showed that the movement affected the whole life of man in society and was to the individual a revelation of a new world instead of being a mere phase in artistic and literary achievement. On the other hand such auxiliaries of history as psychological biography, local genealogy and social (*e.g.,* class) analysis have given new factual and environmental interpretations to movements of thought and opinion and have explained the development of institutions by exploring their local and personal origins. The tendency has been to break down the dichotomy of history into the history of facts and the history of ideas.

Theories of History.—The Augustinian scheme of world history received its last classic statement in J. B. Bossuet's *Histoire universelle.* Voltaire's reply to it in the 18th century (Essai *sur les* moeurs) attacked its limitations on the basis of deism and its miraculous procedure on that of science. But while there are foreshadowings of the evolutionary theory in this work, neither the *philosophe* historians nor David Hume nor Edward Gibbon arrived at a constructive principle in history which could take the place of the Providence that they rejected. Religion, though false, might be a real historic force. History became the tragic spectacle of a game oi dupes—the real movers being priests, kings or warriors. The pawns slowly acquired reason and then were able to regulate the moves themselves. But all this failed to give a satisfactory explanation of the laws which determine the direction of this evolution. Giovanni Battista Vico (1668–1744) was the first to ask why there is no science of human history. But his lonely life and unrecognized labours leit him apart from the main movement until his works were discovered again in the 19th century. The first half of the 19th century (apart from the scientific activity of G. H. Pertz, the statesman Guizot, etc.) was largely dominated by the romanticists, with their exaggeration of the individual. Thomas Carlyle's "great-man theory of history" lent itself to magnificent dramatic creations; but it explained nothing. Hegel got no closer to realities. His idealistic scheme of history, which makes religion the keynote of progress and describes the function of each (Judaism to typify duty, Confucianism order, Mohammedanism justice, Buddhism patience and Christianity love) does not account for the facts of the history enacted by the devotees. It characterizes, not the real process of evolution, but an ideal which history has not realized. More attractive to 19th-century optimism was the interpretation of history given by the Positivists under Auguste Comte, to whom man's history had been a history of his opinions: "the whole social mechanism is ultimately based on opinion." After passing through what he called the "theological" and "metaphysical" stages, man was presently, Comte believed, to enter upon the "positive" stage, when society would be organized in accordance with the views of scientific sociology.

Against the intellectualist interpretations of history, two men in particular were to protest. H. T. Buckle, in his History of Civilization *in England* (1857–61), was to work out the influences of the material world-upon history, developing through a wealth of illustration the importance of food, soil and the general aspect of nature upon the formation of society. Meanwhile, however, the economists had themselves taken up the problem. Karl Marx was led to the conclusion that the evolution of society is conditioned by the economic circumstances of its existence; from Hegel, moreover, he got the idea of a dialectical process in history whereby one stage of development (the thesis) is challenged by its opposite (the antithesis), and the conflict between the two gives place to the third stage (the synthesis). In his *Misère* de la philosophie (1847) Marx lays down the principle that social relationships largely depend upon modes of production, and therefore the principles, ideas and categories thus evolved are no more eternal than the relations that they express, but are historical and transitory products. In the famous *Manifesto* of the *Communist* Party (1848), the theory was applied to demonstrate how the Industrial Revolution had replaced feudal with modern conditions. In *Das* Kapital, Marx showed how the social developments of modern times depend on capital: the essence of modern history is the rise, culmination and final breakdown of capitalism and its replacement by communism. This is, of course, the phenomenon which, according to Marx, the historian should he engaged in portraying. Since the third volume of Das *Kapital,* published in 1894, a controversy over his views has been continual. It is an exaggeration of the theory which makes it an explanation of all human life; but the whole science of dynamic sociology rests upon the postulate of Marx. Without him it is unlikely that such un-Marxian historians as Mas Weber and Maro Bloch could have written their widely influential works: the former to explain the relations between religion and capitalism, the latter to demonstrate the place of economic considerations in the study of any historic society.

The content oi history reflects the interests of the age in which it is written. Modern historians began with politics; but as the complex nature of society became more evident in the age of democracy they came to appreciate that no one branch of history is more than a single glimpse at a vast complex of phenomena, most of which lie forever

beyond the range of our knowledge.

This expansion of interest has intensified specialization. Each historian chooses his epoch or century and his subject and spends his life mastering such traces of it as he can find. He can thus judge the methods of his fellows, but his own work remains restricted by the very wealth of material at his disposal. Thus the great modern enterprises are co-operative — the *Allgemeine Geschiclzte in Einzeldarstellungen,* edited by W. Oncken (qj vol., 1879–93), the *Cambridge* histories (1902 *et seq.; Modern, Medieval* and *Ancient),* the *Historie générale,* edited by E. Lavisse and A. Rambaud (12 vol., 1893–1901), the *Histoire de France,* edited by E. Lavisse (two series, 19 vol., 1908–22) and the *Oxford History of England,* edited by Sir George Clark (12 vol., 1934 *et seq.).*

In contrast with these specialist tendencies, however, from the beginning of the 20th century certain of the more philosophical minds among historians and sociologists have been engaged in the exacting task of reinterpretation. The two leading efforts have been the work oi the German school represented by the philosophers Wilhelm Dilthey, Heinrich Rickert and Ernst Troeltsch and by the historian Friedrich Meinecke; and that of a single British historian, Arnold Toynbee. It is mainly with the problem of evaluation that the Germans have been concerned: how to measure the values of a civilization when the valuer himself is borne along upon the stream of history. Only, it is concluded, in the moment and the act of creative self-consciousness can the solution be found. This school lays stress on social and religious rather than political iactors. The historian's business lies less with the causes of historical events than with their meaning. Troeltsch found the significance of history to rest in the development of social groups and movements of thought and culture, each of which has its own unique inherent value and cannot be explained by historical antecedents alone. The importance of Toynbee (*A Study of History,* 10 vol., 1934–54) lies less in the conclusions that he reaches on the decline and fall of civilizations than in the units that he selects for study and the inclusiveness of the field, looking as he does to humanity in all lands and all ages.

The notion that it is possible to discover patterns or regularly recurring phenomena in the process oi history has been iashionable at various periods. especially during the 4th, the 18th and parts of the 19th and oi the 20th centuries of the Christian era. In face of these alleged uniiormities, the power of the individual to modify his environment seriously or to alter the course oi events has been called in question, and the exceptional person, where he occurs, has been presented as the projection or incarnation of a mass movement rather than as a creative force in himself. To the impersonal school of historians, neither the individuals nor the masses can ultimately be thought responsible for historical change, since the behaviour of men is largely determined by factors of race, culture, national custom and sentiment or class. A more cautious view avoids such universals to hold that every event of human life is an element in a necessary pattern. All men, according to this theory, have iunctions and pursue purposes. These may be governed by divine ordaining or providence, or may, as in the Aristotelian scheme, be part of their nature, by fulfilling which they reach their best or "truest'! realization. Thus. whether oi supernatural direction or as the result of innate forces, human action in historic time must be regarded as planned or determined and in that sense inevitable. The historian's function, then, is to understand and to explain this planning and how people and events are affected by it. Such a view. it need not be said, is strongly a priorist. At the other estreme is the scepticism which not only refuses to pass moral judgments on historical characters but also doubts the possibility of ever fully knowing the causes of historical events and, in suspending judgment, escapes irom the historian's plain duty to seek, as conscientiously as he can, the derivation of movements and events and not to evade the issue of right and wrong. The diversity of moral judgments should not be invoked as an excuse for such abnegation, and the existence of bias and wrongheadedness in writers of history is no solid reason for condemning the whole class of historians to narrative or description alone.

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HIT, a town in Iraq on the right (western) bank of the Euphrates, on which it iorms the limit of navigation, in 34° N. and 43° E.. about 70 mi. N.W. of Baghdad. The importance of the region lies in its oil. The town is of great antiquity and was the chief source of bitumen which was used in ancient times for binding the courses of brick buildings. There are bitter springs and lakes and abundant suriace indications of oil. A pipeline was built, 1932–34, to the Mediterranean ports of Haifa and Tripoli. Population (1953 est.) 19.619.

HITCHCOCK, THOMAS, JR. (1900–1944), generally regarded as polo's greatest player, was born in Aiken, S.C., Feb. 11, 1900.

A brilliant defender in international play against Great Britain for the Westchester cup. Hitchcock got his 10-goal rating in 1922 and dominated polo for the next two decades. Commander of a Mustang fighter group in World War II. Lieutenant Colonel Hitchcock crashed to his death in England. April 19, 1944. See also POLO: *United States.* (J. D. McC.)

HITCHIN, a market town and urban district in the Hitchin parliamentary division of Hertfordshire. Eng.. on the small Hiz river (the name of the town in Domesday). 16 mi. N.W. of Hertford by road. Pop. (1951) 19.963. Area 6.0 sq.mi. An ancient town in an agricultural area. Hitchin has many timber-iramed and gabled houses, and the church of St. Mary (12th to 15th century) has a fine porch. Hitchin priory is a mansion on the site of a Carmelite ioundation of c. 1318 and portions of a 14th-century Gilbertine nunnery appear in an almshouse known as the Biggin. Medicinal distilling, rose growing, and the casting of pipe joints and fittings are some of the chief industries. In 1936 the council obtained one of the few grants of arms issued during the reign of Edward VIII.

HITLER. ADOLF (1889–1935), Austrian-born politician, who became 'dictator of Germany in 1933, was born on April 20, 1889, at Braunau-am-Inn. on the border of Austria-Hungary. His father, Alois (b. 1837), was illegitimate. and for a time bore his mother's name, Schicklgruber. but by 1876 he had established his claim to the surname Hitler. Adolf never used any other name, and the name Schicklgruber was only revived by his political opponents in Vienna in the 1930s.

Adolf Hitler spent most of his childhood in the neighbourhood of Linz. the capital of Upper Austria. after his father's retirement from the Habsburg customs service. His father. Alois Hitler, died in 1903, but left an adequate pension and savings to support his wife and children. Adolf received a secondary education and. although he had a poor record at school and failed to secure the usual certificate, did not leave until he was 16 (1905). There followed two idle years in Linz, when he indulged in grandiose dreams oi becoming an artist without taking any steps to prepare for earning his living. His mother was overindulgent to her willful son and even after her death at the end of 1907 he continued to draw a small allowance with which he maintained himself at first in Vienna. His ambition was to become an art student but he twice failed to secure entry to the Academy of Fine Arts. Thereafter he lived a lonely and isolated life, earning a precarious livelihood by painting postcards and advertisements and drifting from one municipal lodging house to the next.

Hitler already showed traits that characterized his maturity: inability to establish ordinary human relationships; intolerance

and hatred both of the established bourgeois world and of non-German peoples, especially the Jews; a tendency to passionate, denunciatory outbursts; readiness to live in a world of fantasy and so escape from his poverty and failure.

In 1913 he moved to Munich, thereby evading military service in the Habsburg empire. He volunteered, however, on the outbreak of war in 1914, joining a German regiment, the 16th Bavarian reserve infantry ("List") regiment. He served throughout the war, was wounded in Oct. 1916 and gassed two years later. He was still hospitalized when the war ended. Except when hospitalized, he was continuously in the front line as a headquarters runner; his bravery in action was rewarded with the Iron Cross, second class, in Dec. 1914, and the Iron Cross, first class (a rare decoration for a corporal), in Aug. 1918.

He greeted the war with enthusiasm, as a great relief from the frustration and aimlessness of his civilian life. He found comradeship, discipline and participation in conflict intensely satisfying; and was confirmed in his belief in authoritarianism, inequality and the heroic virtues of war.

Rise to Power.— Discharged from the hospital in the atmosphere of confusion that followed the German defeat. Hitler determined to take up political work in order to destroy a peace settlement which he denounced as intolerable. He remained on the strength of his regiment until April 1920 and as an army political agent joined the tiny German Workers' party in Munich (Sept. 1919). In 1920 he was put in charge of the party's propaganda and left the army to devote his time to building up the party which in August was renamed the Nationalsozialistisch Deutsche Arbeiterpartei (of which "Nazi" was an abbreviation). Conditions were ripe for the development of such a party. Resentment toward the victorious powers and economic chaos brought general discontent. This was sharpened in Bavaria (*q.v.*), where Hitler lived throughout the 1920s, by traditional separatism and dislike of the republican government in Berlin. In March 1920 a coup d'état by the army established a strong right-wing government. Munich became the gathering place for dissatisfied ex-servicemen and members of the Freikorps which had been organized in 1918–19 from units of the German army unwilling to return to civilian life, and for political plotters against the republic. Many of these joined the Nazi party. Foremost among them was Ernst Roehm, a member of the staff of the district army command, who had actually joined the German Workers' party before Hitler and who was of great help in furthering his schemes for developing it into an instrument of power. It was he who recruited the "strong-arm" squads used by Hitler to protect party meetings, to attack Socialists and Communists and to exploit violence for the impression of strength it gave. In 1921 these were formally organized under Roehm into a private party army, the SA. (*Sturmabteilung*). Roehm was also able to ensure the protection of the Bavarian government which depended on the local army command for the maintenance of order, and which tacitly accepted his breaches of law and policy of intimidation.

Although conditions were thus favourable to the growth of the party, only Hitler was sufficiently astute to take full advantage of them. When he joined the party he found it small, ineffective, committed to a program of nationalist and socialist principles, but uncertain of its aims and divided in its leadership. He accepted its program, but regarded it only as a means to an end—political power. His propaganda methods and his personal arrogance caused friction with the other members of the committee, resolved when Hitler countered their attempts to curb his freedom by offering his resignation. Aware that the future of the party depended on his power to organize publicity and to acquire funds, they were forced to give in and in July 1921 he became president with unlimited pow-er. From the first he set out to create a mass movement, whose mystique and force would be sufficient to bind its members in loyalty to him. He engaged in unrelenting propaganda through the party newspaper, the Volkischer *Beobachter* (acquired in Aug. 1920), and through a succession of meetings, rapidly growing from audiences of a handful to thousands, where he developed his unique talent for magnetism and mass leadership. At the same time he gathered round him several of the Nazi leaders who later became infamous—Alfred Rosenberg, Rudolf Hess, Hermann Goring and Julius Streicher.

The climax in this rapid growth of the Nazi party in Bavaria came in an attempt to seize power in the Munich Putsch of Nov. 1923 (see BAVARIA), when Hitler and Gen. Erich Ludendorff took advantage of the prevailing lawlessness and opposition to the Weimar republic to force the leaders of the Land government and the local Reichswehr commander to proclaim a national revolution. When released, however, they rescinded the proclamation. When placed on trial, Hitler, although his part in the *Putsch* had been far from glorious, characteristically took advantage of the immense publicity afforded to him. He also drew a vital lesson from the Putsch—that the movement must achieve power by legal means. He was sentenced to prison for five years, but served only nine months, and that in comfort at Landsberg. He used that time to prepare the first volume of *Mein Kampf*.

Hitler's ideas included little that cannot be traced to earlier writers or to the commonly accepted shibboleths of Viennese radicalism in his youth. He regarded inequality between races and individuals as part of an unchangeable natural order, and exalted the "Aryan race" as the sole creative element of mankind. The natural unit of mankind was the Volk, of which the German was the greatest; and the state only existed to serve the Volk—a mission which the Weimar republic betrayed. All morality and truth was judged by this criterion: whether it was in accordance with the interest and preservation of the Volk. For this reason democratic government stood doubly condemned. It assumed an equality within the Volk which did not in fact exist; and it supposed that what was in the interests of the Volk could he decided by discussion and voting. In fact the unity of the Volk found its incarnation in the fuehrer, endowed with absolute authority. Below the fuehrer the party (which Hitler often called the "movement," to distinguish it from democratic parties) was drawn from the best elements of the Volk and was in turn its safeguard.

The greatest enemy of Naziism was not, in Hitler's view, liberal democracy which was already on the verge of collapse. It was rather the rival Weltanschauung, Marxism (which for him embraced Social Democracy as well as Communism), with its insistence on internationalism and class conflict. Behind Marxism he saw the greatest enemy of all, the Jew, who was for Hitler the very incarnation of evil, a mythical figure into which he projected all that he feared and hated.

During Hitler's absence in prison, the Nazi party disintegrated through internal dissension. In the task of reconstruction after his release he faced difficulties that had not existed before 1923. Economic stability had been achieved by currency reform and the Dawes plan; the republic had become more respectable. Hitler was forbidden to make speeches, first in Bavaria, then in many other German states (these prohibitions remained in force until 1927–28). Nevertheless the party grew slowly in numbers, and in Feb. 1926 Hitler successfully established his position against Gregor Strasser, who had built up a rival Kazi movement in north Germany.

The slump of 1929 opened a new period of economic and political instability. Hitler made an alliance with the Nationalist Alfred Hugenberg in a campaign against the Young plan. Through it Hitler was able for the first time to reach a nation-wide audience with the help of Hugenberg's Nationalist party organization and the newspapers it controlled. It also enabled him to commend himself as a gifted agitator to the magnates of business and industry who controlled political funds and were anxious to use them to establish a strong right-wing, antiworking-class government. The subsidies he received from the industrialists placed his party on a secure financial footing and enabled him to make effective his emotional appeal to the lower middle class and the unemployed, based on his proclamation of his faith that Germany would awaken from its sufferings to reassert its natural greatness. Like his later intrigues with the conservatives, Hitler's dealings with the Nationalists and the industrialists provide a striking example of his skill in using those who sought to use him.

Mass agitation and unremitting propaganda, set against the failure of the government to achieve any success in internal or external affairs, produced a steadily mounting electoral strength for the Nazis, who became the second biggest party in the country with more than 6,000,000 votes at the 1930 election. Hitler opposed Hindenburg in the presidential election of 1932, capturing 36.7% of the votes on the second ballot (see GERMANY: History).

Placed in a very strong position by his unprecedented mass following, he took part in a series of intrigues ior the support of the aging president, in which the other principal participants were Franz von Papen, Gen. Kurt von Schleicher, Otto Meissner and Oskar Hindenburg (see GERMANY: History). In spite of a decline in the party's votes in Nov. 1932, he held to the chancellorship as the only office he would accept, and this by constitutional not revolutionary methods. Throughout, he showed a unique ability to exploit conditions favourable to success. He created the Hitler myth; he propagated it by every device of mass agitation, and with an actor's ability to be absorbed in the role which he created for himself. Yet all the time he remained a shrewd and calculating politician, aware of the weaknesses of his own position, perceiving more quickly than anyone else how a situation could best be turned to his own advantage. In Jan. 1933, he reaped his reward when Hindcnburg invited him to be chancellor of Germany, and he took office with the support of Papen and Hugcnberg, and with Field Marshal Werner von Blomberg as minister of defense.

Hitler's personal life grew more relaxed and stable with the added comfort that accompanied the success of the party. After his release from prison he went to live on the Obersalzberg, near Berchtesgaden. His income at this time was derived in a haphazard manner from party funds and from writing in nationalist newspapers. When he became chancellor he accepted the material comforts that followed, but remained independent of them. He was indifferent to clothes and food, never smoking or drinking tea or coffee, far less alcohol. He continued, even as fuehrer, to rebel against routine or regular work—a characteristic which he ascribed to his own artistic temperament.

When he went to live at Berchtesgaden his half sister Angela Raubal and her two daughters accompanied him. Hitler became devoted to one of them, Geli, but his possessive jealousy drove her to suicide in Sept. 1931. For weeks Hitler was inconsolable. Later Eva Braun, a shop assistant from Munich, became his mistress. Hitler rarely allowed her to come to Berlin or appear in public with him; and would not consider marriage on the grounds that it would hamper his career. Eva was a warmhearted girl with no intellectual ability. Her great virtue in Hitler's eyes was her unquestioning loyalty and in recognition of this he made her his legal wife at the end of his life.

Dictator: 1933–39.—Once in power, Hitler proceeded to establish an absolute dictatorship. He secured the president's assent for new elections on the grounds that a majority in the *Reichstag* could not after all be obtained. The *Rrichstag* fire, on the night of Feb. 27, 1933, engineered by the Nazis but attributed by them to a Communist ,plot, provided an excuse for a decree overriding all guarantees of freedom, and for an intensified campaign of violence. In these conditions, the Nazis polled 43.9% of the votes. In March the *Reichstag* assembled in the Potsdam garrison church, a theatrical gathering designed by Hitler to show the unity of his own movement with the old conservative Germany, represented by Hindenburg. Two days later an enabling bill, giving full powers to Hitler, was passed in the *Reichstag,* by the combined votes of Nazi, Nationalist and Centre party deputies.

Thus far successful, Hitler had no desire to inaugurate a radical revolution. Conciliation was still necessary if he was to succeed to the presidency and retain the support of the army; nor had he ever intended to disappropriate the leaders of industry, provided they served the interests of the Nazi state. Ernst Roehm was the chief protagonist of the "continuing revolution"; he was also, as head of the SA., greatly distrusted by the army. Hitler tried first to secure Roehm's support for his policies by persuasion and by giving him government office, but failed to win him over. Goring and Heinrich Himmler were eager to remove Roehm hut Hitler hesitated until the last moment. Finally, on June 29, 1934, he reached his decision. Roehm and his lieutenant Edmund Heines were executed without trial, together with Gregor Strasser, Schleicher and a variety oi other victims. The army leaders, satisfied at seeing the SA. broken up, approved Hitler's actions. When Hindenburg died, on Aug. 2, they, together with Papen, assented to the merging of the chancellorship and the presidency—with which went the supreme command of the armed forces of the reich—and officers and men took an oath of allegiance to Hitler personally. Economic recovery and a reduction in unemployment (coincident with world recovery, but for which Hitler took credit) made the regime more acceptable, and a combination of tyranny and success brought the support of 90% of the voters in a plebiscite.

In power, Hitler devoted little attention to the organization and running oi the domestic affairs of the Nazi state. Responsible for the broad lines of policy, as well as for the system of terror which upheld the state, he left detailed administration to his subordinates. Each of these exercised arbitrary power in his own sphere, but by deliberately creating offices and organizations with overlapping authority Hitler effectively prevented any one of these private empires from ever becoming sufficiently strong to challenge his own absolute authority.

Foreign policy claimed his greater interest. His objectives were laid down in *Mein Kampf,* and Hitler worked toward them with consummate skill. He had early admired the pan-Germanism of the Austrian Georg von Schonerer, and the reunion of the German peoples was hjs first ambition. Beyond that, the natural field of expansion lay eastward, in Poland, the Ukraine and the Soviet Union—expansion which would necessarily involve renewal of Germany's historic conflict with the Slav peoples, who would be subordinate in the new order to the Teutonic master race. He regarded Fascist Italy as a natural ally in this crusade against bolshevism, provided their rivalry in central Europe could be overcome, and was ready to abandon the Germans of the Tirol to this end. Britain was a possible ally provided it abandoned its traditional policy of maintaining the balance of power in Europe and limited itself to its interests overseas. France alone in the west was the natural enemy of Germany, and must therefore be subdued to make possible expansion eastward.

Before such expansion was possible it was necessary to remove the restrictions placed on Germany by the treaty of Versailles. Hitler used all the arts of propaganda to allay the suspicions of the other powers. He posed as the champion of Europe against the scourge of bolshevism and insisted that he was a man of peace who wished only to remove the inequalities of the Versailles treaty. Germany withdrew from the disarmament conference and from the League of Nations (Oct. 1933), but Hitler hastened to sign a nonaggression treaty with Poland (Jan. 1934). Every repudiation of the treaty was followed by an offer to negotiate a fresh agreement and insistence on the limited nature of Germany-'s ambitions. Only once did he overreach himself, when the Austrian Nazis, with the connivance of the German embassy, murdered Chancellor Engelbert Dollfuss of Austria, and attempted a coup d'état (July 1934). The attempt failed, and as Mussolini moved troops to the frontier Hitler disclaimed all responsibility, and sacrificed those who had acted with his sanction. In Jan. 1935 a plebiscite in the Saar returned that territory to Germany, and Hitler took the opportunity to renounce any further claims on France. In March of the same year, he announced the introduction of conscription, and although this provoked the united opposition of Britain, France and Italy at the Stresa conference of the League of Nations, his peace propaganda was sufficiently successful to permit the negotiation of a naval treaty (June 1935) with England, involving the abandonment of the Versailles treaty. His greatest stroke came in March 1936, when he used the excuse of a pact between France and the Soviet Union to remilitarize the Rhineland—a decision which he took against the advice of his own general staff. Meanwhile the alliance with Italy, foreseen in *Mein Kampf,* rapidly became a reality, as a result of the sanctions imposed by Britain and France against Italy; in Oct. 1936 the Rome-Berlin axis was established; shortly aiteru-ard came an anti-Comintern pact with Japan, and these two were linked a year later.

By 1937–38 a new stage had been reached. In Nov. 1937 Hitler outlined his plans of iuture conquest (beginning with Austria and Czechoslovakia) to a secret meeting of his military leaders. He no dispensed with the services of those who were not wholehearted in their acceptance of Nazi dynamism—Hjalmar Schacht, who declared Germany's further rearmament a danger to its economy, Blomberg and Gen. Werner Freiherr von Fritsch, representative of the caution of the professional soldiers, and Ronstantin von Neurath, Hindenburg's appointment at the foreign office.

In Feb. 1938 Hitler invited the Austrian chancellor, Kurt von Schuschnigg, to Berchtesgaden and forced him to sign an agreement giving the Austrian Nazis virtually a free hand. When Schuschnigg attempted to repudiate the agreement and announced a plebiscite on the question of an *Anschluss* with Germany, Hitler immediately ordered the occupation of Austria by German troops. The enthusiastic reception which Hitler himself received decided him to settle the future of Austria by outright annexation. He returned in triumph to Vienna, the scene of his youthful humiliations and hardships. No resistance was encountered from Britain and France. Hitler had taken special care to secure the support of Italy, and when this was forthcoming proclaimed his undying gratitude to Mussolini.

Having given assurances that the *Anschluss* would not affect Germany's relations with Czechoslovakia, Hitler proceeded at once with his plans against that country. Konrad Henlein, leader of the German minority in Czechoslovakia, was instructed to agitate ior impossible demands on the part oi the Sudeten Germans, thereby enabling Hitler to justify the annexation of Czechoslovakia. But the willingness of Britain and France to compel the Czech government to cede the Sudeten areas to Germany presented Hitler with the choice between substantial gains by peaceful agreement, and even greater acquisitions by a spectacular war against Czechoslovakia. Mussolini's intervention appears to have decided him, and he accepted the Munich agreement on Sept. 30—only to ieel resentment immediately afterward at being cheated out of an impressive military conquest.

It was to be expected therefore that Hitler would waste no time in provoking an occasion for occupying the whole of Czechoslovakia. This he did by fostering Slovak discontent. On hlarch 16, 1939, from the Hradcany castle in Prague, he proclaimed the dissolution of the state whose existence he, as an Austrian, had always regarded as unnatural. Immediately afterward, the Lithuanian government was forced to cede Memel, on the northern frontier of East Prussia, to Germany.

Hitler was now ready to advance toward the ultimate objective of *Lebensraum* in the east. Confronted by an uncompromising Poland, guaranteed by Britain and France, he strengthened the alliance with Italy (the "pact oi steel," May 1939) and negotiated a nonaggression pact with the Soviet Union signed on Aug. 23—just within the deadline set for an attack on Poland before the winter. He still disclaimed any quarrel with Britain, but to no avail, and the invasion of Poland (Sept. 1) was follow-ed two days later by a British and French declaration of war.

Throughout these years Hitler had pursued unwaveringly the objectives of his ioreign policy as they had been laid down in *Mein Kampf.* He showed astonishing skill in judging the mood of the democracies and exploiting their weaknesses—in spite of the fact that he had scarcely set foot outside Austria and Germany and spoke no foreign language. Up to this point every move had been successful—even his anxiety over British and French entry into the war was dispelled by the rapid success of the war in Poland. The result was to convince him more and more of his own infallibility, and to induce him to push ahead still faster with his plans for conquest.

World War II.—Hitler irom the first had assumed direction of the major strategy of the war. When the success of the campaign in Poland failed to lead to the peace negotiations with Britain for which he had hoped, he ordered the army to prepare for an immediate offensive in the west. Bad weather, however, provided the reluctant generals with the opportunity to postpone the western offensive and this in turn led to two major changes in planning. The first, on the suggestion of Adm. Erich Raeder, commander in chief of the navy, was Hitler's order to occupy Denmark and Norway in April 1940. Hitler took a close personal interest in the operation, and irom this time his intervention in the detail of military operations was to grow steadily greater.

The second was the adoption of Gen. Erich von Manstein's plan for an attack through the Ardennes (opened May 10) instead of through the Low Countries. Against his generals' advice Hitler held back Guderian's tanks south of Dunkirk, so enabling the British to organize the evacuation from Dunkirk. But the campaign as a whole was a brilliant success and Hitler could claim the major credit ior its over-all

planning. On June 10 Mussolini entered the war on the side of Germany, and at the end of June Hitler avenged the treaty of Versailles by signing an armistice with France on the site of the Armistice of 1918.

The next step was the subjugation of Britain by aerial bombardment, followed by invasion. But in the summer of 1940 long-term preparations were begun for the invasion of the Soviet Union, and as the expected surrender of Britain still failed to materialize, the eastern campaign quickly came to dominate Hitler's conception of the grand strategy of the war, to the exclusion of everything else. The Soviet Union had occupied eastern Poland and Bessarabia, and Hitler sought to counter any further moves by forcing the governments of Hungary and Rumania to accept an agreement which he dictated, and by urging the abandonment of Mussolini's plans for the invasion of Greece. Mussolini, however, piqued at being kept in ignorance of Hitler's intentions, invaded Greece; and the lack of success of the Italian armies made it necessary for German forces to come to their aid in the Balkans and north Africa. Hitler's plans were further disrupted by a coup d'état in Yugoslavia in March 1941, overthrowing the government which had made an agreement with Germany. Regarding this as an insult to Germany and himself, Hitler immediately ordered his armies to subdue Yugoslavia. The campaigns in the Mediterranean theatre, although successful, remained subordinate to the eastern offensive, with which Hitler was so preoccupied that he lost the opportunism and flexibility which he had shown in political affairs. Even when Raeder and Erwin Rommel urged Hitler to destroy the whole British middle east position by a final blow at Suez, he would spare no more forces from Operation "Barbarossa."

The attack against the U.S.S.R. was launched on June 22, 1941, with Hitler so confident of success that he refused to provide winter clothing and equipment for his troops: The German army advanced swiftly into the Soviet Union, but failed to destroy its Russian opponent. Hitler became completely overbearing toward his generals. He disagreed with them about the object of the main attack, and he wasted time and strength by failing to concentrate on a single objective, by frequently reversing his own decisions. In Dec. 1941 an unexpected Russian counterattack made it clear that Hitler's hopes of a single campaign would not he realized.

The next day came the Japanese attack on Pearl Harbor. Hitler precipitately declared war on the United States—although the pact with Japan was purely defensive and he had not been informed of the Japanese intentions. Misled by an essentially central European view of world politics he apparently took no account of the force which a mobilized United States could bring to bear in Europe.

Hitler's conduct throughout 1942 was marked by further errors of judgment—he paid insufficient attention to the Mediterranean and the Atlantic at a time when a relatively small additional effort in those theatres might have been decisive. In the Soviet Union his continued unreadiness to concentrate on a single objective probably forfeited the opportunity to capture Stalingrad while it was still lightly defended.

Meanwhile he directed Himmler to prepare the ground for the "new order" in Europe. The concentration camps were expanded, and there were added to them extermination camps such as Auschwitz and Mauthausen, as well as *mobile* extermination squads. The Jews of Germany, Poland and the Soviet Union were most numerous among the victims; in German-occupied Europe between 4,500,000 and 5,500,000 had been killed by the end of the war as the only solution in Hitler's view to the Jewish "problem." (This approximate total is a compromise betw-een the 6,000,000 quoted during the Nuremberg trials and the 4,500,000 later admitted by German sources.) The sufferings of other races were only less when measured in numbers killed. Such barbarism was indiscriminate, even where, as in the Ukraine, Hitler might have encouraged nationalist feeling to his own advantage.

At the end of 1942, defeat at El Alamein and at Stalingrad brought the turning point in the war and Hitler's character and way of life began to change. Hitherto the success which he had imagined had been largely realized, but to preserve the world of fantasy from defeat and failure he isolated himself more and more from reality. Directing operations from his headquarters in the east, he refused to visit bombed cities or to read reports of setbacks; those close to him, especially Martin Bormann, his secretary, took care that only pleasing information reached him; and he became increasingly dependent on his physician, Theodor Morell, and the injections which he supplied. Even so, he had not yet lost the power to react vigorously in the face of misfortune. Following the arrest of Mussolini in July 1943 and the Italian armistice, he not only directed the occupation of all important positions held by the Italian army, but ordered the kidnapping of Mussolini, with the intention that he should head a new Fascist government. On the eastern front, however, the refusal to withdraw led only to greater losses, without any possibility of holding up the Soviet advance. Inevitably, relations with his army commanders grew increasingly strained, the more so with the growing importance given to the SS. divisions, directly responsible to Hitler. Meanwhile the failure of the U-boat campaign and the bombing of Germany made more evident how reduced were the chances of victory.

All these factors made more desperate the few soldiers and civilians who were ready to remove Hitler and negotiate a peace. Several attempts were planned in 1943–44; the most nearly successful was made on July 20, 1944, when Col. Graf Claus von Stauffenberg exploded a bomb at a conference at Hitler's headquarters in East Prussia. But Hitler escaped, with superficial injuries, and with few exceptions those implicated in the plot were executed. The destruction of the army's independence was now made complete, and National Socialist political officers appointed to all military headquarters.

Thereafter Hitler was increasingly ill and fatigued; but he did not relax or lose control over the Nazi party or the army, and he continued to exercise an almost hypnotic power over his close subordinates, none of whom was able to wield any independent authority. In Dec. 1944 he moved his headquarters to the west, to direct an offensive in the Ardennes for uhich the last reserves of manpower were mobilized. When it failed, his hopes for victory became ever more visionary, based on the use of new weapons, or on the breakup of the grand alliance, especially after the death of Roosevelt. Far from trying to save what could be rescued from defeat, he ordered mass material destruction, and condemned his armies to death by refusing to allow surrender.

From Jan. 1945 he never left the chancellery in Berlin, or its bunker, abandoning a plan to lead a final resistance in the south as the Russians closed in on Berlin. In a state of extreme nervous exhaustion, prematurely senile if not insane, he at last accepted the inevitability of defeat, and thereupon prepared to take his own life, leaving to its fate the country over which he had taken absolute command. Before this, two further acts remained In the small hours of April 29 he married Eva Braun, the ceremony being performed by one of Goebbels' staff. Immediately afterward he dictated his political testament, justifying his career and appointing Karl Dönitz as head of the state and Josef Goebbels as chancellor.

On April 30 he said farewell to Goebbels, Martin Bormann and the few others remaining, then retired to his suite and shot himself, while Eva took poison. In accordance with his instructions, their bodies were burned, and no remains were discovered.

Summary.— Hitler's success must be attributed to the susceptibility of postwar Germany to his own unique talents as a political leader. His rise to power was not inevitable, and any change in a complex conjunction of circumstances might have relegated him to the obscurity and failure of his youth; yet there was no one who equaled his ability to exploit and shape events to his own ends. The power which he wielded was unprecedented, both in its scope and in the technical resources at its command; but he made no permanent contribution, moral or material, to mankind. His originality and distinctiveness lay in his methods rather than his ideas and purpose, which were shared in whole or in part by millions of people, in Germany and elsewhere. By the time he was defeated he had broken down the whole structure of the world in which he lived, and inaugurated a new era with even greater potentialities of power and destruction.

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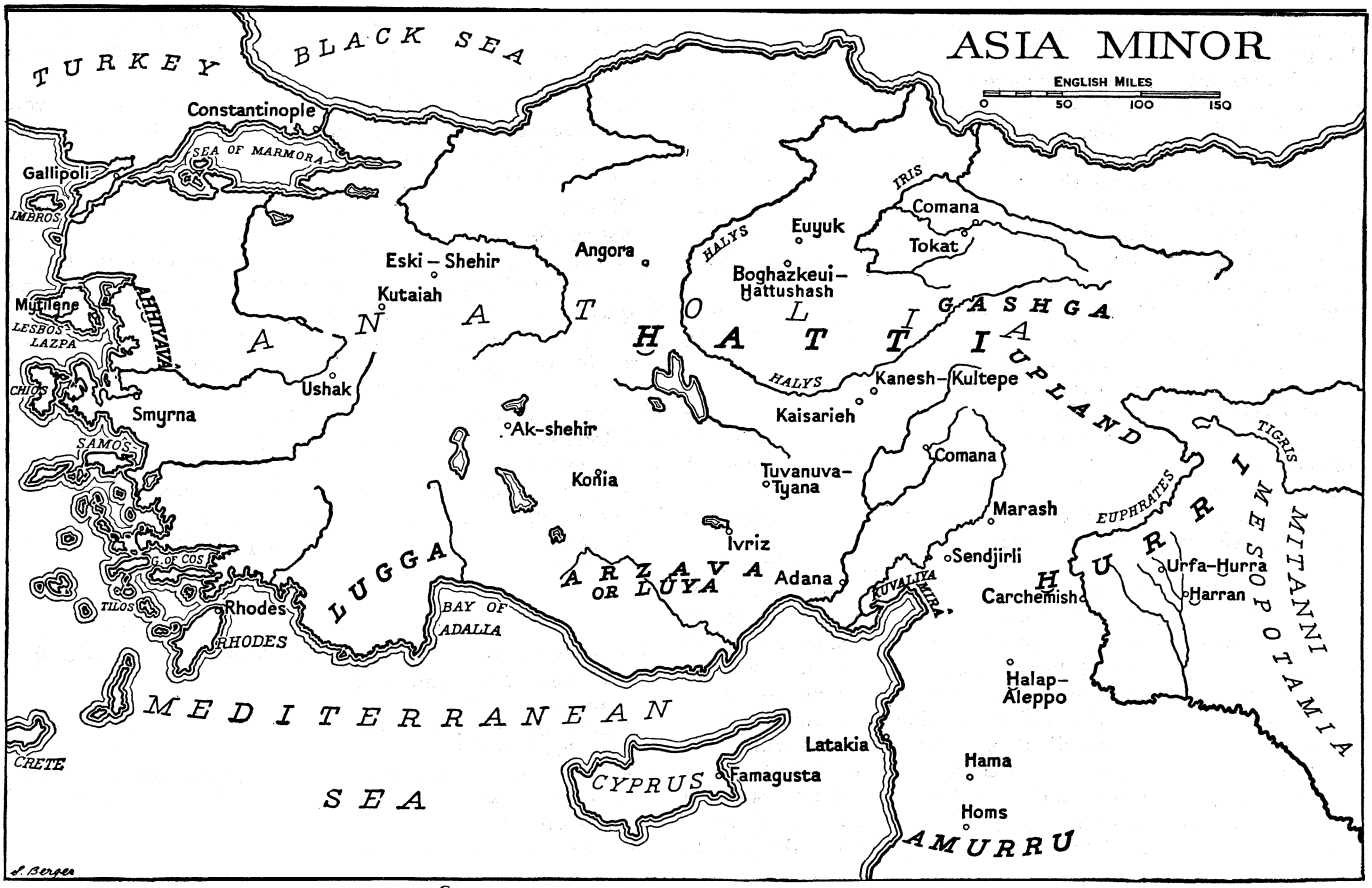
HITTITES, THE. This ancient Oriental people ruled over a great part of Asia Minor and Syria between the years 2000 and 1200 before the birth of Christ. and imposed their own high degree of civilization upon those regions. Rivals of the old Egyptians and Assyro-Babylonians. in comparison with both these nations, the Hittites rank third in importance among the peoples of the ancient east.

Modern research has proved that the ruling people of the Hittite kingdom spoke a language which is related to modern European languages.

The Old Testament, Egyptian and Assyro-Babylonian Knowledge of the Hittites.— The Hittite race, "the sons of Heth" (Hebr. *Hittîm, Benê Hêth*) was known to the writers of the Old Testament. In Gen. x, 15 Heth was a son of Canaan; in Gen. xxiii "the sons of Heth" abode in Hebron, where Abraham traded with them for a grave for his wife Sarah; in Num. xiii, 29, the Hittites occupied the mountains of Canaan; in Gen. xxvi, 34, Esau married the Hittite women, Judith and Basemath. Also Uriah, whose wife David had appropriated (II Sam. xi), is called a Hittite. In I Kings ix, 20, the Hittites, in conjunction with the Amorites, Hivites, etc., were an important element in the population of Canaan. Yet according to the testimony of the Old Testament, Syria was the real home of the Hittites. In Joshua I, 4, the land of the Hittites reached to the Euphrates. In North Palestine, in the time of Solomon, the powerful kings of the Hittites ruled as sovereigns over separate Hittite states, besides



CHIEF HITTITE TOWNS, AND NEIGHBOURING DISTRICTS

the "kings of Arameans" (I Kings x. 29). From there King Solomon obviously brought his Hittite women (I Kings, xi. 1).

In confirmation and amplification of these Old Testament accounts, Egyptian evidence shows that in the time of the 18th to the 20th dynasties, between the years 1500–1190 **B.C.**, a powerful northern kingdom *Kheta* sought perpetually to obtain political influence over Syria and therefore often fought with Egypt. Already the Pharaoh Thutmosis III. (1501–1447), who had conquered Syria as far as the Upper Euphrates, received presents from the prince of Kheta. Under the succezding rulers of the 18th dynasty the Hittites established themselves in Syria. Bitter struggles took place between them and, especially, the Pharaohs of the 19th dynasty, Seti I. (c. 1313–1292) and Ramses II. (*c.* 1292–122 5). About the year 1288 **B.C.** a great battle took place between the two hostile powers near Kadesh on the Orontes; after further combats, about the year 1272 Ramses II. established an alliance with the Hittite king Khattushilish III. and married, about the year 1259, one of his daughters; on this occasion the Hittite king visited Egypt in person. About the year 1190, the Hittite kingdom succumbed to the attacks of the so-called "sea nations."

The Cuneiform inscriptions also know a powerful kingdom and people *Khatti* who gave much trouble to the Babylonians, Assyrians and Egyptians during the II. and I. millenniums B.C. According to a Babylonian chronicle. about the year 1758 B.C. the *Khatti* people overwhelmed Akkad-Babylonia under the rule of King Samsuditana, and made an end of the Khammurabi dynasty. The increasing influence of the Khatti kingdom in Syria about 1400 B.C. is shown by the Amarna inscriptions. After the destruction of the Hittite empire in the 12th century B C. the name Khatti is applied especially, according to the evidence of the inscriptions of the Assyrian kings, after Tiglath Pileser (*cir.* 1110 B.C), to the kingdom of Carchemish on the upper Euphrates, but it also denotes the whole of Syria. Sargon II., it is true, made an end of the Khatti kingdom of Carchemish in 717 B.C., yet the New-Babylonian king, Nebuchadnezer II. (604–562), still used the name Khatti for Syria,

Hittite Monuments and Hieroglyphic **Inscriptions.**—The quoted information pointed to Syria and probably also to the adjoining regions of Asia Minor as the home of the Hittites. When during the 19th century, monuments of unusual style and inscriptions written in an unknown hieroglyphic script, were found in Syria and Commagene, as for example, at Hamah on the Orontes, at Aleppo, at Jerablus on the Euphrates, at Marash and Malatia, further in Cappadocia, as at Boghazkeui and Euyuk, as well as in the Taurus mountains, at Bor, Ivriz and Bulgarmaden, and finally also in western Asia Minor, at Sipylos near hfagnesia, it was very natural to attribute them to the Hittites. The native monuments, together with the Egyptian reliefs representing Hittites, showed the physical characteristics of the Hittite race; in particular, the great curved nose and backward sloping forehead, which proved beysnd any dispute that the Hittites were not Semites or Indo-Europeans. The hieroglyphic writing of the Hittites has nothing to do with the Egyptian hieroglyphic script. It is a pictographic script; but the original meaning of many of the signs is still obscure. In the course of time many signs developed a cursive form. The inscriptions are written *boustrophedon;* after a line written from right to left (or the reverse) there follows one from left to right (or the reverse), so that the figures and heads always face towards the beginning of the line. So far about 200 of the signs of this writing are known. In regard to the age of this writing, the Hittite Archives of Boghazkeui, for example a clay bulls bearing the seal of King Shuppiluliumash (about 1385 B.C), the legend being written both in cuneiform and in hieroglyphics, proves that the latter was used as early as the 14th cent. B.C. Indeed this script may be much older, as is shown by its use in the very old Hittite sanctuary Yasili Kaya, not far from the chief Hittite city Khattushash-Boghazkeui. The invention of this writing may, therefore, be placed in the first half of the second millennium B.C. This script was employed by the Hittites on their rock and stone monuments especially, and upon seals made of stone and metal. It is their monumental writing; for their daily needs and especially for library and archive purposes, as the

archives of Boghazkeui show, they used cuneiform writing and clay tablets.

Much ingenuity has been employed in deciphering the Hittite hieroglyphics. Systems of deciphering were published by F. E. Peiser, A. H. Sayce, P. Jensen, A. Gleye, R. C. Thompson, A. E. Cowley and C. Frank, yet none of them was accepted by the scientific world. It seems that from all these systems only the interpretation of very few signs will prove true. The task is, in fact, very difficult, since bilingual inscriptions are still too few; those that have been discovered so far give but little help in decipherment owing to their brevity, obscurity or damaged condition. They are these: the silver seal of a king Tarkutimme-Tarkondemos of Metan (?), the seal cylinder of one Indilimma, which is, possibly, not bilingual, and the seal impressions of the Kings Shuppiluliumash and Arnuvantash IV.

The Hittite Royal Archives of **Boghazkeui.**—The discoveries of the 19th century failed to solve the very important problem of the affinities of the language of the Hittite people. A firm position was first reached, when in the course of his epoch-making excavations, 145 km. east of Angora, Hugo Winckler, the Berlin Assyriologist, found in the ruins of Boghazkeui a great mass of Hittite clay tablets inscribed with cuneiform characters. Winckler dug there in 1906–07 and in 1911–12, and found about 10,000 broken and whole cuneiform tablets which belonged to the archives of the kings of Khatti, and proved that the capital of the Hittite empire had been at Boghazkeui. Only a relatively small number of the clay tablets discovered in Boghazkeui are written in Babylonian cuneiform script and in Babylonian language. These are state treaties which the Khatti kingdom concluded with other ancient oriental states, and diplomatic letters of the Hittite kings. Babylonian, as the Tell-el-Amarna letters have shown, was the language of eastern diplomats, the ancient oriental French, in the second millennium B.C. The greatest number of the Boghazkeui clay tablets are written, it is true, in Babylonian cuneiform writing, but in the Hittite language. A closer examination of these Hittite documents soon showed the identity of the Hittite language with that of Arzawa (probably Cilicia Tracheia, Isauria and Southeast Lycaonia), which was already known through two letters from the cuneiform collection of Tell-el-Amarna in Egypt. (For the contents of the Hittite archives of Boghazkeui, now for the most part in the museum at Constantinople, some being in Berlin, *see* below)

The Decipherment of Hittite.— After the premature death of Hugo Winckler in 1913, the German Oriental Society, under whose aegis the excavations at Roghazkeui had been carried out, entrusted the publication of the Hittite archives to a group of Assyriologists, one of whom. Professor Bedrich Hrozný, of the Czech University at Prague (but then at the University of Vienna), succeeded in solving the riddle of the Hittite language, in writing the first Hittite grammar and establishing the Indo-European character of the structure of this language. About the same time E. F. Weidner declared the Hittite to be undoubtedly a Caucasian language. Hrozný's decipherment was founded upon the unilingual clay tablets of Boghazkeui: these inscriptions had to be interpreted only on their own content. For this task sentences containing proper names afforded valuable help, as well as those in which Sumero-Babylonian ideograms (word signs) occurred. The Sumrro-Babylonian cuneiform writing *(see* CUNEIFORM) in which the Boghazkeui texts are written was indeed originally a picture-writing, from which later on a syllabic script was developed; but even in the later, more phonetic stage the cuneiform signs were used sometimes as word-signs (for example, the cuneiform sign  , originally the picture of a fish  , as the sign for the word "fish"). Even the Hittites employed these so-called ideograms'in their cuneiform script so that these signs in a Hittite text were intelligible even without knowledge of the Hittite language. Moreover the Hittites also occasionally employed phonetically written Babylonian words as ideograms. Thus, in the middle of an unintelligible Hittite text the Babylonian word *a-bu*, "father" is found: this Babylonian word was naturally read by the Hittites (as we now know) *attash*, but, by its Babylonian form, known to us, it helped us eventually, even without knowledge of the Hittite reading, to penetrate at least in some degree into the sense of the Hittite sentence. A help was derived also from the method of combination which, progressing from the known to the unknown, by means of analogy, parallelism, resemblance of words, etc., endeavours to elucidate the unknown words. In this way, later on, Hittite sentences could be treated which were written only phonetically in Hittite.

Hittite — an Indo-European **Language.**—Hrozný, in the course of his researches, succeeded in identifying most forms of the Hittite language. On the basis of the structure of the language thus established he built his thesis that Hittite is an Indo-European language. He got this idea at first when he established that Hittite has a present participle, which in Nom. Sing. Masc. ends in *-anza*, in other cases in the Masc. in *-ant-* and *-and-*, thus resembling the Indo-European participle in *-nt-* (Lat. *ferens, ferentis*, Gr. *φέρων, φέροντος*). The idea of a relationship between Hittite and Indo-European languages soon took a stronger hold when, having established a complete paradigm of the Hittite participle in *-ant-*, as of other Hittite nouns, he discovered that almost all the case-endings have more or less precise counterparts in Indo-European languages. Thus the Hittite participle *khûmanza* "all" is declined:

	Singular:	
	Masc.-Fem.	Neuter
Nom.	*khûmanza* (compare Lat. *ferens*)	*khdman* (compare *φέρον*)
Gen.	*khûmandash* (compare *ferentis*, *φέροντος*)	
Dat.-Loc.	*khûmanti, -î* (compare *ferenti*, *φέροντι*)	
Xccus.	*khûmandan* (compare *ferentem*, *χρόνον*)	*khûman* (compare *φέρον*)
Abl.	*khûmandaz(a)*[1]	
Instr.	*khûmantet* (compare osk. Abl. *praesentid?*)[1]	
	Plural:	
Nom.	*khûmanteš* (compare *ferentes* *φέροντες*)	*khûmanda* (compare *φέροντα*)
Gen.	*khûmandâsh*[2]	
Dat.-Loc.	*khûmandâsh*[2]	
Accus.	*khdmandush* (compare *lupos*, *λύκους*)	*khdmanda* (compare *φέροντα*)

The Hittite word for "Father" *attash* for example is declined in the same way:

Sing.: Nom. *attash*, Gen. *attash*, Dat.-Loc. *atti*, Acc. *attan*, Abl. *atfaza*, Instr. not yet found would be *attit*;
Plural: Nom. *attêsh*, Gen. and Dat.-Loc. *attâsh*, Accus. *attush*.

Very important was the discovery of a declension which is especially characteristic of Indo-European languages. It is the declension of the Hittite word *vâdar* "water" whose meaning Hrozný succeeded in establishing with the help of the sentence: *nu NINDA-an ezzatteni vâdar-ma ekutteni*. In this sentence the meaning of the Sumero-Babylonian ideogram *NINDA* "bread" was all that was known. The following Hittite ending *-an* has been established as the termination of the Acc. Sing. from examples in other places. In one sentence speaking of bread also the word for "to eat" might possibly (though not necessarily) be expected, and as this meaning fitted for the Hittite root *ezza-* everywhere, Hrozný identified the Hittite *ezza-* and also *ad-* (*adanzi* "they eat") with the Latin *edo*, old High German *ezzan* "to eat," etc. Other passages showed him that *-teni* is the ending of the second Pers.

[1]The ablative (not the locative as was originally assumed by Hrozný) in *-az (a)* is perhaps of the same origin as the Hittite instrum. in *-et, -it*. Compare *kallarit uddanaz* (*Keilschriftt. aus Bogh.* IV. 7, 60) "from the disastrous thing," *ishar-hhuvantazshet* "from its belly" (Code Hittite par. 90), *KAP-laz-tet* "from thy left side" (KBo. 2482 II. 6) etc. Both the Hittite endings *-az(a)* and *-et, -it* are derived from the Indo-European ablative ending *-ōd, -ēd;* before the particle *-a* (from *-e*) the *d* is changed into *z* in Hittite. Thus two forms arise, *-az(a)* and *-et, -it*, which differ also in use: the first, as a rule, is used as the ending of the ablative, the second, chiefly as that of the instrumental.

[2]The origin of the ending *-âsh* is still obscure.

Pl. *Pres.*: ***ezzateni*** *means consequently: "you eat, you will eat." As the sentence:* ***vâdarma*** *ekutteni was clearly in parallelism with the* first *one (NINDA-an ezzatteni), it seemed possible to see in* ***vâdar,*** *which is parallel with "bread," also a simple victual. A* meaning *as "water" was here very convenient and also other passages confirmed this interpretation. A surprising comparison with the English water, old Saxon watar "water," etc., offered itself and proved true. Then ekutteni that is parallel to ezzatteni "you will eat" must signify: "you will drink"; and for the Hittite root eku-, aku- "to drink" and the cognate Hittite word* ***akuvanna*** *"drinking, drink" offered itself as a comparison with the Latin aqua "water." The Hittite sentence above thus runs when translated: "Now you will cat bread, further you will drink water."*

Astonishing as was the discovery of a word for "water" similar to the English one in an ancient oriental language of the middle of the second millennium B.C. *the discovery soon after of the declension of this Hittite word was still more so: Sing. Nom.* ***vâdar,*** *Gen.* ***vedenash,*** Dat.-Loc. ***vedeni,*** *Accus. vddar,* Abl. ***vedenaz,*** *Instr.* ***vedenit;*** *Plural* Nom. *and Accus.* ***vidâr.*** *The Gen. Sing. of* ***vâdar*** *is not, as we might expect,* ***vâdarash,*** *but* ***vedenash,*** *with an alteration in the suffix (n for the r, used in the Nominative). The same very remarkable declension shows however also the quoted Indo-European word for "water" (Old Saxon* ***watar,*** *etc.)*: Gr. Nom. ὕδωρ, Gen. ὕδατος *from* ὑδν-τος. *(Cf. Lat. femur, Gen. feminis.)*

The Hittite pronouns, as established by Prof. Hrozný, *also bear marked resemblance to Indo-European forms as shown in the following list in which the Hittite forms are set in italics at the beginning of each line or paragraph:*

uga, ug "I", compare Lat. ego.
ammug, ammuga "to me, me," compare Gr. ἐμέγε.
ammêl "of me, my," which is similarly related, is connected through the Genitive ending -êl with the languages of Asia Minor and with Etruscan.
zig, ziga "thou," compare Gr. σύγε *or better perhaps according to* Marstrander, *the Accus.* σέγε.
tug, tuga "to thee, thee," compare Goth. thuk.
tuêl "of thee, thy" with the Genitive ending -êl, is also connected.
vêsh "we," compare *Goth. weis.*
anzâsh "us," compare old High German uns.
anzel "our," compare Goth. unsara.
shumêsh, shumâsh "you," compare Gr. ὑμεῖς.
-mu "to me, me," -ta, -du "to thee, thee," compare Gr. μοι, μέ, τοι, *etc.*
-mish "my," -tish "thy," compare Lat. meus, tuus.
enish, annish (compare uni) "that," compare old High German ener *"that," old Slav.* onŭ.
kâsh "this," compare Oscan *e-kas "these"* (fem.)
shash "this," compare Sanskrit sá.
kuish "who, which," *cf. Lat. quis.*
kuit neuter "what, which," *cf. Lat. quid.*
kuvabi "where, whither," cf. Lat. ubi, ne-cubi.
kuish kuish "whoever," neuter kuit kuit, cf. Lat. quisquis, quidquid.
kuishki, neuter kuitki, "somebody, something," cf. Lat. quisque, quidque.
kuvatka, "something, perhaps," cf. Lat. quodque.
kuvabikki "somewhere," *cf. Lat. ubique, etc.*

On the other hand, the Hittite pronoun ***apâsh*** *"that" is connected with the languages of Asia Minor (see* ANATOLIAN LANGUAGES); *cf.* Lycian *ebe "this," Lydian bis "he."*

Hrozný *likewise proved that also the Hittite verb is essentially Indo-European. The present tense of the Hittite verb jami "I make" runs:*

	Hittite	*Sanskrit*	*Greek*
Sing. 1.	*jami "I make"*	*yâmi "I go"*	τίθημι
2.	*jashi*	*yâsi*	τίθης
3.	*jazi*	*yâti*	τίθησι, τίθητι (Dor.)
Plur. 1.	*javeni (javani, jauni)*	*yâmah, cf.* 1. pers. dual *yâvah*	τίθεμεν
2.	*jatteni (jattani)*	*yâtha, yâthana*	τίθετε
3.	*janzi*	*yânti*	τιθέασι, τίθεντι (Dor)

(The forms enclosed in brackets are found, but from another verb — not yet from jami.)

The Hittite verb ***dâkhkhe*** *"I take" for example presents a somewhat different paradigm for the present tense:*

Sing. 1. ***ddkhkhe, dâkhkhi*** *"I take" (cornp.* Lat. *fero? The Hittite kh or h is, perhaps, as elsewhere frequently, secondary).*
2. ***datti*** *(cornp.* 2. *Pers. pret.* ***dâtta*****).**
3. ***dâi*** *(comp.* οἶδε*?).*
Plur. 1. *(dâveni), dâvvani.*
2. *datteni, (dattani).*
3. ***dânzi.***

The Imperative Pres. Active runs:

	Hittite
Sing. 1.	***jallu*** (KUB *xiv. 27,* 19); *also (jallut,* ***jallit*****)?** *Comp. eshlut,* ***eshlit*** *I will do.*

Comp. for ***jal-*** *old ecclesiastical Slav. Part. Pret. Act.* 11. ***neslŭ,*** *umbr. Fut. ex.* ***apelust,*** *Armenian Part. Pres.* ***berol?*** ***-u*** *is an Imperative ending, which is found also in* Indo-Iranian.

The ***-t*** *in eshlut, eshlit is perhaps of medial origin; see below especially the Preterite of the Hittite* Medio-passive.

		Sanskrit
2.	***ja*** *"make"*	*ydhi "go"*
3.	***jaddu***	*yâtu*
Plur. 2.	***jatten***	*yâta, yâtana*
3.	***jandu***	*yântu.*

The Preterite Active runs:

Sing. 1.	***janun*** *"I made" (cornp.* ἔφερον*)*	***ddkhkhun*** *"I took" (Hittite kh is perhaps secondary);* ***tabarkha*** *"I reigned" (cornp.* οἶδα*?).*
2.	***jat*** (comp. ***dâtta*** *2. Pers. sing. and* ***jat*** *3. p. sing.)*	***ddtta*** (comp. οἶσθα), ***dâsh*** *(from* ***dâsh*** *+ sh?).*
3.	***jat*** (comp. *Sanskrit* ***ádhāt*****)**	***dâtta*** *(? Comp.* ***jat*** *3. pers. and* ***ddtta*** *2. Pers. sing. ?)* ***dâsh*** *(from* ***dâsh*** *+ t?).*
Plur. 1.	*javen*	***dâven***
2.	*jatten*	*(datten)*
3.	***jêr*** (comp. Lat. *fuēre*).	***dâir;*** *also* ***dalugnula*** *"they have made long" (cornp. for ex. Czech nesli?).*

Very important is the proof of the existence of a Hittite Medio-passive *form which frequently has an* ***-r*** *ending as exhibiting resemblance to the Latin verbal forms such as amatur, amantur and similar forms in Italo-Celtic and Tocharish. Besides -r, a medial -ti, -t is found as ending in the Hittite Medio-passive in other forms, especially in the Preterite; the forms with -ti are in the old Hittite more frequent than those with -t.*

The present of the Hittite medial verb jakkkhari, "I go" runs:

Sing. 1. *jakhkhari (cornp. Lat. feror? Hittite kh is secondary?), (jakhakhari) "I go." See also* Kuryłowicz *in Symbola grammatica in honor. Rozwadowski,* p. 95–104.
2. *(jatta old Hittite), jattati (cornp.* οἶσθα *and 3. Pers. sing. jatta?) Also eštari "thou* sittest *down," v.* Götze, *Madduwattaš, p. 104, n. 12.*
3. *jatta (cornp.* φέρεται, ἐφέρετο*), jattari, jattâri (cornp. Lat. amatur), also esha, eshari, "he sits down" (cornp. Umbrian ferar).*

Plur. 1. *(javashta, javashtat, javashtati) (cornp. Act. javeni, [javani,] the pronoun vêsh "we" and* 1. *Pers. dual Sansk. svás?)*
2. *jadduma (jatumari old Hittite) (cornp. Sanskrit abharadhvam, old Avestic mazdazdûm).*
3. *janta, (cornp.* φέρονται, ἐφέροντο*), jantari (cornp.* Lat. *amantur).*

The medio-passive imperative of Hittite, whose endings for the most part show the imperative ending -u, already known to US, *runs:*

Sing. 1. *(jakhkharu, jakhakharu) "I will go."*
2. *jakhkhut, (jakhkhuti) (stem with a secondary kh + -u of the Imperative + -t, -ti of the medium?)*
3. *jattaru, also esharu.*

Plur. 2. *jaddumat, (jaddumati)* (comp. 2. *Pers. Plur. Pres. and Preterite.)*
3. *jantaru.*

The Preterite of the Hittite medio-passive runs:

Sing. 1. *(jakhati), jakhkhat, jakhkhakhat "I went" (cornp.* 1. *pers. Sing. present).*
2. *(jattati, jattat) (cornp.* 2nd *pers. sing. Pres. and* 3rd *sing. Pret.), also* ***kîshat*** *(cornp.* ***kîshat,*** *eshat 3rd Sing.?) "thou becamest," besides* ***kîshtat.***

3. *(jatta?), (jattati), jattat* (comp. 3. Sing. pres.), also *eshati, eshat* (= 3rd Sing. pres. *esha*+medial *-ti, -t?*), "he sat down," besides *eshtat.*

Plur. 1. *(javashtati),* (comp. 1. Plur. Pres.)
2. *(jadumat), kîshdumat,* "you became" (comp. 2. Plur. Pres.)
3. *(jantati), jantat* (comp. 3. Plur. Pres.).

(Both Friedrich and Götze have been successful in the interpretation of some medio-passive forms of Hittite. However the paradigms cited above are given on the basis of independent researches of Hroznji with the only exception of the forms *javashta* and *javashtat[i]*, whose identification must be referred to Friedrich. Hrozný found also the form of the 1. Pers. sing. Imp. Act. independently of Friedrich.) Among others, Hittite had also verb stems in *-shk-*, as for example *dashkishi,* "thou takest" (to the simple stem *dâ-* "to take"), as also verb stems in *-nu,* as for example *arnumi* "I send for," to the simple stem *ar-* "come"; comp. Lat *posco,* Greek ὄρνυμι, etc.

That all this correspondence of Hittite with Indo-European languages shows that in its construction Hittite is an Indo-European tongue, is the substance of Hrozný's decipherment of the Hittite language: of his preliminary report Die *Lösung des hethitischen Problems*—"The solution of the Hittite Problem" in the Transactions of the German Oriental Society (*Mitteilungen der deutschen* Orientgesellschaft), No. 56 (1915) and especially of his Hittite grammar Die *Sprache* der Hethiter, *ihr Bau und ihre Zugehörigkeit zum indogermanischen Sprachstamm*—"The Language of the Hittites, its structure and its membership of the Indo-Germanic stock" (Leipzig, 1916–17). Within the Indo-European group of languages the Hittite, which treats the gutturals like the West Indo-European languages, the so-called Kentum group (see INDO-EUROPEANS: Language *Classification*), appears to be related chiefly in respect of its medio-passive endings, such as *-tari,* with the Italo-Celtic languages and Tocharish. (In 1902 Knudtzon published the view that the Arzava language which, as we now know, is identical with Hittite. is an Indo-European language. But his opinion met with such severe and universal opposition from the Indo-European philologists that he withdrew it.)

Foreign Influences. — In the Hittite language, the remains of which date from the second millennium B.C., and which therefore is one of the oldest Indo-European languages, there can be observed a strange extensive simplification and attrition of the language, in spite of the survival of certain ancient features. Further at the present time only a small proportion of the Hittite vocabulary can be traced to Indo-European roots. This, it is true, is perhaps in some extent due to the fact that the cuneiform script invented by the Sumerians is poorly adapted for rendering an Indo-European language. For this reason it is very difficult to set up a complete system of Hittite phonology. In Hittite words such as *khameshkhanza* "spring," antukhshash, *antuvakhkhash* "man." *idâlush* "evil," *karmalashai* "remains crippled," etc., are very numerous, for which a clearly defined Indo-European etymology is—at least at the present time—wanting. All these strange facts are best explained by the supposition that Hittite was largely influenced by other, non-Indo-European, languages. We find in Hittite words, borrowed from Assyro-Babylonian as, for example, the verb *khabalashaizi* "he smashes," which is borrowed from the Assyro-Babylonian verb khabrilu "to destroy." The Hittite word for house *pir* has its origin perhaps in the old Egyptian word per "house," which is found also in the word Pharaoh, properly "great house, palace." For the far greatest number of such non-Indo-European words Hittite is however most probably indebted to the indigenous languages of Asia Minor, with which it was in close association for about 1,000 years. It is even possible that Hittite derives a not unimportant part of its foreign words from non-Indo-European tribes with whom the nation was in contact when it occupied its earliest Indo-European home. As the Hittites belong to the oldest Indo-European peoples, those uho first left their earliest Indo-European home in the north, it must be supposed that they belonged to the borderland tribes of the earliest Indo-European home and, therefore, had already there come into contact with foreign peoples. Later, probably in the second half of the third millennium B.C., when the Hittites, as a conquering apparently not very numerous people, forced their way over the Caucasus, or (less probably) across the Bosporus, into Asia Minor, and overthrew the native inhabitants, also, the languages of the latter exercised considerable influence on the language of the Indo-European conquerors. At the Same time the Hittites came into contact with the Assyro-Babylonian colonies in Asia Minor, from whom they took over cuneiform writing, many religious and cultural goods, and, naturally, many words of their language.

Hrozný's Decipherment and the **Experts.**—Relying chiefly on these foreign influences in Hittite, the philological experts (*e.g.,* Bartholomae, Bork) in the beginning opposed and refused to accept both Hroznji's decipherment and his theory of the Indo-European character of Hittite. They even sometimes doubted the accuracy of his readings which were held to be tendencious. Hrozný himself provided a measure of support to these unfavourable criticisms since, while working out the Indo-European affinity of this language, he sometimes overshot the mark in his first public announcement. Scepticism as to Hrozný's decipherment was carried very far especially in England. But further investigations of Hittite material which achieved notable success, especially in Germany, demonstrated the futility of this criticism and thus obtained a complete victory for Hroznji's position. The first to maintain Hroznji's theory were the Assyriologist Holma (1916), the Indo-Germanist, Marstrander (1919) and the Assyriologist, Forrer (1919). Also the Indo-Germanist, F. Sommer, who learned cuneiform writing on account of Hittite, and thus convinced himself of the exactness of Hroznji's readings, "after long doubt" declared (1920) Hittite "to be by its flexional structure an Indo-Germanic language," and in 1921 the lndo-Germanists, Herbig and Debrunner joined him. The Indo-Germanic (Indo-European) theory won a very warm adherent in the Hittitologist J. Friedrich of Leipzig, an expert in Assyriology and Indo-Germanic learning. Also the assent of both the eminent Indo-Germanists, P. Kretschmer and H. Pedersen (1925–26) to the theory of the Indo-European character of Hittite is very important. Thus in 1924 Friedrich was able to assert that almost all serious students adhere to the theory that Hittite is a newly discovered Indo-Germanic language (Ebert, *Reallexikon* der *Vorgeschichte, s.v.* "Altkleinasiatische Sprachen").

OTHER HITTITE LANGUAGES

Khattish.—Not only the mixed character of the Hittite language, but also the physical characters of the "Hittite" race, its hyperbrachycephalous skull, the large hooked nose and sloping forehead, suggested the hypothesis that here an Indo-European nation is mingled with a non-Indo-European race. At the turn of the year 1919–20 this conjecture was confirmed by the independent and surprising discovery of Hrozný and Forrer that in the State archives of the Hittite kings had been preserved remains of one language which is totally different from the Indo-European Hittite and which these documents call khattili, that is, khattish. According to a collection of instructions an employe shall come out from the Palace and call "khattish" the word trikhaja, whereby the word *tâkhaja* is said to be the "khattish" word for shaver. Also according to another text the doorkeeper calls the employes of the Palace by their "khattish" designations, and this same text gives also the Indo-European-Hittite versions of these titles. Sometimes the rituals composed in the Indo-European Hittite comprise litanies, prayers, exorcisms, etc , "in the Khattish language," "in the language of the town Khatti" (khattili); songs also were very frequently sung by the singers in the Khattish language during religious services. Khattish appears to have played an important rôle, especially in the religion of the Khatti land. The Khattish litanies were left sometimes without translation into the Indo-European-Hittite language, but they sometimes appear there also translated into Indo-European Hittite; in the latter case we have to do with true Khattish-Hittite bilingual texts. The population of the Khatti country therefore. in regard to physical and linguistic characteristics, was mixed and not pure, as was also the case in ancient Babylonia with its Sumerian and Baby-

lonian peoples, and Sumerian used as the ecclesiastical language. We must assume that when the Indo-European Hittites invaded Asia Minor they found there an older population which they subdued, but were in return strongly influenced by them, both in blood and language. The long-nosed type already mentioned, and called "Hittite," also "Armenoid," especially described by the anthropologist von Luschan—so far as Eastern Asia Minor is concerned—goes indeed back to these original inhabitants of Eastern Asia Minor called "khattish" by the Boghazkeui texts. The same type is found also in Syro-Palestine, Mesopotamia, Armenia and Persia. In consequence of mixtures of peoples this large nosed race now speaks (as in antiquity) widely different languages, Indo-European languages, such as Armenian and Persian, and Semitic Hebrew (in antiquity the Semitic Assyrian also). (The so-called "Jewish" type belongs also to this ancient race.) According to the Hittite Boghazkeui texts, to the Khattish race element in the Hittite empire belonged especially, though not exclusively, the lower class of the towns, the minor officials and the craftsmen in temple and palace, a great part of the priesthood and probably also a part of the country people.

The Khattish (by Forrer called proto-khattish) language differs fundamentally from all others of the Khatti kingdom in its construction. It employs almost exclusively prefixes in its inflections and not suffixes; for example, the word *binu,* child, forms its plural *lê-binu.* Knowledge of this language with its astonishing abundance of curious prefixes, which is known to us only through texts of slight extent, is still in its infancy. It is as yet uncertain whether we should regard it, with Forrer, as related to the north east Caucasian tongues, which also make use of prefixes. (Bleichsteiner *[Ber. d. Forsch.-Inst. f. Osten u. Orient, 3,* p. 102 and foll.] believes, on the contrary, that some analogies between Khattish and West Caucasian languages can be established. This also is uncertain.)

Contact between Indo-European Hittite and Khattish can also be established in the words borrowed from the latter tongue. As characteristic of Khattish we may mention the Khatti words *kâtte* "king," *nimkhutun* probably "woman" (Bo. 2039), *vindukkaram* "cup-bearer," in which the Minor Asiatic word *vin* "wine," occurs, *shakhtarîl* (with the suffix *1)* "exorcist," *khantipshuvâ* "cook," and deal with the following Khattish fragment: *imâkhashâil ugga varvh shugga varvashkhap ziptipâil kâtti kurkuvenna bîdush kâbarvun vashkhavûn liggarân varûshemu kurkubenna,* etc.

It proves therefore that the Hittites themselves designated as the speech of the capital city, and probably also that of the country Khatti—K h a t t i s h—the non-Indo-European language just described, that of the original inhabitants of their country. This language should therefore be called "Hittite," because the name "Hittite" goes back to the name Khatti through the Old Testament Heth. So far a name for the Indo-European Hittite, for the official language of the Hittite state, has not been discovered in the Boghazkeui texts; once only is the Hittite state language called *nâshili* which, however, according to Hrozný's interpretation, means no more than "our (language)"—comp. Lat. *nos* "us." In the Hittite religious services, according to the Hittite ritual texts, sometimes Khattish, sometimes Khurrish *(see* below), sometimes Lûish *(see* below) singers took part, sometimes also singers from the city *Kanesh, Kanish,* in Asia Minor. Because these last singers probably used the Indo-European state language, Forrer would call this language the "Kanish language." But nothing else supports the supposition that the Indo-European Hittites called themselves "Kaneshites"; further so far, the expression *Kaneshili*="in Kaneshite (language)" never occurs. We must therefore continue the make-shift of designating the non-Indo-European speech as "Khattish" and the Indo-European, as hitherto, as "Hittite."

Lûish.—Another very important language of the Khatti kingdom is LQish which Hrozný has also shown to be essentially Indo-European. Forrer, who falsely calls this language "Lûvish," regarded it at first as a Finno-ugrian language, but adopted later Hrozný's view that it, too, must be considered as Indo-European. Of this opinion are also, for example, Friedrich, Kretschmer, Ungnad and others. Lûish is closely related to Hittite as is demonstrated by the following passage, written in LQish and Hittite:

Hittite: *Marduk .Innaravantash...eshkhanuvanta kuêsh veshshanta Lûlakhijashshan*
Lûish: *Shantash...Annarummenzi...ashkhanuvanta kuinzi vashantari Lûlakhinzashtar*
English: *Shantash* (and) the *Innaravantash*-deities who put on mantles *and* the *Ldlakhi-deities*
Hittite: *khuprush kuêsh ishkhijantish*
Liiish: *khupparaza kuinzi khishkhijanti*
English: who have tied on their pilgrim bottles(?).

Sentences such as *kuinzi vashantari* (medio-passive; comp. *amantur)*=Hitt. *kuêsh veshshanta* leave no doubt as to the Indo-European character of LQish and its relationship to Hittite. Certainly in this example (and still more perhaps in others) LQish appears to have been already more thoroughly transformed through the autochthonous languages of Asia Minor than Hittite. Unfortunately, LQish passages in the Boghazkeui texts occur but so seldom that a thorough investigation of this language is beset with difficulties.

The name LQish (Hittite *Lûili*) is derived from that of the country *Lhya,* which was also called *Arzava* and which may be possibly sought in West Cilicia, Isauria and South Lycaonia. Besides for Lûya itself the LQish language is also attested for the capital Hittite city *Khatti* or *Kattushash* and for the State of Kizvatna, commonly identified with Pontus on the Black sea. Gotze and Smith look for it on the Gulf of Issos, though with meagre justification. Thus, in the second millennium B.C., the Lûites were dispersed, though probably unequally, throughout the whole of Eastern Asia Minor, but because of their name, we must certainly seek the centre of their distribution in Lûya-Arzava, therefore southerly from the Khatti country. They are the Indo-Europeans who made the furthest advance into the South of Asia Minor in the second millennium B.C. They must—as the earliest Indo-European wave—have reached Asia Minor earlier than the Indo-European Hittites (about 3000 B.C.?). The language of this vanguard of the later Hittites was destroyed to a greater degree by the influence of the autochthonous tongues of Asia Minor than was the case with that of the true Hittites. On the contrary these Indo-European languages have also influenced the autochthonous tongues of Asia Minor, as is shown by the Indo-European elements in Lycian, Lydian, Etruscan, etc. LQish appears to have been spoken in the Khatti kingdom—so far indeed as they did not use Khattish—by the peasants; their language was accounted barbaric by the Hittites. (It is also interesting that the employees, priests and workmen of the royal palace in Khatti-Khattushash were Khattish, its fire-men however LQish.)

Khurrish.—Besides the Hittite, Khattish and LQish, still another language has been revealed by the inscriptions at Boghazkeui—Khurrish (Hittite *khurlili),* which is thus named after a people, empire and, apparently, also a city *Khurri.* The country *Khurri* (which properly means "hollows, caverns"), must be looked for in North Mesopotamia and the bordering Armenian mountains. The name both of this country and its people was formerly read as Kharri which, graphically, was also possible. The Mitanni country, the later Mygdonia on the rivers Djaghdjagh and Khabur in North Mesopotamia, formed one part of the Khurri country. Because the Aryan deities Mitra, Varuna, Indra and Nâsatya are named in the political treaties of Mitanni, Winckler associated the name Kharri with that of the Aryans. However, Hrozný has shown that the character *khar, khur* in the name *Khar-ri* can only be read *khur,* and this name itself therefore only *Khur-ri;* this is proved by the place-name *Bàd-Khu-u-ur-lu-ush-sha* (in the inscription Bo. 434), that is "The fortress of the *Khurri* people," where only the reading with *u* is possible. (Compare also the proper name *Ḫu-u-ur-lu-u* [*i.e.,* "the Khurrite"] in the inscription *Transact. of the Amer. Phil. Assoc. 58,* p. 24, 2. Hrozný regards the North Mesopotamian town Urfa, Gr. Orrhoe, Edessa, as the centre of the empire of *Khurri.* The name of this town and country in Aramaic is *Urhôi,* אדהי, in Arabic *ar-Ruhd'u;* compare also the Arabes Orrhoei or Orroei of Pliny [n.h. V. 85, VI. 25, 117, 129]. In the letter of Tushratta

composed in Mittanish the Khurri country is called Khurvûkhe or Khurrûkhe, *i.e.*, the Khurrish. To a Hurriihe, which may have been spoken with a weak *h*, can easily be traced *Urhôi, Orrhob* [country *Orrhoëne*, later changed into *Osroëne*]; comp. *Khabur*, Gr. *Khaboras* and also *Aborras*. In Assyrian Urfa seems to be called *Khurra* [in an inscription of Adadnarâri I.]. As the name probably means "cavern[s]," it is perhaps possible to suppose that *Khurra-Urfa* received this name on account of the numerous caverns in the Nimrûd Dâgh of the surrounding country.)

As Hrozný has shown, the Khurrish language is not related to Aryan tongues, but to the entirely non-Aryan and non-Indo-European speech of Mitanni, which is represented by a long letter of the king Tushratta of Mitanni from Tell el-Amarna. The two languages are probably distinguished only by very slight dialectical differences. When, in Khurri-Mitanni the nom. sing. ends in *-sh* (as well as in *-l*), and the accus. in *-n*, the influence of the Aryan speech of the *Khurri-Mitanni* country *(see* below), can be perceived in it and, in some degree perhaps also that of Hittite. The genitive endings *-ve* and *-khe*, and the plural ending *-na* are, on the contrary, native to the language. When a genitive is dependent on a substantive, it receives also the ending of that substantive: *ilâni-na Shamûkhakhi-na*, "the gods of the city *Shamûkha*." This phenomenon occurs also in some Caucasian languages, especially in Old Georgian and Cakhurish (Bork). But no definite conclusion can be based as yet upon this isolated phenomenon. Wholly non-Indo-European also is the Khurrish-Mitannish verb which Messerschmidt, Bork. Forrer and Ungnad have studied carefully. In any case Khurrish and Khattish are not related. The following are chosen as examples of Khurrish-Mitannish words: *shena*, brother; *ashte*, wife; *tivi*, word; *katiu*, I will proclaim (Cngnad). The following specimen of the language may be quoted: *Teshubbutte shîlallukhi shâla abkijâve annûn mirzi annûnmân irâne annûn gaggari*, etc.

Khurrish litanies and prayers occur in the Hittite rituals but, unfortunately. without Hittite translations, and Khurrish singers (singers of the city Khurri) also sang in the religious services. This is the case especially in the eastern Khatti provinces, in Kizvatna and in the city Shamûkha, situated somewhere in Commagene or Melitene. But also in Shamûkha were found Hittites and Khatti.

A mixed population of Hittite, Khatti and Khurri was distributed throughout Syria, while in Khurri (Orrhoëne and South Armenia) and Mitanni (Mygdonia) the Khurrish-Mitannish were the preponderating race. Occasionally Khurri is synonymous with Syria generally. The country *Kharu*, more exactly *Khôr* of the Egyptian inscriptions, as also the Old Testament people, the Khorites (until now usually considered to be "dwellers in the caverns") who, according to Gen. xiv. 6, Deut. ii. 12 and 22, inhabited the land of Edom before the Edomites, is identical with this *Khurri*. The Khurri-Khorites also belong, like the Khatti, to the large-nosed Armenoid race which has influenced, physically, the later Semitic (Assyrian, Hebrew, etc.) and Indo-European (Armenian) population of these countries. Not a little literature must have been written in Khurrish, as the fragments of the Gilgamesh epic and also other poetical texts in the same tongue, found in Boghazkeui, testify. Ungnad suggests the name Subarian for Mitannish (and Khurrish), derived from the geographical term Subartu used for the countries lying north and north-west of Babylonia.

In the Boghazkeui inscriptions a language of the country *Palâ* (*palâumnili*) is mentioned occasionally. This must be sought, perhaps, somewhere in Syria (?). Unfortunately, no sure records of this language have, so far, come to light. Two insignificant fragments, published by Forrer, if really written in Pall, suggest perhaps a Lûish-Khattish mixed language.

If. as suggested above. Hittite. Khattish. Liiish and Khurrish were spoken in the Hittite area. and if the cuneiform writing was used for all these languages, it is likely to suppose that also in the monumental writing of the Hittites—that is, in the Hittite hieroglyphs—several languages. presumably Hittite. Khattish and Khurrish. occur. If so, the decipherment of this script becomes still more difficult. since the language in which any given inscription is written must first be determined.

Aryans (Earliest Indians) in Syria and Mesopotamia.—The Boghazkeui inscriptions show that, besides the Hittites and the Liiish, there was also in the second millennium B.C. another Indo-European people within the Hittite area: an Aryan conquering people which formed the governing class in the kingdoms of Khurri and Mitanni and—probably in consequence of a former expansion of the Khurri kingdom in Syria-Palestine—not seldom supplied Syrian and Palestinian cities with their Dynasties. In the treaty of the Hittite king Shuppiluliumash *(cir.* 1380 B.C.) with the king of Mitanni, Mattivaza, among the gods of Mitanni, also the gods *Mitrashshil* (Mitra gods), *Arunashshil* (Aruna gods), *Indara* and *Nashattijannu* are invoked as witnesses of the oath, which are surely identical with the Indian gods *Mitra, Varuna, Indra* and *Nāsatya*. In the Boghazkeui archives four tablets (originally there were still more) have also been discovered of a manual written in Hittite on the management of horses and chariot races of which a certain Kikkuli from Mitanni was the author, and in which expressions used in chariot racing in Indian language occur: *aikavartanna* "in one turning," *teravartannu* "in three turnings," *panzavartanna* "in five turnings," *shattavartanna* "in seven turnings," etc. (comp. old Indian *dka-h*, one, *tráy-ah*, three, *pañca*, five, *saptá*, seven, *vártanam*, the turning). In addition the inscriptions mention a class of military nobility, the so-called *marianni* who play an important rôle in Syria and Khurri-Mitanni, and whose name is derived from the old Indian *márya*="young man, hero." Finally, in the inscriptions of Tell el-Amarna and Boghazkeui, names of Palestinian, Syrian and Mesopotamian kings and princes, of Aryan character, are preserved as, for example, the names of the kings of Khurri and Mitanni, *Artatama* (probably old Indian *Rta-tama*, "the most pious"), *Tushratta, Mattivaza*, the name of the Palestinian prince *Shubandu* (old-Indian *su-bandhu*= "who has good kinsmen"), and others.

It is to be supposed, that in the course of theirwanderingto India the earliest Indians, or, at least, a part of them, touched Mesopotamia and Syria, where the Khurri-Mitanni kingdom was their centre, in the second and even the third millennium B.C. At the present time, Kretschmer pleads for a longer sojourn of all Indians in Near Asia particularly on the ground of his hypothesis that the Indians borrowed the deities *Varuna* and *Indra* from the Hittites; cf. the Hittite *arunash*, sea, and the Hittite god *Inar, Inarash*. (That the Hittites had a god of the sea *Arunash*, whose name was in the cuneiform writing written with the determinative for gods, is now shown—[which could not have been known to Prof. Kretschmer]—by the text *Keilschr.-Urk. aus Bogh. XX.*, 1, 32 and 2, 5, and also by Bo. 3206, II. 16.) On the other hand the Hittite god *Aknish* or *Agnish*, discovered by Hrozný *(Rev. d'assyr.* 1921) may perhaps have been derived from the old Indian god of fire *Agni*. Iranians also may have taken part in this immigration of Aryan stock in the Near Asia. Forrer's proposal to name the Aryan language of Khurri-Mitanni as Mandaean is impossible, for even if the name 'Wanda-people, Manda-warriors" of the paragraph 54 of the Hittite Codex of Laws really denoted the Aryans of Khurri-Mitanni, the Assyrian-Babylonian collective expression *Ummân-Manda* "troops of peoples" for the hostile, mostly—as it is to be supposed—Indo-European north peoples obviously could not be employed to designate the speech only of one of these peoples. It is also doubtful if the name of the country Mitanni (also Metan?) has anything to do with the Medes. On the other hand it is sure that the horse which appears in Near Asia somewhere about 2000 B.C., was there introduced by the Aryans now in question.

HISTORY OF THE HITTITES

The earliest information concerning Asia Minor relates to the first half of the third millennium B.C. Eastern Asia Minor was already inhabited by the non-Indo-European Khatti. The rich natural resources of the country attracted the Sumero-Babylonians and Assyrians, who founded colonies and kingdoms there. About 263j B.C. the powerful ruler, Sargon of Akkad, undertook a campaign against the city *Purushkhanda*, in Asia Minor, governed by a king with the Accadian name *Nûr-Dagan*. According to text

HITTITES

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HITTITE RELIEFS AND HIEROGLYPHIC INSCRIPTIONS FROM CARCHEMISH

1. Hittite-Khurri sculpture of a warrior, one figure on a series of reliefs discovered at Carchemish, the modern Jerablus, on the west bank of the Euphrates.
2. Two men killing a lion. Another relief on basalt found at Carchemish. Head dress, beard and hair, as well as the turned-UP toes, are characteristic of Hittite sculpture
3. Hittite inscription, found on a monument at Carchemish. The hieroglyphic writing of the Hittites is a pictographic script which has not yet been deciphered
4. Hittite-Khurri sculpture cf bird-headed demons

of uncertain historical value the most powerful of the successors of Sargon of Akkad, King Narâmsin (25th century B.C), fought a victorious battle against a coalition of 17 kings which included Pamba, king of Khatti (now Roghazkeui), *Zipani,* king of Kanesh (now Kara Euyuk and Kultepe near Caesarea), and *Khuvâruvash,* king of Amurru in Southern Syria. It is not certain whether it is permitted to infer from the name *Khuvâruvash,* of wholly Hittite character, that the invasion of Asia Minor, even of Syria, by the first Indo-Europeans, the Lûites (in part also the true Hittites?) took place as early as the first centuries of the third millennium B.C. Narbmsin had also to defend his empire against the attack of the *Ummân-Manda* "troops of peoples" which came from the North, and in which then, as later, are to be seen in the first line Indo-European, Aryan peoples. One of these peoples may have been the later Aryans of Khurri-Mitanni.

Further light on the most ancient history of Asia Minor is thrown by the old Assyrian (also called Cappadocian), cuneiform tablets of Kultepe-Kanesh, which date from the 21st century and which were discovered partly by the secret diggings of natives, and partly by the official excavations of Hrozný in 1925. The original stock of the population is Khatti; the native prince of Purushkhanda? (or Khatti) is called Labarsha, in an inscription found by Hrozný's expedition. This name is Khattish (cf. the later Khatti-Hittite royal name and kingly title *Labarna-Tabarna.*) Meanwhile the Assyrian empire had become very powerful; Eastern Asia Minor was subject to it. In the cities resided rich Assyrian merchants who were organized in *gâru*'s "Bazaars" and carried on a flourishing trade in the products of Asia Minor. The Indo-European Hittites had already invaded this territory as is shown by distinctly Indo-European names, such as *Inar* (cf. *ἀνήρ* "man"), also *Inarava, Khalkiashu* (cf. Indo-Eur.-Hittite khalkish "corn") and others. While the political centre of the Khatti was the city Khatti and the first Indo-Europeans, the Lûites, were concentrated in the South, in Arzava-Lûya, it may be that the Indo-European Hittites, at first (probably however after 2000 B.C.), had settled mainly around the cities Kanesh and Kushar. Inscriptions do not state that the city Kanesh was once also a political centre of the Indo-European Hittites. Probably the invasion of the Indo-European Hittites in the 20th century B.C. made an end of the Assyrian rule in Cappadocia. Eastern Asia Minor was subdivided again, as for example in the time of the kings of Akkad, into a number of small mutually hostile states, over which the Indo-European conquering people, called by us Hittites, now attempt to rule. One of the important rulers, of this time, the great king *Anittash,* of *Kushshar,* about the beginning of the 19th century B.C. vanquished *Pijushtish,* then king of the town Khatti (himself, possibly, also a Hittite), then the king of *Nêshash,* the king of the city *Zalpuva* (*Zalpa*), situated apparently somewhere in the coastal region, and rulers of *Purushkhanda* and *Shalativara.*

Some generations later, about 1800 B.C., there ruled in Kushshar the great conqueror *Tlabarnash,* whose name is written *Tabarnash* or Labarnash, and who extended his kingdom as far as to the sea. His successes are so great that his name and that of his wife, Tlabarnash and *Tavannannash,* were used as titles of honour by the later Hittite kings and queens. The kingdom, thus greatly enlarged, later on undertook military expeditions beyond Asia Minor. In Mesopotamia, Syria and South Armenia, in the first half of the second millennium B.C., the effect of the invasion of the East Indo-European peoples—of the Aryans of Khurri-Mitanni—becomes more evident. A series of Aryan-Khurrish states arose here: among which the most notable are Khanigalbat (=Khurri-Mitanni) in Mesopotamia and the great kingdom Khalap (now Aleppo) in Syria. The great king Khattushilish I., a son of Tlabarnash, who lived in Kushshar, but apparently also in Khattushash-Boghazkeui fought against Khalap successfully. His successor Murshilish I. who transferred the seat of the Hittite Dynasty to Khattushash, succeeded about the year 1758 B.C. in vanquishing not only Khalap and the Khurri, but even Babylon itself, and overthrew the Khammurabi dynasty in Babylonia. During the remainder of the 18th and the 17th–15th centuries B.C. the Hittites were engaged in internal disorders and external campaigns, especially against the Khurri. From the Syrian Khurri, who were strongly mingled with Khatti, Hittite and Semite elements, went out the people, known as the Hyksos, who took possession of Egypt about 1685 B.C. (The Hyksos names are probably partly of Semitic and partly of Syrian-Asianic origin. Only the name of the Hyksos king, *Khendder* or Khenddel, may be here mentioned, which is of linguistic interest as recalling the name of the Hittite king *Khantilish,* the successor of Murshilish I.) The great king *Telepinush* attempted, about 1600 B.C., to reorganize the shattered kingdom. The Hittite rulers of the 15th century B.C. may still be reckoned as belonging to the Old Empire, though the forerunners of the New one. *Tudkhalijash II.* succeeded in reuniting the kingdom and breaking the power of the confederate kingdoms of Khanigalbat (Khurri-Mitanni) and Khalap; but still some time after this, Khattushilish *II.* fought successfully against Khalap and Mitanni.

The New Empire which begins about 1385 B.C. with the brilliant Hittite king Shuppiluliumash, son of Tudkhalijesh *III.,* embraced the last two centuries of the Hittite kingdom. During this time the Khatti kingdom exercised the most profound influence on the destiny of the Near East. It may certainly be considered as, for some time, the first military and political power of the East at that epoch. The united Hittite kingdom sought to extend its sphere of influence in all directions, by means of wars, alliances and treaties with vassals, as well as by dynastic marriages. A powerful confederation of States came into existence, which, however, composed of very dissimilar elements, could not be of long duration. The resurrection of the Indo-European Hittite empire was facilitated by the decay of the Khurri kingdom, ruled over by an Aryan dominant class which took place in the 14th century B.C. The Khurri kingdom, Khanigalbat dissolved into two enemy states, Khurri and Mitanni (with the capital *Vashshugganni*), which we may seek perhaps in Râs el-Ain in North Mesopotamia; cf. Opitz in Zeitschr. *f. Assyr.* 1927, 299 et seq.), against which Shuppiluliumash was able to fight. The king Tushratta ruled in Mitanni at this time. Shuppiluliumash established his power almost over the whole of Syria, where he successfully checked the Egyptian influence. His armies advanced thence as far as the territory of Lebanon. He also subdued the people of Gashga between the Euphrates and the Halys, and by means of alliances and marriages, bound Khajasha on the Upper Euphrates and Arzava in southern Asia Minor to the Hittite empire, with which Kizvatna-Pontos was also very closely allied. After the death of the Pharaoh Bibkhururiash (=Tutankhamen?) his widow sought to marry one of the sons of Shuppiluliumash, but the Hittite prince was murdered by Egyptians on his way to Egypt. The political and military activities of the Hittite kingdom were conducted on the same lines with many vicissitudes, in the reign of the successors of Shuppiluliumash which however can not be described here in detail. His son and second successor *Murshilish II.* (about 1340 B.C.) belongs to the most enterprising and warlike rulers not only of the Hittite kingdom, but even of the ancient East as a whole. This great king also took special interest in Western Asia Minor, where he came into touch with the Greeks as Forrer was the first to point out, though his views as Friedrich specially has shown, are in many instances untenable. The city and the country Akhkhiyavd, which now appear in the Hittite inscriptions and which are there named together with *Lazpash,* perhaps = Lesbos, can be probably connected with Gr. Ἀχαιρᾶ and the Achaeans (*q.v.*), which are for the rest mentioned in an inscription of Pharaoh Menneptah (*c.* 1240 B.C.). It is, however, impossible (with Forrer) to seek this Akhkhiyavd in Greece. It is probably a country situated on the coast of Western Asia Minor near the island Lesbos. Further both on linguistic and real grounds, it is not possible to identify Tavagalavash, who at the time of Murshilish was perhaps a vassal of Akhkhiyavd, and who wished to become a vassal of the Hittites, with the mythical king Eteokles (Ἐτεϝοκλεϝης) of Orchomenos in Boeotia. To identify Antaravash, mentioned in an oracle text, which names also *Akhkhiyavâ* and Lazpash, with *Andreus,* the father of Eteokles of Orchomenos, is also very risky. Again, Forrer has failed to prove that the king *Attarishshijash* of Akhkhiyd (probably = Akhkhi-

yavâ), an opponent of the Hittite king *Tudkhaliyash IV.* (*cir.* 1240 B.C.) is the same as *Atreus,* king of Mycenae and father of Agamemnon. Forrer's opinion that the Hittite word *ajavalash* means Aeolian and that Troy might be recognized in Hittite inscriptions in the name Taruiska, which Forrer reads *Troisa,* which however should be read Tarvisha, is also erroneous.

At the present time we may reasonably admit only the existence of an Achaian state in Asia Minor, represented by Akhkhiyavd and Lazpa (probably not to be identified with Zalpa), and await further information from the future. (Kretschmer [Glotta 12] compares the king *Alakshandush* [*cir.* 1300 B.C.] of Vilusha-Elaiussa with the Homeric Alexandros-Paris.) On the relations between the Hittites and the Greeks, *see* also below the chapter on the Hittite myths.

Other powerful Hittite rulers of this age were the sons of *Murshîlish* II., *Muvattallish* (Muttallish) about 1300 B.C., who vanquished at Kadesh the Egyptian Pharaoh Rameses II. (see above), and *Khattushilish III.,* who concluded an alliance with the same Pharaoh about the year 1272 B.C. (See also above.) Tudkhalijash *IV.* (*cir.* 1240 B.C.), son of Khattushilish III., apparently still extended his kingdom westwards by successful wars. But already about the year 1190 B.C. under his second successor Tudkhalijash V., the Hittite kingdom fell under the attack of the so-called sea peoples and that of the Indo-European Thracians, Phrygians and Armenians, who followed in their train and forced their way into Asia Minor. Shortly before this the Mitanni kingdom was conquered by the Assyrians. Subsequently small Hittite-Khurrish states arose in Syria, such as Carchemish and Kunulua. Yet these too were gradually overthrown by the Assyrians; Carchemish itself fell under the attack of Sargon II. in 717 B.C.

HITTITE CIVILIZATION

Generalities. Law.—The cuneiform inscriptions of Boghazkeui show that Hittite civilization had reached a high level. In this civilization the cuneiform script and many other elements were borrowed from Babylon, yet the invention of a native hieroglyphic script, the rich and original Hittite cuneiform literature, the art monuments and other manifestations of Hittite culture, all prove that in spite of all borrowings, due to their comparatively late entry into the civilization of Asia, the Hittites are in no way inferior to the Babylonians and Egyptians.

In the state archives of Boghazkeui, there was found a series of so-called vocabularies, a kind of lexicon, with Sumerian in the first column, Babylonian in the second and Hittite in the third; tor example: Sumerian *gú* = Babylonian *rêshu* "head" = Hittite *khalanta* (cf. Latin *calva,* Armenian *xalam* "skull"). If we add Khattish, Lûish and Khurrish to these three languages, we perceive that there were writers and scholars in the Hittite kingdom, who were masters of six languages.

The historical literature of the Hittites is rich and varied. There exist extremely important State treaties of the great Hittite kings with their vassals, and other powers abroad, diplomatic correspondence; annals of the Hittite kings, their proclamations, which treat the problems of politics and administration (for instance: the succession of the throne, disputes between individual cities, etc.), deeds of royal gifts and so on.

The strict military and political organization of the new Hittite kingdom is clearly portrayed in these documents. The same picture of an administration, ordered and regulated to the smallest details, is presented to us by the preserved prescriptions for different palace and temple employes. A well organized kingdom must also have its code of laws. The Hittite code (published by Hrozný) in two parts, containing about 200 paragraphs, gives us a deep insight into Hittite justice. In regard to punishment it is much milder than that of Khammurabi, Assyria or the Israelites. Mutilations and the death penalty were only seldom imposed in the Hittite kingdom; the Hittite code was very indulgent to certain sexual crimes which throws a not very favourable light on the sexual morality of this nation. A longer section of the Hittite code of laws, regulating prices in the Hittite kingdom is in the economic regard very important. Partly from this, partly from other texts, we learn that the Hittites, like other nations of the ancient East, cultivated especially barley, *Triticum dicoccum* (a kind of spelt) and wheat; that they brewed beer from barley malt after the manner of the Babylonians, and that wine also played an important part among them. The whole economic position of the Hittite kingdom was founded on agriculture and the raising of cattle; beekeeping was zealously cultivated. Silver pieces, which were weighed according to the Babylonian system (*manû,* etc.) were used as circulating medium. In the domain of material civilization, the Babylonians were in many things the teachers of the Hittites who arrived in Asia much later than they.

The Hittite Pantheon.—The numerous religious texts in the archives of Boghazkeui familiarize us with the religion of the Hittites. The Hittite Pantheon, which is known also to us from the State treaties, where all possible gods, "a thousand gods" are summoned as witnesses and in support of the treaty, and which may be here assembled for the first time in its principal divinities, is very mixed. Sumerian-Babylonian, Assyrian, Khurrish, Indo-European-Hittite, Lûish and Indian elements are here bewilderingly blended together. The Weather god and the Sun goddess are the chief divinities. We do not know the names they bore in the proper Khatti territory; in the Khurrish-Mitannish country they were called *Teshup* and *Khepit* (Khepa). The weather gods of Nerig and *Zippalanda* are the sons of the weather god of Khattushash and the sun goddess of the city Arinna (= Euyuk [?]); this is also the case with the god of the fields, *Telepinush,* to whom can be traced back the hero *Telephos,* specially honoured in Mysia and Lycia; the goddess *Mezzullash* is daughter to this divine pair, the goddess *Zentukhîsh* or *Zindukhijash* is the grandchild. The exact position of the goddess Lelvanish in this family circle is uncertain. (By this analysis of the Hittite Pantheon the chief Hittite gods on the rock reliefs at Yasili-Kaya can now be successfully identified. From left to right they are: the Storm-god, Sun-goddess, Telepinush, *Mezzullash* and *Zentukhîsh* [or Lelvanish ?]. The hieroglyphs which accompany the names of these gods can be now adequately interpreted). The wife of Telepinush is called Khatepinush. The sacred bulls of the weather god of Khattushash are called Sherish and *Khurrish.* Of secondary origin in this circle is the goddess Khepit. The very important god of male virtues, *Inar* or *Inarash,* is certainly of Indo-European origin (of period Skt. NARA, Gr. ἀνήρ, "man"); according to a conjecture of Kretschmer he was borrowed by the early Indians (cf. Indara-Indra) from the Hittites. The Hittite god Indra, Indara, may be found—as may here be established for the first time—also in the Egyptian Rameses treaty in the form 'ntrtj which, according to Lexa, is probably the Egyptian word for "goddess," Coptic NTWPE. Apparently the Egyptians simply identified the name of the god Indara, which was unknown to them, with this Egyptian word. Possibly all the divinities of this kind are comprehended in the name *Innaravantash* (probably Plur.; Sing. *innaravanza,* Keilschr.-Urk. aus Bogh. 17, Nr. 20, 11.3), Lûish *Annarummenzi.* For the other Hittite deities, who are also adored by the Indians *Arunash* "Sea" (cf. Ind. *Varuna*) and Agnish (cf. Ind. Agni) see also above. Besides the "Great Sea" which also plays an important part in the Hittite myths, the Hittites worshipped also the Heavens, the Earth, mountains, rivers, wells, winds and clouds. A deity of field fruits is apparently Khalkish, sometimes named with Telepinush and probably of Indo-European origin. Another god who bears probably an Indo-European name, is Vashdulashshish whose name is derived from the Hittite *vashdul* = "transgression, sin." (Cf. Lat. vasto.)

Another Hittite divinity is the father of the gods, *Kumarpish,* who may have been borrowed from the Khurrish Kumarve, and who plays also an important part in the Hittite mythology. He is sometimes identified with the Babylonian Earth god *Enlil,* but is also worshipped beside him. His messenger is called *Mukishanush* (of Babylonian origin?). Related to the god *Inarash* are probably the gods *Âlash* (who must not be confounded with the goddess *Alâsh*), *Zitkharijash,* whose cult arose in the city *Zitkhara, Karzish,* Khapanfalijash or Khapatalijash, and perhaps also the god *Pirinkir* or Pirikar. According to a text the god *Inarash* was worshipped under no less than 112 forms. Others are the

deities *Birvash* (comp. the Syrian deity *Biruva,* Rawl. III. 66, Rev. I. 19), *Mâlijash,* "the mother" *Kamrushepash* or *Kammarushepash,* who appears in Hittite myths, and the goddess (or god?) *Ashkashepash.* The goddesses *Nenattash* or *Ninattash* and *Kulittash* may be regarded as connected to a certain degree with the goddesses *Ishtar* and *Ishkhara; Ninattash* is probably borrowed from the Sumerian-Babylonian goddess *Nina,* while again, *Kulittash* can be traced back to the Sumerian-Babylonian goddess *Gula,* the "great lady doctor"; instead of *Kulittash,* also *Gulittash* may be read. (Comp. the Syrian goddesses *Ninitum* and *Kulittum,* Rawl. III. 66, Rev. I, 27. 28.) Of great importance are the Hittite tutelar deities of the house and of the grave, *Kulshêsh* or *Kulashshêsh* and *MAḪ-nêsh.* From the first name are probably derived the names of the Etruscan deities *Culśanś,* who was the protector of the gates, and of *Culśu,* the goddess of the nether world. (For the relations of the Etruscans to the Hittites *see* Hrozný in *Zeitschrift für Assyriologie,* 1928.) To the Hittite tutelar deities belong also *Zukkish* (or *Zunkish*) and *Anzilish.* The following deities may also be named here: *Khullash, Jarrish, Zappanash* (*Zampanash, Zapnash*), *Khashammilish* or *Khashmilish, Khîlashshish, Târavash, Jajash, Pentarukhshish, Nârash* (originally a Babylonian river god?), *Namsharash* or *Napsharash* (of Sumerian-Babylonian origin? Comp. the Sumerian-Babylonian primeval gods *Ninshar, Enmeshara, Ninmeshara?*), *Minkish* or *Munkish, Ammu(n)kish, Tukhushish* or *Tushshish* (related to the Hittite word *antukhshish,* "man"?), *Ammezadush, Alalush* (of Sumerian-Babylonian origin), and *Apantum* (originally Babylonian??).

Other aboriginal Sumerian-Babylonian divinities in the Hittite Pantheon are: the Heaven god *Anush* and his wife *Antum,* the Earth god *Enlil* and his wife *Ninlil,* the Sea god *Êa* and his wife *Damkina* and his son *Marduk,* the Moon god *Sin* and his wife *Ningal, Nikkal,* the god of the underworld *Nergal* and his wife *Ereshkigal* or *Allatum,* the goddesses *Ishtar* and *Ishkhara,* the war god *Zababa,* and others. Many of the Babylonian divinities were included in the Hittite Pantheon only because the Hittite priests diligently studied the religious literature of the Babylonians: their existence in the realm of the Hittite gods, is therefore somewhat theoretical. On the other hand not a few of the Babylonian names of divinities in Hittite inscriptions may in reality be only ideograms, expressing the names of Hittite native gods. The influence of Babylonia upon the religion of the Hittites, though certainly great, may therefore have been much less than seems to be the case, on the first glance, on the basis of the graphical impression of the names of deities.

Among the numerous local Hittite gods whose names are of interest, the following may be mentioned: *Khantidashshush* of the city *Khurma, Katakhkhash,* also *Khatakhkhash* or *Khataggash* of *Ankuva,* the goddess *Shartijash,* the "queen" (Babylonian in origin; but *cf.* also Hittite *shardijash* "helper"?) of *Katapa, Mammash* or *Ammammash* of *Takhurpa, Khallarash* of *Dunna, Gazbâja* (Babylonian in origin?) and *Khuvashshannash* of *Khûbishna, Tapishuva* of *Ishkhupitta, Bîlat* or *Bêlti* (Babylonian) and *Kunijavannish* of *Lânda* (cf. *Laranda*), *Zashkhabûnâsh* or *Zakhabunash* or *Zakhbunash* of *Kashtama, Khâshigashnavanza* (comp. the name of the city *Khashshiḳḳashanavanta*) and *Mullijarash* of *Lavvazantija* (cf. *Lauzados*), the goddesses *Alâsh* of *Karakhna, Zûlimash* of *Shugazzija, Tashimish* of *Likhshina, Lushitish* of *Nenashsha, Shakhkhashsharash* of *Tuvanuva* (=Tyana), *Shuvanzipash* of *Shuvanzana, Navatijalash* of *Zarvisha, Vashkhalijash* of *Kharziuna, Zanduza* of *Shallapa, Ammamash of Khakhana, Katakhkhash* of *Tavinija, Karmakhish* of *Kalimuna, Karunash* of *Kariuna, Tamishshijash* of *Tabiḳḳa* (*cf.* the modern Dâbik in Syria), *Bishanukhish* of *Kumanni* (Comana) and *Apârash* of *Shamûkha* in the so-called "Upper Land."

Notice also these names of Hittite gods: *Kharishtashshish, Kattishkhapish* (Khattish), *Tashimmet* (Khattish? or comp. Babylonian *Tashmêtu?*), *Vašezzel* (Khattish), *Valizilish* or *Valizalish* (Khattish), *Teteshkhapish* (Khattish), *Shullinkattish* (Khattish), *Âpish, Aduntarish, Zulkish, Irbitigash, Karmakhilish, Zilibûrish, Negmish, Menkishurish, Zibarvâ* or *Zabarvâ* (in *Palâ*) etc.

The worship of the gods *Shantash* (cf. *Sandon*) and *Tarkhunza* (cf. *Tarku*) was characteristic of *Lûya-Arzava* especially; for *Annarumenzi.* In Arzava was also the deity *Ulilijashshish,* in the apparently Lûish city *Ishtanuva* or *Ashtanuva* among other divinities also *Shuvashunash, Vandush, Jashallashshish* or *Vashalla* worshipped. *Teshup* and *Khepit* (*Khepa*) were worshipped in Khurri-Mitanni. For the Aryan gods of these countries and for *Kumarve* see above. Among the other gods of these countries were the goddess *Shaushgash,* further *Shimegi, Êasharri* (Babylonian), *Shâlush* (Babylonian), *Lellûrish,* etc. The Pantheon of Shamûkha is also closely related. Hittite-Khattish, Lûish, Khurrish and Babylonian elements are mingled in the Pantheon of Kizvatna.

Hittite Mythology.—Among the numerous, though mostly badly preserved Hittite mythological texts, the first to be mentioned may be that of the disappearance of the offended god of vegetation *Telepinush,* who brings bad growth, sterility and famine in his train, and of his reappearance, which produces a new fruitfulness. The connection of this myth with the ancient oriental myths of Tammuz, Adonis, Attis, etc. is plainly evident. It is interesting, that the gods have *Telepinush* sought among others also by an eagle and even a bee. Another myth relates to the struggle between the weather god and the serpent *Illujankash,* and still another relates to the sea (?) serpent *Khedammush* (Sumerian-Babylonian? *cf. Khedimme-azag,* the daughter of the Ocean, resp. Êas) and the goddess *Ishtar.* Another myth, though not completely preserved, is that of the goddess *Ashertush,* identical with the west-Semitic goddess *Ashirtu-Ashera,* who attempts to seduce the weather god. On his refusal *Ashertush* contrives that the refusal should appear to be on her side; evidently a parallel to the Old Testament story of Potiphar's wife! The storm-god then betakes himself to *Elkunirshash,* husband of *Ashertush,* and relates what has happened. Another badly preserved myth is that related of *Gurpa-Aranzakhush,* probably king of a city *Ailanuva,* situated, evidently in Asia Minor, who married *Tatizulish,* the daughter of King *Impa-akrush* of *Accad* in Babylonia, and who resides at the court at *Accad,* and is there sought for by the river-god *Aranzakhash,* the personification of the water from the weather god's head. This myth may be a feeble reflection of some historical event. Another myth relates the story of a rich man, *Abbush* (is the name Babylonian?), who lives in the *Lulluvaja* country in the city of *Shudul,* situated on the sea-shore, to whom nothing is wanting (Heth. *vaḳḳari; cf.* Lat. *vaco!*) but a son and a daughter. In his trouble he seeks the help of the sun-goddess. *Abbush,* apparently, then has two sons, one good and one bad, who later on divide the paternal inheritance and separate; but this text also is very incompletely preserved.

In Hittite countries the Babylonian myth of *Gilgamesh* was much in favour. Fragments of the *Gilgamesh* Epos have been discovered in Boghazkeui, written in Babylonian, Hittite and Khurrish. There existed also indigenous adaptations of this grateful material, inasmuch as *Khuvavaish-Khumbaba* of the *Gilgamesh* Epos, who dwells in the cedar wood, appears to have belonged originally to Khurri-Syria. Not less than 15 (possibly still more) tablets in Khurrish existed of the "Songs of *Keshshesh,*" *i.e.,* of *Gilgamesh* (called in Khurrish also *Galgamishul*). The myth of *Gilgamesh* was related and songs of this hero were sung over the whole of Asia Minor. The Greeks of Asia Minor also were certainly familiar with the *Gilgamesh* epic, traces of which may be found in the Odyssey. It is not impossible that the name of Odysseus or Olysseus, Lat. Ulixes (as Gemser suggests in the Archiv f. Orientforschung III. 184) may be traced back to the Hittite name *Ullush* (from the Babylonian *Ullû, i.e.,* "carried away, distant") of the hero of the deluge story who dwelt apparently in the city *Idlash* (at the mouth of the rivers?). Khattish has a *tl*-sound, which is sometimes represented by *t,* at others by *l* (*see* above, the king's name *Tlabarnash*).

Religious Worship, Exorcisms, Omens.—We can learn much concerning the Hittite forms of worship, sacrifices, religious festivals, etc., from the archives of Boghazkeui. Rituals for various temple feasts and other occasions of the public and private

life, which request the intervention of the priest, recorded by priests and priestesses who are named by their names, have been preserved. Purifications, sacrifices, prayers and oaths are the chief features of Hittite worship, whereby many connections with and borrowings from Babylonia can be established. Illnesses and epidemics, famines, evil demons, domestic quarrels, etc., are banished from believers by the exorcists and sacrificial priests. Before every considerable undertaking the future and the will of the gods were ascertained by consulting them; the liver of the sacrificial animals was examined; the flight of birds was observed, a prophetess was questioned, etc. Here the influence of Babylon is unmistakable. Clay models of livers used in hepatoscopy have been discovered in Boghazkeui, bearing Hittite or Babylonian inscriptions. The will of the gods was also revealed to men by appearances in the heavens, and all kinds of unusual occurrences on earth. All these signs and omens were interpreted by competent priests. The manuals used by these priests in the interpretation of omens are mostly of Babylonian origin. The Babylonian influence and origin are disclosed by the astronomical-astrological inscriptions of the Hittites, and by their medical treatises, written in both Hittite and Babylonian, which have been discovered at Boghazkeui. Here it may be remarked that also deeds of landed property and clay tablet catalogues have been found in Boghazkeui.

Hittite Art.—It is certain that, like the script documents, the artistic monuments, generally attributed to the Hittites, which have been discovered in the country between Smyma and Tell Halaf on Khabur in Mesopotamia, are the work of not one, but of the several peoples described above. In the West the monuments are essentially Khatti-Hittite, in the East, Khurri-Mitanni; in Syria both spheres met and later on also Aramaic influence can be stated there.

In the first centuries of the first millennium B.C. Assyrian influence was felt in the East, while late Assyrian art was not a little influenced by the Hittite-Khurrish. That this Hittite-Khurrish art in its beginning was dependent to a wide extent on Sumerian-Babylonian art, is obvious. Egyptian influence was added in the second millennium B.C. But in spite of all these external influences, Hittite-Khurrish art has its independent nature, which is of value for the history of art. Hittite-Khurrish artistic remains can never be confused with those of either Egypt or Babylonia.

If Hittite-Khurrish monuments give a more naïve and awkward impression than either the Egyptian or Babylonian, this can be explained chiefly by the relatively short duration of Hittite-Khurrish civilization, which rendered impossible the attainment of a higher perfection. Hittite art motifs are also found in Greek art.

The application of whole series of reliefs to gates, accesses and bases of palace walls, as well as the use of wooden columns on stone bases are characteristic of Hittite-Khurrite building and architecture.

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HITTORF, JOHANN WILHELM (1824–1914), German physicist, best known for his work on the migration of ions during electrolysis, was born at Bonn on March 27, 1824. He studied at Bonn and Berlin, and became Privatdozent (official but unpaid lecturer) in the academy of Munster. When this institution became the University of Miinster, Hittorf became professor of physics and chemistry; in 1879 the physics and chemistry departments were separated, and he became director of the physical laboratories. Hittorf retained this post until 1889 when he had to resign because of ill-health. After a rest his health improved, and he continued his research work. He died at Miinster on Nov. 28, 1914.

Hittorf's early investigations were on the allotropy of selenium and phosphorus. His most important work on ion migration during electrolysis appeared in the *Annalen* der *Physik* between 1853 and 1859. He investigated the changes in concentration in the electrolyte and from this worked out the "transport numbers" for the migrating ions. With his teacher Plucker, Hittorf made investigations on the spectra of gases and vapours. He made a number of investigations on the passage of electricity through gases, he discovered a number of properties of cathode rays and observed the Crookes dark space. Other investigations were on the passivity of metals.

HITTORFF, JACQUES IGNACE (1792–1867), French architect and archaeologist, was born at Cologne on Aug. 20, 1792, and died in Paris on March 25, 1867. After apprenticeship to a mason in Cologne, he went in 1810 to Paris to study at the Academy of Fine Arts under Bélanger, the government architect, whom Hittorff succeeded in his post in 1818. Thereafter he designed many important buildings. both public and private, in Paris and the south of France. His principal work is the basilica of St. Vincent de Paul (1830–44). His books are. *Architecture antique de la Sicile* (1826–30 and 1866–67); *Architecture moderne* de *la Sicile* (1826–35); *Architecture polychrome chez les Grecs* (1830): *Restitution du temple d'Empédocle à Sélinunte* (1851).

HITZIG, FERDINAND (1807–1875), German biblical critic. was born on June 23, 1807, at Hauingen, Baden, and studied theology at Heidelberg, Halle and Göttingen. Returning to Heidelberg he became *Privatdozent* in theology in 1829, and in 1831 published his *Begriff der Kritik am Alten Testamente praktisch erortert*, in which he explained the critical principles of the grammatico-historical school. and his *Des Propheten Jonas Orakel über Moab*, an exposition of chapters 15 and 16 of Isaiah attributed by him to the prophet Jonah mentioned in 2 Kings xiv. 25. In 1833 he went to Ziirich as professor of theology. and in 1861 to Heidelberg, where he died on June 22, 1875. As a Hebrew philologist Hitzig holds high rank; and as a constructive critic he is remarkable for acuteness and sagacity. As a historian, a number of his speculations have been considered fanciful.

His chief works include commentaries on Isaiah (1833), on the Psalms (1835, 2nd ed, 1863–65); on the minor prophets (1838, 3rd ed, 1863). on Jeremiah (1841, 2nd ed., 1866); archaeological monographs, the *Gesch. des Volkes Israel* (1869), *Zur Kritik paulinischer Brirfe* (1870) and *Sprache u. Sprachen Assyriens* (1871).

HIUNG-NU, HIONG-NU, HEUNG-NU, a people who about the end of the 3rd century B.C. formed, according to Chinese records, a powerful empire from the Great Wall of China to the Caspian. A theory which seems plausible is that which assumes them to have been a heterogeneous collection of Mongol, Tungus, Turki and perhaps even Finnish hordes under a Mongol military caste. though the Mongolo-Tungus element probably predominated. Toward the close of the 1st century of the Christian era the Hiung-nu empire broke up. Their subsequent history is obscure. De Guiques suggests that they were the ancestors of the Huns, and many ethnologists hold that the Hiung-nu were the ancestors of the modern Turks.

HIVES (URTICARIA, NETTLERASH) is a common skin eruption consisting of transitory, circumscribed swellings known as wheals (urticas) which vary from about one centimetre in diameter to very large areas. They are surrounded by redness, last from one to many hours and leave no visible skin changes.

Localized whealing in the skin is produced by certain chemical and physical stimuli. Some of these obligatorily produce a wheal at the site of introduction in every person's skin (*e.g.*, products of nettles and insects; histamine, morphine, etc.). Allergens elicit wheals only in the skin of persons who have become allergically sensitized to them.

In the common variety of hives wheals appear spontaneously in many body areas, usually without any relationship to the site of introduction of the stimulus. They may last from a few hours or days (acute urticaria) to many weeks, months or even years (chronic urticaria). They are often caused by drugs (*e.g.*, penicillin, aspirin) and foods (*e.g.*, shellfish, strawberries) and less frequently by infectious microorganisms, intestinal parasites, inhalants and body-own products. Other manifestations of hives may be swelling of the mucous membranes of the mouth and throat and in the joints and internal organs. Large swellings of the hands, lips, eyelids, etc. (angioneurotic edema) result from involvement of the deeper skin tissue. Cholinogenic urticaria, an uncommon variety of hives, consisting of many minute wheals with large surrounding red zones, is elicited by heat and physical and emotional stress. Hives engendered by contact allergens (*e.g.*, wool, silk) and physical agents (light, cold, trauma) usually remain localized to the site of exposure to the causal agent and last only for a few hours.

The cause of acute hives often can be ascertained from the history and observation of the clinical course, but the cause of chronic hives is found by this method in only a small percentage of cases. Skin tests are generally of no value in finding causal agents in acute or chronic cases Treatment consists of avoiding and eliminating causal factors whenever possible, plus administration of ephinephrine, antihistamines or cortisone type drugs which often help to suppress the lesions of hives.

See also ALLERGY AND ANAPHYLAXIS. (R. L. BR.)

HJÖRRING, an ancient town of Denmark, in the northern insular part of the peninsula of Jutland. Pop. (1955) 14,591. It lies 7 mi. inland from Jammer bay, a stretch of coast notoriously dangerous to shipping. The church of St. Catherine dates from 1300, St. Hans from 1600 and St. Olai from 1200. The principal products include textiles, bricks, tiles and tobacco.

HO, the administrative centre of the Volta region of Ghana and of the Ho district council, is situated 45 mi. N.E. of Akuse on the Volta river. Pop. (1948) 5,852.

The town is surrounded by hilly country, mainly forest to the north and savannah to the south. The people, the majority of whom are of the Ewe tribe, are for the most part engaged in farming, trade and government service. It is an important market centre, mainly for agricultural produce, fish and meat. Palm oil, cotton and cacao are produced. Apart from government offices, the principal buildings are Mawuli secondary school and the sports stadium. Ho is the centre of a network of roads. which link it with Accra, all parts of the Volta region and with the Republic of Togo. The divisional chief of Ho, whose authority also extends over the area to the east of the town, has his seat in Dome. a subdivision of Ho. (A. H. B.)

HOADLY, BENJAMIN (1676–1761), an English bishop, who was born at Westerham. Kent. on the 14th of November, 1676. In 1691 he entered Catharine Hall. Cambridge, where he graduated M.A. and was for two years tutor. after which he held from 1701 to 1711 the lectureship of St. Mildred in the Poultry, and along with it from 1704 the rectory of St. Peter-le-Poor, London. His first important appearance as a controversialist was against Edmund Calamy "the younger" in reference to conformity (1703–1707), and after this he came into conflict with Francis Atterbury, first on the interpretation of certain texts and then on the whole Anglican doctrine of non-resistance. His principal treatises advocating civil and religious liberty were the *.Measures of Submission to the Civil Magistrate* and *The Origin and Institution of Civil Government discussed.* In 1710 he was presented by a private patron to the rectory of Streatham in Surrey. In 1715 he was appointed chaplain to the king, and the same year he obtained the bishopric of Bangor. He held the see for six years, but never visited the diocese. In 1716, in reply to George Hickes (*q v*), he published a *Preservative against the Principles and Practices of Nonjurors in Church and State*, and in the following year preached before the king his famous sermon on the text, "My Kingdom is not of this tvorld," in which he maintained that Christ had not delegated his powers to any ecclesiastical authorities. The sermon was immediately published by royal command. The bishops at once resolved to proceed against him in convocation. The king therefore prorogued the assembly. a step which had vital consequences on the history of the Church of England. since from that period Convocation ceased to transact business of a more than formal nature.

As Convocation was thus debarred from taking action against Hoadly, the dispute took the form of a war of pamphlets known as the Bangorian Controversy, in which the main issues of the dispute were concealed almost beyond the possibility of discovery. But however vague and uncertain might be the meaning of Hoadly in regard to some of the questions around which he aroused discussion, he was explicit in denying the power of the Church over the conscience, and its right to determine the conditions of grace. His own most important contribution to the controversy was his *Reply to Representation of Convocation.* William Law was his ablest opponent; others were Andrew Snape, provost of Eton. and Thomas Sherlock, dean of Chichester. In July 1717 as many as seventy-four "Bangorian" tracts appeared. Hoadly, heing not unskilled in the art of flattery, was translated

in 1721 to the see of Hereford, in 1723 to Salisbury and in 1734 to Winchester. He died at his palace at Chelsea on April 17, 1761. His controversial writings are vigorous if prolix and his theological essays have little merit.

The works of Benjamin Hoadly were collected and published by his son John in 3 vols. (1773). To the first volume was prefixed the article "Hoadly" from the supplement to the *Biographia Britannica.* *See* also *L.* Stephen, *English Thought in the 18th Century.*

HOAR, SAMUEL (1778–1856), American lawyer, was born in Lincoln (Mass.), on May 18, 1778. He graduated at Harvard in 1802, was admitted to the Massachusetts bar in 1805, and began practice at Concord. His success was immediate, and for half a century he was one of the leading lawyers of Massachusetts. He was in early life a Federalist, later an ardent Whig. He was a member of the State Senate in 1825, 1832, and 1833 and of the U.S. House of Representatives in 1835–37, during which time he made a notable speech in favour of the constitutional right of Congress to abolish slavery in the District of Columbia.

In November 1844 he went to Charleston (S.C.) to test in the courts of South Carolina the constitutionality of the State law which provided that "it shall not be lawful for any free negro, or person of colour, to come into this State on board any vessel, as a cook, steward, or mariner, or in any other employment," and that such free negroes should be seized and locked up until the vessels on which they had come were ready for sea, when they should be returned to such vessels. His visit aroused great excitement; he was threatened with personal injury; the State legislature passed resolutions calling for his expulsion, and he was compelled to leave early in December. In 1848 he was prominent in the Free Soil movement and assisted in the organization of the Republican Party. In 1850 he served in the Massachusetts house of representatives. He died at Concord (Mass.), on Nov. 2, 1856.

See a memoir by his son, G. F. Hoar, in *Memorial Biographies of the New England Historic Genealogical Society,* vol. iii. (1883); the estimate by R. W. Emerson in *Lectures and Biographical Sketches* (1903); and "Samuel Hoar's Expulsion from Charleston," Old *South Leaflets,* vol. vi. No. 140.

His son, EBENEZER ROCKWOOD HOAR (1816–1895), was born at Concord (Mass.), on Feb. 21, 1816. He graduated at Harvard in 1835 and at the Harvard Law school in 1839, and was admitted to the Massachusetts bar in 1840. From 1849 to 1855 he was a judge of the Massachusetts court of common pleas, from 1859 to 1869 a judge of the State supreme court, and in 1869–70 as attorney-general in the cabinet of President Grant, fought unmerited "machine" appointments to offices in the civil service until, at the pressure of the "machine," Grant asked for his resignation. In 1871 he was a member of the joint high commission which drew up the Treaty of Washington. In 1872 he was a presidential elector on the Republican ticket, and in 1873–75 was a representative in Congress. He died at Concord on Jan. 31, 1895.

Another son, GEORGE FRISBIE HOAR (1826–1904), was born in Concord (Mass.), on Aug. 29, 1826. He graduated at Harvard in 1846 and at the Harvard Law school in 1849. He settled in the practice of law in Worcester (Mass.), and became a partner of Emory Washburn (1800–77). In 1852 he was elected as a Free Soiler to the Massachusetts house of representatives, and subsequently thereto became the leader of his party. He was active in the organization of the Republican Party in Massachusetts and in 1857 was elected to the State Senate. During 1856–57 he worked for the Free State cause in Kansas. He was a member of the U.S. House of Representatives, 1869–77. A defender of the Freedman's Bureau, he took a leading part in later reconstruction legislation and in the investigation of the Crédit Mobilier scandal, and in 1876 was one of the House managers of the impeachment of Gen. W. W. Belknap, Grant's secretary for war.

In 1877 he was a member of the electoral commission which settled the disputed Hayes-Tilden election. From 1877 until his death he was a leader of the Republican Party in the U.S. Senate. From 1882 until his death he sat on the important judiciary committee, of which he was chairman in 1891–93 and in 1895–1904.

His most important piece of legislation was the Presidential Succession Act of 1886. He was a delegate to every Republican national convention from 1876 to 1904 and presided over that at Chicago in 1880. He was a Conservative, and although he did not leave his party he disagreed with its policy in regard to the Philippines and spoke and voted against the ratification of the Spanish treaty.

He died at Worcester, Mass., on Sept. 30, 1904. A memorial statue has been erected there.

See his *Recollections of Seventy Years* (1903).

HOARFROST is ice deposited when the water vapour in the atmosphere solidifies without passing through the liquid state. It has a crystalline appearance, and takes a variety of interesting forms which are particularly striking on windowpanes. Hoarfrost is a hydrometeor (*q.v.*). See FROST.

HOATZIN, a tropical South American bird, *Opisthocomus hoazin,* remarkable for the keel, only developed on the posterior part of the sternum, and for a very capacious crop resembling a gizzard. It constitutes the family Opisthocomidae and suborder Opisthocomi in the order Galliformes.

Appearing about the size of a small pheasant, though actually much smaller, the hoatzin has a strong, curiously denticulated beak; prominent eyelashes set in a bare space round the eye; a long pendant crest of yellow feathers; and an olive body above, varied with white; below it is dull bay. The wings are short, the tail long and tipped with yellow. The legs are short, the claws long.

The hoatzin lives in bands, feeding on leaves and fruits. Because of its strong smell, it is called the "stinkbird" in British Guiana. The nest is built of sticks in a tree and contains three or four yellowish-white eggs, blotched with red. The young have well-developed claws on the first and second fingers of the wing, with which they can climb; they can also swim.

See H. W. Bates, *Naturalist on the River Amazon* (1910); C. W. Beebe, *Naturalist in Guiana.*

HOBART, GARRET AUGUSTUS (1844–1899), vice-president of the United States 1897–99, was born at Long Branch, N.J., on June 3, 1844. He graduated at Rutgers college in 1863, was admitted to the bar in 1869, practised law at Paterson, N.J., and rose to prominence in the state. He was long conspicuous in the state republican organization. was chairman of the N.J. state republican committee from 1880–90, became a member in 1884 of the Republican National committee, and was the delegate-at-large from New Jersey to five successive Republican national nominating conventions. He served in the N.J. assembly in 1873–74, and in the N.J. senate in 1877–82, and was speaker of the assembly in 1874 and president of the senate in 1881 and 1882. He was also prominent in business. He accepted the nomination as vice-president in 1896 on the ticket with President McKinley, and was elected; but while still in office he died at Paterson, N.J., on Nov. 21, 1899.

See the *Life* (1910) by David Magie.

HOBART, the capital of Tasmania. Pop. (1954), 54,887, including suburbs, 95,206. It was founded in 1804, taking its name from Lord Hobart. then Great Britain's secretary of state for the colonies. It was proclaimed a city in 1842, and the first municipal council was established by an act passed in 1852. Situated on the Derwent river about 12 mi. from the sea, it occupies a site of extreme beauty. standing on a series of low hills at the foot of Mt Wellington (4,166 ft.) which is snow clad for part of the year. The harbour is easy of access, well sheltered and deep. with wharf accommodation for the largest vessels afloat. It is the seat of the Anglican bishop of Tasmania and the Roman Catholic archbishop of Hobart. It is connected with its eastern suburbs by a floating concrete bridge. The great development in recent years owes much to the hydroelectric power generated in the central highlands Hobart is the centre of a large fruit-growing and mixed farming district and the Derwent valley produces 90% of the hops grown in Australia. The only mills in the world manufacturing newsprint from Australian hardwoods are at Boyer. At Risdon are large works for zinc smelting and associated industries, at Electrona calcium carbide is produced on a large scale, while at Claremont are factories producing cocoa, chocolate and confectionery Other industries are jam making and fruit processing. flour milling, motor and omnibus body building, tanning, manufacture of furni-

ture, joinery, ale, beer and cordials. As a contrast with fine hospitals and other modern buildings many of the churches, public schools and other older buildings possess an old-fashioned charm. Among them may be mentioned the houses of parliament; government house; the treasury buildings; St. David's cathedral; the town hall, of Tasmanian freestone; the museum and art gallery; the general post office, with its clock tower and chimes; the University of Tasmania, established in 1890. Among the parks are Queen's Domain, Mt. Wellington park and Knocklofty reserve. Franklin square. named after the explorer and former governor, Sir John Franklin, St. David's park and Long Beach reserve. The Royal Hobart regatta caters for all classes of aquatic competition and is probably unique. (H. J. R. C.)

HOBART PASHA, AUGUSTUS CHARLES HOBART-HAMPDEN (1822–1886), English naval captain and Turkish admiral, 3rd son of the 6th earl of Buckinghamshire, was born in Leicestershire on April 1, 1822. He entered the navy in 1835, and served with distinction until 1862. when he retired with the rank of post-captain. His first engagement was against slave traders off Brazil in 1835. During the American Civil War, he took command of a blockade-runner. He ran the blockade 18 times, conveying war material to Charleston and returning with a cargo of cotton. In 1867 Hobart entered the Turkish service, and was immediately nominated to the command of the fleet. with the rank of "Bahrie Limassi" (rear-admiral). He helped to suppress the insurrection in Crete, and was rewarded by the Sultan with the title of Pasha (1869).

In 1874 Hobart. whose name had, on representations made by Greece. been removed from the British Navy list, was reinstated; his restoration did not. however, last long, for on the outbreak of the Russo-Turkish War he again entered Turkish service. In command of the Turkish squadron he completely dominated the Black sea, blockading the ports of south Russia and the mouths of the Danube. and paralysing the action of the Russian fleet. In 1881 he was appointed Mushir, or marshal, being the first Christian to hold that office.

He died at Milan on June 19, 1886.

See his *Sketches of My* Life (1886), which must, however, be used with caution, since it contains many proved inaccuracies.

HOBBEMA, MEINDERT (1638–1709), one of the foremost Dutch landscape painters of his day. was born at Amsterdam on Oct. 31. 1633. lived there all his life and died there on Dec. 7. 1709. He was a friend, and probably pupil! of Jacob van Ruisdael. The two made sketching tours together and often painted the same views. Thus Ruisdael's "Water Mill" at Amsterdam and Hobbema's "Water Mill" in Washington, D.C.; Ruisdael's "Ruins of the Castle of Brederode," formerly in the Northbrook collection. and Hobbema's on the same subject in the Wallace collection. London, and Frick collection, New York. These were painted from 1661 to 1663.

In Oct. 1668 Hobbema married the cook of the burgomaster of Amsterdam. This marriage marked the end of his artistic career. for through the position and influence of his wife he received a municipal appointment.

He was. however, not able to amass a fortune, for when his wife died in 1704 she was buried as a pauper, and Hobbema was buried in Dec. 1709 in the pauper section of the Westerkerk cemetery at Amsterdam.

Unlike Ruisdael. who liked to paint the sea, the mountain torrent and rocky landscape. Hobbema's favourite motif is the countryside. thickly studded with trees, houses, churches and ruined castles. A peaceful stream with a water mill may enliven the scene, as in "Landscape With Water Mill" (Institute of Art. Minneapolis. Minn.).

His masterpiece is "The Avenue. Middelharnis," in the National gallery. London. "The Avenue" is unique in style among Hobbema's works, and its fine composition bears no resemblance to the somewhat tame and repetitive designs he produced earlier. Hobbema's other masterpieces were painted between 1663 and 1669. Among them are "a wooded landscape with two cows," in which the cons are painted by Adrian van de Velde. "The Mill" is in the Louvre. and there are examples in most European galleries and in many private collections. From 180 to 200 works by the master are extant. (R. E. W. J.; X.)

HOBBES, THOMAS (1588–1679), English philosopher, perhaps the greatest political thinker of his nation, was born at Westport (now part of Malmesbury), Wiltshire, on April 5, 1588, the second son of Thomas Hobbes, vicar of Westport and Charlton. Reports of the Spanish Armada were filling England with alarm at the time of his birth, and Hobbes afterward attributed his own love of peace to the fact that fear and he were twins. His father was "a choleric man": in Hobbes's early years he caused a scandal by engaging in a brawl at the church door, and disappeared, leaving his three children to be brought up by his brother, a well-to-do glover in Malmesbury. At the age of four Hobbes was sent to the church school at Westport; then to a private school kept by Robert Latimer; and finally, at 15, to Magdalen hall, Oxford. He took little interest in the scholastic philosophy taught there and devoted most of his time to books of travel and the study of maps and charts.

Studies and Travels, 1608–36.—On graduating (Feb. 5, 1608), Hobbes became private tutor to William Cavendish, afterward 2nd earl of Devonshire. and began a connection with the Cavendish family which lasted, with interruptions during the Great Rebellion, until the end of his life. He grew very fond of his pupil. who was only a little younger than himself, and in 1610 accompanied him on a tour in Europe. Finding that the philosophy taught at Oxford was held in contempt there. he determined to make himself a scholar and. on his return to England, devoted himself to classical studies. At some time between 1621 and 162 j he came into contact with Francis Bacon: John Aubrey relates that he occasionally acted as Bacon's amanuensis and helped him to render a few of his *Essays* into Latin. But the chief fruit of Hobbes's classical studies was his translation of Thucydides *(English Works,* viii–ix). Its publication in 1629 was inspired by the troubles of the time, for Hobbes saw in the fate of ancient Athens a salutary warning against democracy.

After the death of the 2nd earl of Devonshire (1628) Hobbes remained for a short time in the Cavendish household, but in 1629 he went abroad again as traveling companion to the son of Sir Gervase Clifton. In 1630 he was recalled from Paris to teach the young earl of Devonshire. William Cavendish (1617–84), son of his late patron. He took his pupil to France and Italy in 1634. These last two excursions stimulated Hobbes's interest in science and philosophy by bringing him into contact with the leaders of the new thought in Europe. The turning point in his intellectual history, his discovery of geometry, is described by Aubrey as follows: "Being in a gentleman's library in . . . , Euclid's *Elements* lay open, and 'tmas the 47 El. libri I. He read the proposition. 'By G—', said he (he would now and then swear by way of emphasis). 'this is impossible!' So he reads the demonstration of it. which referred him back to such a proposition; which proposition he read. That referred him back to another. which he also read. *Et sic deinceps,* that at last he was demonstratively convinced of that truth. This made him in love with geometry." In his prose autobiography *(Latin Works,* i) Hobbes himself relates how he was in a gathering of learned men when the question was asked. "What is sense?" On consideration it occurred to him that if material things and all their parts were always at rest or in uniform motion there could be no distinction of anything and consequently no perception, and he concluded that the cause of all things must be sought in diversity of motion. He was therefore driven to geometry to gain insight into the principles of motion. Hobbes's awakening to physical science seems to have taken place during his second European journey in 1629–30; on his third journey the new interest became an overpowering passion, and he was able to discuss his ideas with Marin Nersenne's circle in Paris and with Galileo. whom he visited at Florence in 1636. He now determined to embody his doctrines in a philosophical trilogy: *De corpore* was to show that physical phenomena were explicable in terms of motion; De *homine* was to show what specific bodily motions were involved in human cognition and appetition; and *De cive* was to expound the proper organization of men in society.

Political Interests, 1637–40.—But when Hobbes returned

home in **1637** he was quickly diverted from abstract speculation about body and motion. Finding the peace of his native land endangered by attacks on the royal prerogative, he set to work to prove that the powers and rights called in question were inseparably annexed to sovereignty, which at that time was admitted to reside in the king; and by **1640** his treatise on *The Elements of Law, Natural and Politic* was being circulated in manuscript.

It already embodies Hobbes's characteristic doctrine that social peace requires the existence of an absolute and undivided sovereign power *(see* ABSOLUTISM, **POLITICAL)**; but it differs from his *Leviathan (see* below) by stressing that primary democracy is the first form of commonwealth by institution, monarchy and aristocracy arising when the democratic sovereign created by the social contract between individuals annihilates itself by transferring its power absolutely to one man or a few. Hobbes's views antagonized both parties in the constitutional struggle: the believers in the divine right of kings were irritated by his attempt to base sovereignty on a social contract, the parliamentarians by his advocacy of absolute monarchy.

Exile in **Paris,** 1640–51.—When strife became acute in **1640** with the impeachment of the earl of Strafford and of Archbishop Laud, Hobbes thought he was a marked man and fled to Paris. Probably his fears were exaggerated. In any case the next 11 years were spent in exile, chiefly in Paris, where he was soon in contact with later fugitives from England. He rejoined the Mersenne circle. and Mersenne showed him the unpublished *Meditations* of Descartes. Hobbes put in writing certain objections to the *Meditations* and also to the *Dioptrique (Latin Works,* v); but the self-confident dogmatism of these communications exasperated Descartes, who finally refused to have anything more to do with "the Englishman." In **1642** *De cive (Latin Works,* ii) appeared at Paris, but so few copies were issued that according to Pierre Gassendi they excited rather than satisfied thirst. This work expanded the argument of the second part of *The Elements of Law* and concluded with a section on religion which dealt more fully than the earlier treatise with the relation between church and state. A Christian church and a Christian state were one and the same body; of that body the sovereign was the head; the sovereign had therefore the right to interpret Scripture, to decide religious disputes and to determine the form of public rvorship. Such, in brief, was Hobbes's remedy for the sectarian controversies then disrupting the peace of so many European states.

Having published the third part of his trilogy first in the hope of averting civil war, Hobbes spent the next four years working on *De corpore;* but in **1646** the young prince of Wales, later to become Charles II, sought refuge in Paris, and Hobbes accepted an invitation to instruct him in mathematics. Contact with exiles from England made it increasingly difficult to concentrate on natural philosophy, and he turned once more to political theory. In 1647 a second edition of *De cive,* augmented by explanatory notes and a "Preface to the Reader," appeared at Amsterdam. In **1650** the manuscript of *The Elements of Law* was published as two separate works, the first entitled *Human Nature,* the second *De corpore politico (English Works,* iv).

In 1651 there appeared an English version of *De cive (English Works,* ii); and this was followed in the same year by Hobbes's masterpiece, *Leviathan, or the Matter, Form, and Power of a Commonwealth, Ecclesiastical and Civil (English Works,* iii). In the first two parts, "Of Man" and "Of Commonwealth," he re-covered the ground already traversed in the earlier treatises; in the last two, "Of a Christian Commonwealth" and "Of the Kingdom of Darkness," he embarked upon a discussion of Scripture and made a vigorous attack on the attempts of papists and presbyterian~to challenge the right of the sovereign.

By 1651 Charles I was dead and the royalist cause seemed hopelessly lost; accordingly, in the "Review and Conclusion" at the end of *Leviathan* Hobbes attempted to define the circumstances under which submission to a new sovereign became legitimate. He had always maintained that a subject had the right to abandon a ruler who could no longer protect him and to transfer his allegiance to one who could; but the statement of this view in his "Review and Conclusion" naturally gave serious offense to Prince Charles's advisers, who concluded that Hobbes was trying to curry favour with the new regime in England in order to facilitate his own return. So little was Hobbes himself conscious of any disloyalty that he presented the prince, newly returned to Paris after the defeat at Worcester, with a manuscript copy of *Leviathan,* "engrossed in vellum in a marvellous fair hand" (probably the copy in the British museum, *Egerton Mss. 1910).* Barred from the exiled court and suspected by the French authorities for his attack on the papacy, Hobbes found his position in Paris becoming daily more intolerable and, at the end of **1651,** returned to England. His patron, the earl of Devonshire, had submitted to parliament in **1646** to save the family estates, and now Hobbes too made his peace with the new regime. Instead of joining his patron in the country he settled in London, where he could enjoy the society of men like William Harvey and John Selden.

Later Life and Controversies.—Hobbes was now 63 years of age, but was to retain his vigour for another quarter of a century. For a time he worked quietly on *De corpore,* but in 1654 he became involved in one of the controversies which were to play so large a part in his later life. In **1646** he had discussed the problem of free will with John Bramhall, bishop of Londonderry, at the house of the marquis of Newcastle in Paris. After the discussion Bramhall had put his arguments in writing and sent them to Newcastle; Hobbes had replied; Bramhall had made a rejoinder; and the controversy had then closed. Since Hobbes had requested Newcastle to keep his contribution private the whole correspondence had remained unpublished. But one of the philosopher's admirers had seen and made a copy of Hobbes's answer; and this he now published, without Hobbes's knowledge, under the title *Of Liberty and Necessity (English Works,* iv). The publication of this work, under Hobbes's name and with an offensive prefatory epistle, incensed Bramhall, who in 1655 proceeded to issue the whole correspondence, including his own replies to Hobbes, in a work entitled *A Defence of True Liberty From Antecedent and Extrinsical Necessity.* In the following year Hobbes retorted with *The Questions Concerning Liberty, Necessity, and Chance (English Works,* v), where he reprinted the correspondence with animadversions on the bishop's replies. In **1658** Bramhall returned to the fray with *Castigations of Mr. Hobbes His Last Animadversions,* which contained for good measure an appendix entitled *The Catching of Leviathan or the Great Whale.* Hobbes took no notice of the *Castigations;* but to the charge of atheism made in *The Catching of Leviathan* he replied ten years later in a work which was not published until **1682,** some three years after his death *(English Works,* iv).

Hobbes's argument with Bramhall over free will is still interesting and important; but the same cannot be said of the other controversy which occupied Hobbes's later years. He had made enemies at Oxford by the publication of *Leviathan,* which attacked the university system as being founded originally for the support of the papal against the civil authority and as still working social mischief by adherence to the old learning. Oxford was therefore quick to avail itself of the opportunities for criticism offered by *De corpore (Latin Works,* i), which was published at last in **1655.** Hobbes's main antagonists were Seth Ward. Savilian professor of astronomy, and John Wallis, author of the great treatise *Arithmetica infinitorum,* both of them much abler mathematicians than Hobbes. He replied to their attacks in Six *Lessons to the Professors of Mathematics in the University of Oxford (English Works,* vii), which appeared in **1656** as an appendix to the English translation of *De corpore (English Works,* i). After more rough thrusts on both sides Hobbes retired to complete his *De homine* (1658; *Latin Works,* ii). It consisted for the most part of an elaborate theory of vision, and although it contained a brief account of human psychology, it did little to bridge the gap between *De corpore* and *De cive.*

As soon as *De homine* was through the press Hobbes prepared to join battle again. In the spring of 1660 he published an onslaught on the newfangled methods of mathematical analysis in six dialogues entitled *Examinatio et emendatzo mathematicae hodiernae qualis explicatur in libris Johannis Wallisii (Latin Works,* iv). In *Dialogus physicus, sive De Natura aeris* (1661; *Latin Works,*

iv) he fulminated against Robert Boyle and other friends of Wallis who were then forming themselves into a society (incorporated as the Royal society in 1662) for experimental research, in opposition to the deductive method of physical inquiry advocated in *De corpore*. Wallis, retorted in the scathing satire *Hobbius heautontimorumenos* (1662). Professing to be roused by the attack on his friend Boyle, when he had scorned to lift a finger in defense of himself against the earlier dialogues. he tore them all to shreds with consummate skill, accusing Hobbes, quite unjustly, of having written *Leviathan* in support of Oliver Cromwell's title and of having deserted his royal master in distress. Hobbes answered these charges in a letter about himself in the third person addressed to Wallis in 1662, under the title *Mr. Hobbes Considered in His Loyalty, Religion, Reputation, and Manners (English Works,* iv). In this piece, which is of great biographical value, he told his own and Wallis' "little stories during the time of the late rebellion" so effectively that Wallis wisely attempted no reply.

After a time Hobbes began a third period of controversial activity, which did not end on his side till his 90th year. *De principiis et ratiocinatione geometrarum* (1666; *Latin Works,* iv) was designed to humble the pride of professors of geometry by showing that their works contained as much uncertainty and error as those of writers on physics or ethics. *Quadratura circuli, Cubatio sphaerae, Duplicatio cubi* (1669; *Latin Works,* iv) gave Hobbes's solutions to these famous problems; and although they were promptly refuted by Wallis he worked them up again in later publications. In 1674, at the age of 86, he published *Principia et problemata aliquot geometrica, ante desperata, nunc breviter explicata et demonstrata (Latin Works,* v); and in 1678 appeared his last piece of all, *Decameron physiologicum (English Works,* vii), a new set of dialogues on physical questions. By this time Wallis had given up the vain attempt to cure him of his mathematical aberrations.

These controversial writings on mathematics and physics represent only part of Hobbes's activity after the age of 70. From the time of the Restoration he acquired a new prominence. Two or three days after Charles II's arrival in London, Hobbes attracted the notice of his old pupil in the street and was at once received into favour. The king relished his wit (he used to say, "Here comes the bear to be baited!"), and did not like the old man the less because his presence at court scandalized the bishops and the prim virtue of the chancellor Edward Hyde (1st earl of Clarendon). He even granted Hobbes a pension of £100 a year (not always fully or regularly paid) and had his portrait hung in the royal closet. But "Hobbism" was frequently identified with freethinking and even with atheism, for Hobbes's attack on the church was regarded as subversive of all religion. His enemies were many and powerful. His eagerness to defend himself against Wallis' imputation of disloyalty and his apologetic dedication of *Problemata physica (Latin Works,* iv) to the king are evidence of the hostility with which he was being pressed by the church party as early as 1662; but it was not till 1666 that he felt himself in serious danger. In that year the house of commons embodied the superstitious fear arising from the calamities of the plague and the Great Fire of London in a bill against atheism and profaneness; and the committee to which the bill was referred was instructed to investigate *Leviathan*. Hobbes, then verging upon 80, burned such of his papers as he thought might compromise him and set himself to inquire into the state of the law of heresy.

The results of his investigations appeared in the three short dialogues which in the Latin version of *Leviathan* (1668; *Latin Works,* iii) replaced the old "Review and Conclusion." In these dialogues, as in the tract entitled *An Historical Narration Concerning Heresy and the Punishment Thereof* (published posthumously in 1680; *English Works,* iv), he maintained that since the abolition of the high court of commission there was no court of heresy to which he was amenable and that in any case nothing was to be declared heresy but what was at variance with the Nicene creed, as the doctrine of *Leviathan* was not.

Although parliament dropped the bill on atheism Hobbes could never afterward get permission to print anything on subjects relating to human conduct. In 1668 his Latin works (2 vol.) came out at Amsterdam, because he could not obtain the censor's licence for their publication in England. Some of his other writings were not printed until after his death—the king apparently having made it the price of his protection that no fresh provocation should be offered to popular sentiment. The most important of the works thus withheld from publication was the spirited dialogue *Behemoth, the History of the Causes of the Civil Wars of England* (*English Works,* vi). This was kept back at the king's express desire, but an unauthorized edition was brought out in 1679, while Hobbes was still alive. *Behemoth* was composed about 1668; to the same period probably belongs the unfinished *Dialogue Between a Philosopher and a Student of the Common Laws of England* (published in 1681; *English Works,* vi), a trenchant criticism of the constitutional theory of English government as upheld by Edward Coke. The Latin elegiacs exposing the methods by which ecclesiastics encroached upon the civil power may also date from this period; they were first published in 1688 under the title *Historia ecclesiastica (Latin Works,* v).

For some time, then, Hobbes was not allowed to publish a word in his own defense, and his enemies took every opportunity to discredit him. But no Englishman of the day stood in such high repute abroad, and distinguished foreigners who visited England were always eager to pay their respects to the old man, whose vigour and freshness of intellect no passage of the years seemed able to quench. Among these was the grand duke of Tuscany (Ferdinand 11), who took away some works and a portrait to adorn the Medicean library.

In his last years Hobbes amused himself by returning to the classical studies of his youth. The autobiography in Latin verse *(Latin R'orks,* i), with its playful humour, occasional pathos and sublime self-complacency, was thrown off at the age of 84. In 1673 he produced *The Travels of Ulysses,* a translation of books ix–xii of the *Odyssey* in rugged English rhymes; finding this favourably received, he published in 1675 a rendering of the whole epic, with a lively preface "Concerning the Virtues of an Heroic Poem." A translation of the *Iliad* appeared in the following year *(English Works,* x). As late as Aug. 1679 he was promising his publisher "somewhat to print in English." He died at Hardwick hall in Derbyshire on Dec. 4 of that year and was buried in the neighbouring church of Hault Hucknall.

Personal Character.—Hobbes was tall and erect in figure. Believing that "a beard did not make a philosopher," he had himself shaved close except for a little tuft under his lip. He lived a temperate life. He used to say that he had been drunk about 100 times in all; and after the age of 60 he drank no wine and ate little meat. His favourite sport was tennis, which he still played occasionally even at 75.

Socially he was genial and courteous, though in argument he sometimes lost his temper. Cautious in practical matters, but intellectually bold in the extreme, he claimed to have read little and boasted that he would have known as little as other men if he had read as much. He is said to have had an illegitimate daughter for whom he made generous provision. There is a portrait of him by J. M. Wright in the National Portrait gallery, London, and two others are in the possession of the Royal society.

Hobbes's Place in **Philosophy.**—Hobbes was so impressed by Galileo's achievements in mechanics that he sought to explain all phenomena, and indeed sense itself, in terms of the motion of bodies. His a priori mathematical approach to natural philosophy separated him decisively from Francis Bacon, who had advocated an experimental inductive method; and the laborious investigations which John Locke was later to make into the powers of the human understanding were alien to his dogmatic and self-confident temper.

Yet Hobbes was not only the architect of a grand metaphysical design: he was also a critical philosopher with a lively interest in language and a keen eye for the snares which it spread for the unwary. Indeed, his account of the sources of absurdity, which provided him with a potent weapon against the scholastics, gives him some title to be regarded as a forerunner of modern logical analysis.

But Hobbes's reputation as a thinker rests mainly on his contributions to the philosophy of man. His egoistic psychology was

taken over and elaborated by Spinoza; and in Great Britain it stimulated such thinkers as the 3rd earl of Shaftesbury, Joseph Butler and Francis Hutcheson to seek a more respectable account of human motivation. His contribution to the free-will problem in his controversy with Bramhall had an influence which can be traced not only in Spinoza, Locke, Anthony Collins, David Hume and Jonathan Edwards, but even in modern writers like Moritz Schlick and G. E. Moore. In moral theory he is generally regarded as a pioneer of the utilitarian school. He justified obedience to moral rules as the means to "peaceable, social, and comfortable living"; and, since he was hostile to the political pretensions of ecclesiastics, it obviously suited him to give such rules a purely secular basis. Yet he also said that the laws of nature were God's commands: and it was left to Spinoza to deny that God was a king who laid down laws which men could break. *(See* ETHICS, HISTORY OF: *Modern Ethics.)*

In his political theory he departed from the accepted tradition by making natural right rather than natural law his fundamental concept. The right of nature is essentially a right to self-preservation, and Hobbes maintains that a man has no obligation to act in accordance with the law of nature, and indeed cannot do so, if he thinks such conduct inimical to his own security. Yet peace and its blessings cannot be achieved unless the law of nature is generally observed.

Hobbes's solution is to give everyone a guarantee of the good behaviour of his fellows by creating a power sufficient to keep them in awe. This power will be created if each individual promises every other individual that he will carry out whatever commands some selected person—either one man or an assembly, but preferably one man—shall consider necessary for the peace and defense of all. Such covenants. by convincing each individual that the others will obey the person agreed upon, will inspire him with a belief in the sovereign's power; and a sovereign so established may survive even if all the subjects desire to depose it, provided that they do not communicate their desire to one another. This condition will be satisfied in Hobbes's commonrvealth, whose subjects have no source of unity but the sovereign.

The sovereign's right will be as absolute as its power. Insofar as it is responsible at all, it is responsible only to God. It cannot be unjust to its subjects, since these have authorized its actions, and consent precludes violation (*injuria non fit volenti*). Nor is it bound by any covenant with the people, for there is no people apart from the sovereign.

In essence Hobbes's argument is very simple. He first analyzes the conditions necessary for peace and security and then, in his version of the social contract. provides a recipe for constructing an ideal state in which these conditions will be satisfied. Later thinkers, stimulated and influenced though they were by his doctrine. were critical both of his account of the ends of the state and of the means which he advocated to achieve them. Spinoza maintained that peace was not mere absence of war but voluntary co-operation; Locke and Jean Jacques Rousseau rudely compared the peace of Hobbes's state with the peace of a dungeon. As for the means, Spinoza argued that absolute sovereignty was seldom. if ever, possible in practice and explored the limitations which the intractable nature of man imposed upon those in authority; Locke, denying that security could be attained by submission to an absolute ruler "corrupted by flattery and armed with power." recommended that legislative power and executive power should be placed in different hands and that the former should be vested in an assembly whose members would be subject to the laws which they collectively made; and Rousseau. while accepting absolute sovereignty. equated sovereignty with the legislative power which he vested in the people as a whole (he too found some safeguard against oppressive legislation in the fact that the lawmakers were to be subject *qua* individuals to their own laws).

Hobbes's reputation was soon overshadowed by that of Locke; and when the theory of the social contract went out of fashion he suffered a period of neglect in Great Britain. But in the 19th century interest in him was revived by the followers of Jeremy Benthnm and in particular by John Austin, who made a modified version of Hobbes's doctrine of sovereignty and law the basis of his jurisprudence; and since Austin's day Hobbes has gradually won recognition as one of the greatest of English political thinkers.

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John Aubrey's account of Hobbes (in *Brief Lives,* ed. by A. Clark, vol. i, pp. 321–403 [Oxford, 1898]) gives intimate anecdotes. For further studies *see:* G. C. Robertson, *Hobbes* (London, 1886); F. Tonnies, *Hobbes der Mann und der Denker* (Leipzig, 1912); Sir Leslie Stephen, *Hobbes* (London, 1904); R. Honigswald, *Hobbrs und die Staatsphilosophie* (Munich, 1924); F. Brandt, *Thomas Hobbes' Mechanical Conception of Nature,* Eng. trans. (London. Copenhagen, 1928); Z. Lubienski, *Die Grundlagen des ethisch-politischen Systems von Hobbes* (Munich, 1932); J. Laird. *Hobbes* (London, New York, 1934); J. Vialatoux, *La Cité de Hobbes* (Paris, 1935); L. Strauss, *The Political Philosophy of Hobbes* (London, New York, 1936); C. Schmitt, *Der Leviathan in der Staatslehre des Thomas Hobbes* (Hamburg, 1938); J. Bowle, *Hobbes and His Critics* (London, 1951; New York, 1952); R. Polin, *Politique et Philosophie chez Thonzas Hobbrs* (Paris, 1953); P. Zagorin, A *History of Political Thought in the English Revolution* (London, 1954); R. Peters, *Hobbes* (London, 1956); Howard Warrender, *The Political Philosophy of Hobbes* (Oxford, 1957).

(A. G. WM.)

HOBHOUSE, LEONARD TRELAWNEY (1864–1929), British philosopher and sociologist. was born Sept. 8, 1864, at St. Ive, near Liskeard. Educated at Oxford, he taught at Merton and Corpus Christi colleges until 1897. An active Liberal, he served on the editorial staff of the *Manchester Guardian* until 1902, was secretary of the Free Trade union until 1905 and published several political works, notably *The Labour Movement* (1893; 2nd ed., 1898). *Democracy and Reaction* (1904) and *Liberalism* (1911), showing strong sympathy with collectivism which he maintained was consistent with Liberalism. In 1907 he was appointed professor of sociology in the University of London, a position he retained until his death at Alençon, France, on June 21, 1929. His concept of sociology, not as a specialty, nor a synthesis of specialties but as the interpretation of social life as a whole, helps explain the many fields such as philosophy, biology and psychology into which he ventured and made his own.

His principal works are *The Theory of Knowledge* (3rd ed., 1921); *Mind in Evolution* (2nd ed.. 1915); *Morals in Evolution* (rev. ed., 1915); *Development and Purpose* (rev. ed.. 1927); *Social Evolution and Political Theory* (1911); and, in collaboration with G. C. Wheeler and M. Ginsberg, *The Material Culture and Social Institutions of the Simpler People* (1915). Four works constitute his sociological system and together they are entitled *The Principles of Sociology* (1918–24). The first, *The Metaphysical Tlzeory of the State* (1918), criticizes the Hegelian theory of the state; the second, *The Rational Good* (1921), develops a social philosophy based on individual development and the common good; the third, *Elements of Social Justice* (1922), applies this philosophy to concrete economic and political problems; the final volume, *Social Development* (1924), examines the actual conditions underlying the life of societies and their bearing on the fulfilment of rational purpose.

See Hugh Seiver Carter, *The Social Theories of L. T. Hobhouse* (1927); M. Ginsberg and J. A. Hobson, *L. T. Hobhouse: His Life and Work* (1931); J. A. Nicholson, *Some Aspects oj the Philosophy of L. T. Hobhouse* (1928).

(J. RY.)

HOBOKEN, town of Belgium on the right bank of the Scheldt about 4 mi. above Antwerp. It is an important industrial centre. Many wealthy Antwerp merchants have villas there, and it is the headquarters of several of the leading rowing clubs on the Scheldt. Pop. (1955 est.) 30.867.

HOBOKEN, a city of Hudson county, in northeastern New

Jersey, U.S., adjoining Jersey City and Union City (*qq.v.*), is located on the Hudson river opposite Manhattan Island, with which it is connected by ferry, tunnel and subway.

In 1630 the Dutch, led by Michael Pauw, purchased the site from the Leni-Lenape Indians, who smoked carved stone pipes and named it Hobocan after *Hobocan Hackingh* (land of the tobacco pipe). In 1784 John Stevens (*q.v.*), the locomotive inventor, after whom the Stevens Institute of Technology is named, bought the site and laid out the town more formally.

During the large-scale migrations to the U.S., around the middle of the 19th century, Germans and Irish came to Hoboken and German traditions dominated. The first brewery in America (1642) was built there by a Dutchman. Aert T. van Putten, and beer (which is no longer produced) was later brewed in great quantities by the Germans, who established many beer halls and gardens. The New York Knickerbockers, early baseball team, made the Elysian Fields their home field for the 1846 season *(see* BASEBALL: *History of Baseball).*

During World War I Hoboken was the main port of embarkation of U.S. forces to continental Europe. Under the terms of a 1952 agreement the Port of New York authority leased Port Hoboken for operation as an integral part of the Port of New York. Hoboken's industries include shipbuilding, processing machinery, textiles, food processing, chemicals, furniture, electronic equipment, paints and precision instruments. The modern type ferry slip and the application of steam power to ships and locomotives is closely associated with Hoboken through Stevens' inventions and their later development. For comparative population figures *see* table in NEW JERSEY: *Population.* (D. N. A.; M. P. M.)

HOBSON'S CHOICE, *i.e.,* "this or nothing," an expression that arose from the refusal of the Cambridge-London carrier, Thomas Hobson (1544?–1631), when letting his horses on hire, to allow any animal to leave the stable out of its turn. Among bequests made by Hobson, whose death was commemorated by Milton. was a conduit for the Cambridge market place.

HOBY, SIR THOMAS (1530–1566), English diplomat and translator of Castiglione's *Cortegiano,* was born in 1530. He entered St. John's college, Cambridge, in 1545, but in 1547 went to Strasbourg. Thereafter he traveled extensively on the continent, spending a short time at Augsburg with his half brother, Sir Philip Hoby (1505–58), then ambassador at the emperor's court. By 1552 Thomas was engaged on his translation, *The Courtyer of Count Baldesser Castilio,* printed in 1561. The *Cortegiano,* which Samuel Johnson called "the best book that ever was written upon good breeding." exercised an immense influence on the standards of manners throughout Europe and was the recognized authority for the education of a nobleman. Hoby was knighted by Elizabeth I in 1566, and was sent to France as English ambassador. He died in Paris on July 13 of the same year. His other works include a translation of a Latin work by Martin Bucer as *Gratulation ... Unto the Church of England* and an autobiography, *A Booke of the Travaile and Lief of Me, Thomas Hoby,* edited by *E.* Powell for the Camden Miscellany, vol. x (1902).

HOCHE, LAZARE (1768–1797), French general, was born near Versailles on June 24, 1768. He enlisted in the *Gardes françaises* and soon obtained promotion. When the *Gardes françaises* were broken up in 1789 he served in various line regiments up to the time of his receiving a commission in 1792. He served with credit in the operations of 1792–1793 on the northern frontier of France. When Dumouriez deserted to the Austrians, Hoche, with le Veneur and others, fell under suspicion of treason; but after being kept under arrest for some months he took part in the defence of Dunkirk, and in the same year (1793) he was promoted successively *chef de brigade,* general of brigade, and general of division. During his command in Lorraine he was defeated by the Prussians at Kaiserslautern (Nov. 28, 30, 1793), but the Committee of Public Safety valued his services enough to leave him in command; in December, after he had stormed the lines of Fröschweiler the army of the Rhine was also put under him, and he pursued his success, sweeping the enemy before him to the middle Rhine in four days. Before the following campaign opened, he married Anne Adelaïde Dechaux at Thionville (March 11, 1794). Ten days later he was suddenly arrested, on charges of treason preferred by Pichegru, the displaced commander of the army of the Rhine. Hoche escaped execution, though imprisoned in Paris until the fall of Robespierre. On Aug. 21, 1794 he was appointed to command against the Vendéans and made the peace of Jaunaye (Feb. 15, 1795) when the war was renewed by the royalists. Hoche inflicted a crushing blow on the royalist cause by capturing de Sombreuil's expedition at Quiberon and Penthibvre (July 16–21, 1795). Before the summer of 1796 he had pacified the whole of the west, which had for more than three years been the scene of a pitiless civil war. In December 1796 he was appointed to organize the invasion of Ireland, but the expedition was driven back by bad weather. Hoche was at once transferred to the Rhine frontier, where he defeated the Austrians at Neuwied (April), though operations were soon afterwards brought to an end by the Preliminaries of Leoben. Later in 1797 he was minister of war for a short period, but, finding himself the dupe of Barras and technically guilty of violating the constitution, he returned to his command on the Rhine frontier. But his health grew rapidly worse. and he died at Wetzlar on Sept. 19, 1797.

HO CHI MIMH (originally NGUYEN TAT TAN) (1890–), founder and first president of the Democratic Republic of Viet-, nam (northern Vietnam), was born on May 19, 1890, in a village of Annam. After participating in Tongkingese revolutionary activities, he went to France in 1919 as a dock hand, changing his original name to Nguyen Xi Quoc ("Friend of the People") and, in 1920, joining the French Communist party. He then went to Moscow (1924), whence in 1925 he was sent to Canton to join the staff of Borodin (Mikhail Markovich Grusenberg). the Soviet consul there. Arrested by the Chinese government in 1927 but soon released, he returned for a time to Moscow but was next sent to Thailand to prepare an insurrection in French Indochina. His Vietnam Workers' party (Dan Lao Dong Viet Nam) was banned by the French after riots in Tongking (1931). Moving to Hong Kong. Ho continued to organize Communist activity in Tongking and Thailand from there. In 1941, with the new name of Ho Chi Minh ("Brilliant One"), he appeared in the southern Chinese province of Yunnan as leader of the Vietnam League for Independence (Viet Nam Doc Lap Dong Minh Hoi). After the Japanese surrender at the end of World War II he proclaimed the People's Republic of Vietnam at Hué on Sept. 2, 1945, with himself as president. Invited to Paris by the French government for negotiations, he signed the Fontainebleau agreement of Sept. 1946 to make Vietnam an independent unit in an Indochinese federation, but fighting broke out between the French and his forces in the folloning December. The ensuing war continued until the Geneva armistice of July 1954, which partitioned Vietnam between a northern Communist state and a southern national one. *See* also VIETNAM.

HOCK, a name probably corrupted from Hochheim on the Main, is used to designate nhite table uines produced in the Rhine valley. Elsewhere it is also applied, as is the more frequently encountered term Rhine wine, to any thoroughly dry, tart, light-bodied table wine of straw colour or slightly greenish hue. In at least some portions of the Rhine valley grape vines were started by the Romans, and Charlemagne found them flourishing around 800 A.D. Three celebrated vineyards of the Rhine were founded by monks early in the 12th century.

The finest Rhenish hocks are from the Rhinegau vineyards, situated along the Rhine's right bank from Rudesheim to the juncture with the Main. Here the highly developed Riesling grapes thrive, imparting to the best wines a fresh briskness combined with soft fullness and a distinctive bouquet. Sylvaner grapes are grown also, and at Rudesheim the use of Green Orleans gives local wines a darker colour and a more fruity flavour.

On the Rhine's left bank, from Bingen to Mayence, and then on to Worms are the more extensive vineyards of the Rhinehesse. There the wines, though sweet and full, are less celebrated.

Further up the Rhine, south of Worms, the Rhinepfalz or Bavarian Palatinate favours mixed plantings of Riesling, Gutedel, Traminer and Sylvaner for early-maturing wines usually slighter than those of the Rhinegau or Rhinehesse.

There are other hocks, notably the Stein wines grown in lower Franconia, to the east of Hochheim, which are distinctive and in good years fine. They appear in squat, flasklike *bocksbeutels* instead of the slender bottles commonly used for Rhine wines.

Throughout the Rhine area viticulture is difficult. The soil is forbidding, the vineyards rise on slopes often so steep that even animals may not be employed to till the soil, and the seasons are sometimes too harsh to permit full ripening of all the grapes. Grapes from the same vineyard are gathered at various stages of ripeness, and if possible of over-ripeness, to produce various qualities of wine. In other viticultural areas of the world wines of hock or Rhine-wine type are produced largely from Rhine grape varieties. While in the eastern United States native grapes or crossbreeds are employed in the absence of Rhine varieties, in California the Johannisberger Riesling, Sylvaner, Traminer and Gutedel are favoured. *(See* WINE.)

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(H. A. Cw.)

HOCKEY, an outdoor game played on a grass or hard dirt surface nith a ball by two opposing teams of 11 players on each side. using hooked or bent sticks with which each side attempts to drive the ball into the other's goal. The game is also called field hockey to distinguish it from ice hockey (q v).

A crude form of a stick game was played by the ancient Persians, from whom it was acquired by the Greeks. who in turn passed it on to the Romans. A discovery made at Athens in 1922 gives reason to believe that a form of stick game came from the east. This was a bas-relief found in the wall built by Themistocles (c. 514–449 B C), which depicts six youths taking part in a game resembling hockey. and shows what is termed a bully in the modern game, but with the hooked sticks pointing downward instead of upward. Traces of a sort of stick game have also been found in America, as played by the Aztec Indians, and evidence shows that probably most of the Indian tribes in America played a rough stick game for several thousand years But neither these nor the "London Balle Playe" mentioned by William Fitzstephen in 1175 bear much general resemblance to modern hockey.

Modern Hockey. — About 1875 a game resembling modern hockey began to be played in England. No goal could be scored if hit from a distance of more than 15 yd. from the nearest goal post. but players did not for a time realize the need of a definite marked-out circle A landmark in the progress of the game was the formation of the famous Wimbledon club in 1883. The members at first used a string ball and light ash sticks. A few more clubs soon came into being in the London area and the game spread to the midlands, west and north of England. The real birthday of modern hockey was. however, Jan. 18. 1886. the date of the formation of the Hockey association and of the adoption of the striking circle In 1895 the first international match was played between England and Ireland, resulting in a win for the former by 5 goals to nil. About 1900 the need for an international committee to frame and amend the rules of the game was realized. and the governing bodies of Ireland and Wales were each asked to send two representatives to meet three from the Hockey association. Later this body was called the International Hockey board, its membership being increased by two on the formation of the Scottish Hockey association in 1902. The game grew rapidly throughout the British Isles and is played there by hundreds of clubs as well as by schools and universities and the various armed services.

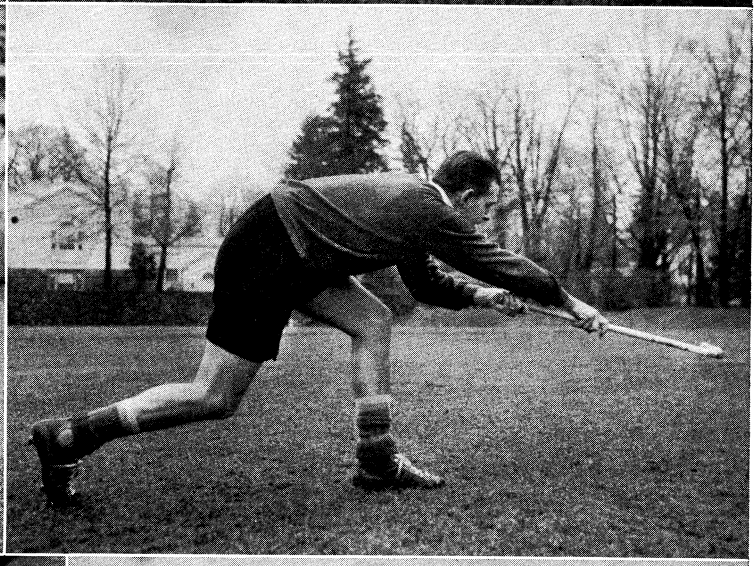
The Game Throughout the World. — Although not played to the same extent as football (soccer), the game is now popular in many countries throughout the world. The national associations of these countries, including those making up the rest of the British commonwealth and also the United States, did not become members of the International Hockey board but of the Fédération Internationale de Hockey. From 1908 hockey was included in the program of the Olympic games. England, after an absence of several years. competed in the Olympic games held in London in 1948. and a close working arrangement was instituted at that time between the International Hockey board and the Fédération Internationale de Hockey whereby the observance thereafter of the same playing rules by all countries was assured. The leading countries *in* this sport in the 1950s were India, the Netherlands, England. Germany and Pakistan. Along with cricket. hockey gained the distinction of being the national game of India. which dominated Olympic competition. Sports writers covering the games of 1932 at Los Angeles. Calif.. voted the performance of the Indian team the outstanding exhibition of skill in any sport. The Indian type of play features short. controlled passes as opposed to the European type. in which the tendency is to hit the ball about the field more. Furthermore, the players in India and Pakistan use sticks with a short toe. By using these sticks and employing a left-handed grip well behind the stick they are able to reverse the stick without changing the grip and thus attain remarkable ball control. The conventional long-toed stick will strike the ground and fail to contact the ball properly if it is reversed in this manner. European players were gradually adopting the short-toed stick in the early 1950s. United States Olympic players attempted to follow the Indian type of play as closely as possible, although they also used some of the European technique.

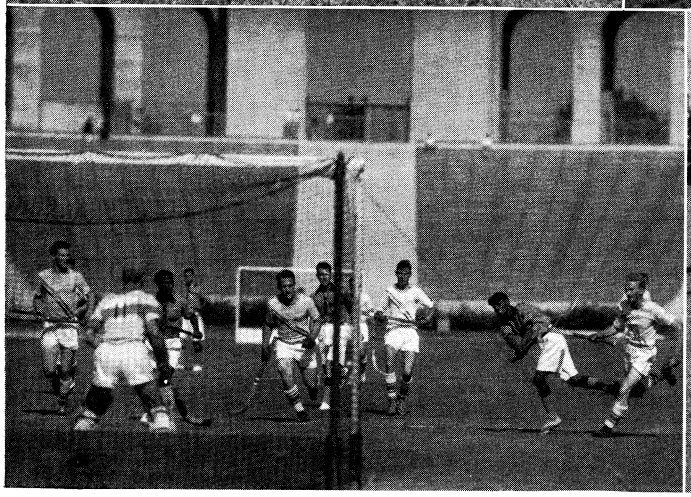
A version of the game to be played indoors was devised. utilizing special rules and a limited number of players.

The Game. — The game is played by two teams of 11 players on a rectangular ground. 100 yd. long and not more than 60 yd. nor less than 55 yd. wide, marked with white lines: the longer boundary lines are the side lines. the others the goal lines. Inside the ground. at a distance of 7 yd. and running parallel with the side lines, a dotted line is marked. called the 7-yd. line. The goals are 12 ft. wide and 7 it. high. In front of each goal there is drawn a white line. 12 ft. long. parallel to and 16 yd. from the goal line. This line is continued each way to meet the goal line by quarter circles having the goal posts as centres. The space thus enclosed is called the striking circle. For a goal (which counts 1 point) to be scored the ball must pass over the goal line between the goal posts and under the crossbar. and while within the striking circle must have been touched by the stick of an attacker. The ball originally was a cricket ball (similar to a baseball) but plastic balls now are also approved. It weighs $5\frac{1}{2}$ to $5\frac{3}{4}$ oz. and is $8\frac{13}{16}$ to $9\frac{1}{4}$ in. in circumference. The average stick is 36 to 38 in. long and weighs 18 to 22 oz. The diameter must not exceed 2 in. nor the weight 28 oz. To prevent stinging the handle is laminated and is attached to the solid head by glue and binding. The striking surface is flat on the left side only and only the flat surface may be used. The usual composition of a team is five forwards, three halfbacks, two fullbacks and a goalkeeper. Two halves of 3j minutes each are played and no subsfitutions are allowed. even for injury. Time out is permitted only in case of injury. Generally speaking. strategy in field hockey is similar to soccer football. However, one big difference is that no obstruction is allowed—that is. it is forbidden to place one's body between the opponent and the ball. The reason for this rule and for the one-sided stick rule is that the sticks are relatively heavy and are used for hard striking. Consequently, if it were permitted to defend the ball with the body the game would become quite dangerous. The goalkeeper wears heavy pads and while in the striking circle is allowed to kick the ball or stop it with the foot or body. All other players, however, may stop the ball with the hand or stick only.

The game is started and restarted after each goal by a bully in the centre of the field. A bully occurs when two players stand at opposite sides of the ball and tap the ground and each other's sticks alternately three times before putting the ball in play. All players must be on side during a bully. If the ball is hit over the goal line by the attackers without a goal being scored or accidentally hit over the goal line by a defender from beyond the 25-yd. line. the game is restarted by a bully on the nearer 25-yd. line. If the ball is hit over the goal line accidentally by the defense from within the 2j-yd. line. a corner is taken, the defenders all being behind the goal line and the attackers being outside the striking circle until the ball is hit in by one of the attackers from the corner of the field scores to which the ball went out. If the defenders hit the ball over the goal line intentionally or commit a foul within the

HOCKEY





BY COURTESY OF (TOP LEFT, TOP RIGHT, CENTRE LEFT, CENTRE RIGHT) HENRY KIRK GREER, (BOTTOM LEFT, BOTTOM RIGHT) UNITED STATES FIELD HOCKEY ASSOCIATION

Top left: The face-off or bully. Player at left is in correct position: the other player is not standing "square" and not using the flat of stick

Top right: Dribble and left lunge. Player with ball is employing grip with left hand well behind the stick, enabling him to reverse stick and control the bail by twisting left wrist forward. The left lunge enables other piayer to tackle from same level or rear. Both players are using the short-toed stick introduced by India and Pakistan

Centre left: Start of flick stroke. The head of the stick is laid back slightly, the ball at its heel. The player has left foot forward, knees bent and weight low

Centre right: Finish of flick stroke. As the stick is pushed ahead the ball rolls toward the toe and is thrown forward, rising slightly

Bottom *left:* Action between Olympic teams of India and the United States at a practice match

Bottom right: Action during a U.S. women's national tournament

circle or a deliberate foul inside the 2j-yd. line. a penalty corner is taken. the only difference being that the attacker hits the ball out from a point on the goal line 10 yd. from either goal post. In the case of a deliberate foul by the defense inside the striking circle or any foul within the circle which prevents a goal being scored. a penalty bully is awarded. This is taken j yd. in front of the goal by the offending player and any player from the attacking team. All other players must remain out of play. In the case of other fouls a free hit is awarded the team opposed to the offender on the spot where the infraction occurred. No other players may stand within 5 yd. of those taking a bully or the one taking a free hit. When the ball goes over the side line it is rolled in by hand by a player of the team opposed to the player who last touched it. all other players remaining back of the 7-yd. line. The stick must not be raised above the shoulder when playing the ball and undercutting the ball and hooking sticks is not allowed. The offside rule is similar to that in soccer except that three opponents are required to place a player on side if he is ahead of the ball and in the attacking half of the field. An important point is that the umpire refrains from enforcing a penalty where he believes that to enforce it would give an advantage to the offending team. There is one umpire for each half of the field. The playing surface is usually grass covered, but in India most of the grounds are of hard dirt. In England and most of continental Europe the game is played through the fall. winter and spring, but in the Cnited States weather conditions usually permit play only in the fall and spring. The *Rules and Official Notes* covering the game were redrafted generally in 1952.

Women's Hockey.—The foregoing comments apply particularly to the game as played by men. Hockey is also played extensively in many countries by women. Although women do not compete in this sport in the Olympic games. they do engage in international competition. The international governing body, the International Federation of Women's Hockey Associations. was formed in 1927. Teams representing England dominated international competition. The game was introduced in the United States in 1901 by Constance M. K. Applebee, a member of the British College of Physical Education. and thereafter became the most popular outdoor team sport among women in the United States. It is played in schools and colleges and sectional and national tournaments are held.

The rules used by women are similar to those used by men, the following being the more important exceptions: the striking wide measurement is 15 yd.; the dotted lines are j yd. from the side lines; the foot may be used to stop the ball provided there be no rebound; on corners the members of the forward line of the defenders are stationed on the 2j-yd. line (United States innovation being gradually adopted); and playing time does not exceed two 30-minute halves.

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HODDESDON, a market town and urban district in the East Hertfordshire parliamentary division. Eng.. in the Lea valley, 18 mi. N. of St. Paul's cathedral, London, by road. Pop. (1951) 13,736. Area 6.9 sq.mi. It was a Great North road coaching station but of its old inns lining the High street many are now private houses; there. too, are St. Monica's priory, once Rawdon house (1622). and the Clock tower which dominates the market place —in use since 1253. By the New river is Rye house generating station (1954). Hoddesdon. well known to anglers in the Lea, is mentioned by Izaak Walton. Though residential, about 320 ac. are covered with glasshouses for tomatoes and flowers and there are sand and gravel pits. In the greater London plan the area, with Broxbourne woods, is a beauty spot and part of the "green. belt."

HODEIDA (HODEDA, HADEDA, HUDAIDA), chief seaport of Yemen, on the Arabian coast of the Red sea, lies on a beach of muddy sand exposed to south and west winds. Steamers anchor more than a mile from shore, and goods are lightered. Its population is estimated at 30.000. In Turkish times, Hodeida contained Indian. African and Greek traders, but after World War I prosperity declined. Coffee, skins and hides are the chief exports. After World War I Hodeida, occupied by British troops, was handed over to the Idrisi ruler of Asir, but in 1921 Imam Yahya of Yemen had no difficulty in wresting the town and district from his son Saiyid Ali ibn-Mohammed. By the Italian treaty with the imam. Hodeida was formally recognized as forming part of Yemen.

HODGE, CHARLES (1797–1878), U.S. Presbyterian theologian, the major figure in the "Princeton school" of Reformed (Calvinist) orthodoxy, was born Dec. 27, 1797, in Philadelphia, Pa.. but moved at age 14 to Princeton, N.J., his home for 68 years. He graduated from Princeton college, then from the seminary, where, in 1822 he became professor of biblical literature. Traveling abroad (1826–28), he met leading continental theologians in Paris, Halle and Berlin, but firmly resisted all the newer trends of thought, significantly forming a lasting friendship with the learned and conservative Friedrich August Tholuck of Halle. Adding systematic theology to exegetical work, Hodge became. after 1840, professor of exegetical, didactic and polemic theology until his retirement in 1877, thereby contributing to the training of about 3.000 ministers. Active as a churchman, he was moderator of the "Old School" Presbyterian Church in 1846. Having founded the *Biblical Repertory and Princeton Review* in 1825, he remained an editor for 46 years, contributing nearly 150 articles. Among his books are biblical commentaries on the Roman, Ephesian and Corinthian epistles; a rejection of "nonteleological" science called *What is Darwinism?* (1874); and his magnum opus, the influential *Systematic Theology,* 3 vol. (1871–73).

Hodge emphasized exegesis of a verbally infallible Bible as the base of all theology and recognized as his intellectual antecedents the church confessions and scholastic systems of 17th-century Calvinism, pre-eminently the thought of François Turretin (d. 1687) of Geneva. He adopted a method described by himself simply as induction and deduction from biblical "facts." By defending his tradition with learned and detailed reference to the history of theology, to Roman Catholic teaching and to the contemporary streams of religious: scientific and philosophic thought: he mediated to United States religious life both a broad learning and an unruffled resistance to innovation.

He was much revered for learning and piety, a pleasant wit and an irenic manner even in polemic. Hodge died June 19, 1878.

See A. A. Hodge, *The Life of Charles Hodge* (1880). (E. **A. Dy.)**

HODGES, COURTNEY HICKS (1887–), U.S. army officer, was born at Perry, Ga., Jan. 5, 1887. Enlisting in the U.S. army in 1906, he was commissioned second lieutenant of infantry three years later, serving in Mexico (1916–17) and France (1918). He headed the infantry school (1940–41) and was chief of infantry from 1941 to 1942. In 1942 he commanded the 10th corps and, in 1943, the 3rd army. He assumed command of the 1st army in Normandy in Aug. 1944, after serving as deputy commander during the invasion. His forces swept through France, Belgium, and Luxembourg and were the first into Germany. They bore the brunt of the Ardennes counterattack and were the first to cross the Rhine and to meet the Russians. Hodges was transferred to the far east in the summer of 1945. He returned after the war to command the 1st army at Governor's Island until his retirement, as full general, in 1949. (F. C. PE.)

HODGKIN, THOMAS (1831–1913), English banker, best remembered for his historical writings, was born in London. July 29, 1831. He was educated as a member of the Society of Friends and at University college, London. In 1859 he became a partner in the banking house of Hodgkin, Barnett & Co., at Newcastle upon Tyne. Hodgkin was a scholar by inclination and devoted much time to historical study. His reputation rests on *Italy and Her Invaders,* 8 vol. (1880–99) and a *History of England from*

the Earliest Times to the Norman Conquest (1906). Although both are dated, the first covered the same ground as Gibbon but with much greater insight into and sympathy toward the Teutonic invaders; the second was the first work on the historical origins of Great Britain considered from a Northumbrian point of view. Hodgkin died at Falmouth, March 2, 1913.

See L. Creighton, *Life and Letters of Thomas Hodgkin* (1917); E. E. Taylor, *Dr. Thomas Hodgkin* (1935).

HODGKIN'S DISEASE is a rare disease of man, of unknown cause, resembling both inflammation and cancer, usually causing at first enlarged lymph nodes in some region, external or internal. Tending to spread eventually to other nodes, it may affect any living tissue of the body, directly or indirectly. Among many synonyms are LYMPHOGRANULOMATOSIS, LYMPHADENOMA and MALIGNANT GRANULOMA. Thomas Hodgkin of London described in 1832 seven fatal cases, of which three fit modern criteria for Hodgkin's disease.

Although most commonly found in the third to fourth decades of life, Hodgkin's disease may occur at any age. Its rarity is indicated by the fact that there are about 16 new cases annually per 1,000,000 population. The true incidence computed according to number of persons living at various ages tends to increase with age. Male to female ratio is about 1.7 to 1 over-all, but in children it is nearer 5 to 1. Although often less aggressive in menstruating women, its course may be worsened by pregnancy. The cause is unknown, despite extensive research. Noncontagious and of extremely slight hereditability, nevertheless it has about 1% familial incidence.

Apparent modes of onset vary greatly. Painless enlargement of lymph nodes in the neck is a common first indication. Routine chest X-rays in some cases disclose enlarged nodes in front between the lungs, before symptoms appear. Low-grade febrile illness without localized symptoms, or a stormy course with high fever and obscure findings, should be suspect. Common symptoms as Hodgkin's disease progresses are fever, sweating, anemia, wasting, itching and pain. Fortunately usually some feature such as enlarged nodes in neck, armpit or groin permits early diagnosis by biopsy (removal of specimen of diseased tissue). showing microscopically a complex of cells including the characteristic Sternberg-Reed cell.

No blood test, chemical test or X-ray examination proves Hodgkin's disease. Common mimicry of or by other serious diseases makes diagnostic proof imperative to permit selection of proper treatment.

Occasionally early biopsies may not be diagnostic. In such cases repetition should be permitted. In most cases experienced pathologists can make the diagnosis if given representative tissue.

The total duration may be from a few weeks or months to 30 years or more. In the course of advancing Hodgkin's disease, skin, lungs. gastrointestinal tract, liver spleen, kidneys. adrenals, spinal cord, brain or bones can be invaded or affected. With the multiplicity of parts that may be affected. and the frequency of bacterial, fungal or viral infections in those debilitated by the disease, recurring diagnostic problems of complications often arise.

Although no treatment is assuredly curative, and no features permit foretelling the outlook, it seems theoretically possible that some early cases may be curable. Surgical removal of a single early localized lesion may be justifiable in selected cases. The treatment of greatest over-all usefulness is irradiation applied externally to various lesions, as by X-rays or gamma rays of cobalt 60. The so-called polyfunctional alkylating chemicals, such as nitrogen mustard, triethylene melamine and chlorambucil, are valuable palliative agents. In certain advanced cases appropriate hormones (adrenal corticosteroids or ACTH) may produce symptomatic benefits. Anemia may necessitate blood transfusions. Judicious treatment may cause more or less complete remissions, sometimes with great prolongation of life, or distinctly worthwhile palliation.

Five-year survivals run from about 25% for all cases to 50% or even 75% for favourable cases.

See also LYMPH AND LYMPHATIC SYSTEM: *Diseases of the Lymphatic System*. (L. F. CR.)

HODGSON, BRIAN HOUGHTON (1800–1894), English administrator, ethnologist and naturalist, was born at Lower Beech, Cheshire, on Feb. 1, 1800. In 1816 he obtained an East Indian writership, went out to India in 1818 and in 1820 was appointed assistant to the resident at Katmandu. In 1833 he became resident in Nepal, and succeeded in concluding a satisfactory treaty in 1839 with the court to which he was accredited; but in 1842 his imperious policy toward the native government was upset by the interference of Lord Ellenborough. Hodgson disobeyed the latter's instructions; he was continued in office for a time, but was recalled in 1843. He died at Alderley Grange in the Cotswold hills, on May 23, 1894.

Hodgson did much to throw light on Buddhism as it exists in Nepal. He presented his collection of Sanskrit manuscripts to the East India office. He also became the greatest authority on the flora of the Himalayas. His principal work, *Illustrations of the Literature and Religion of Buddhists* (1841), was republished with other writings in 1872–80.

HODLER, FERDINAND (1853–1918), Swiss painter and sculptor whose work is transitional between Expressionism and Symbolism, was born on March 14, 1853, at Berne. He studied first at Thun under F. Sommer, who painted landscapes for tourists, but after 1872 he worked in a more congenial atmosphere under B. Menn at Geneva. In 1878 he visited Madrid, but his study of Velazquez was already apparent in works like "Der Student" (1874). By 1879, when Hodler settled in Geneva, he was producing massive, simplified portraits owing something to Courbet and landscapes showing an Impressionist tonal key ("Landschaft bei Madrid," 1879). By the mid-1880s, however, a tendency to self-conscious linear stylization is visible in his subject pictures, which deal increasingly with the symbolism of youth and age, solitude and contemplation (*e.g.*, "Die Reformatoren," Geneva, 1889). From this time his work can be divided between the naturalistic and the symbolic, the latter being the mood of his murals in the town hall at Hanover and at Jena university.

Hodler died at Geneva on May 20, 1918.

See A. Loosli, *Ferdinand Hodler*, 5 vol. (1918–21); H. Mühlestein, *Ferdinand Hodler* (1942). (D. C. T. T.)

HODMEZOVASARHELY, a Hungarian town in the county of Csongrad. Lying near the right bank of the Tisa and protected from normal floods by a large dike, the town is on the edge of a very fertile alluvial plain and is essentially the centre of extensive agriculture and stock rearing, being particularly noted for grapes and melons and the fine breeds of horned cattle and horses. Much of the surrounding plain (294 sq.mi.) is owned by the municipality, Pop. (1957 est.) 54,000 (mun.).

HODOGRAPH. If from any point O a vector OP be drawn representing at any instant in magnitude and direction the velocity of a particle P, which is moving in any manner whatever, the locus of P is the hodograph of the path of P. (Cf. the definition of radial curve under CURVES, SPECIAL.) A fundamental property of this curve is that the velocity of any point P of the hodograph is equal to the acceleration of the corresponding point P'; also that the direction of motion of P is that of the direction of acceleration of P. The hodograph of the orbit of a planet or a comet, considered as in a Newtonian field, is always a circle, whatever may be the form and dimensions of the orbit. The pole O is inside, on, or outside the circle, according as the orbit is an ellipse, a parabola or a hyperbola. The idea of the hodograph originated with Mobius (1843) and, independently, with Sir William Rowan Hamilton (1846) to whom the name and certain original developments of the theory are due. If a particle describes a logarithmic spiral about the pole as a centre of force, the hodograph is also a logarithmic spiral; the same result holds true for sinusoidal spirals (Schouten). If a particle starts from rest at the vertex of a perfectly smooth inverted cycloid and oscillates under the action of gravity, the hodograph of the motion is a circle through the pole, described with constant velocity. An important improvement in nautical charts by A. Smith (*Proc. Roy. Soc.*, vol. xv., 1867) introduced a curve which has been called a tidal hodograph (Thomson and Tait).

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HODSON, WILLIAM STEPHEN RAIKES (1821–1858), British leader of light cavalry during the Indian Mutiny, was born on March 19, 1821 at Maisemore Court, near Gloucester. He was educated at Rugby and Cambridge, and became a cadet in the Indian army at 23.

In 1855 he was charged with having arbitrarily imprisoned a Pathan chief named Khadar Khan, on suspicion of being concerned in the murder of Colonel Mackeson. The man was acquitted. and Dalhousie removed Hodson from his civil functions and remanded him to his regiment. He was also accused of malversation in the funds of his regiment. Hodson's career seemed ruined when the Indian Mutiny broke out. At the outset of the campaign he made his name by riding with dispatches through a country swarming with the rebel cavalry. He then raised a regiment of 2,000 irregular horse. famous as Hodson's Horse, and was placed at the head of the intelligence department.

After the fall of Delhi, Hodson obtained from General Wilson permission to ride out with 50 horsemen to Humayun's tomb, 6 mi. out of Delhi, and bring in Bahadur Shah, the last of the, Moguls. This he did with safety in the face of a large and threatening crowd. Next day with 100 horsemen he went out to the same tomb and obtained the unconditional surrender of the three princes, who had been left behind on the previous occasion. A crowd of 6,000 persons gathered. and Hodson ordered them to disarm, which they proceeded to do. He sent the princes on with an escort of 10 men, while with the remaining 90 he collected the arms of the crowd. On galloping after the princes he found the crowd once more threatening an attack; and fearing that he would be unable to bring his prisoners into Delhi he shot them with his own hand. He gave the king a safe conduct, which was afterward seen by Sir Donald Stewart, before he left the palace. Hodson was killed on March 11, 1858, at Lucknow.

HOE, RICHARD MARCH (1812–1886), U.S. inventor of the rotary printing press, was born in New York city, Sept. 12, 1812. He was the son of Robert Hoe (1784–1833), an English-born U.S. mechanic, who with his brothers-in-law Peter and Mathew Smith had established in New York city a manufactory of printing presses. Educated in public schools, Richard entered Robert Hoe and Co. in 1827 and on his father's death became head. He had considerable inventive genius and the application of his ideas revolutionized printing processes. He discarded the old flat-bed press. placing the type on a revolving cylinder. a model later developed into the Hoe rotary or "lightning" press, patented in 1346, and first used by the Philadelphia *Public Ledger* in 1847. It was further improved under the name of the Hoe web perfecting press. His press enabled publishers to satisfy the increasing circulation demands of the rapidly growing U.S. population.

Hoe died in Florence. Italy, June 7, 1886.

See Robert Hoe, *Short History of the Printing Press* (1902). (R. P. P.)

HOEFNAGEL, JORIS (GEORG HUFNAGEL) (1542–1600), Dutch painter and illustrator, noted for his miniatures, was born at Antwerp. He mas a pupil of Jan Bol. He traveled abroad often in the company of the famous geographer Abraham Ortelius, studying and making dranings of the people, their costumes and customs in France. Spain, England and Italy. He was afternard patronized by the elector of Bavaria at Munich. where he stayed eight years, and by the emperor Rudolph II at Prague. He is famous for his miniature work, especially on a missal in the Imperial library at Vienna; he painted animals and plants to illustrate works on natural history; and his illustrations (especially for Braun's *Civitates orbis terrarum,* 1572), give him a place among early topographical draftsmen.

HOF, town of Germany, in the Land of Bavaria, situated on the Saale, on the northeastern spurs of the Fichtelgebirge, 103 mi. S.W. of Leipzig. Pop. (1950) 61,033. Hof, originally called Regnitzhof, built about 1080, was sold by the dukes of Meran in 1373 to the burgraves of Nuremberg. Cloth manufacture introduced in the 1jth century, and the manufacture of veils begun in the 16th century, greatly helped it. but it suffered severely in various wars. In 1810 it was incorporated with Bavaria. In 1823 the greater part of the town was destroyed by fire. It has a town hall of 1563, and a hospital founded in 1262. It is the seat of woolen and cotton spinning, and manufactures cotton and half-woolen fabrics. It has also dye works, flourmills, sawmills, breweries: ironworks and manufactures of machinery, iron and tin wares, chemicals and sugar. In the neighbourhood there are large marble quarries and extensive iron mines.

HOFBAUER, SAINT CLEMENT MARY (KLEMENS MARIA) (1751–1820), Roman Catholic priest, the "Apostle of Vienna," was born on Dec. 26, 1751, in the Moravian village of Tassmitz, of a poor family. He ardently desired to become a priest, but encountered many obstacles, particularly the anti-Catholic spirit prevalent in the educational institutions of Austria. In 1784, while on a pilgrimage to Rome, he entered the Congregation of the Most Holy Redeemer (the Redemptorists). He was ordained to the priesthood in 1785, and authorized by his superiors to establish Redemptorist monasteries in northern Europe. In 1788 he took up residence in Warsaw, and for 20 years exercised a zealous apostolate and at the same time recruited a large number of members for his congregation. In 1808, by the order of Napoleon, the Redemptorist community at Warsaw was disbanded and the members exiled. Hofbauer spent the remainder of his life in Vienna, where he exerted a wide influence on the intellectuals and contributed much toward the revival of Catholic life. He was particularly popular with the students of the University of Vienna. He continued to seek governmental approbation for Redemptorist monasteries, which was granted shortly after his death (March 1j, 1820). He was canonized by Pope Pius X in 1909, and his feast day is March 15.

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HOFER, ANDREAS (1767–1810), Tirolese patriot, was born Nov. 22, 1767, at St. Leonhard. By the treaty of Pressburg (1805) Tirol was transferred from Austria to Bavaria and Hofer became a leader of the agitation against Bavarian rule. In 1808 with others he visited Vienna at the invitation of Archduke John to concert a rising in 1809. Hofer defeated the Bavarians, enabling the Austrians to re-occupy Innsbruck temporarily; a month later won two further victories on the Iselberg, drove back the Bavarians. who had advanced again, and entered Innsbruck in triumph. Emperor Francis assured him that no peace would be concluded by which Tirol would again be separated from Austria and Hofer returned home.

By the armistice of Znaim (July 12). however, Austria unconditionally surrendered Tirol and Vorarlberg. French and Bavarian troops again invaded the country, which rose once more. Hofer placed himself at the head of the movement,. After defeating the French on the Iselberg, he again entered Innsbruck. Hofer was elected *Oberkommandant* of Tirol and for two months ruled the country in the emperor's name. On Sept. 29 the emperor encouraged Hofer in the belief that Austria did not intend again to desert him; but the treaty of Schonbrunn (Oct. 14) again ceded Tirol to Bavaria. The French re-entered the country, and. an amnesty having been stipulated, Hofer and his companions submitted to France, though not to Bavaria. On Nov. 12, deceived by false reports of Austrian victories?Hofer attempted to renew the revolt; the regular forces proved too strong and Hofer took refuge, but was betrayed. On Jan. 27, 1810, he was captured by Italian troops, sent to Mantua, and was shot.

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HÖFFDING, HARALD (1843–1931), Danish philosopher who is remembered chiefly as a historian of philosophy, was born in Copenhagen on March 11, 1843. He was professor of philosophy there from 1883 to 1915. He died on July 2, 1931, in the same city. Höffding's major work is *Den nyere Filosofis Historie,* 2 vol. (Copenhagen, 1894–95; Eng. trans., *A History of Modern Philosophy,* London, 1900). His own philosophy is notable for his psychological voluntarism and for his view of religion, which he held to be the reaction of mind to the sense of value and which he made the basis of his ethical system.

His writings include, *Den engelske Philosophi i vor Tid* (1874); *Psykologi i Omrids paa Grundlag af Erfaring* (1882); *Etik* (1887); *Kontinuiteten i Kants filosofiske Udviklingsgang* (1893); *Rousseau og hans Filosofi* (1896; Eng. trans., *Jean Jacques Rousseau and His Philosophy,* 1930); *Det psykologiske Grundlag for logiske Domme* (1899); *Mindre Arbejder* (1899); *Religionsfilosofi* (1901; Eng. trans., 1906); *Udvalgte Skrifter,* 7 vol. (1902–09); *Moderne Filosofer* (1904; Eng. trans., 1915); *Danske Filosofer* (1909); *Oplevelse og Tydning* (1918); *Spinoza's Ethica* (1918); *Begrebet Analogi* (1923); and *Erkendelsesteori og Livsopfattelse* (1925).

HOFFMAN, MALVINA (1887–), U.S. sculptor, most famous for her bronze representations of ethnic types, was born in New York city on June 15, 1887. She studied in New York with Herbert Adams and Gutzon Borglum. In 1910 Miss Hoffman went to Paris, where until World War I she worked intermittently under Auguste Rodin. On his advice she studied anatomical drawing and dissecting at the College of Physicians and Surgeons, New York. Rodin's sculpture influenced her work in many ways—in erotic subject matter ("Offrande," 1919), in impressionistic technique ("Lovers' Prayer," 1923), in fleeting movement ("Bacchanale," 1917), and in vivid realism ("The Coal Man," 1928). In 1930 the Field museum (later Chicago Natural History museum) commissioned her to execute a series portraying the various "Races of Man." To make studies for the 101 bronzes, which bear such titles as "Blackfoot American Indian," "Hawaiian Surf-board Rider," and "Family Group of South African Kalahari Bushmen," she traveled around the world.

She also did a number of portraits, marked by unaffected characterization. Among these are three heads of Paderewski, showing him as the Friend, the Statesman, and the Artist (1920), and a bust of Wendell L. Willkie (1944). A war memorial, entitled "The Sacrifice" (1920), in Memorial chapel, Harvard university, is considered the finest of her ideal compositions. After 1911, when her "Russian Bacchanale" won first prize at the Paris Salon, Miss Hoffman received many awards and honorary degrees.

Her autobiography, *Heads and Tales,* appeared in 1936 and *Sculpture Inside and Out* in 1939. (M. I. B.)

HOFFMAN (HOFMANN), **MELCHIOR** (c. 1495–1543/4), German Anabaptist, was born at Schwäbisch-Hall. He was a furrier by trade, and worked as a Lutheran lay missionary in Livonia, Sweden and Lower Germany. Frederick I of Denmark appointed him a preacher at Kiel, in Holstein. The Zwinglian view of the Eucharist that he developed alarmed Martin Luther, and after the colloquy in Flensburg (1529), when he disputed with J. Bugenhagen, Hoffman was banished from Denmark. He went to Strasbourg, where he was converted to Anabaptism (*see* ANABAPTISTS) and became a proponent of the doctrine of the celestial flesh of Christ. Journeying to East Frisia (1530), he became the apostle of Anabaptism in the Netherlands, where his followers were known as Melchiorites. Elaborating his eschatological convictions, he returned in 1533 to Strasbourg, which was to be the seat of the New Jerusalem to await the Last Day. He was arrested there, and imprisoned. The last notice of his continued imprisonment is Nov. 19, 1543. Some of his ideas survived among the Mennonites.

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HOFFMANN, AUGUST HEINRICH (1798–1874), known as HOFFMANN VON FALLERSLEBEN, German patriotic poet, philologist, literary historian, whose "Deutschland über alles" was adopted as the German national anthem after World War I, was born at Fallersleben, near Brunswick, April 2, 1798. Having studied at the universities of Göttingen and Bonn, he was custodian of the university library at Breslau (1823–38), became extraordinary professor of German language and literature there in 1830 and ordinary professor in 1835. Removed by the Prussian authorities in 1842 for his *Unpolitische Lieder* (1840–41), he was allowed to return after the revolution of 1848. In 1860 he was appointed librarian to the duke of Ratibor at Corvey castle, where he died on Jan. 19, 1874.

Hoffmann was among the earliest and most effective of the poets who prepared the way for the revolutionary movement of 1848. He also composed political melodies for many of his songs, which were sung throughout Germany. His "Deutschland über alles," written in 1841, is typical in its expression of popular feeling—the wish for national unity felt by German liberals of the period. In the first line the word "Deutschland" was repeated to fit Haydn's tune, adopted from the Austrian national hymn. As a student of ancient Teutonic literature Hoffmann ranks among the most persevering and cultivated of German scholars. *Die deutsche Philologie im Grundriss* (1836) valuably contributed to philological research, and *Geschichte des deutschen Kirchenlieds bis auf Luthers Zeit* (1832; 3rd ed., 1861), *Unsere Volkstümlichen Lieder* (3rd ed., 1869) and *Die deutschen Gesellschaftslieder des 16 und 17 Jahrh.* (2nd ed., 1860) were also important.

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HOFFMANN, ERNST THEODOR WILHELM (1776–1822), German romance writer, composer, conductor, caricaturist, theatrical manager, lawyer and many other things, was born at Königsberg on Jan. 24, 1776. For the name Wilhelm he himself substituted Amadeus in homage to Mozart. He studied law at Königsberg, and began to practise in the town in 1795. He then moved to Glogau, in 1798 to Berlin, and in 1800 received an official legal appointment at Posen, which he lost through offending the authorities by his caricatures. He was sent to a little country town, Plozk, into virtual banishment. There he spent his leisure in musical composition, which was, throughout his life, his chief delight. In 1804 he received an appointment at Warsaw, where, through Zacharias Werner, he became acquainted with the work of Novalis, Ludwig Tieck, W. H. Wackenroder and other Romanticists. He was happy in Warsaw, where he wrote the music to Brentano's *Lustige Musikanten* and Werner's *Kreuz an der Ostsee;* also an opera, *Liebe und Eifersucht,* based on Calderón's drama *La Banda y la flor.* The French invasion (1806) put an end to this peaceful existence, and Hoffmann lived an uncertain and troubled life until 1814. He was for a short time musical director of a theatre at Bamberg, then at Dresden, and wrote sketches in the *Allgemeine Musikalische Zeitung,* ultimately included in the *Phantasiestücke in Callots Manier* (4 vol., 1814–15).

In 1814 he resumed his legal profession in Berlin, and two years later he was appointed councillor of the court of appeal. Hoffmann had the reputation of being an excellent jurist and a conscientious official; he had leisure for literary pursuits and belonged to the circle of Romantic poets and novelists who gathered around Fouqué, Chamisso and his old friend J. E. Hitzig. He had a great musical success with his opera *Undine* (1816; libretto by F. de la M. Fouqué) and, under the name of "Johannes Kreisler, Kapellmeister," he wrote the excellent musical criticism on J. S. Bach—at that time almost forgotten—Beethoven and others, which inspired Schumann's *Kreisleriana.* To his Berlin period belong the great series of tales which have placed Hoffmann in the short list of great storytellers of the strange and grotesque. Unfortunately habits of intemperance grew on him, and his health became speedily undermined. He died on June 25, 1822.

The *Phantasiestücke,* with a preface by Jean Paul (J. P. F. Richter), were followed by the gruesome novel—to some extent inspired by M. G. Lewis' *Monk—Die Elixiere des Teufels* (1816), and the even more gruesome stories which make up the *Nachtstücke* (1817). The full range of Hoffmann's powers is first

clearly displayed in the collection of stories *Die Serapionsbrüder* (1819–21), this being the name of a small club of Hoffmann's more intimate literary friends. *Die Serapionsbriider* includes not merely stories in which Hoffmann's love for the mysterious and the supernatural is to be seen but novels in which he draws on his own early reminiscences *(Rat Krespel, Fermate),* finely outlined pictures of old German life *(Der Artushoj, Meister Martin der Küfner und seine Gesellen)*, the fairy-tale *Nussknacker* and *Mausekönig* (which inspired Tschaikovsky) and vivid and picturesque incidents from Italian and French history, *Doge und Dogaresse,* the story of Marino Faliero, and *Das Fräulein con Scudéri.* The last-mentioned story is usually regarded as Hoffmann's masterpiece. *Klein Zaches, genannt Zinnober* (1819) and *Lebensansichten des Katers Murr, nebst fragmentarischer Biographie des Kapellmeisters Johannes Kreisler* (1821–22) are good examples of his powers as a humorist.

Hoffmann is one of the master storytellers of the Romantic movement in Germany. He possessed a humour that is reminiscent of Jean Paul, but he was supreme in the almost clairvoyant powers of his imagination. His work abounds in grotesque and gruesome scenes; the morbid and supernatural, animal magnetism, the *Doppelgänger,* the automaton were made famous by him in literature. But this was only one outlet for Hoffmann's genius, and even here the secret of his power lay not in his choice of subjects but in the wonderfully vivid and realistic presentation of them. Every line he wrote leaves the impression that it expresses something felt or experienced. Himself ugly and ridiculous to the eye, he combined detached common sense with ecstatic, alcoholically induced exaltation. This realism, in the best sense of the word, made him the great artist he was, and gave him so extraordinary a power over his contemporaries. His influence in France and in England and America (on Musset, Gautier, Baudelaire, Carlyle. Scott. Poe. Wilde and others) was, in fact, as great as in his own country; it was felt also in Denmark (by, for example, Hans Christian Xndersen). Sweden, Russia and Poland.

With respect to his work as a composer, his *Cndine* was a minor classic of its period. though he will probably be longest remembered by musicians in having provided the inspiration and the book for Offenbach's *Les Contes d'Hoffmann* ("Tales of Hoffmann"), based on three of his fantastic stories.

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HOFFMANN, MAX (1869–1927), German general, was born at Homburg on Jan. 25, 1869. He spent many years in Russia, and was sometime general staff officer in the provinces of Posen and East Prussia. In 1914 he was general staff officer to the VIII army, was present at Tannenberg, became quartermaster-general of the eastern command and in 1916 succeeded Ludendorff as chief of the general staff in the east, under Prince Leopold of Bavaria. From that time he was mainly responsible for the operations on the eastern front. In Dec. 1917 he conducted, on the German side, the negotiations with the Russians at Brest-Litovsk, and in February signed the treaty with the Ukraine. After World War I he engaged in a lively controversy with Ludendorff. The rift seems to have dated from Jan. 1918, when Hoffmann read to the emperor, William II, a memorandum condemning Ludendorff's scheme of Polish annexations. He sharply criticized the German high command in his book (1923), *Der Krieg der versäumten Gelegenheiten* (the War of Lost Opportunities), which, in spite of the evident animus against Hindenburg, Ludendorff and Falkenhayn, is a document of considerable importance to the student of the war. In *Tannenberg wie es wirklich war* (1927) he impugned the official account of the victory of Tannenberg, which was, he says, due to strategic orders drawn up before Hindenburg and Ludendorff arrived, and to the tactics of Gen. François, who commanded the I corps, and went his own way in defiance of Ludendorff's orders. Gen. Hoffmann is credited with a scheme for military intervention in Russia in 1922, and he wrote a book against Bolshevism, entitled *An allen Enden Moskau* (1925). He died on July 8, 1927.

HOFMANN, AUGUST WILHELM VON (1818–1892), German chemist whose research on aniline, with that of Sir William H. Perkin (*q.v.*), helped lay the basis of the aniline dye industry, was born at Giessen in western Germany on April 8, 1818. He first read law and philosophy at Giessen and then studied chemistry under Justus von Liebig. He acted for a short time as *Privatdozent* ("official but unpaid lecturer") at Bonn and then, in 1845, accepted the invitation, made at the suggestion of Prince Albert, to become the first director of the new Royal College of Chemistry, London. Many of the leaders of British chemistry were trained there under him. In 1864 he returned to Bonn, but before he moved into the laboratory there, which had been built under his direction, he succeeded (1865) Eilhardt Mitscherlich as professor of chemistry and director of the laboratory in the University of Berlin. He continued his excellent work there as teacher and researcher until his unexpected death on May 5, 1892. In 1868 Hofmann founded the German Chemical society and he was for many years its president. Its home in Berlin was opened in 1900, and was named the Hofmann Haus in his memory. He also served as president of the British Chemical society. He was ennobled on his 70th birthday.

Hofmann's work covered a wide range of organic chemistry. His first research, carried out in Liebig's laboratory at Giessen, was on coal tar, and his investigation of organic bases established the nature of aniline. In 1845 he developed a method of preparing aniline from benzene. His perception of the analogy between it and ammonia led to his famous work on the amines and organic ammonium bases and the allied phosphorus compounds, while his researches on rosaniline, which he first prepared in 1858, formed the first of a series of investigations on colouring matters which culminated in the discovery of quinoline red in 1887. Hofmann is also known for his discovery of allyl alcohol (with Auguste Cahours), of formaldehyde, hydrazobenzene and the isonitriles. He discovered a method of converting an amide into an amine containing one carbon atom less, and this important reaction is now known by his name. Hofmann's method for determining molecular weight of liquids by means of vapour densities was an important contribution to chemistry.

In addition to the investigations for which he was responsible, he exercised considerable influence on chemical progress through the valuable work of his pupils, among whom were Perkin, discoverer of mauve, Peter Griess, the discoverer of diazo compounds, and Sir William Crookes. Almost 1,000 papers came from his laboratory and nearly 300 of these represent his own work. Among his scientific publications were *Handbook of Organic Analysis* (1853) and *Einleitung in die moderne Chemie* (6th ed., 1877). After Liebig's death (1873) he succeeded to the editorship of the *Annalen der Chemie.* He was the possessor of a clear and graceful, if somewhat florid, style which showed to special advantage in his numerous obituary notices or encomiums (collected and published in three volumes, *Zur Erinnerung an vorangegangene Freunde,* 1888). He delivered speeches in four languages. His other historical works were *Berliner Alchemisten und Chemiker: Ein Jahrhundert chemischen Forschung unter dem Schirm der Hohenzol-*

lern. The two volumes of the letters of Liebig and Friedrich Wohler (1888) were issued under his guidance.

As a teacher, besides the power of accurately gauging the character and capabilities of those who studied under him. he had the faculty of infecting them with his own enthusiasm and thus of stimulating them to put forward their best efforts. In the lecture room he laid great stress on the importance of experimental demonstrations, paying particular attention to their selection and arrangement, though since he himself was a somewhat clumsy manipulator, their actual exhibition was generally entrusted to his assistants. Many of the standard lecture demonstrations were invented by Hofmann.

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(R. E. O.; X.)

HOFMANN, JOSEF CASIMIR (1876–1957), pianist and composer, was born at Cracow, Pol., Jan. 20, 1876. At seven he attracted Rubinstein's attention, becoming his pupil. Touring Europe at nine, he went to the United States two years Iater, giving 52 concerts, but mas compelled to stop by the Society for Prevention of Cruelty to Children. He returned to Europe, studied further under Rubinstein, Urban and Moszkovski, and resumed public performances in 1894. When the Curtis Institute of Music, Philadelphia, was endowed in 1924, he was invited to head the piano department. He became the director in May 1927, not long after his naturalization as a U.S. citizen, and served until 1938. His compositions include a symphony, much piano music. an orchestral suite. *Mignonettes,* four *Old Dutch Songs, Trois Impressions* and *Valse Caprice.* He was the author of *Piano Playing* (1898). Hofmann died in Los Angeles, Calif., on Feb. 16, 1957.

HOFMANNSTHAL, HUGO VON (1874–1929), Austrian poet, was born in Vienna on Feb. 1, 1874. He took the degree of Ph.D. at the University of Vienna and when still a schoolboy originated the romantic school in Austria by his lyric and semidramatic poetry, which aroused much controversy at the time. He was not uninfluenced by Stefan Georg's example and Hermann Bahr's criticism, but the melody and colour of his language, and the art with which he gave poetic expression to complicated spiritual moods were new. He had genius for appreciating bygone cultures and a sensitive understanding of the beautiful in art and in nature.

Hofmannsthal is little indebted to contemporary realism, but his almost too susceptible personality is tinged by innumerable literary influences from the Attic tragedians down to Victor Hugo, Swinburne, Browning and D'Annunzio. This is especially noticeable in his dramatic poems, not a few of which are simply old plays of Sophocles, of Calderon, Molière and Otway cloaked in modern form and spirit. Nevertheless he has an abiding place in the history of literature as founder of the whole German neo-romantic drama. Some of his dramas became known outside Austria and Germany through the music of his friend Richard Strauss, others through Reinhardt's Festival plays at Salzburg. His collected poems appeared in 1911, his collected prose began to appear in 1907. In later years he turned his attention to society comedy. The most characteristic of his original dramas are: *Gestern* (1891); *Der Tod des Tizian* (1892); *Der Tor und der Tod* (1893); *Der Abenteurer und die Sängerin* (1899); *Oedipus und die Sphinx* (1906); *Cristinas Heimkehr* (1910); and his libretti: *Elektra* (1903); *Der Rosenkavalier* (1911); *Ariadne auf Naxos* (1912); *Die Frau ohne Schatten* (1919); and *Der Unbestechliche* (1923). He died on July 15, 1929.

HOFMEISTER, WILHELM (FRIEDRICH BENEDICT) (1824–1877), German botanist and pioneer investigator of the comparative embryology of plants who greatly influenced botanical research, was born at Leipzig on May 18, 1824. He entered his father's publishing and bookselling business in 1841. Meanwhile his interest in botany was developing. Entirely self-taught, he published his first paper, on investigations concerning the process of fertilization of *Oenothera,* in 1847. His next studies concerned sexuality and origin of the embryo of phanerogams (seed plants). His short hut epoch-making paper, "Embryology of Flowering Plants" (1849), settled the question of the origin of the embryo from an ovum, as against the prevalent pollen-tube theory of M. J. Schleiden. Hofmeister's study of the embryology of Bryophytes and Pteridophytes led to his accounts of the germination of the spores and fertilization in *Pilularin, Salvinia, Selaginella.* His important work, *On the Germination, Development and Fructification of the Higher Cryptogamia* (1851; Eng. trans., 1862) demonstrated the life story of liverworts, mosses, ferns. equiseta. rhizocarps. lycopodiaceae and even gymnosperms, and the analogy between these higher cryptogams and the conifers. He clearly established that there is an alternation of generations in plants as had recently been shown in animals.

Hofmeister remained in business until 1863, then was appointed professor of botany and director of the botanical garden at Heidelberg. He became professor at Tübingen in 1871. He died at Lindenau, near Leipzig. on Jan. 12, 18; 7.

See K. E. von Goebel, *Wilhelm Hofmeister* (1924, Eng. trans., 1926).

HOFMEYR, JAN HENDRIK (1845–1909), South African statesman, for many years leader of the Afrikander Bond in the Cape Colony, was born in Cape Town on July 4, 1845, and educated at the South African college. He entered public life through journalism, as editor of the *Volksvriend* (1861–71) and of the united *Zuid Afrikaan* and *Volksvriend* (1871–83). He also founded a literary periodical, *Zuid Afrikaansche Tijdschrift,* in 1878. Though an admirer of English culture, "Onze Jan," as he later came to be called, worked successfully to revive the waning Dutch culture of the Cape. more especially the Dutch language (which he always preferred to the spoken Afrikaans); and his efforts, with the help of many others, led by the end of the century to the recognition of Dutch as an official language for most purposes.

The son of a wine farmer. Hofmeyr established a Boeren Beschermings Vereeniging (Farmers' Protection association) in 1878, with the long-term object of making the Afrikaner Boer as politically conscious as his English-speaking counterpart. In 1879 he entered parliament as member for Stellenbosch at the head of a small, loosely knit party. The establishment of the Afrikander Bond in 1879 faced Hofmeyr with a difficult problem, for he did not share the hostility toward things English which this rival political movement then manifested. By astute maneuvering, however. he secured the amalgamation of the Bond and his own association in 1883, retaining the parliamentary leadership of the united body; he strengthened his hold still more in 1889, when he became chairman of the organization's new disciplinary committee, Commissie van Toezicht op Electies.

As leader of the only organized party in the Cape parliament. Hofmepr commanded enough votes to make and unmake ministries and secure the passage of measures agreeable to the Bondsmen. His refusal to form a government was a constant theme of attack by his opponents, though it may be doubted if it mas ever in fact possible for him to form a stable administration. He held cabinet rank only for a few unhappy months in 1881, and retired from parliament in 1895, though his political influence was hardly diminished thereby. To some extent, Hofmeyr was affected by the anti-imperial spirit of the early 1880s, opposing the restoration of British rule in Basutoland or its establishment in Bechuanaland. Native policy, he considered, was a matter not for the British, but for South African governments working in co-operation. He was slow to grasp the need for South African economic federation until after the discovery of gold on the Rand (1886), and even then continued to back for a while the isolationist railway policy of the Transvaal. By degrees, however, his political horizon broadened, as shown by the constructive part he played in the imperial conferences of 1887 and 1894. By 1890 he had moved far enough to support Cecil Rhodes's schemes for the opening up of the north as a Cape colonial venture.

His alliance with Rhodes during the latter's premiership (1890–95) was of advantage to both parties. Rhodes obtained a secure basis of power in the colony; the Bondsmen obtained agricultural. labour and railway policies to their liking, and their membership rose markedly. The Jameson raid, however. led to a complete breach between Hofmeyr and Rhodes, and the dark night of Hofmeyr's political career began. His masterly statesmanship during

the raid crisis, designed not only to expose the guilty but also to reconcile the imperial and Transvaal authorities, was matched by his responsible handling of the 1899 crisis. But his efforts to maintain peace were ineffective. partly because, though he persuaded Paul Kruger to give a little ground, he was not correspondingly successful with Sir Alfred Milner. He retired to Europe during. the South African War. a sick and disillusioned man.

Returning to the Cape in 1902. Hofmeyr resumed effective leadership of the Bond. which supported a policy of reconciliation between Boer and Briton. In the movement tonard union, he was a lively supporter of Dutch language rights and of the Cape nonwhite franchise and, unlike most leaders outside Satal. advocated a federal rather than a unitary constitution. He went to London, however, in the delegation which presented the draft Act of Cnion to the British government. and died there on Odt. 16. 1009.

See J. H. Hoimcyr, *The Life of Jan Hendrik Hofmeyr (1913).*

(T. R. H. D.)

HOFSTADTER, ROBERT (1915–), U.S. physicist awarded the 1961 Nobel prize for physics, jointly with Rudolph Mössbauer. for his investigations of the structure .of atomic nuclei and nucleons, was born in New York city on Feb. 5. 1915. He received his undergraduate education at City College of New York and attended Princeton university. where he obtained the degree of doctor of philosophy in 1938. During World War II he worked on military equipment at the national bureau of standards and the Norden Corp.. returning to Princeton in 1916. Up to the time he left there to join the faculty of Stanford university in 1950, his principal scientific work dealt with infrared spectroscopy. photoconductivity? and crystal and scintillation counters. At Stanford, he first used the high-voltage linear electron accelerator to explore the structure of atomic nuclei by means of electron scattering. Using the same equipment, he also made quantitative measurements of the sizes and shapes of nucleons (protons and neutrons), the basic building blocks of nuclei. (L. I. S.)

HOG: *see* PIG.

HOGARTH, DAVID GEORGE (1862–1927), English archaeologist, was born on May 23, 1862, at Barton-on-Humber, Lincs, the son of a clergyman, and died at Oxford on Nov. 6, 1927. He had been president of the Royal Geographical Society since 192j and keeper of the Ashmolean museum since 1909. He was not only one of the greatest scholars of his time but also a man of action who left his mark on the middle east through the magnificent work which he did as director of the Arab Bureau at Cairo during the World War.

Hogarth was educated at Winchester and Magdalen college, Oxford, of which he became a fellow in 1886. In 1893 he was elected a research fellow to carry out archaeological investigations in the Levant. He conducted explorations in Cyprus, Egypt, Ephesus, Carchemish and Crete (1887–1907). He was for a time director of the British school at Athens and in 1899 became director of the Cretan exploration fund.

In 191j he was sent to Cairo by the director of naval intelligence with the temporary rank of lieutenant-commander to take charge of the communications with the Xrab leaders which were intended to lead to the Arab revolt against Turkish rule. Sext year he began to build up at Cairo that Xrab Bureau which drew into its service Gertrude Bell. Mark Sykes, T. E. Lawrence and other brilliant servants. He then returned to London to work there on Arab and middle-eastern problems. returning to Cairo in the last year of the war. In 1919 he was British commissioner at the Middle-East Commission of the Paris Peace Conference.

His works include *A Wandering Scholar in the Levant* (1896), which at once won for him the love of many readers: *Philip and Alexander of Macedon* (1897); *The Nearer East* (1902); The *Penetration* of *Arabia* (1904); *Carchemish* I. (1914); *The Wandering Scholar* (1925); *Kings oj the Hittites* (1926); etc. etc.

HOGARTH, WILLIAM (1697–1764), the first great English-born painter and engraver, who uas especially popular on account of his moral and satirical paintings. was born in the City of London on Sov. 10. 1697. His father was Kichard Hogarth, a schoolmaster who had come to London from Westmorland to obtain literary work, but failed to make more than a meagre living. The son was from childhood fond of drawing and this interest led to his being apprenticed to an engraver of arms on silver plate near Leicester Fields, nhere he came in touch with the Huguenot community who brought over prints from France 'The end of his apprenticeship, together nith the death of his father in 1718, left Hogarth free to follow his own devices. Heraldry did not appeal to him and by 1720 he had set up for himself in the same neighbourhood as an engraver on copper. Beginning with shop hills, he proceeded in 1723 to book illustrations. the best of which are those for Samuel Butler's *Hudibras* (1726) He also designed satiric prints on the fashions of the day. such as "Masquerades and Operas" (1724) These had a brief popularity, but were soon pirated

In 1720 Hogarth had become a not very diligent student at Cheron and Vanderbank's academy in St Martin's lane in order to study from the model, and he may also have attended the free school opened by Sir James Thornhill However, he disapproved of copying as an exercise and preferred to rely on his own method of training the memory by close observation of persons and scenes noticed in the course of his amusements until he could reproduce their characteristics. He took naturally to the use of oils. a fluid medium which lent itself to the free expression of his ideas. In 1727, he painted a design called "The Element of Earth" for a tapestry maker. who rejected it on the grounds that he had since learned that Hogarth was an engraver and not a painter: but in the ensuing litigation Hogarth was able to produce evidence of his ability and won his suit. The following year he produced his first painting of a scene from The *Beggar's Opera* then running in London. and this proved so popular that he was called upon for repetitions (one in the Tate gallery. London).

In 1729 Hogarth eloped with Sir James Thornhill's daughter Jane. an event which affected the subsequent course of his work. Being now under an obligation to provide for a family. he took to painting small portrait groups of the type known as conversation pieces. Those done during the next three years include "The Wedding" (New York), "The Assembly at Wanstead House" (Philadelphia,), "The Wollaston Family." "The Conquest of Mexico," "The Cholmondeley Family." and two unfinished sketches of the royal family (one at Dublin). Some of these have great charm and vivacity. which has made them among the most popular of his works. In fact, though it was only a short time since he had been dependent on his engravings. Hogarth was now at the height of his fame as a painter, and George Vertue could write of him in 1729, "happy are they who can get a picture of his painting." Unfortunately the labour was immense in relation to the remuneration (in one instance the number of likenesses to be included were 25), so that this only proved another form of drudgery.

Meanwhile. Hogarth had been following his natural bent for social satire in such works as "The Denunciation" (Dublin). By 1731, he had completed the six pictures entitled "A Harlot's Progress" (destroyed by fire in 1755), the first of the great sets of works arranged like acts in a play, on which his fame as an original artist most securely rests. "Subjects." he wrote. "I considered as writers do. My picture was my stage and men and women my actors who were by means of certain actions and expressions to exhibit a dumb show." He engraved the "Harlot's Progress" himself. and when the prints were published the next year they had an instantaneous success. which was enhanced by the fact that gossip could identify some of the figures with well-known people. So many were sold that Hogarth could henceforth look upon the proceeds of his printing press as the revenues of ,an estate, and in 1733 he bought himself a large house in Leicester square. which he occupied for the rest of his life. The eight pictures of "A Rake's Progress" (Sir John Soane's museum. London) soon followed; but he still suffered from piracy and publication of the engravings was held up until 1735, when he secured the passing of a statute, still known as "Hogarth's act." to protect the copyright of original artists in their own designs. Other popular prints from paintings appearing during 1733–38 were "A Midnight Modern Conversation." "Sarah Malcolm." "South\\-ark Fair." "The Distressed Poet," "Four Times of the Day," and "Strolling Actresses Dressing in a

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"HEADS OF SIX OF HOGARTH'S SERVANTS" BY WILLIAM HOGARTH. IN THE NATIONAL GALLERY, LONDON

Barn"; but these had no such moral purpose as the "progresses," being intended simply for entertainment.

Thus assured of a regular income. Hogarth could afford to divert his energies to less remunerative work. A major influence on his determination to become an artist had been Thornhill's frescoes for St. Paul's cathedral, and "history painting," as it was then called, was regarded as the highest form of art. In 1733, having been elected a governor of St. Bartholomew's hospital, he announced his intention of adorning the staircase with large mural paintings at his own expense and carried out his offer in the next year or so with "The Pool of Bethesda" and "The Good Samaritan," the first of his scriptural subjects. The experiment, however, met nith little response.

On Thornhill's death in 1734 his art school in St. Martin's lane had passed to Hogarth, who turned it into a sort of club, where many of the leading artists came to study and hold lively debates on the state of British art, still overshadowed by that of the continent. Hogarth refused to accept the defeatist attitude of his colleagues, and the opening in 1739 of the Foundling hospital, London, in which he was actively interested, gave him a chance of displaying his own prowess by presenting it with a large portrait of the founder, his friend Capt. Thomas Coram. Ambitious to succeed in the most profitable branch of his profession, he painted a number of portraits during the next few years, notably "The Graham Children" in 1742 and "Mrs. Salter" in 1744 (both in the Tate gallery, London). But his reputation as a satirist was against him and though he had a few staunch supporters and received the highest fee yet paid in England for his "Garrick as Richard III" (Liverpool), he did not meet with the success for which he had hoped.

In 1743 he announced the forthcoming publication of his most famous set of works, "Marriage a la Mode" (Tate gallery), in which the disastrous results of a union contrived from mercenary motives are displayed. Having no high opinion of his own powers as an engraver where fine work was required, he decided to have the paintings engraved by other hands, and his visit to Paris in the same year may have been for this purpose. The six plates appeared in 1745 and added to his laurels in this field. His reputation as a painter, however, was falling in inverse proportion to the popularity of his prints. As a result of a feud with the art dealers, whom he held responsible for foisting bogus old masters on the public, he conducted a sale by auction of his best-known pictures in 1745. The prices bid were ridiculously low and the originals of "Marriage à la Mode" remained on his hands? to be sold six years later for 20 guineas apiece. This may explain why the series of paintings to be known as "The Happy Marriage" remained unfinished, though "The Dance" (Camberwell, London). with its effect of flickering light, ranks among his finest efforts, along with other oil sketches, such as "The Shrimp Girl" (National gallery, London).

In 1746 Hogarth renewed his attempt to encourage British artists by organizing a permanent exhibition of their works at the Foundling hospital, the first exhibition of its kind in England, his own contribution being "Moses Brought to Pharaoh's Daughter." The so-called "March to Finchley" (Foundling hospital), a return to satirical subjects, is of the same period. The didactic prints of "Industry and Idleness." done from drawings, came out in 1747, to be followed four years later by "The Four Stages of Cruelty," "Gin Lane" and "Beer Street," which were intended to reform rather than amuse. In 1748 Hogarth painted "Paul before Felix" for Lincoln's Inn and went over to France again, only to be turned back at Calais on suspicion of spying while sketching the fortifications, as seen in "Calais Gate" (Tate gallery).

Having acquired a summer villa at Chiswick in 1749, and discouraged by the reception of his paintings, Hogarth went into seclusion for the next few years to compose his *Analysis of Beauty*, "written with a view to fixing the fluctuating Ideas of Taste" and published in 1753. The notion had long been simmering in his mind and the serpentine "Line of Beauty," shown on the palette in his self-portrait of 1745 (Tate gallery), had raised enquiries as to its meaning, which he now sought to satisfy by demonstrating that it was the underlying principle of enjoyment of beauty in life as well as in art. The line, it should be noted, was three-dimensional, his doctrine being based on seeing things in the round. The book had some success abroad, but only served to harden opinion against him in England as an arrogant ignoramus.

He returned to painting with the "Election" series of 1754 (Soane's museum), a large altarpiece for Bristol in 1756, and a few more portraits. In spite of his appointment as serjeant-painter to the king in 1757, in the closing years of his life Hogarth was frustrated and unhappy. After painting "The Lady's Last Stake" (Fine Arts academy, Buffalo, N.Y.) in 1759 by way of a farewell to his brush, he was persuaded to take it up once more and produced his ambitious "Sigismonda" (Tate gallery), which provoked a storm of ridicule. As the result of a political quarrel in 1762, when he was in ill health, he was savagely attacked by John Wilkes and his friend Charles Churchill and retaliated with biting caricatures of both men. He died suddenly at his house in Leicester square on Oct. 26, 1764, and was buried at Chiswick.

Although he was the first English-born artist of international status and innumerable feeble imitations of his prints were made, Hogarth can hardly be said to have had any great influence on the art of his time, except possibly through his conversation pieces. His prints passed rapidly abroad and it is impossible to estimate the effect of his works on later generations of artists. The incisive quality of his engravings was well suited to their purpose of inculcating a moral, while his merits as a painter have come to be more and more appreciated since the first exhibition of his paintings in 1814. He played an important part in the emancipation of British art by means of his own academy and exhibitions of contemporary works.

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HOG CHOLERA: *see* SWINE FEVER.

HOG DEER, small, stocky, reddish-brown deer, *Cervus (Axis, Hyelaphus) porcinus,* native to southeastern Asia. *See* DEER.

HOGG, JAMES (1770–1835), Scottish poet, known as "the Ettrick shepherd," was baptized at Ettrick, Selkirkshire, on Dec. 9, 1770. His ancestors had been shepherds for generations, and he himself was a shepherd from 1790 to 1799 at Yarrow. On the recommendation of Sir Walter Scott. Constable published his miscellaneous poems *(The Mountain Bard)* in 1807. The proceeds of this book and of another on the treatment of sheep were invested by Hogg in a ruinous farming enterprise in Dumfrieshire,

and the poet went to Edinburgh to make his living by writing. In 161; he was provided by the duke of Buccleuch with a small farm at Altrive, Yarrow, and in 1820 he married Margaret Phillips. He died on Nov. 21, 1S3j. and was buried at his native place. Hogg is familiar to many readers as the "Shepherd" of Wilson's *Noctes Ambrosianae*. Hogg's most important volumes are: *Scattish Pastorals* !1801), *The Mountain Bard* (1807), *The Queen's Wake* (1813), *Evening Tales* (1820), *The Shepherd's Calendar* (1829) and *Lay Sermons* (1834).

See Hogg's "Memoir of the Author's Life, written by himseli." prefixed to the 3rd ed. (1821) of *The Mountain Bard;* also *Memorials of James Hogg, the Ettrick Shepherd,* ed. by his daughter, Mrs. M. G. Garden (enlarged ed. with preface by Veitch, 1903), and Sir G. B. S. Douglas; *James Hogg,* "Famous Scots Series" (1899); also *Poems of James Hogg,* selected by William Wallace (1903). *See* also Mrs Oliphant. *Annals of a Publishing House,* vol. i., chap. vii., and G. Gilfillan, *First Gallery of Literary Portraits.*

HOGG, QUINTIN (1845–1903), English philanthropist and originator of the Polytechnic. was born in London Feb. 14. 1845, and educated at Eton. He chose mercantile n-ork in London and became associated n-ith Lord Kinnaird and his philanthropic "ragged schools." intended to educate destitute children and "save them from vagrancy and crime." Hogg's interest in education began with a reading lesson given to a couple of crossing sweepers. He opened a ragged school in "Of Alley," no!~Cork place. Charing Cross. and in 1868 it was moved to Castle street. Ten years later a Working Lads' institute was set up at Long Acre and in 1881 Hogg acquired the building known as the Polytechnic in Regent street. This had previously been a place of popular entertainment. Hogg carried on the work of the Polytechnic without the aid of public funds until 1889, when it received money through a redistribution of the city parochial charities and came under the supervision of the London County council. The Polytechnic developed a large number of activities. social, recreational and educational. and the parent institution gave rise to similar education centres elsewhere (*see* POLYTECHNIC). Hogg died in London on Jan. 17, 1903.

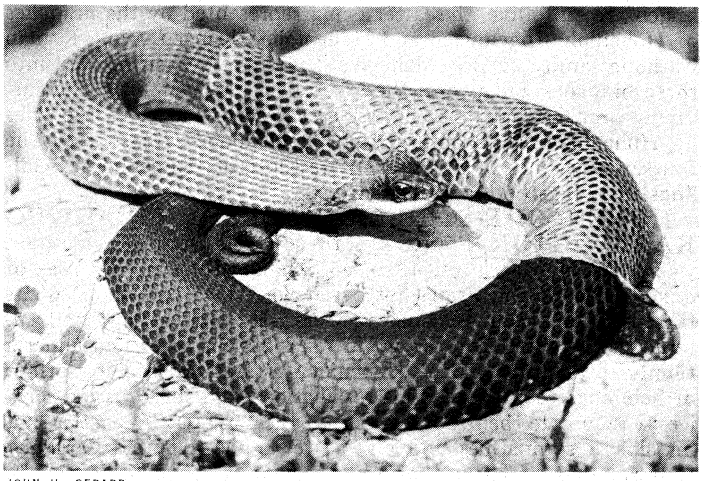
Hogg's remarkable success with boys sprang from his understanding of them, his sincerity and his convinced belief in Christianity, which he put into practice.

See E. M. Hogg (afterward Wood), *The Polytechnic and Its Founder, Quintin Hogg* (1932). (S. J. C.)

HOGG, THOMAS JEFFERSON (1792–1862), English man of letters, was born in Norton. Durham. He was educated at Durham grammar school and at University college. Oxford. where he became the friend of Shelley. with whom in 1811 he nas expelled from the university for refusing to disclaim connection with the authorship of the pamphlet *The Necessity for Atheism.* He then studied law at Tork for six months. Hogg's behaviour to Harriet Shelley interrupted his relations with her husband for some time. but in 1813 the friendship was renewed in London. In 1817 Hogg was called to the bar, and became later a revising barrister. In 1844 he inherited £2.000 under Shelley's will; and in 1855, in accordance with the wishes of the poet's family, began to write Shelley's biography. The first two volumes were published in 1858, but they proved to be more autobiography than biography, and Shelley's representatives refused Hogg further access to the materials necessary for its completion,

HOGMANAY, the name in Scotland and parts of the north of England for New Year's Eve, as also ior the dole of bread. cake or sweets then given to the children that go from house to house soliciting it with traditional rhymes, one of n-hich concludes with "Rise up and gie's our Hogmanay." On this evening also it is traditional for parties of masked children or young men to visit houses as guisers or mummers. Of local customs formerly observed at Hogmanay. the "burning of the clavie" (a bonfire of split casks, in which a nail plays a part) still flourishes at Burghead in Moray. The derivation of the term is doubtful. For \-arious theories *see* R. Chambers (ed.). *The Book of Days* (1864; reprinted 1914). (J. F. OF K.)

HOGNOSE SNAKE, the name applied to the North American snakes of the genus *Heterodon.* The name is due to the sharp angular snout, used in burrowing. The commonest species.



JOHN H. GERARD

HOGNOSE SNAKE SHEDDING ITS SKIN

H. platyrhinos, may reach a length of 3 ft. All species are harmless. feeding especially on toads. Eggs. laid in midsummer. hatch in autumn. Although the several species of hognose are harmless. they have an aggressive, bluffing defense—all spread the neck and inflate the lungs when molested, the front half of the body being puffed up to twice its normal diameter; if this fails to repel an enemy. they "play dead." (K. P. S.; X.)

HOHENLIMBURG, German town, on the Lenne. in the *Land* of North Rhine-Westphalia, 30 mi. S. of Dortmund. Pop. (1950) 23.862. Iron and metal and textile industries are carried on. It is the chief town of the *Kreis* of Limburg. Hohenlimburg castle overlooks the town.

HOHENLINDEN, BATTLE OF. In this battle on Dec. 3, 1800, Moreau turned the tables on the Austrians, who had planned his encirclement, and, destroying them by an able countermaneuver. struck the decisive blow of the campaign in Germany. The result. combined n-ith Napoleon's victory at Marengo in Italy, led to the peace oi Lunéville which ended the war of the Second Coalition. *See* FRENCH REVOLUTIONARY WARS.

HOHENLOHE, a German princely family which took its name from the district of Hohenlohe in Franconia. At first a countship. its two branches were raised to the rank of principalities of the empire in 1744 and 1764 respectively. In 1806 they lost their independence and their lands became part of the kingdoms of Bavaria and oi Württemberg. At the time of the mediatization the area of Hohenlohe was 680 sq.mi. and its estimated population 108.000. The family is first mentioned in the 12th century as possessing the castle of Hohenloch or Hohenlohe, near Uffenheim, and its influence was soon perceptible in several of the Franconian valleys. including those of the Kocher, the Jagst and the Tauber. Henry I id. 1183) was the first to take the title of count of Hohenlohe. and in 1230 his grandsons Gottfried and Conrad. supporters of the emperor Frederick II, founded the lines of Hohenlohe—Hohenlohe and Hohenlohe-Brauneck. The latter became extinct in 1390, while the former was divided into several branches. only two of which, Hohenlohe-Weikersheim and Hohenlohe-Uffenheim-Speckfeld (extinct in 1412), need be mentioned here. Hohenlohe-Weikersheim, descended from Count Kraft I (d. 1313), also underwent several divisions, that which took place after the deaths of Count Albert and Count George in 1j51 being specially important. In 1j51 the lines of Hohenlohe-Neuenstein and Hohenlohe-Waldenburg were founded by the sons of Count George, from which are descended the existing branches of the Hohenlohe family.

The former of these became Protestant. while the latter remained Catholic. Of the family of Hohenlohe-Neuenstein, which underwent several partitions and inherited Gleichen in 1631, the senior line became extinct in 1805, while in 1701 the junior line divided itself into three branches, those of Langenburg. Ingelfingen and Kirchberg. Kirchberg died out in 1861. Members of the families of Hohenlohe-Langenburg and Hohenlohe-Ingel-

fingen are still alive. the latter being represented by the branches of Hohenlohe-Ingelfingen and Hohenlohe-Öhringen. The Roman Catholic family of Hohenlohe-Waldenburg was soon divided into three branches. but two of these had died out by 1729. The surviving branch, that of Schillingsfiirst, was divided into the lines of Hohenlohe-Schillingsfürst and Hohenlohe-Bartenstein. The four existing lines of this branch are those of Waldenburg, Schillingsfiirst, Jagstberg and Bartenstein.

HOHENLOHE-SCHILLINGSFURST, CHLODWIG KARL VICTOR, PRINCE OF (1819–1901), German chancellor, was born on March 31, 1819, at Schillingsfürst in Bavaria, of mixed Catholic and Protestant parentage, which perhaps accounts for his tolerance in religious matters. He studied law, and entered the Prussian civil service in 1844, but his accession, under a family distribution of the Hohenlohe estates, as reigning prince of Schillingsfurst, entailed his resignation from the Prussian service in 1846. He then took his seat in the Bavarian Reichsrat, but his liberal sympathies and his desire to see a united Germany compromised his chances of advancement at the Bavarian court. Prince Hohenlohe married, in 1847, a Russian heiress, the Princess Marie of Sayn-Wittgenstein-Berleburg. He spent much time at various European courts, and was in touch with important people in Vienna, St. Petersburg (now Leningrad), and London.

It was Wagner, apparently, who persuaded the Bavarian king to place Hohenlohe at the head of his Government (*Denkwürdigkeiten*, i. 178, 211), and on Dec. 31, 1866, the prince was duly appointed minister of the royal house and of foreign affairs and president of the council of ministers.

As head of the Bavarian Government Hohenlohe's principal task was to discover some basis for an effective union of the South German States with the North German Confederation, and during the three critical years of his tenure of office he was, next to Bismarck, the most important statesman in Germany. He reorganized the Bavarian army on the Prussian model, brought about the military union of the southern States, and took a leading share in the creation of the customs parliament (*Zollparlament*), of which on April 28, 1868, he was elected a vice-president. On the question of the Vatican council Hohenlohe took up an attitude of strong opposition to the ultramontane position. He believed that the policy of Pius IX. of setting the Church in opposition to the modern State would prove ruinous to both, and that the definition of the dogma of papal infallibility, by raising the pronouncements of the Syllabus of 1864 into articles of faith, would commit the Church to this policy irrevocably. This view he embodied into a circular note to the Catholic powers (April 9, 1869) drawn up by Döllinger, inviting them to exercise the right of sending ambassadors to the council and to combine to prevent the definition of the dogma. The only practical outcome of Hohenlohe's action was that in Bavaria the powerful ultramontane party combined against him with the Bavarian "patriots" who accused him of bartering away Bavarian independence to Prussia. The combination was too strong for him; a bill which he brought in for curbing the influence of the Church over education was defeated, the elections of 1869 went against him, and in spite of the continued support of the king he was forced to resign (March 7, 1870).

Though out of office, his personal influence continued very great both at Munich and Berlin, and had not a little to do with favourable terms of the treaty of the North German Confederation with Bavaria, which embodied his views, and with its acceptance by the Bavarian parliament. Elected a member of the German reichstag, he was, on March 23, 1871, chosen one of its vice-presidents, and was one of the founders of the Liberal Imperial Party (Liberale *Reichspartei*), the objects of which were to support the new empire, to secure its internal development on Liberal lines, and to oppose clerical aggression as represented by the Catholic Centre. Hohenlohe strenuously supported Bismarck's anti-papal policy, the main lines of which (prohibition of the Society of Jesus, etc.) he himself suggested.

In 1873 Bismarck chose Prince Hohenlohe to succeed Count Harry Arnim as ambassador in Paris. In 1878 he attended the Congress of Berlin as third German representative, and in 1880, on the death of von Bulow (Oct. 20), secretary of State for foreign affairs, he was called to Berlin as temporary head of the Foreign Office and representative of Bismarck during his absence through illness. In 1885 he was chosen to succeed Manteuffel as governor of Alsace-Lorraine. In this capacity he had to carry out the coercive measures introduced by the chancellor in 1887–88, though he largely disapproved of them; his conciliatory disposition, however, did much to reconcile the Alsace-Lorrainers to German rule. He remained at Strasbourg till Oct. 1894, when, at the urgent request of the emperor, he consented, in spite of his age, to accept the chancellorship in succession of Caprivi. The events of his chancellorship belong to the general history of Germany. In general, during his term of office, the personality of the chancellor was less conspicuous in public affairs than in the case of either of his predecessors. His appearances in the Prussian and German parliaments were rare, and great independence was left to the secretaries of State. What influence the tact and experience of Hohenlohe exercised behind the scenes on the masterful will and impulsive character of the emperor cannot as yet be generally known.

Prince Hohenlohe resigned the chancellorship on Oct. 17, 1900, and died at Ragaz on July 6, 1901.

Prince Hohenlohe's *Denkwürdigkeiten* (2 vols., Stuttgart and Leipzig, 1906) are singularly full and outspoken, the latter quality causing no little scandal in Germany and bringing down on his son, Prince Alexander, who was responsible for their publication, the disfavour of the emperor.

For the Hohenlohes generally *see* A. F. Fischer, *Geschichte des Hauses Hohenlohe* (1866–71); K. Weller, *Hohenlohisches Urkundenbuch, 1153–1350* (Stuttgart, 1899–1901), and *Geschichte des Hauses Hohenlohe* (Stuttgart, 1904). *See* also Prinz Alex. Hohenlohe, *Aus meinen Leben* (edit. G. Anhauser. 1925).

HOHENSTAUFEN, a German princely family which derived its name from a village and ruined castle near Lorsch in Swabia, now in Württemberg. Its members were emperors or German kings from 1138 to 1208, and again from 1214 to 1254. The earliest known ancestor was Frederick, count of Biiren (d. 1094), whose son Frederick built a castle at Staufen, or Hohenstaufen, and called himself by this name. He supported the emperor Henry IV., who granted him the dukedom of Swabia in 1079, and gave him his daughter Agnes in marriage. In 1081 he remained in Germany as Henry's representative, but only secured possession of Swabia after a struggle lasting twenty years. In 1105 Frederick was succeeded by his son Frederick II., called the One-eyed, who, together with his brother Conrad, afterwards the German king Conrad III., held south-west Germany for their uncle the emperor Henry V. Frederick inherited the estates of Henry V. in 1125, but failed to secure the throne. He opposed the new emperor, Lothair the Saxon, who claimed some of the estates of the late emperor as crown property. A war broke out and ended in the complete submission of Frederick at Bamberg. In 1138 Conrad of Hohenstaufen was elected German king, and was succeeded in 1152, not by his son but by his nephew Frederick Barbarossa, son of his brother Frederick (d. 1147). Conrad's son Frederick inherited the duchy of Franconia which his father had received in 1115, and this was retained by the Hohenstaufen until the death of Duke Conrad II. in 1196. In 1152 Frederick received the duchy of Swabia from his cousin the German king Frederick I., and on his death in 1167 it passed successively to Frederick's three sons Frederick, Conrad and Philip. The second Hohenstaufen emperot was Frederick Barbarossa's son, Henry VI., after whose death a struggle for the throne took place between Henry's brother Philip, duke of Swabia, and Otto of Brunswick, afterwards the emperor Otto IV. Regained for the Hohenstaufen by Henry's son, Frederick II., in 1214, the German kingdom passed to his son, Conrad IV, and when Conrad's son Conradin was beheaded in Italy in 1268, the male line of the Hohenstaufen became extinct

Daughters of Philip of Swabia married Ferdinand III., king of Castile and Leon, and Henry II. duke of Brabant.

See F von Raumer, *Geschichte der Hohenstaufen und ihrer Zeit* (1878); B Zimmermann *Geschichte der Hohenstaufen*, 2nd ed (1865); F Schirrmacher, *Die letzten Hohenstaufen* (1871).

HOHENSTEIN (Hohenstein-Ernstthal), town of Germany,

in the district of Karl-Marx-Stadt, on the railway Zwickau-Karl-Marx-Stadt (Chemnitz), 12 mi. N.E. of the former. Pop, (1950) 18.015.

The city has textile industries, and there are copper and arsenic mines in the neighbourhood. Hohenstein was united to the town of Ernstthal in 1898. Hohenstein was founded by the Teutonic Order in 1359.

HOHENZOLLERN DYNASTY. The Hohenzollerns were a German family of counts, who in the 11th century were living in comparative obscurity in the south-eastern corner of the empire, in the 12th received a Burgrafdom in Franconia, thanks to the friendship of one emperor, in the 1 jth were invested by another emperor with the electorate of Brandenburg, in the 17th acquired by marriage Prussia in the north-eastern corner of Germany. and at the same time fragments on the Rhine and the Ruhr, on its western frontier, in the 18th rounded off and enlarged their centrifugal possessions by conquest and also assumed the title of king. in the 19th outstripped the other German states by means of victorious wars, united them and thereby won the title of German emperors, and in the 20th, after an unsuccessful war, lost empire, kingdom, and markgravate at a blow and abandoned their defeated country to its fate.

When they entered the German empire, it was a very shadowy entity. Up to the 19th century they were never interested in the empire, much less in a position to consolidate it. They remained immersed in the factions of rival German dynasties, until at last they achieved the hegemony in a whole so solid that their disappearance left it unshaken. For exactly five centuries they extended and increased their rule over northern Germany. seldom lost territory, and then only for short times, and gradually consolidated a State that was only a patchwork of scattered fragments, with no organic connection.

Thus their State could only be held together from above, by an army of soldiers and an army of officials, by severity, police and punctuality; it was often found necessary to suppress by force the centrifugal forces of certain parts which had been accustomed to other dynasties or other forms of State, and always felt themselves rather German than Prussian. The basic principle of this dynasty thus came to be absolutism, which survived here longer and more vigorously than in most parts of Europe, looked on its citizens to the last as subjects, was opposed to any democratic movement, and sought to impress obedience as the chief virtue In the place of national sentiment there arose a spirit of caste, and interest in the State went no further than the wish to belong to the upper caste. On top of this came a militaristic system, rnore prominent in domestic than in foreign affairs; for the Hohenzollerns were by no means more warlike than the majority of ruling houses. and their subjects cared less for the pursuit of the laurel than many another nation It was the necessity of unifying their scattered subject peoples that gained the Hohenzollerns their bellicose reputation; and this is how the sober and peaceable Prussian nation has acquired a name for brawling.

The fortuitous character of the origin of this State, the lack of a great guiding line of development, is reflected and in part influenced by the personal characters of the dynasty. Of the 20 rulers who reigned in Brandenburg and Prussia for five centuries, from the first elector to the last emperor-king, there were not more than eight who ruled with efficiency, industry and talent, while the rest were weak and vain, and squandered the money and success accumulated by their fathers; and these two types followed one another in almost regular alternation, grandfather often resembling grandson, while their country flourished or decayed alternately, according to the personal characters of these almost unrestricted autocrats

As these princes were generally long-lived (their reigns averaged 25 years each) the shocks of abrupt changes of character were mitigated. Moreover, the two greatest rulers had each nearly half a century to impress his nature on the people These two rulers, the Great Elector and Frederick the Great, mere able, thanks only to their very long reigns, to draw the tatters of the land together into a real State. These two, with Frederick William I. and William I., incorporated the best characteristics of the family: economy, industry, honesty, courage. Of them all, Frederick the Great alone showed any traces of genius.

Origins.—The name Hohenzollern, first borne by a certain Wezel of Zolorin, is derived from the word "Söller," a watch tower or castle. The family demesne in Swabia extends from the upper Neckar to the Lake of Constance. In the 12th century one of these counts was invested by the emperor, whose friend he was, with the Burggravate of Nürnberg. His successors acquired further lands in the neighbourhood through purchase or marriage, and in the 14th century one of them was raised to the rank of prince of the empire. His son. the Burggraf Frederick, saved the life of the Emperor Sigmund, king of Hungary, in battle, and was appointed by him Imperial Governor in Brandenburg The family thus divided, a secondogeniture was formed in Franconia, which ruled there from 1486 to 1791, when the territories in question became Bavarian. The original Swabian line, meanwhile, survived from 1251 to 1850 This line played a part in the outbreak of the war of 1870, one of its princes having come forward as candidate for the throne of Spain, a suggestion which France vetoed. His younger brother Charles (1839–1914) also aspired to a foreign throne, and became Prince and afterwards king of Rumania. His nephew and successor, Ferdinand of Rumania, the son of the prince intended for Spain, fought in the World War against Germany. The head of the Swabian line in 1919 was Prince William (b. 1867).

The Margraf Frederick, who became hereditary elector of Brandenburg in 141 j, a brave and able man, was despised and opposed by the native, half-Slav nobles as a petty foreign prince. and felt so out of place that after ten years he returned home, leaving his son to rule in the desolate North. His successor, Frederick II. (1440–70) met with equally violent resistance from the nobles, and also from the towns, until, disregarding their ancient rights, he appeared with 600 horsemen before the gates of the young city of Berlin, took the city, built a castle on the Spree to overawe it, and made this new place in the middle of the sandy waste into his capital. He destroyed all old privileges, turned the citizens into subjects, deprived them of their courts, and in 1443, forced them to swear fealty to him, an oath which the people of Berlin kept until their first rebellion, 400 years later This iron right hand of his knew not what his pious left hand was doing, for at the same time he founded an Order of holy living for noblemen; but at last, like his father, he abdicated in disgust—not before his reason had half given way.

Albert Achilles (1470–86), called by his contemporaries the "German Fox," and twice excommunicated by the pope, established a brilliant court. enslaved burgess and peasant (whose part consisted only of paying and serving), involved the country in unprofitable disputes—only to desert it in the end, like his two predecessors. All three, and their successors, the weak John (1486–99), who died young, and the brilliant, crafty Joachim I. (1499–1535) were hated in the land, which was still strange to them, although the family had now been ruling there for 100 years. Joachim, a strong opponent of Luther, was also the first to show a mystic side. He dabbled in astrology, pursued and encouraged education, founded the first university, in Frankfurt on the Oder, but also passed many cruel sentences and once had 38 innocent Jeus burned in the centre of Berlin.

More unbridled still was the life of Joachim II. (1535–71), who during his long reign built churches and castles with a lavishness that verged on madness. sought to outshine all other princes, squandered the burgesses' gold on favourites, mistresses and the chase, forbidding them the while to wear trunk-hose or to hold rich wedding feasts, but forcing them five times to pay his debts, which ran into millions.

His son and opposite. John George (1571–98), an Evangelical Protestant, as his father had been before him. economical, pious, father of more than 20 children, tried to make up the 2 joo ooo thalers of debts aith nhich his predecessors had saddled the country, lived quietly and respectably, and managed, by clever marriages for his relatives, to secure important heritages. His successor, Joachim Frederick (1598–1608) lived staidly also, and was wise enough to fashion himself a staff for all questions

of government by empanelling nine learned men on his privy council — the actual beginning of the Prussian bureaucratic State.

After him, John Sigismund (1608–19) reaped the fruits of the marriage arranged by his grandfather, and for the first time enlarged the land very considerably through his wife's heritage; he became duke in Prussia, and at the same time lord of rich and storied lands on the Ruhr, the Maas and the right bank of the Rhine, for the sake of which he turned Calvinist. Thus, without merit of his own, but also without war, he extended the land "from the Maas to the Memel," as the song said; yet had no pleasure of these strange lands, but sat disgruntled in the middle of a long chain of provinces, linked together by nothing but a dynasty that was still feeble. Under his successor it all went to pieces; this George William (1619–40), another of the frivolous, showy sort, the hunters and carousers, had none of the qualities needed to weather the storms of the Thirty Years' War, for, as Gustavus Adolphus said, "a new livery, a handsome horse or a pair of greyhounds drove everything else out of his mind." He remained neutral in the war, which nevertheless brought famine and misery into his lands. Thereupon he left Berlin, and went to Prussia, the duchy in the far north-east, where there was better fare and sport, leaving everything in ruin behind him, and bequeathing to his son a hopelessly disorganized country.

The **Great** Elector. — This twenty-year old youth, Frederick William (1640–88), rightly called the Great Elector, began by repairing all the damage his father had done. In the confusion of the war, the end of which was still far away, he built up a solid army, and played the rival combatants off skilfully against each other until he had a trained force of 8.000 men; all in great secrecy, for he was a master of dissimulation although also personally brave. Thus playing the double game which the times forced upon him, and which was also native to his character, he won the trick every time, through the power of his ever-growing army, which he employed now for, now against his neighbours. First he allied himself with Sweden, then ten months later broke this alliance and joined Sweden's mortal enemies, the Poles. Nor had he any compunction in signing a secret treaty with the "Roi Soleil," promising the German Imperial crown for the Dauphin if he himself only got back Pomerania. When Louis XIV. failed to pay the promised subsidies, the elector forthwith joined the league against him.

An excellent general, he never spared himself in the fight, fought in person among his men at the great victory over the Swedes at Fehrbellin in 1675, and generally developed gifts and qualities possessed by none of his forefathers, and not more than one of his successors. It was only blended slyness and courage that enabled him to assert his authority in Prussia, after an involved struggle to rid himself of Poland's suzerainty, and thus become master in his own house. But scarcely had he overcome the enemy abroad, when he turned in the same absolutist spirit against the enemy within, and as his ancestor had subdued Berlin, two centuries before, so he forced Konigsberg to submit to him, in the teeth of the constitution, compelled the recalcitrant towns and nobles to do him homage, cancelled the privileges of the Estates where they inconvenienced him, and threw into prison the leader of the burgesses. against his pledged knightly word.

On the other hand, after a reign of nearly 50 years, he left behind him a unity, created by violence, but surpassed in Germany only by the house of Habsburg, hundreds of villages new-built, new canals, dykes and roads, the State revenue increased five-fold, a first-class army 30,000 strong, and the general awe of his neighbours. Shortly before his death, by one of his cleverest inspirations, he had invited into his country the Protestants expelled from France. Only now and then, and of special purpose, did he make a brave outer show; his nature was simple; he loved to water the flowers himself in his palace garden, in which, and afterwards in the country, he planted the pioneer potatoes, went himself to the market and bought singing birds, enjoyed unsophisticated pleasures, and in an age which despised burgess and peasant, was yet a fairly just ruler.

His son and successor was his opposite: a weak, vain and silly man, who tried to hide his hump back under a huge wig; affected, greedy and ungrateful. Frederick III. (1688–1713) had only one passion: he wanted to be king. At the age of ten he founded his first Order, and went on playing to the day of his death with feasts, processions and problems of etiquette. Seeking to embellish the ever-growing castle on the Spree, he discovered a great artist, Andreas Schliiter. When he founded the Academy of Arts, its first and also its second task was: the coronation of the king.

His wife, Sophie Charlotte, an enlightened princess from Hanover, who laid out the castle and town of Charlottenburg outside the gates of Berlin, unluckily meddled in politics, which were in the excellent keeping, not of the king, but of his tutor and adviser, the grave and indefatigable Danckelman. She hated this man's honesty and not only hunted him out of his offices, after he had ruled the land with success for a decade, but set the law against him, threw him into prison, and only released him ten years later. His place was taken by thieving adventurers. The work of the Great Elector was ruined.

Meanwhile Frederick took umbrage at the glory in which his cousins of Orange and Saxony were sunning themselves as kings of England and Poland, negotiated for several years with the emperor, and at last, by great promise of military help for Spain, extorted from him the concession that he would raise no objection to his coronation as king. This took place on Jan. 18, 1701 in Konigsberg, with unexampled pomp, and cost 4,000,000 thaler, or two years revenue. The elector, who placed the crown on his own head, called himself henceforward Frederick **I.,** king in Prussia.

Now he began to play at Versailles, founded dozens of grades among the courtiers, and kept a mistress, although he neither needed her nor liked her, for the sole purpose of taking her out publicly, at regular hours, like the king of France. At the same time, as price for kingly rank, he sent a part of his subjects to the emperor, and the emperor sent them to Spain, to death. The rest groaned under the most fantastic taxes, including a tax on wigs, or had to hand in the bristles of the swine they slaughtered, the king proposing to start a trade in bristles. The peasant had to spare the wild swine which trod down his field for the new king to shoot, and antelopes and aurochs were imported into Prussia.

It was fortunate that the son was once more of the economic, efficient type. Frederick William **I.** (1713–40), unfairly overshadowed by the figure of his son, was one of the best. rulers in Prussia. Short, fat, sound and active, pious, moral and thick-skulled, looking like a peasant whenever he laid uniform and pigtail aside, he stood four-square in life and in the State, asking none, always commanding, but usually commanding the right thing. His first act was to clear away all the paternal luxury, to send the favourites packing, to order simplicity in all things; for he had only one idea — economy. Simple in manner, more of a burgess than a king, he liked thick soups, drank thin beer, smoked moderate shag in his pipe, and only now and then let his ministers invite him to delicacies on which he would fall half in mockery, half in enjoyment. His idea of his post was that of a father of a family — a despotic one, of course. He interfered in everything, took account of no laws, clapped his bad ministers of State into jail, woke up the porters who kept people waiting, forced the rich burgesses of Berlin to build houses, forced his generals to buy the bad portraits of them that he insisted on painting in the evenings; ran, rode and drove about from five in the morning to six in the evening, inspecting, giving orders, and always finding fault.

All the same, he was usually just, and was popular, did everything for the country, nothing for himself and little for the upper classes. Out of the nobles, in particular, he squeezed so many taxes that they complained to the imperial council in Vienna, and won their appeal. Yet the king went on threatening them: "I will stabilize the sovereignty and set the crown as fast as a rock of bronze! I am king and lord. and will do what I wish! Holiness is God's, but all else must be mine!" But his severity grew milder as it reached the lower classes, worthy burgesses might rise to high posts, bad counts were thrown out, the peasant prospered again throughout the land. Tax-farmers and officials were punished for abuses, sometimes even hanged for them. When ravaged districts were to be restored, the king gave the money himself, rewarded every man who built a new house there with a post,

enlarged Berlin. made his residence in Potsdam, cut out all the sinecures at court, founded the Kammergericht, a treasury department to check expenditure and most important of all, the State Exchequer.

It was iron discipline; but the land prospered and got back much of the power and solidity which the Great Elector had given it. Compulsory military service was introduced in 1726—although only for burgesses and peasants. This compulsion was hated most by the educated classes in the towns, especially as the rules of the service were pedantic. The Great Elector created the Prussian military, but his grandson must answer for the militarism, for then it was that the barrack-yard tone spread like a pestilence through the people. whom the endless years of service spoiled for any more genial regime, so that they tortured themselves and the rest with rudeness and exactitude.

The king had a weakness for "tall fellows," whom he mistakenly held to be the best soldiers. He had the tallest men pressed in all Europe, paid fantastic prices, up to £3,700 a man, for them, spent 12,000,000 thaler on this toy, sold offices for it, broke the law, had giants stolen and carried away from abroad, started a sort of slave traffic, came to the edge of wars—all over the passion which this short, fat man entertained for the tall and slender. Here his piety and his economy broke down.

As he looked after the state like a *pater-familias,* so in his house he played the king, and with the best will in the world, he would have broken up any family life. Aghast, he saw his children go over into inevitable opposition, the daughters reading French books, the son playing the flute in a silk dressing-gown, instead of practising musket-drill as he should have done, having been born, as it were, in uniform. Finding in the crown prince the weaknesses and vanities of his own father renewed, he saw that they must be destroyed, and thrusting a cruel hand into the tangled woof of a complex young soul, driving a young man to desperation, by that very act he saved just what his nature held of genius. But for the horrors endured in his youth, Frederick II. would never have become "the Great." His father served Prussia well in many respects, and not least in saving his son for the State and for history.

Frederick **the** Great.—For Frederick II. (1740–86) was decidedly what his father called him, an "effeminate fellow." Things came to a crisis over a marriage which the young prince was to have concluded with the daughter of the king of England, but his father spoiled it. Even before this, at 16, when on a visit to the court at Dresden, he had made the acquaintance of another world, and thereafter shunned military service, accumulated debts and scandals, till his father, in a rage, beat him in the presence of strangers and once came near running him through. Then the prince tried to escape over the frontier, at some manoeuvring in the west, was hailed back, thrown into jail, with a friend who had helped him was sentenced to be shot as a deserter, was pardoned, but forced to see Katte, his friend, beheaded before his eyes, and finally came out of this affair, after a time of complete spiritual collapse. a changed man. He had become a cynic.

At first he began to study the country only to please his father, but he learned to value a fruitful activity and when the king, in his last years, saw the prince busy about his future task, he relaxed the military fetters, allowed him, when his work was done, to occupy himself, generally far from his unloved wife, with the teachings of Voltaire, with giving concerts in his country palace; for the king looked on all this only as a sort of recreation, like his own, which he mostly took in a room full of tobacco smoke, among doxies and bawdy stories. So it came that when he died, he called himself fortunate to have left such a son behind.

The young king had no love for the people, whom he called the *canaille,* but still less for the nobles. He loved nothing at all, in fact, except wit and his dogs, and perhaps his sister and a few old soldiers. But he applied that great tolerance which he had learned from Voltaire and from the ideas of Locke, called himself and felt himself the first servant of the State, allowed complete freedom of the press, had a caricature of himself hung lower down in the window. so that the people might see it better, and proclaimed at once that his people were free to be happy in their own fashion.

He abolished the tall fellows at once, but strengthened and enlarged the army, and put a stop to pedantry and brutality. He saved up, and spent little when he built himself a solitary, one-storied country house, the Sanssouci, where the best wits, not, indeed, out of Prussia, but mostly out of France, foregathered at his table; for the king was fond of speaking French, which he did as badly as he did German.

As crown prince, mostly out of boredom, he had written a thesis against Macchiavelli's "Prince," based on misunderstandings, but containing some principles which he afterwards followed: "The Prince is not lord, but servant of the people, his power rests in the last end only on the people's choice. No man has the right to allow himself unlimited sway over his fellow-men. Only the tyranny of government brings the peoples to rebellion." These principles of domestic policy accorded with the age and his own ideas; in foreign policy Frederick behaved exactly like Macchiavelli, denying any morality in affairs of State, or any valid consideration except personal interest. Thus, scarcely had he begun to reign, when he provoked a war to conquer Silesia, on which he had no claim. "My age, the fire of my passion" he wrote to a friend, "the thirst for glory, even curiosity, to tell you the whole truth, in short, a secret instinct has torn me out of pleasant ease and the satisfaction of reading my name in the gazettes and the history-books has seduced me." In the first and second Silesian Wars he was able, with the help of his father's army, to conquer this land from Maria Theresa and retain it.

In the decade of peace that followed he lived as a man of the world, not a philosophical one by any means, adorned himself with Voltaire's presence, dabbled in the arts and sciences, kept up the best opera in Europe, was generous towards artists, and wrote his own history so quickly that in 1746 he was already dictating the events of 1745. But when he was half-way through the forties, the consequences of his youthful ambitions rose up before him like black shadows. He saw the revenge of the empress of Austria join hands with the disfavour of the tsarina, the hate of the king of Saxony and the pride of the king of France allied with them, and all at once half Europe stood united against him, to destroy this young kingdom, become too strong.

Frederick went into the Seven Years' War (1756–63) with about 200,000 men against twice the number. This third war, which he had provoked through the conquest of Silesia, brought the enemy as far as Berlin and Sanssouci, and Frederick himself to the verge of despair. In this war a million men fell to no purpose, for it ended on approximately the status quo ante. Half of this million were Prussians. Some 30 years after those candid words on thirst of glory and curiosity, Frederick wrote: "Glory is vain. Have men ever deserved praise? They have only been praised because they made a stir." At the Peace of Hubertusburg, Frederick gained nothing, but also lost not so much as a village, although his enemies had meant to break the new great Power into pieces. This result, shattering in both ways, must have shattered the king as well, like the conflict with his father when he was crown prince. For the second time he returned home a changed man.

Although only 52 years of age, he looked an old man; although an old man, he had 23 years before him still. Now he became great. The work of reconstruction to which his conscience, his experience, his age, his loneliness alike urged him, showed him the father of his fatherland; all for the peasant and the poor, all, where possible, against the noble, all always against the idle. He quarrelled with Voltaire and most of the other Frenchmen; his sister was dead, his oldest friends were ageing around him, the circle fell silent, dust lay on the flute; only the greyhounds loved him, lay in his chairs, in his bed, and when they died, he set up marble memorials to them. In his will he wrote that he wanted to be buried beside them. He could still be interested in the French spirit, but the German was foreign and unsympathetic to him. That Kant, a Prussian professor, was building up a new world, that Herder and Klopstock, Lessing and Wieland were writing quite near him, he was unaware, or else disliked it; he wrote a sneering pamphlet against Goethe's *Götz* von *Berlichingen*; the fact was, he was neither philosopher nor poet, only a dilettante, and not even a good one.

On the other hand, he worked harder than any man in his State, harder, too, than any Hohenzollern before or after him. He drained morasses, planted woods, made roads, built countless houses, went on tours of inspection among his people, distrusted his officers, backed up the peasant against the count, even when he was in the wrong, and now lived truly in the heart of his people. At 70 he wrote, in the true spirit of Voltaire and the old Faust: "He who improves his land, makes waste land fruitful, and who drains swamps, he wins victories over barbarism."

Weak Monarchs. — His successor was one more of the bad sort. Frederick's nephew, Frederick William II. (1786–97), lazy and sensual, vacillating and romantic, managed in the single decade of his reign to squander on favourites, male and female, half of what his predecessors had spent seven decades in accumulating, and what chance brought him through a partition of Poland and a heritage in his own family was never assimilated and soon lost. The army soon became undisciplined, and when it was sent to fight the French revolution, it dared not even attack it. The day of Valmy, no victory for the French, yet made the deepest impression, for all Europe said that the army of Frederick the Great had ceased to fight.

The next one, too, was weak and without talent, although his life was simple, sober and respectable. Frederick William III. (1797–1840) imitated his ancestors' policy in the Thirty Years' War, and tried to preserve neutrality through the tempests of the Napoleonic Wars. He watched his neighbours' lands occupied, unperturbed, al ays spoke of "soothing" (which was not very appropriate) Napoleon, refused to listen to his wife, the talented and ambitious Queen Luise, and then suddenly found himself forced into war, after all, and at the Battle of Jena (1806) lost the fame of Frederick's army, and in the Peace of Tilsit lost more than half of his possessions-everything, in fact, west of the Elbe. He failed to recognize the natural saviour who offered himself to him, the Freiherr vom Stein, one of Prussia's two great statesmen, and when Stein made his entry into the Government conditional on the dismissal of the intriguing privy council, the king wrote to him: "You are a recalcitrant, stubborn, obstinate and disobedient servant of the State, full of your own genius and talents, and instead of looking to the good of the State, led only by caprices, swayed by passions and personal animosity."

All the administrative reforms which Stein and Hardenberg effected, were done in the king's despite; he was drawn into the Wars of Liberation and the alliance with Russia in 1813 against his will, he took no personal part in any battle, but entered conquered Paris in state. For all that, the popular struggle against France evoked the first democratic movement in Prussia. The towns got back the self-government filched from them 300 years before, in another form, the term of general military service was fixed at three years, the conduct of the State was concentrated in the hands of a ministry, which, however, was only empowered to debate, and not to decide. The grant of a constitution now could have bound together the disunited nations of the State, one third of which, into the bargain, were Catholics — a further point of difference. The king promised, indeed, in 181 j, just before the last war against Napoleon, the rudiments of a constitution, which involved no losses for him, as the Estates envisaged were also only to have an advisory voice.

When the people had driven out the conquerors, it was quickly forgotten. The reaction, led by part of the Prussian nobility, fed by Metternich in Vienna, conquered in Prussia also; the Holy Alliance testified that kings were appointed by God, the fall of the Corsican willed by God, and the princes, therefore, infallible in their way. The king threw himself against the popular movement, dissolved athletic and students' associations, suppressed dangerous books and papers, dismissed professors, threw the most popular leaders into prison, punished every request for fulfilment of his promise as treasonable, filled the country with police and spies, or at least, was glad to let his servants do so.

The son was exactly snch a failure as his father: Frederick William IV. (1840–61), a man of decided talent, but weak, confused, romantic; in person short-sighted, slovenly, thin-haired, he never dared do what he would, and only took a definite decision to abandon it as soon as taken. Liberal, like all crown princes, before his accession, he soon disappointed the people. The guiding idea of the day, citizenship, the contract between prince and people, he dismissed as nonsense, the sovereignty of the people he described as the principle of evil in the world, and tried vainly to gloss over his hostility to the people by smooth phrases.

It was only seven years later that he began to notice the gathering storms, and under the pressure of public opinion, convoked, in the shape of the "united diet" (1847) the first parliament that Prussia had seen, graded on the caste system, but yet empowered to reject State loans or taxes. In his very first speech, however, the king took everything back, declaring it to be God's will that he should reign — he was always adept at hiding his own fear of the people under a mystic light. The diet was closed again immediately, with nothing accomplished; but the February revolution in Paris soon after strengthened the people's forces in Berlin. When revolution broke out there in March.1848, when the people of Berlin broke their oath of loyalty exactly 400 years after they had sworn it, the king hesitated, characteristically, assembled troops, but immediately afterwards, in his mortal fear, issued a Patent promising a Liberal Constitution, which he proclaimed in person from the balcony of his palace.

Those first shots which can never be prevented in any riot, were fired by the military. Two hours later, 200 barricades had been erected in Berlin. The troops had the upper hand in the fighting, but the next day the king issued a proclamation "to my dear Berlin," begging the people to disperse quietly, and withdrew his own troops. He sat in his palace, irresolute, listened to all councils, approved a citizens' defence corps, proclaimed an amnesty, ordered a new ministry, till the beaten bourgeoisie were turned into victors by the Crown's timidity. Three days later there appeared an unintelligible proclamation, saying "Prussia was to be absorbed in Germany" and the king would take his place at the head of Germany. Elections were held for a parliament for Prussia and one for Germany. When the latter, sitting in Frankfurt, elected the king German emperor, on April 3, 1849, those who were nearest to him did not know whether he would accept or refuse the crown. Up to the last moment his chief intimates believed that he would accept. Suddenly he refused.

Out of fear of a coalition which threatened to form against him under Austria's leadership, he dropped all plans for uniting Germany, but took the oath to the new Prussian Constitution before the two Chambers. This reproduced the principles of the modern constitutions of other countries; but the ministers were still responsible to the king alone, who enjoyed the sole right of appointing them, and also the sole right of concluding treaties with foreign powers, and declaring war or concluding peace at discretion. Only the spirit of an absolutism 400 years old was capable of burdening itself with this two-fold responsibility which the king of Prussia received, and indeed, really assumed for the first time before the whole people, without himself being responsible to anyone but God. At the same time, these two most dangerous clauses cut the people off from any attempt to educate themselves politically, and gave the citizens an excuse for living on as subjects. Only so can it be explained how these provisions lived on into the 20th century. The next decade passed in Prussia amid the growing discontent of the Liberals, and the growing irritability of the sick king, till the king, too late, was declared of unsound mind and his brother became regent, and afterwards successor to the throne.

The German Empire. — William I. (1861–88) ascended the throne as a man of almost 64 years of age, and no one could have anticipated that he would retain it till his 91st year. He was suspect to all Liberals on account of his attitude in the days of the revolution, when he had had to escape out of the country, and sealed his unpopularity when, in Sept. 1862, he could find no other way out of the internal impasse than to appoint the notorious Junker, Otto von Bismarck-Schonhausen, his minister. That he kept, on the whole, on friendly terms with this man for 26 years without a break, in spite of many conflicts of opinion, and although he was convinced that he ruled by Divine Grace and at heart felt no greater inclination towards intimacy with a Junker

than with any other mortal, cannot be explained only by the successes of his minister. It is also a proof that this truly honest and chivalrous old gentleman admitted to himself the superiority of his servant, who, indeed, treated him like a master, and sometimes too, being nearly 20 years the junior, like a son. Besides, William was past the vagaries of youth and the ambition of manhood, and would have liked best to yield to old age's need of rest, had not his minister's uncanny energy led him ever onward on the path of daring.

For the King began by objecting to all the three wars which Bismarck had decided to wage, to put Prussia at the head of Germany, and thus to solve the German question without and against Austria. In 1864, 1866 and 1870 he swore not to draw the sword, yet in the end his adviser wrung his consent from him. Before the Schleswig-Holstein war he said that he really had no rights at all to these two duchies; before the war against Austria, that he would never shed German blood; before the war against France he gave way to Napoleon's and Grammont's arrogant demands to the limit of what was possible. But when he was swimming on the full tide of victory, it was only with great difficulty that he could be restrained by Bismarck's foresight from impolitic immoderation. He neither understood nor liked Bismarck's consistent purpose, for if Bismarck cared more for Prussia's greatness than for Germany's unity, the king cared even less for Germany, and he refused for weeks to assume the imperial title, which he thought looked "like a major's title," while clinging to the insignia of Prussia, like his brother before him, who had also refused to become emperor.

None of the important steps in the king's career were due to his own initiative; in fact, at the decisive moments at Nikolsburg, Gastein and Versailles, Bismarck had always had to employ threats of resignation, nervous breakdowns and outbursts of tears, before he got his way. "I carried him on my shoulders on to the imperial throne," he said afterwards, and it was true. In the end the king was so angry with him over the whole emperor business, that when he descended from his throne in the Hall of Mirrors at Versailles, on Jan. 18, 1871, he walked past Bismarck without a word, when he went to thank his generals.

The old monarch long remained strange to his people, and it was only through the surprising elevation of his position, and especially through his more than patriarchal age, that he achieved a gradual and tardy popularity. He always remained simple and very economical, as he had been brought up to be in Prussia's lean years; slept and died in his iron camp bed, but left over 20,000,000 marks. But he had a really warm and tactful heart, and like a true king, always managed to leave his chancellor a free hand and all possible glory, without losing any of his own natural dignity. This, and the loyalty with which he stood by his chief minister, although the great nobles tried very hard for years, and his wife for decades, to separate them, the gratitude with which he heaped honours and riches on the founder of his empire—this combination of qualities was not to be found in any of his ancestors. For all his unsophisticated mind. for all his narrow upbringing, William I., with his courage, his piety and his kingly nature was always a true nobleman.

His son, who mounted the throne a dying man, and ruled only 100 days, as Frrderick III., had won by his share in famous battles, his good looks, and above all, his sorrows, a popularity which he bore with exemplary patience. In character he belonged rather to the romantic type of the family; when the empire was being founded, he proposed that the other princes should be compelled to do homage; he adored old thrones and brilliant pageants, and only betrayed his domineering instincts so seldom as he did because the superior intelligence of his wife, Victoria of England, primed him with democratic demands or catch-words.

The Ambitions of William II.—William II. (1888–1918) inherited both his mother's great gifts and her dilettantism, with his father's love of display; together with other ancestral qualities which Bismarck, in his character-sketch of the last emperor, summed up as follows: "From Frederick I. he inherited love of display, vanity and an autocratic nature; from Frederick William I. only the taste for tall fellows; from Frederick the Great only the love of interfering in his officials' business; from Frederick William II. a mystic turn and strong sexual impulses, from Frederick William IV. the desire to talk a lot.'

The dangerous mixture of weaknesses and talents, in both of which William II. was rich, of vanity and timidity, both of which were equally strongly developed in him, is only partly to be explained by the withered arm which all his life he hid from the world and tried to overcome in his own soul by an exaggeratedly manly and military manner. An over-strict upbringing, keenly resented because of his physical defect, gave him, too, an unhappy youth reminiscent of the repression suffered by Frederick the Great. In this case, however, there was no instruction to mature the prince, no restraint to moderate him. On the contrary, fate willed it that at 29, suddenly and almost unprepared, he should inherit an empire which had grown steadily in power as he grew from boyhood to manhood. Could it be wondered at that the young monarch, impelled by the will to please, bemused with ideas of God's peculiar grace, inspired with the rise of his house, too long repressed, too suddenly master, began to follow the promptings of his vanity rather than of his duty? And how was a State whose constitution was still practically the same as in 1850, whose citizens had no political experience and in which the higher officials and officers had for centuries been drawn almost exclusively from the nobility—how was such a State suddenly to produce men with the courage to turn their backs on the throne, or even to warn the king? The empire was at its zenith. What could happen to it with the strongest army in the world, and an officialdom which ran as smoothly and as incorruptibly as a machine?

When the young emperor overthrew the old chancellor in March 1890, after 28 years' service, in the same brutal way as Frederick I. of old had cast aside his minister Danckelman and as William had suggested in talk among his friends, nothing hindered him from making himself supreme except lack of Frederick the Great's genius. He did not, indeed, like Frederick, unleash a war, for all his life, in natural and explicable fear he dreaded nothing so much as the danger of battle and war; but he dissolved the treaty with Russia on which Bismarck had bound the security of the empire. Almost at the same moment as William dismissed Bismarck, he cut the wire which linked Berlin to Petersburg, and so cleared away the obstacle which had kept the tsar aloof from a French *rapprochement;* and thus William opened the door for that war on two fronts which Bismarck, with an eye to Germany's unfavourable situation, had managed for three decades to prevent.

From now onward, the encirclement of Germany proceeded the more inevitably, as William, out of personal hatred of his uncle, Edward VII. of England, rejected every advance from England, even the offer of an alliance from Chamberlain, and instead of this aspired to colonies and began to build a great fleet—two things that Bismarck had avoided on the principle that Germany's dangerous situation forbade her from engaging in any adventures abroad. All these enterprises were accompanied by a flood of high-flown and even provocative speeches, the echoes of which made the cabinets of Europe, and the peoples too, uneasy for 25 years. To shout down his weakness, the emperor in these hundreds of public speeches proclaimed again and again his phrases of the shining armour, of the victorious German sword, of the mailed fist, Nibeiungen loyalty and Neptune's trident, until the world he addressed held him for a warlike conqueror, only waiting for the moment to fall upon his neighbours.

In reality he was pushed on by the little military circle, that, in Prussia as everywhere else, was urging new wars after a generation of peace, called him a coward in secret, and thought out machinations how to bring him from words to deeds, from threats to mobilization. The middle classes listened with ironic smiles, paid less and less attention to these speeches every year, and buried themselves in business, which was flourishing everywhere. Only the workmen and Socialists, in their press, brochures and speeches uttered warnings, year after year, against the dangers of the ever-increasing boasting and court display. When the consequences of the imperial speeches became a national danger, in Kov. 1908, over an incautious interview in the Daily Telegraph, and all Germany arose and demanded a remedy, it was not the

Socialists, but members of the highest nobility who debated whether the emperor should not be put under control, as of unsound mind.

The murder of the Austrian heir to the throne in July 1914 was a personal blow to William, because the victim was his friend. and a prince by God's grace as well; his mind, too, appears at the time to have been in a state of maniac excitement, so that he encouraged the bellicose cabinet of Vienna with violent words, letters and marginal notes, and promised them help. Three weeks later, when all was lost, and his mind was passing through a state of less exaltation, his anger burned out, he shrank away from the threatening spectre of war, which he, oftenest of all men, had evoked, and sought at the last moment to avoid it. When the first signs of unrest began among a starving, bleeding people, he thought it could be crushed by force, as in peace. It mas only when the general collapse began, in Oct. 1918, that in a memorable scene he sanctioned the new constitution, even as Frederick William IV. had not promised his till the first shots were heard in Berlin; and thus in the last weeks of his reign, against his declared will, yet founded that new democratic Germany in which ministers rule instead of kings, and are nominated by a people's parliament.

In vain first Wilson in America, then a section of public opinion in Germany, appealed to him to abdicate, to ease the situation of his country. He remained, until in the first days of November, the people rose in different cities and ports, and demanded his abdication. Even on Nov. 8, when his cousin and chancellor, Prince Max of Baden, himself proposed his abdication as a means of saving the monarchy, which could easily have been carried on by his grandson, a minor, the emperor refused. and in the end, when at last the capital itself rose, declared that he would abdicate as emperor, that is, from the empty title, but not from his place of real power as king of Prussia. But on the morning of the 10th, fear of sharing the fate of the tsar, and the advice of his Field-marshal Hindenburg sent him fleeing out of his country over the frontier into Holland.

Thus ended the dynasty of the Hohenzollerns. The deeds of the best Hohenzollerns were not entirely in vain. however. It was only through their work and energy in welding the land together out of so many different parts that Germany was able to survive the fall of the dynasty without dissolving into its component parts, and only because Bismarck had united the many German states into one state could the *Reich* continue to survive until its defeat under Hitler. (E. LED.)

See also PRUSSIA; BRANDENBURG; GERMANY; and separate biographical articles on the kings of Prussia and the German emperors.

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HOHOKAM. Hohokam is the name of an American Indian tribe which lived long ago in the semiarid region of central and southern Arizona. The word Hohokam is of Pima Indian origin and means "the people who have gone." It has been adopted as the name of this old tribe whose accomplishments have been brought to light through archaeology.

No one knows exactly when the Hohokam's history began or what their origin was, but there are reasons for believing that they were descendants of early hunters and food gatherers who lived in the southwestern United States before the time of Christ. A village way of life was firmly established by the beginning of the Christian era. From this time on for at least 1,500 years the history of the tribe has been painstakingly traced and pieced together through excavations in its villages.

Hohokam history was sharply influenced by the desert environment in which it developed The heartland. along the broad flat valleys of the Gila and Salt rivers. was hot and low in rainfall, but the ground was incredibly fertile and the rivers ran permanently, fed by mountain water from the east. The combination of living water in shallow stream channels, nearby flat and rich lands and an enterprising people resulted in the development of agriculture by canal irrigation. It was this achievement in large-scale systematic irrigation, unsurpassed in North America, that brought fame to the Hohokam as engineers and farmers.

By about A D 700 canal systems were in use, and before AD. 1400 the netnork of canals reached their greatest extent In the Salt river valley aggregate canal length was probably in excess of 150 mi. Ditch nidths were 30 ft. or more and depths to 10 ft. have been noted. These nere dug by hand because the Hohokam had no mechanical earth movers or beasts of burden. This was truly a monumental accomplishment in planning and execution, and it hints that these Indians nere strongly organized politically to create what may be regarded as an intervillage public waterworks program long before the arrival of Europeans.

The principal crops were corn, beans, squash and cotton. These foodstuffs, produced in abundance and supplemented by game, blessed the Hohokam during most of their history with comparative economic security. Through the centuries their villages grew in size. their material arts flourished and Hohokam influence among neighbouring tribes increased.

The archaeological record reveals that the Hohokam developed their unique achievements slowly through many centuries of time. Scholars have divided the history of this people into four stages—the pioneer, colonial. sedentary and classic periods—which broadly express, by the names applied the transitions through which the society passed. Although from the beginning the Hohokam nere living in pit houses, making pottery and groning corn, it was not until about A.D. 1000 that the culture reached its pinnacle. It was then that the tribe's greatest artistic expression is seen in the weaving of cotton cloth. the carving of stone, shell and bone and the making of pottery. At that time too. and for several centuries thereafter, the Hohokam developed their greatest ability to extract a livelihood from the soil and were strongest socially and politically. After about 1400 Hohokam society declined, the large populous centres broke up and the record becomes dim. No one knows certainly nhy this happened.

Hohokam architecture consisted of flimsy structures of wood, brush and clay built over a shallow pit dug into the ground. These are known as pit houses. Each house was an independent unit, probably sheltering a single family, and because the buildings were widely scattered, Hohokam villages were rambling and exhibited little or no plan. Changes in the shape of the floor and in the method of roofing through the centuries have been determined, but the principle of lowering the floors below ground level was adhered to throughout Hohokam prehistory. Formal religious architecture evidently did not exist.

The dead were cremated, and the ashes of the deceased were placed in pits in the ground or in jars which were buried. Mortuary offerings of pottery, ornately carved stone objects and shell jewelry often accompanied the ashes. This custom of burning the dead destroyed most of the evidence needed to determine the physical appearance of the Hohokam An exceptional discovery of Hohokam mummies in Ventana cave in Arizona revealed that they closely resembled the modern Papago and Pima Indians.

An interesting and significant sidelight of the Hohokam is the fact that they were in communication nith the Indians far to the south in the Mexican highlands. This resulted in the direct importation of objects. such as copper bells and mosaic plaques or mirrors. and in the borrowing of ideas, such as a ball game played in a large oval court with earth embankments. A ball of native rubber. possibly used in this game, dating from about 1100, was found in Arizona. The time of strong Mexican influence broadly coincides with the peak of Hohokam achievement.

They left no written records and had no system of noting the passage of time—at least not any which has survived. For these reasons the dating of their remains has to be done by the standard

archaeological procedures of stratigraphy, comparison with other cultures of known age and through the presence of trade goods. also of known age. The most famous village was Snaketown, on the Gila river southeast of Phoenix, Ariz., in which more than 1,000 years of Hohokam history has been recovered.

Not all of the Hohokam lived in the fortunate surroundings provided by the fertile and well-watered valleys of the Gila and Salt rivers. There were some who settled in the harsher environment of what is now the Papago Indian reservation west of Tucson, Ariz. Little surface water and arable land forced them to depend more heavily upon natural plant foods than on the yield of cultivated products. and as a consequence there were no large villages or concentrations of population. In most respects the level of cultural attainment was below that of their river kinsmen because of the rigours of the environment.

What happened to the Hohokam has long puzzled archaeologists. The answer that best fits the facts known about them is that the Pima and Papago Indians, who inhabit southern Arizona, are the living descendants of this famous culture.

See also INDIAN, NORTH AMERICAN: *Culture Provinces.*

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HŌJŌ, the name of an illustrious family of medieval Japan. established by Tokimasa (1138–1211) of the Taira clan. In the 12th century he adopted the new family name of Hōjō, derived from his domain in eastern Japan. The Hōjō political career was launched when Yoritomo Minamoto was arrested by the Taira and placed under the guardianship of Tokimasa. But an alliance of the Hōjō and Minamoto, achieved through the marriage of Yoritomo and Tokimasa's daughter. laid the basis for a successful revolt against Taira power (1180–8j). The Hōjō then assisted Yoritomo in setting up the Kamakura *bakufu,* or military government. In 120j Tokimasa assumed the position of regent for the shogun, an office which was held until 1333 by nine successive members of the Hōjō family. The descendants of Tokimasa, by dominating the military regime at Kamakura. were also able thereby to control the imperial government and court at Kyōto for more than a century. The Hōjō regents were usually able administrators and contributed greatly to the extension of feudal power in 13th-century Japan. Though the Hōjō ascendancy was finally destroyed, together with the Kamakura *bakufu,* in 1333, the family endured as a leading military house for several centuries afterward. *See* also JAPAN: *History: The Development of Feudalism.* (HN. KN.)

HOKAN. This term unites as genetically related a number of North American Indian linguistic stocks, scattered over a large area and previously considered distinct.' Dixon and Kroeber in 1913 (*Amer. Anthrop.,* vol. xv) coined the name from the word for "two" in some north Californian dialects, including in the family Shasta. Achomawi. Karok. Chimariko. Pomo (*q.v.*), Yana, Esselen, Yuman (*q.v.*) and subsequently Salinan. Chumash and Washo, all in or near California. Seri (*q.v.*) in Sonora, and Tequistlatecan in southern Mexico. Sapir *(Intern. Journ. Amer. Linguistics,* vol. i, 1920) added Coahuiltecan. Karankawa, Tonkawa and, in 1925 (*Amer. Anthrop.,* vol. xxvii), Subtiaba in Nicaragua, suggesting further that Siouan, Muskogian, Caddo and Iroquois would ultimately prove to be related to Hokan-Coahuiltecan. The historic significance of these linguistic determinations. if confirmed, is considerable, but some authorities (Boas. Goddard, Michelson, Uhlenbeck) remain unconvinced of the validity even of the narrower Hokan family in California, though others (Rivet W. Schmidt) accept the full findings. (A. L. K.)

HOKE, MICHAEL (1874–1944), U.S. orthopedic surgeon. was born at Lincolnton, N.C., on June 28. 1874. He took his medical degree from the University of Virginia. Charlottesville, in 1895, and practised at Atlanta, Ga., after 1897. Hoke soon became one of the leading orthopedic surgeons in the world: among his contributions being new operative methods of straightening twisted bones. He was one of the founders of the Shriners' hospitals and was chief surgeon of the Scottish Rite hospital in Atlanta from its foundation in 1915. He became chief surgeon at the Warm Springs, Ga.. Infantile Paralysis foundation in 1931, serving there five years before he resigned to resume private practice. He retired in 1937. Much of Hoke's outstanding work in orthopedic surgery was done without charge for thousands of crippled children throughout the United States. He died at Beaufort, S.C., on Sept. 24, 1944.

HOKKAIDO, the name of a group of islands (one large island and a few small adjacent islands) in northern Japan. Hokkaido constitutes an autonomous administrative division (do), with an area of 30.312 sq.mi., comprising 21% of Japan's land territory. The population of 5,039.206 (1960) was but 5.4% of the national total. The administrative centre is Sapporo (*q.v.*). Hokkaido is characterized by a microthermal climate and recent land settlement. Long the domain of the Ainu (*q.v.*), except for fishing populations on the southern coasts, serious Japanese settlement did not begin until 1869, when the division. then called Yezo, was renamed Hokkaido. Prior to 1945 the Hokkaido government administered some of the Kuril Islands (*q.v.*), which were ceded to the U.S.S.R. under the terms of the Yalta agreement.

The present economic development includes agriculture, mining and fisheries. The agrarian population accounts for 40% of the total. Rice is the first crop. Soy and kidney beans. oats. barley. hay and white potatoes are important. Thirty per cent of Japan's coal is mined there. *See* JAPAN. (R. B. H.)

HOKUSAI, KATSUSHIKA (1760–1849), Japanese painter, one of the greatest masters of the popular school *(Ukiyo-e),* was born in Edo (Tokyo). He was adopted into an artisan family and apprenticed at an early age to a wood engraver. At 18 he entered the studio of Katsukawa Shunshti. considered one of the foremost artists of the day, to learn the art of designing woodcuts. He was given the art name of Katsukawa Shunrō. but Hokusai was an eccentric, and a quarrel with his master resulted in his changing his name and launching out on a career for himself. Then began a period of intensive study, for Hokusai, a man of great vitality and a terrific worker with an insatiable curiosity, allowed nothing to escape his searching eyes: no scene was too small or too sublime to escape his brush. He lived in poverty most of his life, and in his later years proudly called himself the "peasant of Katsushika."

During his lifetime Hokusai used more than 30 different names and is said to have lived in more than 90 houses, moving only when the place was too dirty to clean or the landlord would no longer extend credit.

Hokusai illustrated large numbers of books, and his famous *Manga,* sketches and caricatures from life. appeared in 15 volumes during the years from 1812 to 1875. Outstanding among his colour prints. the "Thirty-six Views of Fuji" is generally considered the culmination of Hokusai's art. The set contains 46 prints in all and was published between 1823 and 1829. Other series issued around this time were "Views of Famous Bridges," "Waterfalls of the Provinces" and "Pictures of Flowers and Birds." A set, designed in upright format, commonly called the "Imagery of the Poets" is among his masterpieces. These designs are executed in the great landscape tradition and are full of a poignant beauty. Hokusai also designed some superb large sheets published separately. and his *surimono* (greeting card) prints are unequaled for delicacy. When Hokusai was in his 70s his finest book, the *Hundred Views oj Fuji,* was published in monochrome; the designs are full of extraordinary originality.

Hokusai possessed great powers of observation and characterization. a singular technical skill and untiring industry. He was an eager student to the end of his life and at the age of 7j wrote *Once Hokusai, Today the Old Man Mad About Drawing.*

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HOLBACH, PAUL HENWI THIRY, BARON D' (1723–1789). French philosopher and man of letters, celebrated for his outspoken atheism and materialism, was born at Edesheim, near

Landau in the Palatinate, in Dec. 1723, and baptized as a Roman Catholic. His family. German in origin, was French in its loyalties. and his uncle F. A. d'Holbach, to whom he owed his fortune and whose surname he added to that of Thiry, was a naturalized French subject. After spending some time in Paris. Paul Henri completed his education at the University of Leiden, where he made the acquaintance of Mark Akenside and John Wilkes. He returned to France and was naturalized in 1749. His intellectual interests nere first displayed in the field of geology, mineralogy and metallurgy. For Diderot's *Encyclopédie,* starting with the second volume, published early in 1752, D'Holbach wrote articles on diverse scientific subjects. eventually publishing 376 in all. He became a prominent figure in French intellectual society. facilitated in this by his considerable fortune, which enabled him to make his table a meeting place of the philosophes, notably of Diderot. D'Alembert, Helvétius, Raynal. Grimm, Buffon, Marmontel and, for a time. J J. Rousseau. He became before long the most advanced and outspoken of their number. In 1761 he published, under the name of his then deceased friend Nicolas Antoine Boulanger, *Le* Christianisme *dévoilé* (reprinted 1766 and 1767), an open and sustained attack on Christianity as contrary to reason and nature. Nine years later, over the name of J. B. Mirabaud (the late secretary of the Académie Française), he published his *Système* de la nature (1770), the most celebrated 18th-century exposition of atheism, materialism and determinism. Here he unambiguously asserts doctrines which his predecessors had hinted at: all causal relationships are simply relationships of motion; man is entirely a machine; the soul is a false notion; free will is nonexistent; the arguments for the existence of God whether proposed by Christians or deists, are totally false: religion is harmful as well as untrue. The aise man's course is to accept necessity and to follow nature. The non sequiturs and inconsistencies which abound in the work did not prevent it from being sensational in its impact on public opinion. It provoked replies and challenges. notably from Voltaire, whose deistic position now appeared conservative, and had a great influence on Goethe and later on Shelley. Of D'Holbach's other works the most significant is his *Système* social (1773), in which he outlines principles of morality and politics on a utilitarian basis.

See W. H Wickwar, *Baron d'Holbach: a Prelude to the French Revolution* (1935); *P.* Naville, *Paul Thiry d'Holbach* (1943).

(RT. S.)

HOLBEIN, HANS, THE ELDER (*c.* 1465–1524), was the senior member of a family of painters that included also his brother Sigismund and his sons Xmbrosius (c. 1494–1519/20) and the famous Hans Holbein the Younger (*q.v.*). Nothing is known of his early life and training, but he was married and established as a painter in his native Augsburg by about 1493. His early works, which include the Weingarten altar (1493, Augsburg cathedral). the St. Afra altar (1495. parts in the bishop's palace at Eichstatt and in the Basel museum). the picture called the "Basilica of St. Mary" (1499, Augsburg) and a Passion series in 12 scenes (Donaueschingeni, are characterized by deep, rich colouring and by balanced compositions of figures moving slowly and deliberately on a narrow stage. They show a knowledge of the art of Rogier van der Weyden which has led some authorities to suppose that Holbein had visited the Netherlands, but ignorance of his Augsburg predecessors precludes any real evaluation of the immediate sources of his style.

A visit in 1501 to Frankfurt am Main, where, with the assistance of Sigismund Holbein and Leonhard Beck, he painted the high altar of the Dominican monastery (Frankfurt, Stadelsches Institut), initiated a new stylistic phase which includes also the Kaisheim altar (1502, Munich) and the "Basilica of St. Paul" (1502, Augsburg). These paintings have much greater depth than before. with a freer grouping of highly individualized figures — often portraits — in rather lively movement. It has been suggested that this new manner was perhaps inspired by a contact with the early work of Matthias Griinewald in Frankfurt.

In a third and last phase, after 1510, including the St. Catherine altar (1512, Augsburgj, the St. Sebastian altar (1516, Munich) and the "Fountain of Life" (1519, Lisbon), Holbein began to use Italianate ornament and evolved a compromise between the late Gothic and Renaissance styles similar to that of Gerard David in Bruges. But he then found himself overshadowed by masters whose grasp of the Italian idiom was sounder than his own. In 1517, having fallen into financial difficulties, he withdrew from Augsburg to Isenheim. where he died.

Holbein's honesty and insight as a portraitist are best seen in his many silverpoint drawings (Basel, Berlin; self-portrait in this medium at Chantilly); it is clear that the incomparable portraiture of his more famous son must have owed much to his teaching. He also made designs for glass painting, and windows were designed by him in Eichstatt cathedral (1502) and in the churches of St. Ulrich at Augsburg and St. James at Straubing.

See C. Glaser, *Hans Holbein der Altere (1908).* (D. Kc.)

HOLBEIN, HANS, THE YOUNGER (1497?–1543), German painter and designer for printers and craftsmen, best known for his portraits and historical scenes, was born at Augsburg in 1497 or 1498. He was the son of the painter Hans Holbein the elder, the nephew of the painter Sigismund Holbein and the younger brother of the painter Ambrosius Holbein.

Holbein the elder sent both his sons on their travels about 1513–14 and their first stopping place is thought to have been Constance. In 1515, Hans Holbein the younger was in Basel and there both brothers entered the workshop of the painter Hans Herbster.

In the spring of 1j17, commissions from the magistrate Jacob von Hertenstein took Hans Holbein to Lucerne. His first journey to Italy (Lombardy) for study purposes was taken about 1518–19. He was evidently influenced there not only by works by Mantegna and other north Italian engravers but also by Lombard building styles and by the paintings of Leonardo da Vinci and his circle.

In Sept. 1519, the young artist was received as master into the painters' guild in Basel, and a year later he became a citizen of the town and married the widow Elsbeth Schmid. In 1522 he worked for the municipality of Solothurn. In Sept. 1523 he spent some time around Lake Constance; and in the early summer of 1524 went to Lyons and probably also Avignon, in France.

ONE OF THE WOODCUTS DESIGNED BY HANS HOLBEIN, THE YOUNGER, FOR THE "DANCE OF DEATH"

Furnished with letters of recommendation from Erasmus, Holbein wandered. in the autumn of 1526, through the Netherlands and visited Antwerp. In October he crossed to England. where he found a friendly patron in Sir Thomas More, who took him into his home in Chelsea.

In the summer of 1528, Holbein returned to Basel and acquired a house in St. Johann. In 1528–29 he experienced the fury of the iconoclasts. About 1529, Holbein was apparently in Milan for the second time. In 1531 the artist bought another house in Basel.

A payment was made to Holbein in Basel in Oct. 1531, but the next document. dated Sept. 1532, shows him to have been once more in London, where he first worked chiefly for the German merchants of the Steelyard. About 1536, he seems to have entered court service. In March 1538, he was in Brussels, on a commission from Henry VIII; in June he was in Le Havre and in August in Nancy and Joinville. He spent September to October of that year in Basel, where the city council offered him a pension. The same autumn, however, he returned to London by way of Paris. In July and Aug. 1539, he was once more on the continent and, commissioned by Henry VIII, painted a portrait of Anne of Cleves at Schloss Duren, near Aachen.

Between Oct. 7 and Nov. 29, 1543, Holbein died in London during a plague epidemic He left two illegitimate children there. His legitimate sons Jacob and Philipp were both goldsmiths. Descendants called Holbein, mostly goldsmiths, were long to be found in

England, France, Italy and Portugal.

One would expect to find the artistic influence of his father in Holbein's early work. and this is in fact present in a small Madonna with a Mantegnesque frame of *putti* (children) in Basel (1514) and in the portrait of the painter H. Herbster. which is also in Basel (1516). It is disputed, however, whether these two pictures are the work of Hans the Younger or his brother Ambrosius. It is with the imaginatively painted table for Hans Baer in Zurich (1515) and the free marginal drawings in a copy of Erasmus's *Laus Stultitiae* (151j, Basel) that Holbein the younger first appears as a definite artistic personality. A "Christ Carrying the Cross" (hitherto ascribed to Herbster) with a "Crowning With Thorns" on the back (1515, Basel) and the 1j16 portrait of the Burgomaster Meyer and his wife (Basel) show the young artist as a disciple of the conventional early Renaissance. At the same time, he had naturalistic tendencies, these showing themselves most freely in the two genre scenes on a double-sided schoolmaster's sign (1516, Basel). About 1516–17 he also began to work in woodcut for book decoration and to design paintings on glass.

GIRAUDON

"ERASMUS" BY HANS HOLBEIN. THE YOUNGER. IN THE LOUVRE, PARIS

Toward the end of the second decade of the century. Holbein was drawn into the international mannerist stream. This is already suggested in a small "Fall of Alan" of 1517 (Basel). The five dramatically impetuous scenes of a Basel Passion altarpiece and the 1519 sketch for a "Christ Crucified" (Berlin) are extreme examples of this mannerist tendency. The two leaves of the Oberried altarpiece (Freiburg) also incline in this direction. The 1517 portrait of the youthful Benedikt von Hertenstein (New York) Indicates that this extreme mannerism was overcome. Only fragments and copies remain of the façade paintings for the Hertenstein house in Lucerne. There Holbein returned to a quieter and more constrained composition and style, under the influence of Mantegna ("Triumph of Caesar"). The eight scenes of another Basel Passion altarpiece represent a classicism in which reminiscences of Mantegna and Dürer combine with Holbein's own striving toward simplicity and 'breadth of style. Leonardo's "Last Supper" inspired Holbein to a picture on the same subject, pared down, in Basel. Holbein was preserved from the dangers of eclecticism at that time by the clearsighted realism that is illustrated in the "Christ in the Tomb" of 1521 (Basel).

The portrait of Johannes Xilotectus of 1j20 (Nürnberg), that of Bonifacius Xmerbach of 1519 (Basel) and the full-face portrait of Erasmus of 1 ja.3 (Longford castle. Wiltshire) are shot through with the humanistic spirit and are connected in style with the Hertenstein portrait of 1517. In the contemporary profiles of Erasmus. Holbein goes back to the simplest portrait type of the early Italian Renaissance. The "Solothurn Madonna" (1522) and the "Burgomaster Meyer's Madonna" in Darmstadt, Ger., (preliminary sketch in Basel, repetition in Dresden) are classical compositions of almost symmetrical balance. Two half-length pictures in Basel dating from 1526, the "Venus" and the "Lais of Corinth," again show reminiscences of Leonardo. Connected with them in conception and style is the portrait of a musician in Berlin.

Between 1519 and 1526, Holbein gave more time to book and craft design. At this period he was probably already busy with plans for the two series of woodcuts. the "Dance of Death" (41 pictures) and the Old Testament illustrations (92 pictures), neither of which were brought out until 1538, by K. and M. Trechsel in Lyons. In addition, he designed numerous title pages, initials. etc., for Basel printers.

Two types are to be distinguished, at this period, in Holbein's decorative painting for buildings. In the ornament of the wall decorations for the house "Zum Tanz" (Basel, 1520–22; destroyed) Holbein, remembering Lombard prototypes in antique style. exploited all the possibilities of a playful fantastic illusionism. which breaks up the architectural planes with rich imagination. On the other hand, in the interior frescoes for the walls of the great council chamber in Basel (first payment made in June 1522). Holbein concentrated on the serene. closely organized design of classical fresco; some original fragments. sketches and numerous copies still bear witness to the work. The painting on the organ in Basel cathedral (1523–24) shows similar characteristics.

During his first stay in England (1526–28), Holbein painted a number of portraits which follow the severely objective lines of the Erasmus pictures, but which show a greater degree of detachment and calm. Outstanding examples of this new style of portraiture are the half-length Thomas More (New York city), William Warham (London; variant in Paris) and Henry Guildford with his wife (Windsor castle; copy in New York), all from the year 1527. There are coloured drawings for most of these and for the portraits enumerated below (largest collection in Windsor castle), marvelous in the soft distinctness of their contours, the economy of their modeling and their passionate objectivity.

In the portrait of the astronomer Niklas Kratzer (1528; Paris), Holbein attempts a certain "interior" mood by including the scholar's study and his instruments, the intention being to bring out the characteristic features of the subject. The double portrait of Thomas Godsalve and his son (1528; Dresden) displays an expressive kind of rhythmical grouping.

Everything which Holbein there tried out separately is brought together in the Thomas More family group, which consists of ten figures in an interior. Unfortunately, it exists no longer, but an outline drawing (1527 or 1528; Basel), seven portrait studies (Windsor) and several copies still give an idea of its appearance. In 1527 Holbein was in charge of the festal decoration of a hall in Greenwich; London, and also painted a battle scene.

To the beginning of Holbein's third stay in Basel belong portraits of a more intimate, private character: the "Holbein Family" (copies in Glarus. Switz., and Lille, Fr.), which is broadly painted on paper, the unfinished half-length picture of a woman with her hair loose (Basel) and the portrait of a burgher's wife (copy? The Hague). Some miniaturesand various craftsmen's designs may be assigned to the same period; the most important of them is the glass design with ten scenes from the Passion (before 1528). Holbein's chief concern, however, was the completion of the frescoes in the great council chamber, Basel.

The portrait of Georg Gisze, (1532; Berlin) must have been painted soon after Holbein's return to England. This is allied in style to the 1528 interior portrait of the astroiiomer, and he extended the method to the double portrait in the monumental interior of the ".Ambassadors" (1j33; London). He also painted a great number of half-length portraits, which show a constant advance in simplicity and objectivity: Hans von Antwerpen (1532; Windsor), Dietrich Born (1533; Windsor), two members of the Wedigh family (1532, Chicago; 1533, Berlin). Robert Cheseman (1533; The Hague), Charles de Solier (Dresden), Cyriacus Kale (1533; Brunswick), Dirk Berck (1536; New York city), and Richard Southwell (1536; Florence). Many of Holbein's most beautiful drawings and miniatures are among his portraits.

For the Steelyard. Holbein did frescoes and decorative work. The two *grisaille* frescoes, "The Triumphs of Wealth and Poverty," are lost. but they have come down to us through a preliminary sketch in the Louvre and later copies by Federico Zuccaro and others. There, Holbein apparently turned to account reminiscences of hlantegna's "Triumphal Procession of Caesar" and Dürer's "Triumphal Car of Maximilian." For the entry of Anne Boleyn, Holbein ornamented the Steelyard with a figurative festal decoration representing the Parnassus (preliminary drawing of 1533 in Berlin). His most mature religious work. the Venetian-inspired "Noli me tangere," in Hampton court, Eng., probably dates from the same period.

Most of Holbein's last works were commissioned by Henry VIII. Half-length court portraits predominate, and for these the artist

had developed a formula of great vitality: Jane Seymour (1536, Vienna), Henry VIII (1537, Althorp), Thomas Howard (Windsor), Anton the Good of Lorraine (Berlin), Anne of Cleves (1539, Paris), Henry VIII (Rome), John Chambers (Vienna).

A number of miniatures (the king's wives, Charles and Henry Brandon, etc., in London, Windsor, Munich, etc.) also date from about 1540. Besides these official portraits, there are others of a more intimate character: Simon George of Quocoute (Frankfurt am Main), the prince of Wales (New York city, Basel) and the full-length Christine of Denmark (1538, London).

In this last period, Holbein also created monumental group pictures — besides a rather dry mass scene, "Henry VIII Confers a Charter on the London Barber Surgeons' Guild" (1541?; London, Barbers' hall; much damaged), and the lost group portrait of Henry VIII with Jane Seymour and his parents, which was one of the wall paintings commissioned for the palace of Whitehall (part of 1537 sketch at Chatsworth, and copies).

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HOLBERG, LUDVIG HOLBERG, BARON (1684–1754), Scandinavian writer, has been called the founder of Danish literature. He was born at Bergen, Nor.. on Dec. 3. 1684. Both of Holberg's parents died in his childhood. his father first. leaving considerable property; and at the age of 11 he lost his mother also. Beiore the latter event. however, the family had been seriously impoverished by a great fire which destroyed several valuable buildings; notwithstanding this. the mother left to each of her six children some little fortune.

In 1695 the boy Holberg was taken into the house of his uncle, Peder Lem, nho sent him to the Latin school and prepared him for the profession of a soldier, but soon after this he was adopted by his cousin Otto klunthe. and went to him up in the mountains. His great desire for instruction. however, at last induced his family to send him back to Bergen to his uncle. There he remained, eagerly studying. until the destruction of that city by fire in 1702, when he was sent to the University of Copenhagen.

But he soon exhausted his resources and. having nothing to live upon. was glad to hurry back to Norway, where he accepted the position of tutor in the house of a rural dean at Voss. He soon returned to Copenhagen where, in 1704, he took his degree. and worked hard at French, English and Italian. But he had to earn his living, and accordingly he accepted the post of tutor once more, this time in the house of the vice-bishop of Bergen. The vice-bishop had travelled much. and the reading of his itineraries and notebooks awakened such a longing for travel in the young Holberg that at last. at the close of 1704, having scraped together 60 thaler, he went on board a ship bound for Holland. He proceeded as far as Aachen, where he fell ill. He suffered much from weakness and poverty and had to make his way back to Norway on foot.

Ashamed to be seen so soon in Bergen, he stopped at Christianssand, where he lived through the winter, supporting himself by giving lessons in French. In the spring of 1706 he travelled. in company with a student named Brix, through London to Oxford, where he studied for two years, gaining his livelihood by giving lessons on the violin and flute. He mentions. with gratitude. the valuable libraries of Oxford, and said it was while he was there that it first occurred to him "how splendid and glorious a thing it would be to take a place among the authors."

Through London and Elsinore he reached Copenhagen a third time, and began to lecture at the university; his lectures were attended but he received no money. He was asked in 1 jog to conduct a rich young gentleman to Dresden, and on his return journey he lectured at Leipzig, Halle and Hamburg.

Once more in Copenhagen, he undertook to teach the children of Admiral Gedde. Weary with that work, he took a post at Borch college in 1710, where he wrote, and published in 1711, his first work, *An Introduction to the History of the Nations of Europe,* and was permitted to present to King Frederick IV two manuscript essays on Christian IV and Frederick III.

The king soon after presented him with the title of professor and with the Rosenkrantz grant, the holder of which was expected to travel. Holberg accordingly started in 1714, and visited. chiefly on foot, a great portion of Europe. From Amsterdam he walked through Rotterdam to Antwerp, took a boat to Brussels and on foot again reached Paris. Walking and skating, he proceeded in the depth of winter to Marseilles, and on by sea to Genoa. On the last mentioned voyage he fell ill. and nearly died in that city. On his recovery, he pushed on to Civitavecchia and Rome. When the spring had come, being still poor and in feeble health. he started homeward on foot by Florence, across the Xpennines. through Bologna, Parma, Piacenza, Turin, over the Alps, through Savoy and Dauphiné to Lyons, and finally to Paris, where he arrived in excellent health.

After spending a month in Paris, he walked on to Amsterdam, took sail to Hamburg and so went to Denmark in 1716. He spent the next two years in extreme poverty. and published his *Introduction to Natural and Popular Law.* At last, in 1718. his talents were recognized by his appointment as professor of metaphysics at the University of Copenhagen, and in 1720 he was promoted to the lucrative chair of public eloquence. which gave him a seat in the consisiory. His pecuniary troubles were now at an end.

Hitherto he had written only on law, history and philology, although in a Latin controversy with the jurist Xndreas Hojer of Flensborg his satirical genius had flashed out. But now. and until 1728, he created an entirely new class of humorous literature under the pseudonym of Hans Mikkelsen. The seriocomic epic of *Peder Paars*, the earliest of the great classics of the Danish language, appeared in 1719. This poem was a brilliant satire on contemporary manners and enjoyed an extraordinary success. But the author had offended in it several powerful persons who threatened his life. and, if Count Danneskjold had not personally interested the king in him, Holberg's career might have had an untimely close. During the next two years he published five shorter satires. In 1721 Holberg became director of the first Danish theatre in Grönnegade, Copenhagen. where, in Sept. 1722, a Danish translation of *L'Avare* was produced. Until this time no plays had been acted in Denmark except in French and German, but Holberg now determined to use his talent in writing Danish comedy. The first of his original pieces performed was *Den politiske Kundestiiber* ("The Pewterer Turned Politician"); and before the end of 1722 he produced *Den Vaegelsindede* ("The Waverer"), *Jean de France, Jeppe paa Bjerget* and *Gert the Westphalian.* Of these five plays, four are masterpieces. Holberg took no rest, and before the end of 1723 the comedies of *Barselstuen* ("The Lying-in Room"), *The Eleventh of July, Jakob von Thyboe, Den Sundeslöse* ("The Fidget"), *Erasmus Montanus, Don Ranudo, Ulysses of Ithaca, Without Head or Tail, Witchcraft* and *Melampe* had all been written, and some of them acted. In 1724 the most famous comedy that Holberg produced was *Henrik and Pernille.* But in spite of this unprecedented blaze of dramatic genius the theatre had to be closed for lack of money, Holberg composing for the last night's performance, in Feb. 1727, a *Funeral of Danish Comedy.*

This excessive labour for the stage had undermined the poet's health. and in 1725 he had determined to take the baths at Xachen; but instead of going thither he wandered through Belgium to Paris, and spent the winter in that city. In the spring he returned to Copenhagen with recovered health and spirits, and worked quietly at his protean literary labours until the great fire of 1728.

In the period of national poverty and depression that followed this event. a puritanical spirit. which was little in sympathy with Holberg's dramatic or satiric genius, predominated. He there-

fore closed his career as a dramatic poet by publishing in 1731 his acted comedies, with the addition sf five which he had no opportunity of putting on the stage. He adopted the serious tone of the new age and busied himself for the next 20 years with historical, philosophical and statistical writings. During this period he published his poetical satire called *Metamorphosis* (1726) and his *Epistolae ad virum perillustrem* (1727), his *Description of Denmark and Norway* (1729), *History of Denmark, Universal Church History, Biographies of Famous Men, Moral Reflections, Description of Bergen* (1737), *A History of the Jews* and other learned and laborious compilations. The only poem he published at this time was the famous *Nicolai Klimii iter subterrancum* (1741), afterward translated into Danish by Baggesen.

When Christian VI died in 1747, pietism lost its sway; the theatre was reopened and Holberg was appointed director, but he soon resigned this arduous post. The six comedies he wrote in his old age did not add to his reputation. His last published work was his *Epistles,* in five volumes, the last of them posthumous (1754). In 1747 he was created by the new king Baron of Holberg. He died at Copenhagen on Jan. 28, 1754, at 70 years of age. He was buried at Soro, in Zealand. He had never married, and he bequeathed all his property, which was considerable, to Soro college.

Holberg was not only a great Danish author, but he was, with the exception of Voltaire, the first writer in Europe during his own generation. Neither Pope nor Swift, who perhaps excelled him in particular branches of literary production, approached him in range of genius or in encyclopaedic versatility. Holberg found Denmark provided with no books, and he wrote a library for it. When he arrived in the country, the Danish language was never heard in a gentleman's house. Polite Danes were wont to say that a man wrote Latin to his friends, talked French to the ladies, called his dogs in German and only used Danish to swear at his servants. The single genius of Holberg revolutionized this system.

He wrote poems of all kinds in a language hitherto employed only for ballads and hymns; he instituted a theatre, and composed a rich collection of comedies for it; he filled the shelves of the citizens with works in their own tongue on history, law, politics, science, philology and philosophy, all written in a true and manly style and representing the extreme attainment of European culture at the moment.

Perhaps no author who ever lived had so vast an influence over his countrymen, an influence that was still at work after two centuries.

The editions of Holberg's works are legion. Complete editions of the *Comedies* are too numerous to be quoted; the best is that brought out in 3 vol. by F. L. Lichtenberg (1870). Of *Peder Paars* there exist *more* than 20 editions, besides translations in Dutch, German and Swedish. The *Iter subterraneum* was translated into Danish, German, Swedish, Dutch, English, French, Russian and Hungarian. The life of Holberg was written by Welhaven in 1858 and by Georg Brandes in 1884. Among other works may be mentioned those by Robert Prutz (1857) and A. Legrelle (1864).

HOLBORN, a metropolitan (1900) and parliamentary borough of London. Eng.. bounded northwest by St. Pancras, northeast by Finsbury, southeast by the City of London. southwest by the City of Westminster and west by St. Marylebone. Pop. (1951) 24,810, the day population being about 250,000. It is the smallest borough in London (0.6 sq.mi.). It is a legal centre containing two of the four Inns of Court—Gray's Inn and Lincoln's Inn—and a concentration of solicitors as well as insurance firms. architects, auctioneers: estate agents, engineers, office equipment suppliers and government offices. Near the patent office are many patent and trade-mark agents.

The origin of the name is found in *Holebourne,* "the stream in the hollow." in allusion to the Fleet. The fall and rise of the road across the valley before the construction of the viaduct (1869) was abrupt and inconvenient. The site of Holborn bars. where tolls were levied at the entrance to the City. is $\frac{1}{4}$ mi. W. of the viaduct. The residential district is mainly within the parish of St. George. Bloomsbury (derived from William Blemund, a lord of the manor in the 13th century). though many of its 18th-century houses. built round squares. are used as offices. Succeeding the nobility in Bloomsbury came the medical profession followed in the 19th century by writers. From the 17th century until the building of New Oxford street in 1847 the district of St. Giles. which includes Seven Dials, was notorious as a home of crime and poverty, and in the Rookery of St. Giles were some of the most dangerous of London's alleys. Many of Charles Dickens' characters lived and moved there and in other parts of Holborn: Hatton Garden, leading north from Holborn circus, is a centre of the diamond. gold and silver trades.

Ely place takes its name from a palace of the bishops of Ely. The property was acquired by Sir Christopher Hatton, lord chancellor under Elizabeth I. The chapel of St. Etheldreda (Roman Catholic) is the only remnant of the palace and was built in the 13th century with a vaulted crypt. The parish church of St. Giles-in-the-Fields, between Shaftesbury avenue and New Oxford street, dates from 1734 and is the successor to the chapel of a lepers' hospital founded there in 1101 by Matilda, wife of Henry I. St. George's church (1720–31), Bloomsbury way, by North Hawksmoor. has a statue of George I on a stepped spire. The Tudor gateway of Lincoln's Inn opens (east) upon Chancery lane while west lies the square called Lincoln's Inn Fields, with the Sir John Soane's museum. Gray's Inn is between High Holborn and Theobald's road. Of the former Inns of Chancery attached to these Inns of Court the most noteworthy building remaining in Holborn is Staple Inn, with its unique timbered and gabled Elizabethan front, in High Holborn, once attached to Gray's Inn.

The British Museum stands north of New Oxford street, and also in Bloomsbury are the Senate house and library of the University of London, Birkbeck college and other institutions belonging to the university and the Royal Academy of Dramatic Art. Holborn also contains the Hospital for Sick Children in Great Ormond street, Moorfield's Eye hospital and other hospitals: the Central School of Arts and Crafts, the City Literary institute; the London Central Y.M.C.A.. the Y.W.C.A. central club and the headquarters of the T.U.C. (1956). all in Great Russell street; the Freemasons' hall, Africa house, the Winter Garden and six other theatres. From 1950 onward many great blocks of offices were built on areas bombed in World War II.

HOLBROOKE, JOSEPH (JOSEF) **CHARLES** (1878–1958), English composer whose works were popular at the beginning of the 20th century. He was born at Croydon. Surrey. July 5, 1878, and became a pupil of Frederick Corder at the Royal Academy of Music, London. His symphonic poem *The Raven,* inspired by the poem by Edgar Allan Poe, was performed in 1900, and uas followed by a series of over 20 orchestral and chamber works also based on Poe, including *Ulalume, The Bells,* a dramatic choral symphony, and *The Masque of the Red Death.* His operas, which were of Wagnerian proportions, include the trilogy *The Cauldron of Annwyn,* based on Welsh legends and consisting of *The Children of Don* (1912), *Dylan* (1914) and *Bronwen* (1929). A prolific composer, Holbrooke wrote in all forms. His orchestral variations "Three Blind Mice" best succeeded in retaining a hold on the public. He died in London, Aug. 5, 1958.

HOLCROFT, THOMAS (1745–1809), English dramatist whose melodrama *The Road to Ruin* (1791) has often been revived, was born in London, Dec. 10, 1745. His father, a cobbler who turned peddler, was so poor that Thomas had sometimes to beg his bread; but he taught him the uncompromising honesty which won admiration later. His life was a struggle against adversity. After working as a Newmarket stableboy. a cobbler and a teacher, meanwhile teaching himself languages and music, he secured in 1778 a minor position at Drury Lane theatre, where his first play. *The Crisis,* had one performance. *Duplicity* (1781) was more successful. While in Paris as *Morning Herald* correspondent in 1782 he saw Beaumarchais' *Le Mariage de Figaro* every night until he knew it by heart. and his translation, *The Follies of a Day* (1784), enjoyed great success. He himself acted Figaro. Meanwhile he was writing novels, verse, translations and articles. Holcroft supported the French Revolution and joined the Society for Constitutional Information: in 1794 he was indicted for high treason and imprisoned, but was released two months later. He then tried to found a journal in Hamburg; later. after two years in Paris, he started a printing-press in London (1803) which failed dismally.

He died there on March 23. 1809.

Holcroft's friends included Coleridge, Lamb, William Godwin and William Hazlitt. who in 1816 edited his *Memoirs, Written by Himself and Continued Down to the Time of His Death, From His Diary, Notes and Other Papers.* This vivid autobiography shows the gentleness and humour of a man who often appeared harsh. It was re-edited by E. Colby (1925), who also published a bibliography of Holcroft's works (1922).

HOLD, a nautical term applied to the interior or cargo-containing part of a ship, below the deck or lower deck. The term hold beam applies to beams crossing the ship above the hold.

The derivation is not from the same root as the verb "to hold," but from the Dutch *hol,* a "hole" or "cavity."

HOLDEN, SIR EDWARD HOPKINSON, 1ST BART. (1848–1919), English banker, was born on May 11, 1848, at Tottington. Lancashire. He became managing director (1898) and eventually chairman (1908) of the Birmingham and Midland bank. He devoted himself to the development of the amalgamating policy of his bank, which ultimately became the London Joint City and Midland bank *(see* BANKING: *Great Britain and the Commonwealth).* From 1898 he interested himself in international banking, and became as great an expert on foreign exchange questions as on home finance. He was the first of the larger London joint-stock bankers to open a foreign exchange department.

In 1906 Holden was elected Liberal M.P. for the Heywood division of Lancashire and in 1909 received a baronetcy. In 1915 he went with Lord Reading to the United States on behalf of the government and arranged there the Anglo-French loan. He died on July 23, 1919.

HOLDEN, SIR ISAAC, BART. (1807–1897), English inventor and manufacturer, was the son of Isaac Holden, a native of Cumberland, and was born at Hurlet, near Paisley, on May 7, 1807.

His early life was passed in straitened circumstances, but his father spared no pains to give him as much elementary education as possible. At the age of ten he began to work as weaver's drawboy, and afterward was employed in a cotton mill.

Meanwhile his education was continued at night school, and from time to time, as funds allowed. he was taken from work and sent to the grammar school, to which he at last went regularly for a year or two until he was 15, when his father moved to Paisley and apprenticed him to an uncle, a shawl weaver there.

In 1828 he was appointed mathematical teacher in the Queen's Square academy, Leeds. After six months he transferred to Lingard's grammar school, near Huddersfield, and shortly afterward to Castle Street academy. Reading.

It was there that he developed a lucifer match by adopting sulphur as the medium between the explosive material and the wood, but he refused to patent the invention. In 1830, when his health failed. he returned to Scotland, where a Glasgow friend offered to set up a school for him. However, he was recommended for the post of bookkeeper to the firm of Townend Brothers, worsted manufacturers, of Cullingworth, Yorkshire. His interest in machinery soon led to his transfer from the countinghouse to the mill.

His experiments led him to the invention of his square-motion wool comber and of a process for making genappe yarns, a patent for which was taken out by him in conjunction with S. C. Lister (Lord Masham) in 1847.

The firm of Lister and Holden, which established a factory near Paris in 1848, carried on a successful business, and in 1859. when Lister retired. was succeeded by Isaac Holden and Sons, which became the largest wool-combing business in the world, employing more than 4,000 workpeople.

In 1865 Holden, who was advised by his physicians to make a complete change of occupation, entered parliament as Liberal member for Knaresborough. From 1868 to 1882 he was without a seat, but in the latter year he was elected for the northern division of the West Riding and in 1885 for Keighley.

He was created a baronet in 1893. He died suddenly at Oakworth house, near Keighley, on Aug. 13, 1897.

HOLDER, ALFRED THEOPHIL (1840–1916), Austrian philologist of astonishing productivity in the fields of ancient and medieval Latin, Germanic and Celtic, was born in Vienna on April 4, 1840. After an interlude as schoolmaster, in 1867 he joined, and in 1870 became chief librarian of, the Court and National library at Karlsruhe, Ger., where he died on Jan. 12, 1916.

Holder's work, almost entirely in the form of text editions and manuscript catalogues, embraced four main fields: (1) the editions of Horace (1864–69, in collaboration with Otto Keller) and of the ancient commentaries on Horace (1894), of Tacitus (1882), Caesar (1882, 1898), Avienus (1887) and of works by Cicero, Cato, Seneca and later Latin writers; (2) the extensive study of medieval Latin from which resulted his catalogue *Die Reichenauer Handschriften* (3 vol., 1906–18); (3) in the field of Germanic antiquities, besides producing part 2 of his teacher Holtzmann's *Altdeutsche Grammatik* (1870–75) and *Germanische Alterthümer* (1873), he edited texts of Ekkehardus (1874), *Beowulf* (1882–84), Bede (1890), Einhardus, Nithardus and Jordanes (1882), Saxo Grammaticus (1886) and a Dutch Passion (1877); (4) his *Alt-celtischer Sprachschatz* (1891–1913), a monumental compilation of Celtic names culled from antiquity.

See K. Preisendanz, *Biographisches Jahrbuch* fur *Altertumskunde* (Bursian's *Jahresbericht)* 47:54–93 (1927). (E. P. H.)

HÖLDERLIN, JOHANN CHRISTIAN FRIEDRICH (1770–1843), one of the greatest German poets, was born on March 20, 1770, at Lauffen on the Neckar. He was destined for the church and studied theology at Tiibingen. He was already writing poetry and had begun to sketch his novel *Hyperion* when he was introduced to Schiller, who published some of his early writings in his periodicals *Die neue Thalia* and *Die Horen.* Schiller also obtained for Holderlin the post of tutor to the son of Charlotte von Kalb. A year later Holderlin moved to Jena to attend J. G. Fichte's lectures and to be near Schiller; but in 1796 he was forced by poverty to accept another post as tutor to the family of the banker J. F. Gontard in Frankfurt-on-Main. He fell deeply in love with Susette, Gontard's beautiful and gifted wife, the "Diotima" of *Hyperion* and some of the poems, and she returned his affection. Gontard's jealousy was aroused and the poet was obliged to leave Frankfurt. Physically and mentally shaken, he nevertheless completed the second volume of *Hyperion,* which appeared in 1799, the first having been published in 1797. He also began a tragedy, *Der Tod des Empedokles,* of which the first version was nearly completed; a magnificent fragment written for a second version has survived. Symptoms of great nervous irritability alarmed his family and friends, who persuaded him to go to S itzerland as tutor to a family in Hauptwyl. He wrote several fine poems during this period, among them "Der blinde Sanger," "An die Hoffnung" and "Dichtermut." His employer, however, found himself obliged to make other arrangements and Holderlin returned home in 1801. After vainly attempting to obtain a lectureship in Greek literature at Jena through the influence of Schiller, who ignored his appeal, he once more accepted a post as tutor, at Bordeaux. Susette Gontard died a year later in June, and the news is supposed to have reached Holderlin shortly afterward; for in the following month he suddenly left Bordeaux and traveled homeward on foot through France, arriving at Niirtingen completely destitute and mentally deranged, in an advanced stage of schizophrenia. He seemed to recover somewhat as a result of the kind and gentle treatment he received at home; and in his lucid intervals he continued to write magnificent poetry, most of it published by friends after he had lost his reason. He also completed verse translations of Sophocles' *Antigorte* and *Oedipus Tyrannus,* published in 1804. In this year Hölderlin's devoted friend Isaac von Sinclair obtained for him the sinecure post of librarian to the landgrave Frederick V of Hesse-Homburg. Sinclair provided the modest emoluments himself, and Holderlin improved noticeably under his care and companionship. But unfortunately Sinclair (who refused to believe that Holderlin was insane) was shortly afterward arrested on a charge of high treason and imprisoned for many months. By the time he was released, Holderlin had succumbed irretrievably, and, after a spell in a clinic in Tiibingen, was moved to a carpenter's house in that town, where he died on

June 7, 1843.

Holderlin ranks as one of the greatest of German poets. Strongly influenced by Friedrich Klopstock and Schiller in his early youth, he was emancipated from the latter's overpowering personality by the inspiration of "Diotima," and abandoned rhymed metres for classical hexameters and free rhythms. His ardent love of ancient Greece and its deities fused with his pantheistic conception of nature into a prophetic and visionary whole which forms the background of his work. *Hyperion, oder der Eremit in Griechenland* (1797–99), in spite of the beauty of the language and the inspiring enthusiasm for Greece, cannot compare with the great hymns and odes of Holderlin's latter period in which the classical inspiration met and mingled with Christian conceptions and the worship of Christ. Among these *Der Archipelagus, Brot und Wein, Der Rhein,* "Germanien," "Der Einzige" and "Patmos" are perhaps the most famous; *Der Tod des Empedokles* and the fragmentary *Empedokles auf dem Aetna* have an almost Aeschylean grandeur. and the translations from Sophocles are unparalleled in any language.

Holderlin is to all intents and purposes a discovery of the 20th century, largely because of Torbert von Hellingrath's beautiful edition. which caught the eye of such poets as Rainer Maria Rilke and Stefan George and established his reputation in Europe. The definitive edition of his collected works was edited by F. Beissner (1943). Previous collected editions were those by N. von Hellingrath, F. Seebass and L. von Pigenot, 6 vol., 2nd ed. (1923); by F. Zinkernagel, 5 vol. (1914–26); and by W. R. Bohm, 5 vol., 4th ed. (1924). *Selected Poems* were translated by J. B. Leishman (1944). The collected letters were edited by E. Bertram (1936).

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HOLDERNESSE, EARL OF, an English title borne by Sir John Ramsay and later by the family of Darcy. John Ramsay (*c.* 1580–1626), a member of the Scottish family of Ramsay of Dalhousie, was knighted for his share in rescuing James VI from the hands of John Ruthven, earl of Gowrie. in Aug. 1600. In 1606 the king created him Viscount Haddington and Lord Ramsay of Barns, and in 1621 made him an English peer as earl of Holdernesse. Ramsay died in Feb. 1626, at which time his titles became extinct.

In 1644 Charles I created his nephew, Prince Rupert, earl of Holdernesse, but when the prince died unmarried in Nov. 1682 the earldom again became extinct. Conyers Darcy (1599–1689), who was made earl of Holdernesse in 1682, only a few days after the death of Rupert, was the son and heir of Conyers Darcy, Lord Darcy and Conyers (*c.* 1571–1654). Robert Darcy, 4th and last earl of Holdernesse, died in 1778.

HOLDHEIM, SAMUEL (1806–1860), Jewish rabbi, a founder and leader of Reform Judaism in Germany, was born in Posen. He officiated at Frankfurt-on-Oder (1836–40), Mecklenburg-Schwerin (1840–46) and Berlin (1847–60). Holdheim was one of the dominant personalities in the rabbinical conferences of 1844–46, which elaborated the ideology of Reform. He advocated changing the language of prayer in the synagogue from Hebrew to the vernacular. In general he favoured the elimination of all nationalistic elements, particularly the hope for the return to Zion, from the prayer book. In his later years he advocated the observance of Sunday as the Sabbath. Holdheim died at Berlin on Aug. 22, 1860.

Holdheim's writings form part of the classical literature of Reform, though his ideas are not generally accepted within the movement. They include, besides numerous contributions to periodicals and essays, *Gottesdienstliche Vortrage* (1839); *Geschichte der Entstehung und Entwicklung der jiidischen Reformgemeinde in Berlin* (1857); and three volumes of sermons.

See E. G. Hirsch, "Holdheim!' in *The Jewish Encyclopedia,* vol. vi.

HOLGUÍN, a city in Oriente province, Cuba, about 65 mi. N.W. of Santiago de Cuba. It is located on the rolling northeastern plains of the island and is the most important communication and trading centre of northern Oriente. Due to excellent climate and surrounding fertile soils, the city has grown rapidly (pop. [1953] 57,573). Sugar cane and tobacco are the chief products of the region, though cattle are important. The city is on the Central highway and is served by railroads and airlines. Its port, Gibara, is 19 mi. north.

Holguin was founded in the first half of the 16th century by a group of families under Garcia Holguin, a veteran of the Spanish conquest of Mexico. The town was an insurgent centre and suffered intensely the effects of the Ten Years' War (1868–78) and the 1895–98 revolution for Cuban independence. (D. R. D.)

HOLIDAY, originally "holy day," a festival in honour of some sacred event or person. When the Psalmist spoke of going to the house of God "with a multitude that kept holyday" (Ps. xlii, 4), the word he used for holyday also meant "dancing in a circle," thus suggesting that some aspects of the festival were joyful and carefree

In the course of time, holidays came to include rest or recreation days not necessarily connected with religion. It is significant that the idea of dancing, a primitive mode of expressing joy, persisted for centuries; even in 1577 we find an English poet. Barnabe Googe, saying. "Do you not knom that it is a holiday, a day to dance in?"; and days of celebration were traditionally days for dancing in the streets

Secular holidays were usually weekdays on which work was suspended. Shakespeare makes this clear when in the opening scene of *Julius Caesar* he has Flavius rebuke a group of workingmen: "Hence, home, you idle creatures . . . Is this a holiday?" and the cobbler explains, "We make holiday to see Caesar and to rejoice in his triumph."

How Holidays Became Vacations. — In olden times the common people did little travelling. They worked hard and earned little; furthermore, the highways were poor and unsafe. Holidays, usually of one-day duration, were celebrated close to home, often on the traditional village green. As economic conditions improved, especially as the result of the Industrial Revolution, people began to be able to absent tbemselves from work for more than a day, and even visit other towns. The term "holiday" began to be expanded to include recreation periods of a week or more, sometimes called vacations. When this happened, some of the one-day "festival" holidays became less important. When "holiday" began to mean "vacation" it was a sign that the people had more leisure. It was a symbol of more freedom. mental as well as physical. For a few brief days they could be away from the watchful eye of inquisitive neighbours, free from the limiting surveillance of paternalistic employers.

The new type of holiday enabled a man to fulfil some of his hitherto suppressed desires. One who had longed to go fishing could betake himself to a river and devote his whole free period to the felicities of angling Another could spend a few days in the big city. and perhaps find out if the city folk were really smarter than their rustic brethren. At the same time city people were getting their first glimpses of country life, discovering a new world of nature. Holidays of this type uere symptoms of motion, of circulation, of groning national vitality. Even when, as often happened, a man would use his "time off' to study some aspect of his own trade, it was the purest kind of recreation; on "the busman's holiday." riding on another driver's bus, he was no longer a drudge but an eager amateur, able to sit back and study the operations of his dally job with complete detachment.

Expanding Holidays. — A simple example of how a church holiday can expand into a vacation is seen at Eastertide, in the three-day period from Good Friday to Easter Monday This is sometimes lengthened to four days by adding Easter Monday (in England a bank holiday). It is five days long in Denmark, where the vacation includes the Thursday before Easter. The tendency to "take off" an extra day or so is seen also when Christmas falls near the beginning or end of a week, leaving only one workday between the holiday and Sunday.

Independence Days.— Holidays celebrating national independence occur largely in the period from July through September. Examples are Argentina, July 9; Belgium, July 21; Bolivia. Aug. 6; Brazil, Sept. 7; Chile, Sept. 18; Colombia, July 20; Costa Rica, Sept. 15; Ecuador, Aug. 10; France, July 14; Guatemala, Sept. 15; Honduras, Sept. 15; Liberia. July 26; Mexico. Sept. 16: Nicaragua. Sept. 15; Peru, July 28; Republic of the Philippines, July 4; El Salvador, Sept. 1j; United States. July 4; Uruguay, Aug. 25; Venezuela. July 5.

The nations celebrating their independence on Sept. 1j were members of a confederation of Central American states which lasted from 1824 to 1839 Sept. 1j, 1821. is the date of their independence from Spain.

Dates of some other independence days are: Cuba. June 17; Dominican Republic. Feb. 27; Finland, Dec. 6: Greece, March 2j; Haiti. Jan. 1; Iceland, June 17; Lebanon, Nov. 22; Panamá, Nov. 3.

The Republic of Israel may be said to have two independence days, the ancient Passover, commemorating deliverance from Egypt, and the modern Proclamation of the Jenish State, nhich took place on May 14. 1948 (5th day of Iyar in the Jewish year 5708). Because the Jenish calendar is a lunar one, both of these feasts are movable. the Passover falling in March or April, and the modern festival in April or May. Also a movable feast is the Irish independence day (often so called). It recalls the rising of Irish Republican volunteers in Dublin. on Easter Monday, April 24. 1916, and is celebrated on Easter Monday. regardless of the date.

Independence days mark the trend auay from monarchy and from colonialism. Much may be learned by comparing the character and behaviour of a nation before and after its day of independence; the study of such national holidays is full of dramatic revelations.

Akin to independence days are days honouring the defenders of a nation. In the United States are two of these, Memorial (Decoration) day. on May 30, a full holiday, and Veterans' (formerly Armistice) day, Nov. 11, the latter for living as well as dead veterans.

Holidays of **Limited** Observance.—In the United States, certain anniversaries are celebrated on days devoted to "business as usual." When there is cessation or curtailment of postal and banking services on such days. it causes inconvenience to the public. Examples are Feb. 22 and Nov. 11, respectively George Washington's birthday and Veterans' day. Such days, honoured by appropriate exercises in schools and elsewhere, though sometimes called holidays. are not such in the full sense of the word; perhaps they should be classed as patriotic anniversaries.

Thanksgiving.— Days or periods of thanksgiving have been known in many lands from ancient times. In the United States, from early colonial times onward, days for thanksgiving have been appointed for various reasons, and in at least eight different months. Sometimes the thanks was for food and shelter. sometimes for victory over Indians, or for peace with the Indians; sometimes for other reasons. Early Thanksgivings in Plymouth Colony were held in September, July and February. In Revolutionary times the continental congress appointed several thanksgiving days. which fell in May, July and December. In 1789 the *Book of Common Prayer* of the Protestant Episcopal Church in America directed that Thanksgiving be observed on the first Thursday of November, "unless another day be appointed by the civil authorities."

On Oct. 3. 1789, Pres. George Washington appointed Thursday, Nov. 26 (which happened to be the fourth Thursday in the month). a day of general thanksgiving throughout the union. Because this was the first festival of its kind proclaimed by a president of the United States. it is considered the first national Thanksgiving day. In Washington's diary he wrote "Thursday, 26th: Being the day appointed for a thanksgiving. I went to St. Paul's Chapel. though it was most inclement and stormy—but few people at Church."

In Oct. 1863 Pres. Abraham Lincoln "invited" citizens of the United States "to set apart and observe the last Thursday of November next as a day of Thanksgiving." He did the same in 1864. It is understood that he was following a suggestion of Sarah Josepha Hale. editor of *Godey's Lady's Book*. Most of the states had already held the festival on such a day, and Mrs. Hale sought to achieve national unity.

In 186j Pres. Andrew Johnson named the first Thursday in December the Thanksgiving festival, and in 1869 Pres. Ulysses Grant chose the third Thursday in November. Otherwise Lincoln's "last Thursday in November" was the accepted date for many years. In 1939 businessmen. who wished to create a longer shopping period between Thanksgiving and Christmas, petitioned Pres. Franklin Roosevelt to move Thanksgiving back one week. He complied, in 1939 specifying the fourth Thursday and in 1940 and 1941 the third Thursday in November. In 1941 congress rejected both "third" and "last," and decreed that Thanksgiving henceforth be on the fourth Thursday in November.

Labour **Day,** in the United States the first Monday in September, was first celebrated in New York city in 1882. Then often referred to as a holiday for workmen. it gained in importance and in general participation. As early as 1884, readers of the *New York Heruld* were told that "This . . . is a day that should be honored above all others. It is in honor of the greatest of saints—St. Labor." After various developments *(see* LABOUR DAY) it became one of the country's principal holidays.

Changing Status of Holidays.— Under modern conditions, holidays as such tend to lose their importance. They provide opportunities for leisure and recreation to a public already largely enjoying those advantages. With a reduced work week and vastly improved means of transportation. workers by the millions are able to turn every week-end into a holiday. In some countries, notably in the United States. a holiday became an opportunity to stay at home, free from the rigours of the crowded highway. One of the by-products of such holidays at home was the rise of the "do-it-yourself" movement, and work-away-from-work became a hobby. There still continued to be, nevertheless, a strong appeal in a day that is special and set apart; and while that appeal lasts there will always be men and women and children who find some magic in a holiday.

(Religious and secular holidays and holiday customs in Europe, the Unittd States and other parts of the world are discussed at some length in articles such as: ARBOR DAY; ARMISTICE DAY; BANK HOLIDAYS; BOXING DAY; CARNIVAL; CHRISTMAS; EASTER; FEAST ASD FESTIVAL; GOOD FRIDAY; HALLOWEEN; INDEPENDENCE DAY; LABOUR DAY; LUPERCALIA; MEMORIAL DAY; MISRULE, LORD OF; NEW YEAR'S DAY; PASSOVER; SATURN; SUNDAY; THANKSGIVING DAY; WAKE.) (A. McQ.)

HOLINSHED, RAPHAEL (d. *c.* 1580), English chronicler, is remembered chiefly because his *Chronicles* enjoyed great popularity and became a quarry for many Elizabethan dramatists, especially Shakespeare, who found in the second edition material for *Macbeth, King Lear, Cymbeline* and many of his historical plays. Holinshed probably belonged to a Cheshire family and may possibly be identified with the Holinshed who matriculated from Christ's college, Cambridge, in 1544; he was in London from about 1560. His will, dated Oct. 1, 1578, describes him as steward to Thomas Burdet, of Bramcote, Warwickshire, and was proved, April 24, 1582.

In London he was employed as a translator by Reginald Wolfe, who was preparing a universal history; but after Wolfe's death (1573), the scope of the work was abridged and it appeared, with many illustrations, as the *Chronicles of England, Scotland, and Ireland* (2 vol.; dated 1577). although not licensed for publication until July 1578. Holinshed received valuable assistance from William Harrison (*q.v.*) and others, and from John Leland's manuscripts. The part dealing with the history of Scotland is mainly a translation from Hector Boece's *Scotorum historiae* (1527).

The *Chronicles* is a work of largely uncritical compilation from many sources of varying degrees of .trustworthiness. The texts of the first and second (1587) editions were expurgated by order of the privy council, and the excisions from the second edition were published separately in 1723. An edition of the complete text of 1587 was published in six volumes (1807–08). A selection, *Holinshed's Chronicle as used in Shakespeare's Plays*, was edited by A. and J. Nicoll (1927).

HOLKAR, the family name of the Maratha ruler of Indore (*q.v.*), which was adopted as a dynastic title. The termination *-kar* implies that the founder of the family came from the village of Hol near Poona.

HOLL, FRANK (1845–1888), English painter. was born in London on July 4. 1845. and was educated chiefly at University College school. He was a grandson of William Holl, an engraver of note, and the son of Francis Holl. A.R.X. Entering the Royal academy schools as a probationer in painting in 1860, he exhibited at the academy in 1864 "A Portrait" and "Turned out of Church," a subject picture. "A Fern Gatherer" (1865); "The Ordeal" (1866); "Convalescent" (the somewhat grim pathos of which attracted much attention) and "Faces in the Fire" (1867) succeeded.

Holl gained the travelling studentship in 1868; the successful work was characteristic of the young painter's mood, being "The Lord Gave. and the Lord Hath Taken Away." Holl was much below Millais in portraiture. The range of his studies and the manner of his painting were narrower than those of Josef Israels. with whom. except as a portrait painter, he may better be compared than with Millais.

In 1878 he was elected A.R.A., and exhibited "The Gifts of the Fairies." "The Daughter of the House," "Absconded" and a very fine portrait of Samuel Cousins now in the National gallery. London. This last canvas is a masterpiece. Holl was elected R.A. in 1883 and in 1886 he produced a portrait of Millais as his diploma work, but his health rapidly declined and he died at Hampstead, on July 31. 1888.

HOLL, KARL (1866–1926), German theologian, remembered chiefly for his historic contribution to the interpretation of Luther, was born at Tubingen, May 1j, 1866. He studied at Tubingen, Berlin. Giessen and Marburg, becoming professor of church history at Tiibingen in 1900 and at Berlin in 1906. He died at Charlottenburg, Berlin, May 23, 1926.

Holl's interests ranged. from the early church to urgent contemporary problems, but his chief work was divided between the Greek Church and the Reformation. He was a paleographer, a textual critic and a conscientious scholar, and these gifts find expression in such works as *Die Sacra Parallela des Johannes Damascenus* (1897), *Enthusiasmus und Bussgewalt beim griechischen Monchtum* (1898) and *Amphilochius in seinem Verhältnis zu den grossen Kappadozien* (1904), which contains a history of the doctrine of the Trinity in the 4th century.

His highly erudite study of Luther's doctrine, forming vol. i of his *Gesammelte Aufsätze zur Kirchengeschichte* (3 vol., 1923–28; 7th ed. of vol. i, 1948), was the fruit of his passionate interest in theology as the study of man's meeting with God and shows his profound knowledge of his period. The work's remarkable impact, ho ever, was due mainly to Holl's insight into Luther's personality, and to his understanding of Luther's experience of God and the confrontation of God and the conscience. With this, and his handling of the doctrine of justification, Holl made his most telling contribution to Luther studies. The book's effect was all the greater for being published in the period of uncertainty and moral crisis after World War I. It gave a new direction to Luther interpretation and remains a classic work on the subject.

See A. von Harnack and H. Lietzmann, *Karl Holl. Zwei Gedachtnisreden (1926)*; and H. Bornkamm "Karl Holl" in *Evangelisches Kirchenlexicon* (1958).

HOLLAND, CLIFFORD MILBURN (1883–1924), U.S. engineer, directed the design and construction of the Hudson river tunnel connecting New York and Jersey City. officially named the Holland tunnel in his honour. He was born at Somerset, Mass., on March 13, 1883.

He graduated from Harvard university in 1906 and was soon appointed assistant engineer of the Battery-Joralemon street tunnel, New York city. On the completion of this work in 1908, he was in charge of a portion of the Fourth avenue subway in Brooklyn. In 1914 he took direct charge of the Old Slip-Clark street and Whitehall-Montague street tunnels and, later, of the Willoughby, 14th and 60th street tunnels in New York city, all, like the Battery-Joralemon street tunnel, connecting Manhattan and Long Island.

On July 1. 1919, he became chief engineer of the New York and New Jersey interstate bridge and tunnel commissions for the construction of a vehicular tunnel under the Hudson river. He died on Oct. 27, 1924, at Battle Creek. Mich., before the project was completed.

HOLLAND, SIR (THOMAS) ERSKINE (1835–1926), English international jurist and outstanding professor of international law and diplomacy at Oxford, was born at Brighton, Sussex, on July 17. 1835. He was educated at Brighton college and Balliol and Magdalen colleges, Oxford. He studied Greek philosophy and in 1859 was elected fellow of Exeter college. In 1875 he was elected fellow of All Souls.

In 1863 he was called to the bar by Lincoln's Inn, and joined the home circuit. In 1874 he was appointed Vinerian reader in English law at Oxford and later in the same year, on the resignation of M. Bernard. Chichele professor of international law and diplomacy. a post which he held for 36 years.

In 1875 Holland became associate (and later member) of the Institut de Droit International, which held a meeting in Oxford on his invitation in 1880. The Naval Prize act, 1894, was drafted by him, and also the Admiralty Manual of Naval Prize law (1888). He was particularly interested in law in its scientific and literary aspects, and in 1894 gained the Swiney prize for his *Elements of Jurisprudence,* which went through numerous editions. The war office made use of his services in drafting orders for troops in the field; these were subsequently co-ordinated and published under the title of *Laws of War on Land* (1904). In 1903–05 Holland served on the Royal Commission on the Supply of Food and Raw Material in Time of War and attended the Geneva conference (1906) as plenipotentiary. In 1917 he was knighted. He died at Oxford on May 24, 1926.

Sir Robert Erskine Holland (1873–), the distinguished civil servant, was his son.

HOLLAND, SIR HENRY, BART. (1788–1873), English physician and author, was born at Knutsford, Cheshire, on Oct. 27, 1788. His maternal grandmother was the sister of the potter Josiah Wedgwood, whose grandson was Charles Darwin; and his paternal aunt was the mother of Elizabeth Gaskell, the novelist and biographer. After spending several years at a private school at Knutsford, he was sent to a school at Newcastle upon Tyne, whence after four years he was transferred to J. P. Estlin's school near Bristol. There he at once took the position of head boy, in succession to John Cam Hobhouse, afterward Lord Broughton, an honour which required to be maintained by physical prowess.

On leaving school he became articled clerk to a mercantile firm in Liverpool, but, as the privilege was reserved to him of passing two sessions at Glasgow university, he at the close of his second session sought relief from his articles. In 1806 he began the study of medicine in the University of Edinburgh. where he was graduated in 1811.

After several years spent in foreign travel. he began practice in 1816 as a physician in London—according to his own statement, "with a fair augury of success speedily and completely fulfilled." This "success," he added, "was materially aided by visits for four successive years to Spa, at the close of that which is called the London season." It must also, however, be in a great degree attributed to his happy temperament and his gifts as a conversationalist--qualities the influence of which. in many cases belonging to his class of practice, were often of more importance than direct medical treatment.

In 1816 he was elected F.R.S. and in 1828 F.R.C.S. He became physician in ordinary to Prince Albert in 1840. and was appointed in 1852, physician in ordinary to the queen. In April 1853 he was created a baronet. He was also a D.C.L. of Oxford and a member of the principal learned societies of Europe.

He was married twice, his second wife being a daughter of Sydney Smith. She had considerable literary talent and published a biography of her father.

Sir Henry Holland at an early period of his practice resolved to devote to his professional duties no more of his time than was

necessary to secure an income of £5,000 a year, and also to spend two months of every year solely in foreign travel. By the former resolution he secured leisure for a wide acquaintance with general literature and for a more than superficial cultivation of several branches of science. The latter enabled him, beside visiting. "and most of them repeatedly. every country of Europe," to make extensive tours in the other three continents, journeying often to places little frequented by European travellers.

He procured, moreover, an introduction to nearly all the eminent persons in his line of travel and knew many of them in his capacity of physician.

The *London Medical Record,* in noticing his death, which took place on his 85th birthday, Oct, 27, 1873, remarked that it "had occurred under circumstances highly characteristic of his remarkable career." On his return from a journey in Russia he was present, on Friday. Oct. 24, at the trial of Marshal A. F. Bazaine in Paris. dining with some of the judges in the evening. He reached London on Saturday, took ill the following day and died quietly on Monday afternoon.

HOLLAND, HENRY (1745–1806). British architect, who designed the original Brighton pavilion, was born on July 20, 1745. He became the assistant and, later, partner of the well-known landscape gardener, Lancelot Brown. Holland carried out extensive alterations and additions at Carlton house, the London home of the Prince of Wales; he was also architect of the Brighton Marine pavilion, which was later buried under the "Hindu" accretions of John Nash. His principal surviving works are Brooks's club in London, Althorp in Northamptonshire, parts of Woburn abbey in Bedfordshire and Southill in the same county. All show a quality of restrained elegance that was felt by contemporaries to be a welcome change after the more lavish interiors of Robert Adam. The last three also show a large degree of French influence, which had first appeared in Carlton house. He died on June 17, 1806, in Chelsea.

See Dorothy Stroud, *Henry Holland* (1951); *Capability Brown* (1951). *(Ms. W.)*

HOLLAND, HENRY FOX, 1ST BARON (1705–1774), English politician, notable chiefly for the success with which he exploited public office for private gain, second son of Sir Stephen Fox. was born on Sept. 28, 1705. Inheriting a large share of the riches which his father had accumulated. he squandered it soon after attaining his majority and went to the continent to escape from his creditors. He contracted a wealthy marriage which enabled him to enter parliament in 1735 as member for Hindon, Wiltshire. He became the favourite pupil and devoted supporter of Sir Robert Walpole. He was surveyor general of works from 1737 to 1742, was member for Windsor from 1741 to 1761, lord of the treasury in 1743. secretary at war and member of the privy council in 1746 and became leader of the house of commons and secretary of state under the duke of Newcastle in 1755. In 1757. in the rearrangements of the government, Fox was ultimately excluded from the cabinet and became paymaster of the forces.

During the Seven Years' War Fox devoted himself mainly to accumulating a vast fortune. He again became leader of the house, with a seat in the cabinet. under the earl of Bute in 1762 and exercised his skill in cajolery and corruption to induce the house of commons to countenance the treaty of Paris of 1763; as a recompense. he was raised to the house of lords with the title of Baron Holland of Foxley, Wiltshire.

In 1765 he was forced to resign the paymaster generalship, and four years later a petition of the livery of the City of London against the ministers referred to him as "the public defaulter of unaccounted millions." The proceedings brought against him in the court of exchequer were stayed by a royal warrant and he justified the delays by appealing to custom. He died at Holland house, Kensington, on July 1, 1774. One of his four sons was the Whig leader Charles James Fox (*q.v.*).

HOLLAND, HENRY RICH, 1ST EARL OF (1590–1649), second son of Robert, 1st earl of Warwick, and of Penelope. Sir Philip Sidney's "Stella," daughter of Walter Devereux. 1st earl of Essex, was baptized on Xug. 19. 1590, educated at Emmanuel college. Cambridge, knighted in 1610 and returned to parliament for Leicester in 1610 and 1614. In 1610 he was present at the siege of Juliers. Favours were showered upon him by James I. He was made gentleman of the bedchamber to Charles. prince of Wales. and captain of the yeomen of the guard; and in 1623 he was raised to the peerage as Baron Kensington. In 1624 he was sent to Paris to negotiate the marriage treaty between Charles and Henrietta Maria.

In September he was created earl of Holland, and in 1625 was sent on two further missions, first to Paris to arrange a treaty between Louis XIII and the Huguenots, and later to the Netherlands with Buckingham. He held various places under Charles I. but deserted his cause in 1641. He was chosen by the parliament in March and July 1642 to communicate its votes to Charles, who received him with studied coldness.

He was appointed one of the committee of safety in July, and joined Essex' army at Twickenham. where. it is said, he persuaded him to avoid a battle. In 1643 he appeared as a peacemaker! and after failing to bring over Essex, he returned to the king. His reception. however, was not a cordial one, and after the first battle of Newbury he once more returned to the parliament. Once again he renewed his allegiance to the king's cause; and after endeavouring to promote the negotiations for peace in 1645 and 1647 he took up arms in the second Civil War, received a commission as general and put himself at the head of 600 men at Kingston. He was defeated on July 7, 1647, captured at St. Neots shortly afterward. and imprisoned at Warwick castle. He was sentenced to death. and was executed together with Hamilton and Capel on March 9, 1649.

HOLLAND, HENRY RICHARD VASSALL FOX, 3RD BARON (1773–1840), one of the leading members of the Whig party'as refounded by Charles Grey, and a disciple of Charles James Fox, was the son of Stephen Fox (1745–74), 2nd Lord Holland, and Lady Mary Fitzpatrick. daughter of John, earl of Upper Osaory. He was born at Winterslow house. Wiltshire, on Nov. 21. 1773. and was soon orphaned. his father dying in 1774, his mother in 1778. While in Italy in 1796 he fell in love with the young wife of Sir Godfrey Webster, who divorced her in 1797 after she had given birth to a son by her lover. Lord Holland then married her. and she bore him four legitimate children.

After the death of his uncle, Charles James Fox, in Sept. 1806, Holland became lord privy seal in the Grenville ministry, with a seat in the cabinet of the ministry of "all the talents," until it was dismissed in March 1807. Lord Grey in vain urged him to take over the leadership of the Whig opposition in 1812. As Fox's nephew he would have been particularly acceptable to Fox's friends, and the prince regent had no dislike for him as he had for Grey: an important consideration whenever there was a possibility of forming a Whig administration. The Whigs who joined the Canning and Goderich ministries in 1827 would have liked to strengthen their own position by securing the foreign secretaryship for Holland. hut George IV could not stomach a further infusion of Whiggism into the cabinet. Holland therefore remained out of office from 1807 to Nov. 1830 when he was appointed chancellor of the duchy of Lancaster in Lord Grey's reform ministry (1830–34), after refusing an offer of the foreign secretaryship as too arduous a post, since he had for years suffered from gout. This cabinet office Holland retained under Lord Melbourne from 1834 (except for the brief interlude of the Peel ministry. Dec. 1834–April 1835) until his death on Oct. 22. 1840. In the house of lords he was the recognized exponent of the political ideas of his uncle; Lady Holland made their London home. Holland house. the most celebrated of the Whig *salons.* His *Memoirs of the Whig Party,* 2 vol., ed. by the 4th Lord Holland (1852), and *Further Memoirs of the Whig Party, 1807–1821,* ed. by Lord Stavordale (1905). enshrine the Whig creed and vividly portray the contemporary literary and social world.

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HOLLAND, HENRY SCOTT (1847–1918), English divine, was born at Ledbury, Hereford, on Jan. 27 1847. He was edu-

cated at Eton and at Balliol college. Oxford; in **1872** he was ordained, becoming the same year a tutor at Christ Church. In **1882** he was senior proctor of the university, and the same year was made a canon of Truro and examining chaplain to its bishop. He was appointed a canon of St. Paul's in 1884, and in **1886** precentor.

He refused the offer of the see of Norwich in **1893,** but in 1910 was appointed regius professor of divinity at Oxford. He died at Oxford on March 17, 1918. Scott Holland was closely associated with the Christian Social union for many years. He was a successful tutor and a popular professor; but it is as a preacher that he is most vividly remembered.

See his *Life,* by Stephen Paget (1921).

HOLLAND, JOHN PHILIP (1841–1914), U.S. inventor and developer of the modern submarine, designed and built the first submarine accepted by the U.S. navy.

Holland was born at Liscannor, County Clare, Ireland, on Feb. 24, 1841, and received his primary education at Limerick. His real interest was in ships, but because of his poor eyesight, he decided to become a schoolteacher. He taught in Ireland until **1872,** then went to the United States, where he taught in Paterson, N.J., until **1879.**

He drew plans of submarines and, in 1879, with funds from Irish associates, built a small submarine which operated submerged successfully. He formed a company in 1895 and was awarded a contract to build a submarine for the U.S. navy. His first boat was a failure but his second, the "Holland," passed navy tests. This boat had a gasoline engine for surface propulsion and an electric motor fed by storage batteries for power when submerged. The arrangement of tanks to be flooded to submerge this boat was similar to that in modern submarines. It was purchased by the navy on April **18,** 1900.

Holland died at Newark, N.J., on Aug. 12, 1914. (M. **R. D.**)

HOLLAND, JOSIAH GILBERT (pen name **TIMOTHY** TITCOMB) (1819–1881), U.S. journalist and editor: wrote a number of sentimental, didactic books which were popular during his lifetime. He was born in Belchertown, Mass., on July 24, **1819,** into a family of straitened circumstances. He worked at various occupations and for a brief period attended secondary school. After graduation from a medical college at Pittsfield, Mass., he practised medicine in Massachusetts from **1844** and made an unsuccessful attempt with Charles Robinson (1818–94), later first governor of the state of Kansas, to establish a hospital for women. He abandoned medicine, however, and in **1848** was superintendent of schools in Vicksburg, Miss. He also taught for a short period of time in Richmond, Va.

In **1849** he returned to Massachusetts, where he became assistant editor under Samuel Bowles, and later one of the owners, of the *Springfield Republican.* Under Holland. who contributed items of human interest, and Bowles, who was primarily responsible for news of public affairs. the newspaper prospered and earned a high reputation. Holland first won prominence with a series of "letters" in the paper satirically pointing up differences between life in urban and rural areas.

In 1870, in New York city, he helped establish and became editor of *Scribner's Monthly.* The title was changed in **1881** to *The Century.* He remained editor of the magazine until his death on Oct. 12, 1881.

His writings fall into four classes: **(1)** history and biography, represented by a *History of Western Massachusetts* (1855) and a *Life of Abraham Lincoln* **(1866)**; **(2)** fiction, of which *Miss Gilbert's Career* (1860) and *Sevenoaks* (1875) were pictures of village life in the eastern United States; **(3)** poetry, of which *Bitter-Sweet* **(1859)** and *Kathrina, Her Life and Mine* (1867) were widely read; and (4) a series of homely essays on the art of living, of which the most characteristic were *Titcomb's Letters to Young People, Single and Married* (1858), *Gold Foil, Hammered From Popular Proverbs* **(1859)**, *Letters to the Joneses* **(1863)** and *Every-Day Topics* (two series, **1876** and **1882**).

See Harry Houston Peckham, *Josiah Gilbert Holland in Relation to His Times* (1940).

HOLLAND, PHILEMON (1552–1637), English scholar called by Thomas Fuller "the translator general in his age," was born at Chelmsford, Essex, in 1552. He studied under John Whitgift at Trinity college, Cambridge, 1566–74, was elected fellow in 1573, and became an M.D. in 1597. He had been incorporated M.A. at Oxford in 1585. About 1595 he settled at Coventry, Warwickshire. practising medicine and teaching, but his main work was translating. He died there on Feb. 9, **1637.**

Holland's version of Livy appeared in **1600.** His translation of Pliny's *Natural History* was finished in **1601,** and was followed by Plutarch's *Morals* (1603), Suetonius (1606), Ammianus Marcellinus **(1609)** and Xenophon's *Cyropaedia* **(1632).** In 1610 he completed an English version (with additions) of his friend William Camden's *Brztannia.*

Holland translated not so many books as big books. His prose is marked by clarity and colloquial ease. His Suetonius (probably his masterpiece) is spirited. and more accurate than any other English translation.

BIBLIOGRAPHY.—Holland's *Suetonius, History of Twelve Caesars,* was ed. by C. Whibley (1899). *See* also H. *B.* Lathrop. *Translations from the Classics into English, 1477–1620* (1933); *F.* O. Matthiessen, *Translation: an Elizabethan Art* (1931). (H. H. Ds.)

HOLLAND, RICHARD, or RICHARD DE HOLANDE (*fl.* 1450), Scottish writer, author of the *Buke of the Howlat,* was secretary or chaplain to the earl of Moray **(1450)** and rector of Halkirk, near Thurso. He was afterward rector of Abbreochy, Loch Ness. He was an ardent partisan of the Douglases, and on their overthrow retired to Orkney and later to Shetland. He was employed by Edward IV in his attempt to rouse the Western Isles through Douglas agency, and in **1482** was excluded from the general pardon granted by James III to those who would renounce their fealty to the Douglases.

The poem, entitled the *Buke of the Howlat,* written about 1450, shows his devotion to the house of Douglas:

> On ilk beugh till embrace
> Writtin in a bill was
> O Dowglass, O Dowglass
> Tender and trewe!
>
> **(ii, 400–403)**

and is dedicated to the wife of a Douglas:

> Thus for ane Dow of Dunbar drew I this Dyte,
> Dowit with ane Dowglass, and boith war thei dowis,

but all theories of its being a political allegory in favour of that house may be discarded. The poem, which extends to 1,001 lines written in the irregular alliterative rhymed stanza. is a bird allegory. of the type familiar in the *Parlement of Foules.*

The text of the poem is preserved in the Asloan and Bannatyne manuscripts. Fragments of an early 16th-century black-letter edition, discovered by D. Laing, are reproduced in the *Adversaria* of the Bannatyne club.

See F. J. Amours in *Scottish Alliterative Poems,* pp. 47–81, also Introduction, pp. xx–xxxiv (1897).

HOLLAND, SIR SIDNEY GEORGE (1893–1961). prime minister of New Zealand from **1949** to **1957,** was born at Greendale. N.Z., on Oct. **18, 1893.** and educated at West Christchurch high school. He started work at **18** in a hardware store. but at 19 joined his father's rural haulage and mobile threshing firm. After service in World War I he founded with his brother a successful engineering firm in Christchurch. and at the age of **42** succeeded to his father's seat in parliament. Party maneuvering made him leader of the National party in **1940.** and stout opposition to Labour policy at every opportunity strengthened his hold on his followers through the war years and after. The **1949** election made him prime minister, when he set out to remove controls over the country's economy and to adopt a "strong" policy toward industrial unrest, at that time concentrated in water-front work. He broke a serious strike **(1951).** capitalizing on this with a snap election. which gave him an increased majority. Holland combined great force as leader of a cabinet with a certain naïveté in his, pronouncements on matters of both internal and external concern to the country; his popularity waned and his government was defeated in **1957.** Bad health had already forced him to resign the premiership earlier in the pear, and he did not stand again

for parliament. On ceasing to be premier he was knighted. He died at Wellington, N.Z., on Aug. 5, 1961. (J. C. BE.)

HOLLAND is a maritime country of northwestern Europe, whose official title is the Netherlands. It extends from lat. 53° 33' (the island of Rottum off the northeastern coast) to lat. 50° 46' N. (Slenaken in southern Limburg) and from long. 3° 22' (St. Anna ter Muiden, near Sluis in Zeeland) to 7° 13' long. E. (Nieuwe-Schans in east Groningen). The Netherlands' maximum length from north to south is thus 190 mi.; its breadth, which varies considerably, is greatest on its southwest-to-northeast axis (160 mi.).

The country is bounded on the east by Germany. In 1949, after World War II, certain minor rectifications were made on the German frontier (thenceforth 304 mi. in length); these resulted in the inclusion within the Netherlands of the districts around Elten and Tuddern, together with smaller areas at various scattered points along the eastern boundary. The total area of these acquisitions was about 23 sq.mi. (60 sq.km.).

To the south of the Netherlands lies Belgium (frontier 246 mi.), and on the west and north the country is bounded by the North sea. The extent of coast line, including estuaries but not the Zuider Zee (IJsselmeer) coast line, is about 429 mi. This length is increased by about 647 mi. if the coasts of close-lying islands are included, making a total of 1,076 mi.

The area of the country has shown a continual variation. It has been decreased by coastal erosion and flooding by the sea; on the other hand this has often been compensated by extensive silting up, by withdrawal of the sea and also by such artificinl land reclamation as diking and impoldering. The total land area of the Netherlands was estimated to be 12.616 sq.mi. by 1957, as compared with 12.482 sq.mi. in 1947. The increase. which was continuing at mid-century. was largely the result of extensive poldering in the IJsselmeer area.

Much of the country (approximately two-fifths) lies below sea level and is protected from inundation by dunes and dikes. A large part of the remainder is composed of sandy regions and rarely rises above 300 ft. except in south Limburg. Through the centre of the country flow in close proximity and roughly parallel three great rivers, which have formed a wide alluvial plain.

The Netherlands is divided administratively into 11 provinces; its capital is Amsterdam, though The Hague ('s Gravenhage) is the seat of the government and the principal residence of the sovereign.

PHYSICAL FEATURES

The geology of the Netherlands is relatively simple. The surface characteristics are more artificial, probably, than those of any other country; most natural physical features date from the later Tertiary stages (Pleistocene and Holocene periods), and their deposits cover most of the country in considerable depth. Beneath this layer of recent formations lie fresh-water, deltaic and marine Tertiary sediments and earlier Mesozoic rocks. The latter are so deep over most of Holland that they are only met in borings on the east and south of the country and in rare outcrops near Maastricht and in the Enschede and Winterswijk areas of Gelderland. Beneath the Mesozoic rocks lie Carboniferous strata in which coal measures occur widely. Because of the great depth of these Carboniferous layers the coal measures cannot be exploited over much of the country. Productive seams do approach the surface, however, in Limburg and, less closely, in the Peel region (between North Brabant and Limburg) and also along the frontier region of east Overijssel and Gelderland. In Limburg, measures that have been worked since the middle of the 14th century approach to within 300 ft. of the surface; in the Peel district borings have proved that there is coal at depths between 2,000 and 3,000 ft.

Earlier Permian and Triassic rocks, which were the first cover of the "North Sea depression" of which the Netherlands was a southern part, probably underlie the whole country at considerable depths. They contain beds of salt and Triassic salt which are exploited at Boekelo in Gelderland.

During the Pliocene period of the later Tertiary stage, the forerunners of the Rhine, Meuse (Maas) and Scheldt deposited over the area huge quantities of sediment, mostly of sand with a later surface of fluviomarine or deltaic. The area, in the succeeding Pleistocene period, did not experience the first and second glaciation; but ice expansion spread over the northern part during the third (Riss). In the provinces of Drenthe, Friesland and Groningen are large areas of boulder clay with blocks of Scandinavian rock. Another legacy is the existing glacial ridges of Gelderland, Drenthe and Overijssel. which run from north to south. Along the southern margin of the ice expansion are the remnants of terminal moraines, composed of sand and gravel. Further south, the rivers built up terraces of gravel, mostly later submerged under delta deposits.

The postglacial period saw the return of sea level to its approximate modern position. Then followed the initiation and subsequent development of an offshore bar (part of that stretching from the eastern mouth of the English channel along the northwestern European coast to German Friesland). It was breached by the estuaries of the Scheldt, Meuse and Rhine, but swept unbroken from the Hook of Holland to Den Helder and then continued in what are now the Frisian Islands. In time this bar was covered with sand dunes, which represent successive periods of building. Within the bar were created lagoons, in which formed peat areas, or marine clay, where for a time the sea breached the bar.

Through the centre of the area the rivers had created a broad plain of clay alluvium within a sandy region to the south and north. The growth of the Rhine-Meuse delta in the west occurred through a stoppage of an original outlet toward the north, and a consequent shift to the west. A second alluvial plain had also been created by the IJssel now flowing north from the Rhine, through the sands of the eastern area.

Nearly two-fifths of the Netherlands lies below sea level. The rest of the area rarely rises above 150 ft., though in parts of southern Limburg occasional heights of more than 1,000 ft. may be reached. Geologically and physically the country can be roughly divided into four areas. There is the low deep coastal belt, much of which is below sea level and is protected by stretches of dunes and dikes; this belt is flanked in the southwest and northeast by neighbouring islands. A central area comprises the plains of the Rhine and its chief distributaries and the Meuse. To the north of these plains are higher sandy regions, themselves sometimes divided by alluvial plains: the so-called Utrecht-Gelderland ridge and the Veluwe region, and lower-lying eastern Gelderland and Overijssel in the east of the country. To the south along the Belgian border stretches the sandy belt of southern Brabant and of Limburg. The tongue of southern Limburg itself thrusts between Belgium and Germany; it is a relatively high plateau of Cretaceous rocks rising above 300 ft. in large areas and to more than 1,000 ft. at points in the south. In the northeast of the Netherlands stretch the low-lying areas of Drenthe and the interior of Friesland and Groningen, composed of peat and sandy heath.

The **Coastal** Belt.—The coastal belt itself can be divided into several zones. Stretching northeast from the Belgian frontier it is deeply indented by the wide estuaries of the Wester and Ooster Schelde (Scheldt), the Mastgat, the Grevelingen Meuse and the Haringvliet Meuse. These estuaries themselves divide about the large islands of Walcheren, Zuid and Noord Beveland, Schouwen-Duiveland, Tholen and Goeree-Overflakkee. Most of this area (including the islands) is protected by dikes or sand dunes and edged with marshes, mud flats and more rarely by sandy beaches. The land is mostly in polders, as land reclamation has been in progress for many centuries, and the soil, a fertile marine clay, is suitable for arable farming. From the Hook of Holland the coast line runs northward in a continuous sweep to Den Helder at the northern tip of the mainland; all its hinterland, which comprises the provinces of North Holland and much of South Holland, between the North sea and the Zuider Zee can be termed as the coastal belt. It is bisected approximately halfway from IJmuiden (Ymuiden) to Amsterddm by the North Sea canal. The North sea coast line is low and fringed by sandy beaches, and along it land reclamation has proved impossible. The interior of the belt,

which is below sea level, is protected mostly by coastal dunes, It includes much polder land and is traversed, particularly in the south, by large rivers. Much of the surface area is peat, and the land suitable for all types of agriculture.

Stretching from the tip of North Holland in a northeasterly curve are the Frisian Islands. The first three, Texel, Vlieland and Terschelling, low flat areas protected by dunes or dikes. enclose a stretch of shallow tidal sea, the Wadden Zee, which led formerly into the Zuider Zee but is now separated from it by the Afsluitdijk (the IJsselmeer dam). The dam, which connects North Holland with Friesland, is 18½ mi. long and carries both a motor road and railway. The northeastern coastal belt of Friesland and Groningen to the German frontier at Ems is also extensively diked. Land reclamation is made in the more suitable places, and the entire zone is poldered. The area consists largely of heavy clays and less extensive districts of peat. The coast itself is flanked by the more northeasterly Frisian Islands, the smaller of which are uninhabited.

The Alluvial Plains and Valleys.—The broadest alluvial plains stretch through central Netherlands; this area is in effect a delta of the Rhine and its divergent distributaries. The Rhine itself divides shortly on entering Dutch territory into the Waal and a more northerly stream, first called the Pannerdensch canal and later the Neder-Rijn (Lower Rhine). At Arnhem this last-named river throws off an important tributary, the IJssel. It flows northward into the Zuider Zee through a relatively narrow alluvial plain, bordered by the sandy plateau of Veluwe on the west and the lower sandy areas of eastern Gelderland and Overijssel on the east. The Neder-Rijn itself, later named the Lek, winds westward to Rotterdam and the North sea. The more southerly Waal follows an approximately parallel course. A third great river, the Meuse, flowing first north through Limburg, turns westward just below Nijmegen and winds several miles south of the Waal. It gathers in its later course various small tributaries, coming from the higher land which borders the Dutch and Belgian frontier. The rivers are slow moving and meandering and deposit much silt. They are, of course, subject to considerable flooding and are diked along considerable stretches, usually some distance from their summer beds.

A smaller valley, the Geldersche, lies between the Utrecht-Gelderland ridge and the Veluwe region; it is a triangular strip with its basis on the southern coast of the Zuider Zee and its apex on the Seder-Rijn. The region is one of clays in the north, and of peat and outcrops of sand.

The Sand Areas.—A third type of area is the higher sandy regions with which may also be grouped more low-lying and mixed districts in the northeast of the country. The most extensive of these regions is the area stretching to the Dutch-Belgian frontier (the south of Brabant) and northern Limburg. Altitude rarely exceeds 150 ft. Cutting through the area are the alluvial valleys of various streams. Patches of peat bog (notably on the boundary between Brabant and Limburg) occur, but many, which existed formerly, have been reclaimed. A second strip, the Utrecht-Gelderland ridge, comprises a narrow belt of moraine hills running from the Zuider Zee to the Neder-Rijn. The northern part, the hills of Gooiland, rises in places above zoo ft.; east and southeast of Utrecht similar heights are attained. The ridge sinks to the east in the Geldersche valley, but the sandy uplands reappear in the Veluwe, of which the Over Veluwe rises in places to more than 300 ft. This region is surrounded by the chief terminal moraines of the Netherlands, which fall into the valley of the Neder-Rijn on the south and the IJssel on the east. Still further east across the valley of the IJssel lie eastern Gelderland and Overijssel, where the lower sand heaths are frequently interspersed by the alluvial channels of streams. Woodland is extensive, and in the north of the region occur areas of bog, though much reclamation has been carried out.

To the north and northeast of this last district stretch the province of Drenthe and the interior of Friesland and Groningen. Altitude there is seldom above 40 ft., except on the glacial ridges of the Hondsrug, running southeast of Groningen, where altitudes of 100 ft. are reached. Much of the region comprises bog peat, of which large regions have been reclaimed. Extensive areas of sandy heath remain. much of which has been converted into woodland.

The Southern Limburg Plateau.—Finally there is the small plateau in southern Limburg, thrusting for about 20 mi. between Belgium and Germany, with a maximum width of about 20 mi. Except for the plain of the Meuse, this is a plateau of Cretaceous rocks, rising in extensive areas to more than 300 ft. and to more than 1,000 ft. in the south. The plateau is dissected by deep valleys with swift streams. Its surface is covered with a fine soil (loess) which is suited to wheat and sugar beet. Underlying Carboniferous deposits, a continuation of those in the Belgian Kempenland, have led to the industrialization of the area.

Climate.—Climate is practically uniform throughout the Netherlands. The prevailing winds are westerly and southwesterly, with a late spring period of cool northwesterly winds. High winds are fairly frequent in coastal areas. Extreme temperatures are −4° F. on the one hand and 95° on the other, with mean winter temperature around freezing and mean summer temperature about 70°.

Mean average rainfall varies between 22 and 32 in.; the wettest regions are the northeast, the Veluwe area and southern Limburg, with heaviest falls from July to September. Marsh mists and sea fogs are common particularly in winter.

Dikes and Polders.—Protection of the land by sea and river dikes has long been practised by the inhabitants of the Netherlands. The earliest of these people in the north, the Free Frisians, had by the 1st century A.D. built extensive mounds against the tidal rises. These primitive attempts to secure refuge appear to have become more systematic in the 8th and 9th centuries along most of the Dutch coast and were particularly undertaken in the later 12th and 13th centuries, when the steady sinking of the land or rise of the sea became a serious threat. Until the 16th century, however, the sea usually held the upper hand, and losses of land were considerable while gains were few.

The technique of diking slowly improved, and initial constructions such as the Westkapelle dike between Westkapelle and Domburg and the Hondsbossche Zeewering from Kamperduin to near Petten, built in the 15th century, were reconstructed and extended between 1860 and 1884. Later still, several additional dikes were built, and the government has devoted considerabie expenditure to the construction of protective works, a corps of engineers (De Waterstaat) being exclusively occupied with protection and reclamation. The entire coast of the Netherlands, except in the dune belt of the west and small isolated areas sheltered by low cliffs, is protected by dikes. The protected areas are either of low peat and marine clays or land reclaimed from the tidal flats.

Problems of inundation were also created by the large rivers, the Rhine and its various branches, the Meuse and the IJssel, which tended to raise their beds with depository sediment. Their courses, however, were artificially controlled, especially that of the Meuse, which was particularly prone to flooding. The Rhine and its distributaries are diked practically throughout the Netherlands. Dikes are continuous along either the north bank or south bank of the Meuse.

Parallel with the process of soil protection has been one of reclamation, and during the centuries about a quarter of the arable land of the Netherlands has been gained by this device. Reclamation has ranged from small areas of marsh, lake or bog throughout the country to the extensive undertaking of draining a large part of the Zuider Zee. This was first begun in 1923 and progressed by the creation of various polders; for example, the Wieringermeer (75.18 sq.mi.; out of the northwestern corner of the Zuider Zee), the Noord-oost (182.76 sq.mi.; in the east) and one (210.42 sq.mi.) a little farther south near Kampen.

Flora.—The four physiographical divisions, beach land, pasture, dunes and coasts, are characterized by differing flora. Heath, ling, gorse and juniper cover the sandy waste regions in the east. In the more damp meadowlands are marsh trefoil. carex and rush, nith water lilies, reed mace, etc., in the ditches and pools. Dune flora types are usually stunted: a smooth reed grass *(helm)*

is sown to bind the loose sand, as do also the dewberry bramble and buckthorn. Other dune plants are marram and sea lyme grass, thyme, dune rose, fever ort, etc. Certain plants are cultivated to assist in consolidating the mud flats and enlarging the littoral deposits; *e.g.*, sea aster and sea lavender. Except for the pollarded willows along the rivers, nearly all natural woods are found on the sandy gravel soils; they are chiefly copses of elm, poplar, beech and elder. (J. D. L.)

HISTORY

The following section deals with the history of the Netherlands after the confederation of 1579. For the events preceding that year the reader is referred to the article NETHERLANDS.

THE UNITED PROVINCES

William the Silent and **Anjou.**—The Union of Utrecht, by which the northern provinces were confederated, was signed on Jan. 29, 1579. It remained in force until the fall of the Dutch republic in 1795, and its formation may therefore be taken as the starting point of the history of the newly created state; but that state was as yet so far from being fully grown that its leaders did not even consciously desire either republicanism or independence. In this first stage it was a loose federation for defense, finance and other limited purposes. The, states-general were still controlled by the estates of the provinces, in which the work of government had always been shared between the estates and a monarch or his representative. It was eight years before the possibility of a monarch was ruled out, and throughout the whole history of the republic there was never a finally satisfactory adjustment between the powers of the estates, among which the estates of Holland were predominant (see HOLLAND. COUNTY AND PROVINCE OF), and those of the stadholders, the old royal lieutenants, who continued to exercise the executive functions which had been theirs as the overlord's representatives. Collisions between the estates and the stadholders were to lead to constant strife and to five successive revolutions: in 1618, in 1650, in 1672, in 1747 and in 1787. For the first 30 years after the Union of Utrecht the war of independence was being waged, and constitutional developments were dictated by its fortunes. William the Silent, who was supreme in Holland and Zeeland, did not welcome the union, because he still hoped to unite all the 17 provinces against Spain. That proved to be impossible, and the military situation grew alarming. Maastricht, Koevorden, Groningen, Delfszyl, Steenwyk were lost. Philip II felt himself strong enough to pronounce the "ban" against William; that is, to declare him an outlaw whom anyone might lawfully kill. William saw that, without foreign aid, the northern provinces could not maintain themselves. He therefore gained the support of France by the offer of the sovereignty of the Netherlands to Francis, duke of Anjou, brother of Henry III of France. With the reservation of ultimate control in all important matters to the estates, this arrangement was made in the treaty of Plessis-les-Tours, in Sept. 1580. Anjou, who took the field next year, was inaugurated early in 1582 as duke of Brabant and of Gelderland, count of Flanders and lord of Friesland. He did not become count of Holland and Zeeland. In these provinces he was distrusted as a Catholic, and they would have no sovereign except William nimself, who reluctantly yielded to their insistence and had agreed, before his death, to accept the title of count. At the same time the northern provinces solemnly repudiated the sovereignty of Philip and declared themselves absolved from their allegiance to him (July 26, 1581). In 1581 and 1582 military events continued unfavourable: more fortresses were lost, and Anjou was chafing at the limitations imposed on his sovereignty. On Jan. 17, 1583, his troops attempted to obtain possession of the city of Antwerp. By the vigilance of the citizens, this "French fury" was frustrated, and in June the discredited Anjou returned to France, where he died while planning his return. William continued to organize defense from his refuge in Delft, though with little success, for Zutphen fell. He had been severely wounded by one of the gunmen let loose by Philip's ban; on July 10, 1584, another, a fanatical young Catholic from Franche-Comté named Balthazar Gerard, got admission to his house and shot him dead.

The Estates and **Leicester.**—The loss of the "father of his country" made the position of the rebels almost desperate, but their courage did not flag. His eldest son being in the hands of the Spaniards, the second, Maurice of Nassau, was appointed president of the newly constituted council of state and stadholder of Holland and Zeeland: but as he was still only 17 years old, the real leadership passed for the time being to the ablest men of the estates, in particular to Paul Buys, advocate of Holland until 1585, and Johan van Oldenbarneveldt, who was to hold that office from 1586 until 1618. They tried to revive the French policy of William, but Henry III of France was in no position to take risks, and refused their offers of sovereignty in July 1585. Meanwhile the war went from bad to worse. One after another the towns fell before Alexander Farnese: Ypres, Bruges and Ghent in Flanders; Brussels and Malines in Brabant; then Nijmegen and Doesburg in the east. Antwerp itself, the richest and most vitally needed of all, was besieged., While its fate was in the balance ambassadors were pleading for the help of the queen of Protestant England. Elizabeth I, who had allowed her subjects to give unofficial help since 1572, was no friend to rebellion; she did not wish to precipitate open war between herself and Spain, and if it seemed to her interest she would leave her allies in the lurch. It was only after Antwerp had fallen (1585) that she came to terms. Refusing the sovereignty, she promised to send 5,000 foot and 1,000 horse under her favourite, the earl of Leicester; but her expenses were to be guaranteed, and as surety she took the towns of Flushing and Brill and the fort of Rammekens. These pledges were held until the debt was settled in 1616.

Leicester was in Holland from Dec. 1585 and did not finally leave until Dec. 1587, but his rule was an utter failure. Without Elizabeth's authority and against her wishes, he accepted the title of governor general, with greater powers than had been enjoyed by Anjou or even William himself. His influence with the queen had been his greatest asset, but it proved almost useless, and he had little ability either in war or in politics. He saw clearly the defects of the improvised constitution, and tried to remedy them by centralizing the financial and naval organization; but he did not know how to work with the estates of Holland. He alienated them by prohibiting all trading with the enemy, though Holland and Zeeland were growing rich by that means and drawing from it taxes which financed the war. He set himself at the head of democratic and Calvinist extremists. Worst of all, he could not check the victories of Alexander Farnese (since 1586 duke of Parma): Grave, Venlo and Deventer and the siegeworks made for the recovery of Zutphen were lost, the last two reverses being the result of the treachery of English Catholic commanders. Finally Sluys, a port to the south of the Scheldt, surrendered. Made still more unpopular by a peace move which Elizabeth compelled him to take, Leicester attempted a coup d'état but failed.

Maurice and **Oldenbarneveldt.**—This was the lowest ebb of the rebels' fortunes. After 1587 Parma could not press them so hard. The year 1588 was that of the Spanish armada: the shifting of Spain's effort to England and the sea meant that less could be done against Holland. Twice within the next four years, in 1590 and 1592, Philip made Parma, against his better judgment, lead away his forces against Henry of Navarre in the civil wars of France. Such a course might have been justifiable if nothing had changed on the side of the rebels; but Maurice and his older cousin, William Louis, stadholder of Friesland, proved to be soldiers of genius. They reorganized the Dutch army and worked out innovations in discipline, equipment, tactics and transport which gave them the model fighting force of the world. Parma's absence in 1590 was the signal for ending the defensive action which had lasted so many years. Maurice took Breda by surprise and then captured Steenbergen and other places. Next year he got the consent of the states-general to a bolder offensive campaign, and with brilliant results. The recovery of Zutphen and the capture of Deventer gave him the line of the IJssel. He pushed on to take Delfszyl, Hulst and Nijmegen. In 1592 he added Steenwyk and Koevorden, and his troops, successful in so many sieges, won their first victory in open battle since the pacification of Ghent. At the

end of that year Parma died a disappointed man. The prizes of the next two years were Geertruidenberg and Groningen. The latter was the capital of the most northerly province, of which William Louis became stadholder. Practically no Spanish garrisons now remained in the northern provinces. The estates had complete control of the resources and communications within their territories. The war had ceased to have any of the aspects of a civil war and had become a regular war along the frontiers of the new state. The triple alliance concluded in **1596** between the Dutch, the French and the English, though it brought little military help, was significant of the republic's progress: it now took its place as a state of which France and England could make an open ally. The successes of Prince Maurice, though not absolutely unbroken., continued, and this phase of the struggle culminated in 1597, when a considerable battle was won at Turnhout and there was added to the tale of captured towns Rheinberg (lost in 1590), Meurs, Grol, Breedevoort, Enschede, Ootmarsum, Oldenzaal and the fortress of Lingen.

The year **1598** saw important political changes. By the treaty of Vervins, France made peace with Spain, a separate peace in which neither the Dutch nor the English were included. Philip II died in the same year, after arranging a new regime for the southern Netherlands. The cardinal archduke Albert of Austria, who had become governor in **1596,** was to marry his cousin, Philip's daughter, the infanta Isabella, and the two were jointly to rule the Netherlands as an independent sovereignty. If, however, they had no heirs, the sovereignty was to revert to Spain, as it ultimately did in **1633.** In practice, however, the "cession" made little difference to the dependence of the provinces on Spain, and it did nothing toward bringing about a reconciliation with the north. The Spaniards could not bring themselves to concede freedom of worship, and another factor now arose which made it impossible for the Dutch to gain peace except through victory. In 1595–98 came the first Dutch voyage to the East Indies. By **1602,** when the united Dutch East India company was founded (see DUTCH EAST INDIA COMPANY), Dutch ships were trading everywhere in the east and west, and the Spanish colonial empire was endangered. But not until **1609** would the Spaniards recede from their colonial claims. On land the character of the war altered. In **1600** Oldenbarneveldt and the other politicians made the unwilling Maurice undertake a march westward across Flanders to strike at Dunkirk, from which port privateers preyed on the commerce of the channel. Maurice won a spectacular victory at Nieupoort (July 1), but nothing more. The great business of the next three years was the archduke Albert's siege of Ostend, the isolated port which the Dutch were enabled to hold by their command of the sea. While the siege was in progress Maurice took Cadzand, Grave and the port of Sluys, which had been lost by Leicester; but Ostend itself he could not save. It fell on Sept. 20, **1604.** after a resistance of **38** months, to Ambrose Spinola, a member of the great Genoese banking house, who was equally eminent in policy and in arms. In **1604** King James I of England made his peace with Spain, and the Dutch. now without allies, could no longer make such headway as before. Oldenzaal and Lingen were lost, and after them Grol and Rheinberg; but the resources of Spcin had been sapped by the long war and especially by disasters at sea. In **1607** Jacob van Heemskerk sharpened the threat to the Indies by a striking victory off Gibraltar. Soon after that the Spaniards' need for peace led to serious negotiations. These were not easy, and the two stadholders would have been well content to continue the war; but by the mediation of France there was concluded. on April **9, 1609,** a 12 years' truce. It was made with the provinces as free states over which neither Spain nor the archdukes made any claims. The frontiers were to be as they actually stood at the time. Nothing was said about religion or the Indies, but in a secret treaty King Philip III undertook to permit Dutch trading there. So ended gloriously and advantageously the first act of the war of independence.

The interval provided by the truce was marked by little of importance in external relations. The only event that need be named is the intervention of the republic in the dangerous succession dispute in the neighbouring duchies of Jiilich and Cleve (1609–14). With this external calm went growing economic prosperity, but also lamentable strife in domestic politics and religion. Estrangement between Maurice and Oldenbarneveldt had begun as far back as the Nieupoort campaign, had been accentuated in the negotiations for the truce and now became open enmity. A theological professor at Leyden, Jacobus Arminius (*q.v.*), had criticized the orthodox Calvinistic doctrine of predestination. His subtle argument led to a raging controversy in which one of the issues was the right of the estates to control the church. The followers of Arminius addressed a remonstrance, from which they were called Remonstrants, to the estates of Holland. Among the liberal-minded men of affairs who composed that body they had many supporters, including the advocate himself, though not the representatives of Amsterdam, the leading town. The estates tried to preserve unity, first by silencing the controversy and, when that failed, by taking the side of the Remonstrants; but the theological dispute had political implications. A weakening of the anti-Catholic front might make it harder to resume hostilities when the truce came to an end. For this reason among others Maurice and four provinces out of seven in the states-general took the orthodox Calvinist side. The states-general wished to call a national synod or church assembly to settle the disputed questions, but the estates of Holland refused their consent. Exasperated by their failures, they passed a resolution which asserted the principle of provincial independence in such a way as to threaten the unity of the republic; they raised levies of local militia (waardgelders) to enforce their will and instructed the contingents of the regular army paid by Holland that they owed no allegiance to the "generality." The states-general and Maurice, with the army behind him, overawed the opposition and removed its leaders from their positions in the town governments. Oldenbarneveldt, the famous Hugo Grotius and others were arrested. A special tribunal was erected to try, or rather to condemn, them. Meanwhile, the national synod had met at Dordrecht (Dort) on Nov. 13, **1618.** Its decisions were entirely against the Arminians, who were silenced. The synod closed on May **9, 1619,** and four days later Oldenbarneveldt, in spite of long public service, was beheaded.

Frederick Henry. — The 12 years' truce came to a conclusion in **1621,** and, Maurice and his party being supreme, the war with Spain was automatically resumed. Three years earlier the Thirty Years' War had broken out, and the Dutch frontiers were therefore merely one of the theatres of a general conflict. The republic at first failed to adapt its policy to the new conditions, and Maurice had lost his old vigour. After failing to relieve Breda from Spinola's siege, he died on April **23, 1625.** His younger brother Frederick Henry (*q.v.*), now prince of Orange, who succeeded him in all his titles and offices, was an abler politician and a competent soldier. During his stadholdership of more than a quarter of a century the golden age of the republic set in. Political and religious affairs became more harmonious; the stadholder maintained a princely court; learning. literature and painting reached a dazzling brilliance. Commerce flourished ; an eastern empire was acquired, and large, though not lasting, conquests were made in South America. The capture of the Mexican silver fleet by Piet Hein, in **1628,** was the greatest of many naval exploits (see DUTCH WEST INDIA COMPANY).

Financial and other help came from England and France, the latter in exchange for the grant of naval assistance to Cardinal Richelieu for the subjugation of the Huguenots in La Rochelle. This was withdrawn, but the old dreams of international religious solidarity were ending. In **1626** Oldenzaal was recovered, and in **1627** Grol. In **1629** Frederick Henry captured the virgin fortress of 's Hertogenbosch (Bois-le-duc), and the seizure of Wesel interrupted the enemy's communications by the Rhine. Two years later there came the defeat of an invading fleet in the Slaak, and in **1632** the taking of Maastricht, a crossing of the Meuse. After this there were negotiations for peace, which in spite of the growth of a peace party in Holland led to nothing. A treaty of alliance with France in **163j** opened the prospect of a partition of the southern Netherlands between the French and Dutch, but the dissensions of the allies and the good generalship of their new opponent, the cardinal infante Ferdinand (brother of Philip IV),

prevented any notable success until 1637, when Breda was retaken, The grudging grants of supply from the province of Holland were insufficient for ambitious plans in the next two years, and a dash on Antwerp was frustrated; but Spanish sea power received a smashing blow when on Oct. 21, 1639, a great fleet of warships and transports under Antonio de Oquendo was engaged in the Downs by Martin Tromp. This gave umbrage to Charles I of England, a squadron of whose navy had watched this battle in waters where he claimed sovereignty. He and his father had already, in connection with the herring fishery and other matters, tried to assert this sovereignty against the Dutch. Commercial jealousy of the Dutch was becoming strocg in England, and there was a growing tale of grievances against their East India company, of which the "massacre of Amboina" of 1623 was the most sensational. But Charles, far from being able to press these home, was in need of help against the opposition that was soon to break out in civil war. He therefore consented to the marriage of his daughter Mary, the princess royal, to Frederick Henry's 14-year-old son William, who had been recognized as his father's heir in all his offices. This was the first of three marriages of princes of Orange with English princesses, a social promotion which was to bring the republic into the cross currents of dynastic interests. It had no influence on the course of the war.

Two great changes now brought the possibility of a satisfactory peace in sight. Portugal, subject to Spain since 1580, broke away again in 1640, and the Spaniards, besides being weakened in Europe, had no longer much reason for maintaining the colonial quarrel with the Dutch, since it was in the Portuguese spice islands and Brazil, now lost to Spain, that the Dutch had established themselves. The other great change was the rise of France as a military power. At Rocroi, in 1643, the Spaniards were thoroughly beaten by the French. The danger opened out that the southern Netherlands might pass from decadent Spain to the rising power of France. Negotiations were begun in that year and ultimately led to a settlement. While they were in progress, Frederick Henry won his last victories. He captured Sas van Ghent in 1644 and Hulst in 1645, thus gaining a foothold on the southern bank of the Scheldt. The frontier line to which he had pushed forward his armies remained almost unaltered until the end of the republic. He died on March 14, 1647, less than a year before the treaty of Münster (part of the Peace of Westphalia), in which this frontier was confirmed. The Scheldt was closed to trade, as it had been, in fact, since 1572. Dutch independence was finally recognized, and with it all that had been gained in the east and west. The "eighty years' war" was over.

William II of Orange.—The separate peace, however, left France and Spain at war, and that had not been to the liking of the able and ambitious young soldier, William II, who had lately succeeded his father. With the support of Zeeland and Utrecht he had opposed the settlement. For the time being the estates of Holland, with the help of the other provinces, had easily got their way; but the peace meant a renewal of the contest which had arisen after the truce of 1609 between the Organist tendency toward constitutional unity and the decentralizing policy of the pacific oligarchies of the states. The latter had its stronghold in the patriciate of Amsterdam, then the richest trading city of the continent. William entered upon secret negotiations for a renewal of the war in alliance with France, of which the daring purposes were to be a partition of the southern Netherlands and the restoration of his exiled cousin, Charles II of England. The domestic counterpart of this was to be the strengthening of his own powers. Issue was joined over the disbanding of the troops rendered superfluous by the conclusion of peace. The states-general, in which the other six provinces now took the prince's side, wished to retain the cadres of the disbanded regiments, which could thus be quickly raised to a war footing; the estates of Holland objected, and ordered the disbanding of those troops for which they provided the money. There thus arose an intricate legal question similar to that of 1618, and the resources of the constitution were exhausted in the attempt to settle it. On July 31, 1650, six leaders of the estates of Holland were clapped into the castle of Loevestein, from which the estates party was known until long afterward as the Loevestein faction. Troops under the command of William Frederick, stadholder of Friesland, moved against Amsterdam. The gates were manned, but the town council had no heart to fight. It made its submission. William used his success as skilfully as he had won it. The prisoners were released, and he was virtually master of the republic. His triumph ended suddenly; he died of smallpox on Nov. 6.

First "Stadholderless Period."—A week after William's death his widow gave birth to a son, who was to become William III of Orange and of England. This child was now the head of the house of Orange; but the power of that house was only what a strong man could make it. The Loevestein party took its opportunity. A great assembly of the provinces, like the states-general but more numerous and solemn, met at The Hague on Jan. 18, 1651, to regulate the constitution for this first "stadholderless period." Its results were to strengthen the sovereignty of the provinces within their own borders, including the control of the army and religion. This implied the preponderance of Holland, by far the richest and strongest in external and general affairs. None of the provinces, except Friesland and Groningen, which remained faithful to William Frederick, now had a stadholder. This limitation of the central and executive powers aggravated the defects of the constitution: delays, obstructions and disputes were multiplied. But the Dutch were experts in public business, and they worked this cumbrous machine through 20 years of difficulties and dangers until the greatest crisis of their history, for which alone it proved inadequate. Much of the credit for this is due to John de Witt, the son of one of the prisoners of Loevestein, who became *raadpensionaris* (council pensionary or, more properly, stipendiary councillor) of Holland in 1653 (see HOLLAND, COUNTY AND PROVINCE OF). In this office all the business of the estates of Holland passed through his hands. He had no equal in the art of political management and few in that of international diplomacy; but with these he combined higher gifts. His intellectual distinction, his broad and deep political knowledge, entitle him to be called the most scientific statesman of his time. His appointment came during the course of the first English war.

The commercial and colonial rivalry with England had been growing hotter all through the century. In the year 1651 it reached boiling point. The Dutch had declined far-reaching proposals of alliance from the new sister republic, and Orange partisans had insulted the ambassadors of the regicides. The English navy, in stamping out royalist resistance, interfered with Dutch commerce. The celebrated Navigation act inflicted, or rather was meant to inflict, a severe blow on the Dutch carrying trade. The war was fought entirely at sea. It lasted from May 1652 to April 1654, in which time there were 12 fleet actions. This evenly balanced fighting was something new in naval history; the Dutch commanders, Tromp (killed Aug. 10, 1653) and Michel de Ruyter, did wonders, as did the Englishmen Robert Blake and George Monk. Dutch commerce suffered enormously. In the end the English had the upper hand, and the Protestant idealist Oliver Cromwell, now protector, had no wish to continue the war. In the treaty of Westminster (April 5, 1654) the Dutch agreed to pay compensation for the East Indian claims and to make formal acknowledgment of the British sovereignty of the narrow seas by saluting with the flag. Another condition was added, since the states-general refused to accept it, in a secret treaty which the estates of Holland under De Witt's influence made as a separate sovereign state. In this Holland was pledged to the Act of Seclusion, by which the prince of Orange, in despite of popular opinion, was to be excluded from the office of stadholder.

Baltic affairs next gave trouble. The trade there was of great importance to the Dutch and was adversely affected by the war between Sweden and Denmark (1657–60). By a skilful use of force and diplomacy John de Witt, in concert with France and England, imposed a settlement. The expulsion of the Dutch from Brazil had led to war with Portugal in 1657, but this, too, was satisfactorily terminated in 1661. Meanwhile, Charles II had been restored to England, and to conciliate him De Witt secured the repeal of the Act of Seclusion. The dynastic question was, however, subordinate. It was in an alliance not with England but

with France (1662) that the Dutch put their trust. Parliament re-enacted and strengthened the Navigation act. Dutch posts on the west coast of Africa were seized (1664) in time of peace; the colony of New Netherland was seized soon afterward and its capital. New Amsterdam, renamed New York after James, duke of York. The second English war broke out in 1665. This, too, was an obstinately contested sea war. The land operations were insignificant, but it differed from the first war in that it was not a mere duel, the English having as an ally the bishop of Miinster, against whom the Dutch were aided by the French, in accordance with the alliance of 1662. The general result was less favourable to the English, and negotiations were already in progress when the Dutch made their memorable raid on the Medway and burned the English fleet where it had been unwisely laid up in harbour. Naturally they had the better of the treaty. True. New Netherland was handed over in exchange for Surinam and Run; but it may be doubted whether it could have had much future under the Dutch, and the treaty marked the end of effective English rivalry in the East Indies.

In the following year De Witt and Sir William Temple negotiated the triple alliance of England. Holland and Sweden. The purpose of this was to force a peace upon Louis XIV, uho in 1667 had invaded the Spanish Netherlands and now was making dangerous progress. In later days, when England and Holland stood side by side against French ambition, the alliance was famous as an anticipation of their policy; but its immediate consequences were far from splendid. Louis did indeed make peace, for which he had other sufficient reasons, but he kept it for no more than four years and spent those years in preparing the way for a new war of aggression in which the Spanish Netherlands were still the ultimate objective; but the direct enemy was the Dutch republic, which had taken upon itself to be their friend. Louis's diplomacy isolated the Dutch completely. Charles II sold himself cheap by the treaty of Dover (1670); neither to Sweden nor to Spain, nor to any among the German states, could the republic look for support. John de Witt with all his foresight had not done enough. The fleet was strong and well-equipped, but from jealousy of its Orange sympathies the oligarchs had neglected the army. By 1672 Louis was ready. He moved against the eastern frontier in apparently overwhelming force. The English picked a quarrel over the salute to the flag and, before declaring war, attacked a Dutch merchant fleet in the channel.

William III of Orange.— In this extremity it was futile to resist the wave of feeling which demanded that William of Orange should be called to power; he became stadholder of Zeeland, stadholder of Holland, captain general of the union (June 1672). Unable to hold the frontier on the line of the IJssel, he prevailed on his countrymen to save the more westerly territory by opening the dikes and awaiting the enemy behind the inundations of the "Old Holland water line." The French were held up within a day's march of Amsterdam. The insulting peace terms offered by Louis were rejected. Unhappily. those heroic days were stained by a brutal crime. In The Hague an infuriated mob set upon John de Witt and his brother Cornelius and tore them limb from limb.

For the next 40 years Dutch history turned on the struggle against France. William, though not the equal of the French marshals who opposed him, was the most resolute man in Europe. In the field he never admitted defeat and in diplomacy he seldom met it. Before the end of 1673 the direct danger to the existence of the Dutch republic was ended. Brandenburg, the emperor and Spain were induced to declare war against France. William was able to come out and surprise the Rhine fortress of Bonn, thus threatening the enemy's communications. In 1674 the land war made no great headway, but at sea the English, among whom a powerful section was unfriendly to Louis, had had enough. The treaty of Westminster (Feb. 19, new style; 9, old style) provided for the restoration of all conquests.

Before very long Charles found it to be to his advantage to work for a time with the anti-French party, and the improvement in the republic's military and diplomatic situation was signally shown by the marriage (1677) of William to Mary, the elder daughter of Charles's heir presumptive, James, duke of York. The bridegroom had still his war to finish, but the years 1675–77 had been tolerably successful at sea, though not in the principal theatre, and negotiations were already in progress. They terminated by the general settlement of Nijmegen (Aug. 1678), in which, though it marked the greatest extent of Louis's conquests, the Dutch surrendered nothing. Ten years elapsed before the next war between Holland and France and, in contrast with the period before 1672, ended with the almost complete isolation of Louis XIV. England remained an uncertain factor until 1688, when the clumsiness of James and Louis, the generous patriotism of the Dutch regents, including those of Amsterdam, and the genius of William brought about one of the decisive events of modern times. William and Mary became king and queen of England (see FRANCE: History; ENGLISH HISTORY). In Holland this greatly raised William's authority, which in no way suffered from his frequent absences in his kingdom. He still had to contend with the particularism of the regents in Amsterdam and elsewhere, but his mastery of Dutch political devices was equal to that of John de Witt, and he exercised a less restricted power as stadholder of Holland than as king of England. In the War of the Grand Alliance (*q.v.*) he was an undisputed leader. Holland's part was subordinate to England's, and it suffered by sea and by land only less severely than in the earlier wars of the century; but by the Treaty of Ryswyk (1697) it gained, besides the indirect benefit of William's recognition as king, a favourable commercial treaty. Afterward it garrisoned a number of "barrier fortresses" in the Spanish Netherlands. This barrier policy was, however, unsound. The mercantile Dutch did not desire an extension of frontiers but trusted to making themselves safe in the south, as they had already done in the east, by maintaining garrisons which should shore up the resistance of buffer states, strong enough to serve for defense but too weak to be dangerous. In the great War of the Spanish Succession, which began soon after William's death in 1702 and was a continuation, with still greater stakes, of the last war, one weakness of this scheme at once became apparent. Spain was now in alliance with France, and the garrisons could not hold on in what had thus become an unfriendly country.

Second "Stadholderless Period."— After William's death there was no stadholder until 1747. In 1672 the stadholdership in his five provinces had been declared hereditary; but William died childless, and the jealousy of Holland prevented the appointment of his cousin's son, John William Friso, the stadholder of Friesland and Groningen, whom he had named as his heir. The evils of this disunion were, however, mitigated by the statesmanship of Antonius Heinsius (council-pensionary, 1689–1720) and the duke of Marlborough (deputy captain general and British ambassador at The Hague), who carried on the tradition of William III. After the fall of Marlborough, however, a treaty settlement was made (1713–15) which disappointed Dutch expectations. Small patches of territory on the Meuse were gained. In the southern Netherlands, now handed over by Spain to Austria, a barrier was conceded less advantageous than had been promised by the English during the course of the war.

The finances of the republic were exhausted. From this time it was no longer one of the great powers; but its geographical situation and the wars of its great neighbours, England and France, made international politics the ruling factor in its destiny. Economic decline began to set in seriously toward the middle of the 18th century, so that the political influence of the Dutch was further diminished. They supported the Hanoverian dynasty in England by sending troops when it was in danger, but they followed in general a policy of peace and abstention from European complications. In 1723–31 they departed from this in order to obtain the suppression of the East India company that the emperor Charles VI had set up at Ostend in the Austrian Netherlands, a competitor which might have undone much of the advantage gained by the Dutch from the closing of the Scheldt (see OSTEND COMPANY). In exchange for this suppression they guaranteed the Pragmatic Sanction, by which Maria Theresa was to succeed to all the hereditary dominions of her father, Charles VI, and therefore they were unable to avoid joining, in 1743, in the War of the Austrian Succession. They were now, as in 1689–1713,

in alliance with the English and Austrians against the French, but they confined their help to unimportant contingents and subsidies. The French under Maurice, comte de Saxe, made short work of the Austrian Netherlands and the barrier fortresses. After holding back in the hope that the Dutch would be neutral, they marched in 1747 into the defenseless Dutch territory south of the Scheldt, Dutch Flanders.

William IV of Orange.—Then followed a parody of the revolution of 1672. Popular opinion everywhere demanded a stadholder who should save the country as it had been saved by William III. The man marked out by fate was John William Friso's son. William IV of Orange, who was already stadholder of Friesland, Groningen and Gelderland and the son-in-law of George II of England. Some English men-of-war in port in Orangist Zeeland gave the first impulse to a swift and bloodless revolution, by which William became stadholder of the remaining provinces and captain and admiral general of the union. Before long his offices were declared hereditary. He was an eloquent speaker and a believer in constitutional legality, but he lacked all the qualities of the man of action. His high hopes of effective Dutch exertions in the war came to nothing; even in the making of the treaty of Aix-la-Chapelle in 1748 he had no influence. He and still more his adviser, Willem Bentinck van Rhoon, saw the need for reform in the system of taxation and the machinery of government, but they could not overcome the slackness and obstructiveness of the regents. By the time of William's death (Oct. 22, 1751) nothing remained of the dreams of a revived republic strongly led by a stadholder in the old alliance with Austria and England.

William V of Orange.—In the Seven Years' War (1756–63) the republic remained neutral. After the death in 1759 of William's English widow, Anne, the estates were regents for her son, who was declared to be of age in 1766. William V was a man of the feeblest character, ruled by his spirited wife Wilhelmina of Prussia, niece of Frederick the Great. In the American War of Independence he favoured the English; most of the Dutch people sympathized with the rebellious colonists. It was, however, the interference of the British with neutral shipping which brought the Dutch into their fourth English war. By a majority of four provinces to three the states-general decided to join the "armed neutrality," the combination promoted by Catherine II of Russia (1 8) The war which ensued was an unrelieved disaster. Party strife paralyzed every organ of the state, and, though a stout fight was put up in the indecisive naval action of the Dogger bank (1780), the Dutch could not hinder the English from taking possession of all their shipping and all their colonies. In the treaty of Paris (1784), deserted by their allies, they had to give up Negapatam in southern India and grant the English the right of navigating through the Moluccas. The economic effects of the war had been disastrous.

Perhaps undeservedly but not unnaturally it was the stadholder and his party who were blamed for these humiliations, and the strongest element in the republic for the next few years was that of the sbccessors of the old "Estates party." These were the "Patriots," liberals inspired by French philosophical ideas and politically inclined to France. They used their power to hamper and limit that of the stadholder. In 1784 the emperor Joseph II took advantage of these dissensions to announce his intention of opening the Scheldt, and the Dutch had no means of averting this except by the payment of a heavy compensation. But the Patriots went too far, and the opponents of France were determined not to lose their chances of controlling Dutch policy through the house of Orange. Sir James Harris, the British ambassador, had long been preparing a stroke. In 1787 Frederick William II of Prussia, on the pretext of an insult offered to his sister Wilhelmina, princess of Orange, dispatched an army of invasion. Amsterdam capitulated, the Patriots were driven from office and the authority of William V, such as it was, was restored.

The Revolutionary and Napoleonic Wars.—This might have been the prelude to fundamental reforms had not Dutch history been projected into a new era by the French Revolution. In 1792 the French threw open the Scheldt, as Joseph II had threatened to do. They declared war on George III of England in the following year, and they were merely registering the results of 1787 when they included the prince of Orange in the declaration. The course of events in the war and in France protected the Dutch until the winter of 1794–95, when the army of Charles Pichegru swept all before it, even the fleet being captured in the Texel by cavalry which crossed the ice. William V and his family fled to England. All the characteristic institutions of the antiquated republic were done away with, and the French and Patriots together organized the Batavian republic on the French model (1795–98). The Dutch soon found what it was to be a client state of France. The English seized all their colonies, shut up all their shipping and, at Camperdown (1797), destroyed their navy. Constitutions, growing less democratic, followed one another as in France. At the peace of Amiens England restored the Cape of Good Hope and the West Indian colonies, only to occupy them anew when war was resumed in 1803. In 1805 Napoleon imposed a new constitution, and Rutger Jan Schimmelpenninck took the leading place with the title of council-pensionary. In the next year, however, the French emperor sent his brother Louis to Holland to rule it as a king. Louis, particularly in the matter of the continental system, put his subjects' interests before his master's; hence in 1810 he had to abdicate. The country was incorporated in the French empire and had to pay its share of men and money for Napoleon's costly last campaigns. (G. N. C.)

MONARCHY

William I.—When Napoleon was defeated at Leipzig in 1813 the French power in the Netherlands melted away. The prince of Orange, son of William V (who had died in exile, 1806), hastened back and, amid general enthusiasm, accepted at Amsterdam (Dec. 1813) the title of sovereign prince. The drafting of a constitution was begun. Next year the powers victorious over Napoleon decided to set up, as a bulwark against the French, a state uniting all the Netherlands, divided since 1579, together with the bishopric of Liège and the little duchy of Bouillon. At its head was William VI of Orange with the title of William I (*q.v.*), king of the Netherlands. His share in the German inheritance of the Nassau family was exchanged for Luxembourg, of which he became grand duke, thus bringing it into a personal union with his kingdom. When Napoleon returned for the Hundred Days, the king's son and heir, now called prince of Orange, at the head of the Dutch troops, won distinction at Quatre Bras and at Waterloo, where he was wounded. King William's coronation at Brussels on Sept. 27, 1815, inaugurated a new era.

The Belgian Revolution.—The inclusion of the Belgian Netherlands in the new state of William I set Dutch statesmanship a great task. In the conception of the European powers who had promoted the creation of the united Netherlands kingdom (of England in the first place) it was to be a bulwark against the aggression of France. This conception harmonized quite naturally with the heroic traditions of Dutch foreign policy, of which the house of Orange could consider itself to be in a special sense the guardian, but which were regarded as out of date by those who had no further national ambition beyond neutrality. Yet from another point of view the union might have been expected to appeal to Dutch public opinion. The Flemish half of the southern Netherlands had, since the forced separation in the 1580s, become estranged from the northern Netherlands; during the 20 years of annexation to France the upper classes had been deliberately and to a large extent successfully denationalized. The union might well seem a great opportunity to win the people back for Dutch nationality.

The government endeavoured to restore the Dutch language to its natural position in the public life of the Flemish regions and tried to base a new conception of a greater Netherlands nationality on what the king ostentatiously called "the national language." The inclusion of the Walloons in his kingdom was inevitably a hindrance to a policy of this kind. The conflict with the Roman Catholic heirarchy which the king, heedless of the warning example of Joseph II's reign, did not avoid, tended to alienate the sympathies of the Flemings even more than of the

Walloons. Yet when in 1830, under the immediate effect of the July Revolution in France, the rising against Dutch rule began at Brussels, it was the Walloons who, with the Gallicized Bruxellois, assumed the initiative. The Flemish provinces followed only after the first reverses of the government, and, in fact, in the new Belgian kingdom they were destined to play a subordinate part. The Dutch regime had not lasted long enough to weld them and the northern provinces together in a conscious national unity, but it had, by reversing the process of Gallicization and introducing a system of elementary education, saved the Flemish language from extinction and paved the way for the Flemish movement in Belgium.

Dutch public opinion had taken little interest in the great work that had been done in the south for Dutch civilization and was glad that the nnion had come to an end. At the time of the restoration the Dutch people, shaken by the vicissitudes of the "French period" and impoverished by the loss of trade, had entrusted their interests to William of Orange with the confidence of exhaustion. The years of union with Belgium are marked by an absence of interest in public affairs, surprising on the part of a people with the political tradition of the Dutch. When the Belgian opposition began to ask for ministerial responsibility and similar reforms, the Dutch had only supported the government with greater docility. Events after 1831 brought about a change in this attitude.

It had become clear almost at once after the insurrection of the southern provinces that no foreign help was to be expected to coerce the rebels back under the sovereignty of William I. The attention of Russia, Prussia and Austria was soon distracted by an insurrection in Poland, while England, especially after the formation of the Whig cabinet in November, was anxious to settle the whole question in amicable consultation with France. The international conference that met in London at the request of William I to discuss the matter had, on Dec. 20, 1830, pronounced the dissolution of the kingdom. The principles of separation which it laid down a month later were not inacceptable to Dutch opinion, but in June–July 1831 the conference drew up the so-called Eighteen Articles, which differed essentially from the Bases of January and which the Netherlands rejected. When Leopold I accepted them, William I-denounced the armistice, and in the ten days' campaign the Dutch army routed the Belgians and withdrew only when a French army appeared on the scene. The demonstration was not without effect. The conference again altered its verdict, and the Twenty-four Articles (Oct. 1831) were much more favourable to the Netherlands. But it was not until March 1838 that William intimated his readiness to accept them, and more than a year later the definitive treaty of separation between the Netherlands and Belgium was signed at London and guaranteed in a collective treaty by the five powers.

The treaty left to the Netherlands the ancient territory of the Dutch republic with the addition of a strip of land along the Meuse in order to connect the old enclaves of Maastricht and Venlo with the body of the country. The Belgians undertook to share the burden of the public debt of the defunct kingdom. The Scheldt was declared to be free to international navigation and the Netherlands undertook to maintain its navigability. (See also BELGIUM.)

Financial Policy.—The obstinacy with which King William had maintained his "system of persistence" from 1831 to 1838 had greatly embarrassed Dutch finances and had roused Dutch public opinion against the system of irresponsible government which in 1814 had been accepted without a murmur. The government had been able to finance the protracted mobilization only by drawing largely on the colonies. Here the so-called "cultures system" had been introduced by Jan van den Bosch, who had first been governor general then minister of the colonies. This system really meant a return to the principles of the Dutch East India company; under it the Dutch government asserted a monopoly for trading in agricultural articles obtained by forced labour on a large scale. The Netherlands Trading company (1824), in which the king had a considerable personal interest, was drawn into the service of the government cultures, and both through it and directly the state made enormous annual profits, Altogether, these financial transactions evoked much criticism and intensified the demand for a revision of the constitution. A revision undertaken in 1840 brought colonial finance under the competence of the chambers. A few weeks afterward the king abdicated (Oct. 1840).

William II.—Under William I's son, William II. the drastic fiscal measures necessary to avoid a public bankruptcy were forced through by Floris Adrian van Hall, but at the same time it appeared that the revision of 1840 had by no means satisfied liberal opinion, and the agitation for a further strengthening of the power of the states-general continued.

The leader of liberal thought in the country was Jan Rudolf Thorbecke, professor of constitutional law at Leyden and member of the second chamber. When in 1848 the government suddenly moved in his direction, it was impelled by the revolutionary events in France and Germany rather than by any immediate menace in the country itself. Thorbecke's was the ruling mind in the royal commission which elaborated the new constitution, and the largely conservative states-general dared not block the way when the king himself led the forces of progress. In Oct. 1848 the new constitution came into force. under which full ministerial responsibility, complete control by the states-general of public finance and of colonial administration, direct elections and freedom of meeting were introduced.

William III.—King William II died a few months later (March 17, 1849). It was under his son, William III, that the first great lesson in the practice of parliamentary government was taught, when the new king saw himself obliged to entrust Thorbecke, whom he hated, with the formation of a ministry. The lesson had not been taught so completely but that in 1853, when the institution of a new Roman Catholic hierarchy gave rise, in Holland as in England, to an outburst of Protestant feeling, the king at once used the opportunity to get rid of him; nor was it until 1868, after two general elections had been fought on the issue of royal v. parliamentary ministries, that the question was definitely decided in the liberal sense.

Thorbecke's first ministry (he was again at the head of the government from 1862 to 1866 and died shortly after the formation of his third cabinet in 1872) produced a great record of legislative achievements. The liberal state, postulated in the new constitution, was realized by means of organic laws, regulating the electoral system and provincial and municipal administration. A navigation act did away with differential treatment of Dutch shipping, a first step in the direction of complete free trade. The impulse given by Thorbecke lost much of its force after his resignation in 1853. In his second ministry Bosch's cultures system was attacked both because of the hardships that it inflicted on the native populations of the colonies and in the name of liberal economics; "free labour" was advocated in the interests of the Javanese and of Dutch capitalists alike. On this point Thorbecke and his more radical colonial minister, Fransen van de Putte, differed, and it was not until 1870 that the cultures system was abolished; only government cultures of coffee were maintained for a further number of years.

Education Controversy.—During the whole of this period liberalism may be said to have been the only vital force in Dutch political life. The conservatives had no principle of their own to oppose it; they only questioned and retarded. Other parties, however, were in being, the guardians of distinct and positive traditions of their own. If so far they had been powerless or had not cared to exert their power against liberalism, the time had now come when they had begun to oust the colourless conservatism of men like Van Hall and Heemskerk and to plan an increasingly important part in politics.

The Catholics had long supported the Liberal party, to whose political progenitors, the Patriots, they owed possession since 1795 of full citizens' rights and whose victory in 1848 had enabled them to organize their church again. The formation of the kingdom of Italy, Pius IX's challenge of liberal principles and the rise of ultramontanism disturbed these friendly relations. The Catholics were organized in a separate party and, as they numbcrcd about one-third of the total population, this party was bound to be a powerful one. Its views on the education question soon

brought about an alliance with a party that in the past had been its chief enemy.

Calvinism had suffered a long eclipse. In the first decades of the 19th century the prevailing tone in religious life was "liberal" and "enlightened." But among the people the old doctrines lingered on, and in the 1830s there had been a Calvinist secession from the Reformed Church which William I, imbued with Napoleonic *étatisme* and Erastianism, had vainly tried to dragoon back to conformity. At the same time a religious revival, comparable with the evangelical movement in England, had affected a number of men and women in other classes of society. To this group belonged Guillaume Groen van Prinsterer, who stood for the application of orthodox Protestant principles to politics. But it was only after Groen van Prinsterer's death (1876) that, helped by the political awakening and enfranchisement of the lower classes and by pooling forces with the Roman Catholic party, the new leader of his Antirevolutionary party, Abraham Kuyper, could undermine the Liberal ascendancy until, at length, in 1901, it crashed.

It was the education question that made the Calvinist-Catholic coalition possible. The Netherlands had possessed a national elementary school system since 1806. The constitution of 1848 laid down that the government was to see that public elementary instruction was available in all parts of the kingdom. According to an act of 1857, the public elementary school was to educate the child to "all social and Christian virtues," a provision which it was hoped would meet the objection of the orthodox to the neutral or, as they said, the "godless" character of the state schools. It did nothing of the sort, and when in 1878 the Liberals under J. Kappeyne van de Coppello strengthened the act of 1857 without making any concessions to religious scruples the agitation was doubled in intensity. It was urged that to make people pay toward the upkeep of state schools to which conscience forbade their sending their children, so that they had to pay again for the upkeep of private denominational schools, was unfair, and it was proposed that the state should give financial support to private denominational schools as well. This demand was strenuously resisted by the Liberals, and the constitution, by committing public elementary instruction to the government's especial care, undoubtedly made it difficult to go very far in the direction of state support for denominational education. The constitution could be altered only by the two-thirds vote of a specially elected states-general. So the first coalition (Antirevolutionary *cum* Catholic) ministry, 1887–91, could make only a modest beginning with the subsidizing of denominational schools.

The Franchise. — The coalition majority in 1887 was the direct outcome of an extension of the franchise which increased the number of electors from 140,000 to 300,000, in a population of 4,400,000. The Liberal party had failed to adapt itself to the new circumstances. Both radicals and conservatives split off from it to form independent parties. The growth of the Socialist party was at first slow, not only because of internal dissensions, but also because the Netherlands was still a not very strongly industrialized country. Moreover, the bulk of the working-class population was still without the vote, although a new franchise act in 1896 increased the number of voters to 577,000. It was again the constitution that blocked the way to universal suffrage, but the failure of the Liberal party to solve the question in a bold fashion alienated working-class sympathies from it. Yet, shortly before their final fall from power, the Liberals produced 'a cabinet that tackled social legislation firmly. Workmen's insurance against accidents, improvement of housing conditions and compulsory education for children from 6 to 12 were carried by the Hendrik Goeman Borgesius ministry between 1897 and 1901.

Progress. — A very great change had by this time taken place in the economic and intellectual life of the country. The Netherlands had been very slow in recovering from the exhaustion which the interruption of overseas trade during the "French period" had caused. The working-class population of the towns remained poor, capital cautious and unenterprising, the whole tone of society middle class and dull. Great writers such as Everhardus Johannes Potgieter, Conrad Busken-Huet and Edward Douwes Dekker (Multatuli) felt profoundly dissatisfied and they criticized often with an almost despairing bitterness. In the last quarter of the 19th century, however, hope for the future was born afresh. The rapid economic development of Germany and particularly of the industrial districts on the Rhine after 1870 enabled Rotterdam to grow into a port of the first magnitude. Amsterdam was given good access to the sea by the construction of the North Sea canal to IJmuiden (1865–76). Rotterdam, too, got its new waterway (1866–71). Lakes were turned into land, waste grounds were reclaimed. In Twente and North Brabant textile industries grew up, while along the rivers shipbuilding yards increased in numbers. The Dutch merchant fleet began to grow rapidly. Economic development and increasing prosperity reacted on politics. The new vitality of the Socialist movement as well as the democratic tendencies of the Antirevolutionary and Catholic parties were largely attributable to the passing of material stagnation. In literature, although its promise was hardly fulfilled, poetry was permanently enriched by the Nieuwe Gids movement of the 1880s. The revival of scientific studies in the universities was to bear its richest fruit a little later and in the 20th century.

Wilhelmina.—William III died on Nov. 23, 1890, and was succeeded by his ten-year-old daughter Wilhelmina. For the first eight years of the new reign the queen mother, Emma of Waldeck-Pyrmont, was regent.

In 1901 the clerical parties won a decisive victory at the polls, and a cabinet was formed by Abraham Kuyper. This remarkable man, a dissident minister of religion, a powerful writer and a speaker with a gift of arresting statement, had for 25 years already exercised an enormous influence over the orthodox Calvinists. Events, however, took an unexpected turn. A further instalment of educational reform was procured by the act making it possible to found private universities on a denominational basis. This act emancipated the existing Calvinist University of Amsterdam (a different body from the municipal university of that town) and enabled the Catholics to erect a university of their own (Nijmegen, 1924). But the program of social reform, sponsored by Kuyper's colleague A. S. Talma, was slow in materializing. Instead, in 1903, Kuyper got into a very violent conflict with the growing forces of trade unionism and socialism when he used the forces of the state to break a railway strike. From that moment onward, the Socialists derided his professions of democratic sentiment and religious faith. The general election of 1905 resulted in a deadlock. A very weak Liberal government was formed, which was in 1907 replaced by another coalition government. The political situation did not permit Kuyper's strong personality to be included even in 1909 when the general election led to further disaster for the Liberals.

Theodore Heemskerk was the leading member of this government, which was somewhat too moderate in its religious policy for the more fanatical Kuyperians. Talma's scheme for state disability and old-age insurance had not yet been carried into effect when the defeat of the coalition at the polls in 1913 hung it up indefinitely.

The parties of the left proved unable, in 1913, to assume the responsibilities of government. The Socialist party had now won a large proportion of the left, and there was little sympathy between it and the so-called Free Liberals, one of the sections into which the Liberal party had been split. An attempt was made, nevertheless, to form a coalition of the left, under Bos, the Radical leader, on a program that included universal suffrage. The Free Liberals agreed to this program, but the Socialists (although their leader, P. J. Troelstra, was in favour of accepting) refused to cooperate.

In this difficulty an extraparliamentary cabinet was formed by Cort van der Linden, who attempted to find final solutions for both the questions which had long paralyzed Dutch political life. A revision of the conititution (for which purpose a two-thirds majority of the chamber is required) was to be achieved by an agreement of all parties. In it the clerical groups would find the solution of the school problem and the Liberals, Radicals and Socialists the final extension of the suffrage. The dangers arising from World War I quickened the sense of national solidarity, and

in 1917 agreement was reached. Universal suffrage and proportional representation were introduced; at the same time, the principle of absolute equality with regard to the public exchequer of public undenominational education and private denominational education was conceded in full and written in the constitution.

World **War** I.—In the years before the war, more than one acute controversy between the two opposing groups of Eurcpean powers had centred round the position of the Netherlands. The Dutch-Belgian rapprochement so much talked about in those years proceeded not from the Dutch-speaking Flemings but from Francophil circles. A great outcry was raised over the proposal to fortify the mouth of the Scheldt which was submitted by the Dutch government to the chamber in 1910. The contention, however, that the Netherlands was obliged, or even that it had the right, to allow Entente forces to use the Dutch part of that river in case of a German threat to Antwerp was quite untenable. In 1911 and 1912 official visits of Pres. Clement Armand Fallières to The Hague and of Queen Wilhelmina to Brussels and Paris made it plain that there was no ill will between the Netherlands and the Entente.

Probably, indeed, a desire to allow Germany no possible pretext for an attempt to occupy the Dutch ports in case of an Anglo-German conflict had as much to do with the decision to fortify the mouths of the rivers as any idea that the fortifications might ever actually be used against Great Britain. The Netherlands was at the same time remodelling its system of land defense to excellent effect. At least the German general staff thought it necessary to rearrange its plan of operations for the event of a war with France. H. J. L. von Moltke, realizing that the Dutch army was made mobile and would be used to strike, even if only the outlying province of Limburg were violated, decided to respect Dutch neutrality.

The Netherlands' attitude, then, in those crucial years was strictly and impartially neutral. The sympathies of the public could less easily be controlled. The economic prosperity of the country was to a certain extent bound up with the tremendous development of the German hinterland since 1870, but the Dutch people felt oppressed by German militarism-imperialism. On the outbreak of war in 1914, it was the violation of Belgian neutrality and the subsequent acts of repression in the occupied territory that determined the attitude of Dutch public opinion.

The government at once proclaimed strict neutrality. Inevitably there were times when each group of belligerents felt the Netherlands' neutrality, however impartially administered, as a burden. The British enforcement of a blockade gave rise to a good deal of friction. Moreover, the Netherlands' neutrality undoubtedly had the effect of covering Germany's right flank. On the other hand, the closure of the Scheldt, once Antwerp had fallen, was all to the advantage of Great Britain, as Germany was thus prevented from using Antwerp as a submarine base. The efficiency of the Netherlands' defense forces contributed to its neutrality's being respected. The army, 450,000 strong, had been mobilized without a hitch in the last days of July 1914 and was kept on a war footing, at a great cost financially and morally, till 1918.

Unfortunately, frequent cases arose in which the vague principles of international law could be variously interpreted. The sand and gravel dispute, which dragged on throughout 1917 and 1918, was the most acrimonious and at one time endangered the Netherlands' neutrality. The Entente governments protested against the Netherlands' allowing the Germans to use Dutch waterways for the transport of sand and gravel to Belgium for use in the construction of a new kind of ferroconcrete dugouts. Pressed by both sides, the Netherlands at last consented to ration this traffic on the footing of prewar statistics; but in the spring of 1918 Erich Ludendorff wanted this arrangement to be used as a pretext to overrun the Netherlands and was restrained only by the determined intervention of representatives of the German civil power.

The most real difficulties, however, were economic, and these began to be of the most tragic importance to the Dutch people in 1915. Sea-borne trade was gradually extinguished as the war went on. The Germans began by laying mines in front of the English ports. The British retaliated by laying a mine field in the North sea. In order to make their blockade of Germany effective they exercised an ever more stringent control over imports into the adjacent states, regardless of the provisions of the declaration of London. In March 1915 the Entente powers did away with all distinctions between legitimate and contraband trade and prohibited the import into the Netherlands of all goods, whatever their nature, which could be suspected of being destined for transmission to Germany. All goods imported into the Netherlands had to be consigned to an unofficial body (the Netherlands Oversea trust), which possessed the confidence of the Entente authorities and undertook that they should go no further.

The Allies gradually assumed control of the entire economic life of the Netherlands, allowing it the bare necessities of life, withholding anything that could be used to replace goods sent to Germany. Even the Netherlands' trade with its own colonies was subject to this control. As the Netherlands depended on Germany for certain indispensable articles (*e.g.*, coal), it was driven to export food which it really could not do without, in order to obtain them in exchange. Meanwhile, in 1915 Dutch vessels had begun to fall victims to German U-boats. Food scarcity became almost as serious in the Netherlands as in Germany itself, certainly more serious than in England. In the last stages of the war the Netherlands' industrial life was at a complete standstill.

Negotiations with Belgium.—In the first months of the war, when the Germans advanced through Belgium, a stream of Belgian refugees had sought safety on Dutch soil, where they were hospitably received. At one time their number exceeded 1,000,000, and their support, the provision of food and shelter, was an exceedingly heavy charge. In spite of this the Netherlands found itself decidedly unpopular in some of the Allied countries, and the firm refusal of the Dutch government in 1920 to surrender the former emperor William, who had taken refuge there in Nov. 1918, gave rise to excited denunciations of the Netherlands' alleged tenderness for the Hohenzollerns. During the peace conference, then, Belgium declared that the Netherlands' claim to sovereignty over the Scheldt mouth and its action in closing it against the Allied forces had made the defense of Antwerp impossible, while its possession of the province of Limburg had hindered the defense of Belgium's eastern frontier, which ought to have been based on the river Meuse. The Belgian *Comité* de Politique Nationale advocated that Belgium should be given sovereignty over Dutch Flanders, on the left bank of the Scheldt, and over Dutch Limburg, on the ground that the treaties of 1839, guaranteeing the neutrality of Belgium, having lapsed, these territories were now necessary for its protection. The question was eventually referred to direct negotiation between the two countries.

These negotiations on new arrangements for the regime on the Scheldt, on the Ghent-Terneuzen canal, etc., were, however, carried on in a somewhat unfavourable atmosphere. Although the populations of Limburg and Dutch Flanders protested their loyalty to the Dutch fatherland. the annexationist agitation in Belgium went on, and was still supported by the government. Yet the Dutch government was prepared to go far to meet Belgian wishes.

Early in 1920 a treaty in which several Dutch concessions were laid down was ready for signature when a new dispute arose about the sovereignty of the Wielingen channel, which connects the Scheldt estuary with the open sea. Although that channel runs along the Belgian coast within the three-mile limit, the Netherlands had exercised sovereign rights over it since mediaeval times. But, later, when conditions everywhere grew more stable. the treaty of 1920 was signed at The Hague on April 3, 1925, without the Netherlands' having changed its attitude toward the Wielingen question, which was suffered to remain in its original state. Pending ratification, however, the agreement was subjected to lively criticism in the Netherlands. In 1919 and 1920 the Netherlands had been willing to make economic concessions to avoid a threat to its sovereign rights;. but in 1925, when the treaty was at last published in its entirety, the danger that had loomed so large five

years before seemed altogether negligible, and the proposed concessions were scrutinized entirely on their merits, widespread dissatisfaction manifesting itself at the one-sided character of the treaty. When the second chamber on Nov. 11, 1926, nevertheless approved it, agitation redoubled in intensity. with the result that on March 24, 1927, the first chamber, by 33 votes against 17, rejected it.

Internal Politics, 1919–39.—The first elections under the new suffrage law after the revision of the constitution were held while the war was still going on, and resulted in further disaster for the Liberal groups; the Cort van der Linden administration resigned, and another Calvinist-Catholic cabinet was formed (July 1918). J. M. Ruys de Beerenbrouck was the first Catholic premier in Dutch history. This government's mandate was confirmed by the elections of 1921, when the coalition parties got 60 of the 100 seats of the second chamber. At the elections of June–July 1925 they lost some ground but still retained the majority, and when Ruys retired. Hendrik Colijn, leader of the Calvinist Anti-revolutionary party, formed another coalition cabinet. Each of these elections since proportional representation came into force meant a further stage in the disintegration of the Liberal parties, but the Socialists. with 24 members, became the largest party in the chamber after the Catholics, with 30, in 1925.

The years 1919 and 1920 were feverish ones, when a fallacious sense of prosperity stimulated enterprise in business and politics alike. Indeed the zeal for social reform which characterized them may perhaps be connected with a certain nervousness remaining after the "November days" of 1918. But the fictitious prosperity was succeeded by a severe depression. Shipping and shipbuilding particularly felt the effects. and Rotterdam suffered from the occupation of the Ruhr area and from the preference grdnted by France to its own and Belgian commerce. Unemployment remained a drain on Dutch resources. The one really bright spot in the picture was the prosperity of the East Indian cultures. Economy came to be the cry. The building subsidies were cut down, dispensations from the act restricting the hours of labour were freely granted, and it was felt that the multiplication of small state-subsidized schools, resulting from the compromise of 1917, overburdened the taxpayer. Colijn's appointment as minister of finance in 1923 strengthened the government, and he succeeded in balancing the budget in 1925. thanks largely to the improvement in the yield of direct taxation resulting from economic revival. (P. GE)

The coalition government under Colijn lasted only a few months. It had to resign in Nov. 1925, and there ensued a period of crisis in the parliamentary system that lasted until a short time before World War II. The cabinet of D. J. de Geer (1926–29) and that of Ruys de Beerenbrouck (1929–33) and the four Colijn cabinets during the years of 1933–39 were all wholly or partly extraparliamentary. This crisis, partly a result of proportional representation and the consequent formation of splinter parties, was mainly the result of two factors: (1) the circumstance that the political dividing line between "Christian" and "non-Christian" that had obtained since the struggle for the schools no longer corresponded with reality, while the logical division based on the distinction between economically and socially progressive policies on the one hand and conservative ones on the other was not accepted in its place; and (2) disappointment at the inability of democracy and the parliamentary system to solve the burning questions of the day.

These questions were raised especially by the world financial and economic crisis, which affected the Netherlands between 1929 and 1937, leading to continually increasing unemployment and sapping the financial and moral strength of part of the population. Colijn's remedy for the country's plight was retrenchment first and foremost: he thus became the "strong man" for all those who hoped to see the liberal-capitalistic economic system saved from ruin. As against this policy the Socialist or Social Democratic Workers' party (S.D.A.P.), which had continued in opposition all these years, brought forward its proposals for a planned economy and published its *Plan for Labour (Plan van de* Arbeid). The leaders of this party, seeing that their plan could be realized only if Socialists took part in the government, dropped their extreme internationalism; they recognized the rights of the monarchy and repudiated their former slogan for one-sided disarmament.

The economic and social crisis promoted the emergence, there as elsewhere. of extremist parties rejecting the democratic system of government altogether. Such were the Communist party (C.P.N.), which was never of much importance and won 3 seats of 100 in the 1937 elections, and the National Socialist movement (N.S.B.) with its "leader" Anton Mussert. At first the N.S.B. seemed likely to gain considerably by the prevailing discontent. At the provincial elections in 1935 it obtained 8% of the votes, but only two years later at the general election its poll was merely 3.8% (with four seats in the house), a decline which was caused by political developments abroad, particularly in Germany, as well as by improvement in the economic sphere. In opposition to both totalitarian movements a national concentration of democrats, cutting across the traditional political dividing lines. was formed in Eenheid *door Democratie* ("Unity through Democracy"). The only government measure against the extremist parties was an order declaring membership of either of them incompatible with public employment of any description.

That the Social Democrats abandoned their former rigid disarmament line was partly a result of the steady deterioration of the international situation during the 1930s. The country was disappointed in the League of Nations and was the first of the so-called Oslo states to abandon the policy of collective security. From 1936, after the war in Abyssinia, the Dutch government adhered to a policy of strict neutrality and complete independence. At the same time rearmament was taken in hand, at home as well as in the East Indies. Though it was on a modest scale. this nevertheless proved considerable strain on the country's financial resources.

Colijn's retrenchment policy met with increasing opposition. not least from the Catholic party. It was as a result of a Catholic motion that the fifth Colijn cabinet fell on July 25, 1939, only a few days after its formation. The road was now clear for Social Democrats to enter the government, and in the De Geer cabinet of Aug. 1939 two of them were included.

World War II.—A few weeks later World War II began. The Netherlands declared its neutrality, but from the first it seemed obvious that the country's chances to keep out of the war were smaller than they had been during World War I. Indeed Adolf Hitler, despite solemn promises to the contrary, apparently never intended to respect either Dutch or Belgian neutrality once it had become clear that England and France were prepared to fight on after the fall of Poland. During the winter of 1939 there was a series of incidents (among others, the Venlo incident of Nov. 9) as part of a cold war of nervous attrition, clearly showing from which side danger threatened. Nevertheless. the government continued its preparations for defense against attack from either of the belligerent sides and protested with equal force against violations of the country's neutrality by either and against impediments to trade by sea or on land.

On May 10, 1940, German planes and motorized land forces crossed the Dutch frontier, and paratroopers were dropped at strategically important points behind the Dutch defenses, in the west of the country. The Dutch foreign minister. E. N. van Kleffens, indignantly repudiated the German offer of "protection against an impending Alhed attack." The Netherlands considered itself at war with the third reich.

The struggle was of short duration. German troops advanced rapidly through North Brabant (the French 7th army came too late for effective aid), the small Dutch air arm was destroyed almost at once, the IJssel and Grebbe lines of defense were forced On May 13 Queen Wilhelmina and the cabinet embarked for England, whither Princess Juliana had gone the day before with her children. The departure of the queen, for which the public had not been prepared. had a demoralizing effect on both soldiers and civilians. The bombardment of the open town of Rotterdam on May 14 did the rest. On the evening of that day the army capitulated, except for the forces fighting in

Zeeland, where the unequal struggle continued until May 17. The navy joined the Allied fleets. The Netherlands was occupied by the *Wehrmacht.*

Reichskommissar Arthur Seyss-Inquart took office on May *30* and, in his inaugural address, promised the Dutch not to press national socialism on them. At that moment the struggle for the continent had not yet been won by the Germans, and they were out to show moderation. For a year after the capitulation of France it was the German tactic to play the wolf in sheep's clothes. Nevertheless. there were occasional symptoms of their ultimate intention: for example. the ban on listening to Allied broadcasts; the muzzling of the press; the suppression of the S.D.A.P. and of the Socialist trade-union movement: the first anti-Jewish measures; and the maiming of political and intellectual life by the internment in Buchenwald of a number of leading personalities as hostages. Characteristic of these early steps was their gradualness; categories of the population were attacked separately, one after the other, so that many were lulled preliminarily into a mistaken sense of relief and expectation of further respite. This method, moreover, was applied right to the end of the occupation.

In the first year of the occupation the Germans tolerated a certain amount of political activity by the newly formed *Nederlandse Unie,* which was led by a triumvirate of well-meaning but somewhat naïve persons from outside the ranks of regular party politicians. It soon became obvious. however. that this semblance of liberty had to be bought by unworthy pandering to the Nazi ideology. Two signs of awakening resistance were already discernible, though only a small number of people were involved as yet: these were the appearance of illegal newssheets *(Vrij Nederland, Het Parool, Je Maintiendrai)* and the strike in Amsterdam and other towns as a protest against the first open anti-Jenish action (Jews being arrested haphazardly and deported).

BY COURTESY OF DOESER FOTOS

BRONZE MONUMENT SCULPTURED BY OSSIP ZADKINE (1890–) COMMEMORATING THE DESTRUCTION OF ROTTERDAM DURING WORLD WAR II. THE STATUE STANDS NEAR THE HARBOUR

After the attack on the Soviet Union the German measures of *Gleichschaltung* became more frequent and far reaching More and more groups of the population were affected (denominational trade unions, artists, journalists, doctors, etc.). The terror, growing fiercer and more barefaced, was especially directed against the Jews and the resistance movement. Toward the end of 1942 the Dutch National Socialists were given a certain measure of authority. But the chance of gaining support for the German cause by alternating benevolence and ruthlessness had dwindled with the belief in a German victory. The broadcasts by the British Broadcasting corporation and Radio-Orange did much to prevent a reawakening of this belief. There had at first been hesitations in Dutch government circles in London. These came to an end when the aging Premier De Geer was replaced by Pieter Sjoerds Gerbrandy, who, strongly supported by the queen, pursued an unnavering policy of no compromise. (De Geer, sent in Sept. 1940 on a mission to Indonesia, broke his trust by returning to the Netherlands instead. For this feat he was brought to trial after the liberation.)

After Stalingrad and the Allied victory in north Africa the German terror set in with full force. while at the same time organized resistance grew The *Arbeitseinsatz* became a mass deportation of labour to Germany and served also to remove Dutchmen from possible temptation in the event of an Allied invasion. It was also the pretext for the calling up of demobilized soldiers for internment (the Germans had already, by deceitful means. got hold of the officers). The announcement of this measure by the German military commander. General Christiansen, on April *29,* 1943, resulted in a spontaneous strike in a large part of the country. The Germans. taken by surprise, immediately proclaimed summary justice and overcame resistance in a few days, with bloody reprisals. If the strike brought no direct gain, at least thousands of people were forced to realize what was at stake, and the resistance movement was greatly strengthened.

The University of Leyden and the technical school at Delft had been closed as early as the autumn of 1940 in response to protests against the dismissal of Jewish staff members. In 1944 academic life as a whole was paralyzed by the closure of the universities when the students refused (March) to sign a declaration of loyalty to the occupying power. The resistance movement answered the terror by the nation-wide organization of hiding out (called "diving") for men and women sought by the Germans, for Jews, for men of the "dangerous age," etc.; by raids on food offices (for ration cards) and on municipal registries (the data stored there were useful to the Germans); and by the "liquidation" of Dutch traitors and *provocateurs.*

The Dutch government in London, which had for a long time been ill informed about the real situation in the Netherlands, now gave a determined lead and forbade all collaboration with the Germans and all compliance with unlawful German orders. The London government's declaration of war on Japan and the Japanese invasion of the Netherlands Indies had already made a profound impression. The battle of the Java sea (Feb. *27–28,* 1942), in which the Dutch fleet sacrificed itself in defense of Australia, aroused feelings of grief and pride.

After the Allied invasion of Normandy. the warfare itself drew close to the Dutch frontier. At the beginning of Sept. 1944 Gen. Bernard Law Montgomery's army entered North Brabant; on Sept. 5 *(Dolle Dinsdag,* "Mad Tuesday." as it was called afterward) Germans and Dutch National Socialists began to pack up and actually to leave. Unfortunately the reports that Allied troops were marching in were premature. Not until Sept. 17 did the drive to cross the rivers begin, and then, although Nijmegen was captured and the Waal river crossed, it was held up on the Rhine at Arnhem. where a German armoured column that happened to be at hand threw the British parachutists back. Meanwhile, however, the Dutch government in London had instructed the railwaymen to strike (for months already trains and railway junctions had been targets for Allied planes), an order carried out promptly and completely.

The loss of the battle of Arnhem meant that, although Torth Brabant and Limburg were now liberated, the rest of the country was to face the worst winter of the war. The Netherlands now lay in the front line of battle, with the German forces stubbornly resisting attack. Walcheren and with it the passage to Antwerp could be won only by the inundation of the island through the bombardment of the dike at Westkapelle, and there were severe civilian losses caused by mistakes made in Allied air attacks on German positions and communications. The struggle between the resistance movement and the occupiers reached its peak; the German terror became more and more ruthless. But worse than the effects of warfare and as horrible as the terror and the renewed deportations involving further thousands of men were the cold and hunger. There was no gas, no electricity, no fuel and no food. In the big towns in the western part of the country the famine nas especially serious: every day thousands of men and women left their cold homes to scavenge for food in the countryside, often for weeks on end. The rationing system virtually ceased to function, and food mas only to be obtained on the black market. Money no longer had any value, and only goods were accepted in exchange for food.

The final great Allied offensive against the third reich in 1945 liberated the Netherlands at last. Canadian forces drove the enemy from the east and north of the country. But still the Germans stood their ground in the west, where they destroyed the harbours of Rotterdam and Amsterdam, threatened to inundate large areas and were apparently prepared to let the population starve to death. Then, toward the end of April, Seyss-lnquart

was prevailed upon by the Committee of Trustees (a body of men recently appointed to represent the government and hitherto not even known to the Germans) to permit food droppings by the Allies. A few days later, on May 5, the German 25th army under Gen. Johannes von Blaskowitz surrendered to the Canadian commander Gen. Charles Foulkes.

Postwar Policies.—The Gerbrandy cabinet had in Jan. 1945 been reformed to include several ministers from the liberated southern provinces. After the liberation of the entire country it resigned and mas replaced by an interim cabinet led by Willem Schermerhorn, leader of a progressive nonparty movement initiated during the occupation, and by Willem Drees, leader of the Socialist party, who had been among the hostages at Buchenwald and had afterward played a part in the resistance. This government announced a progressive program, based on the apparently general desire for renewal that had developed during the war. It soon became clear, however, that the progressive mentality was neither so deeply rooted nor so widespread as the leading group of politicians and intellectuals had been led to think through their association in the resistance movement and the hostage camps. The majority of the electorate seems rather to have desired a speedy restoration of prewar political and economic circumstances, as far as the radical effects of the war allowed. This inclination was shown by the relative failure of the so-called "breakthrough" in the outmoded political dividing line (still largely determined by religion).

A new Labour party (Partij van de Arbeid, P.v.d.A.) was formed by the amalgamation of the old Socialist party. the Radical party (Vrijzinnig Democratische Partij) and a considerable number of progressives of either Catholic or Protestant persuasion and political antecedents, but the resuscitated denominational parties showed at the first genera1 election (May 17, 1946) that they had practically retained their former following. The Labour party, with 29 seats in the house of 100, was no more a national party than any of the others. If it had made gains on the right (the denominational parties included) it had lost as much on the left, nhere the Communists now held ten seats.

This situation remained essentially unchanged after the election of July 7, 1948. The election of June 25, 1952, had shown, however, that the idea of a "breakthrough" gained some ground, Labour increasing from 27 to 30 seats, while the Catholic People's party was reduced from 32 to 30.

After the first postuar election a mainly Catholic-Labour coalition government nas formed by the Catholic Louis Joseph Maria Beel. The governments formed in Aug. 1948 and in March 1951 by Drees were similarly composed. After the 1952 election the Catholic-Labour coalition remained in power, with Drees as premier.

After the liberation the people and government of the Netherlands were faced by an immense task of political, economic, social and moral rehabilitation and by many problems comparable nith those of other western European countries. The housing shortage created by wartime destruction was intensified by the increase of population, nhich continued to exceed that of any other country in western Europe. The catastrophic flood of Jan. 31–Feb. 1, 1953, struck especially the province of Zeeland. causing 1,783 deaths and enormous material damage. In 1954 the Dutch launched a great project for the closing of the sea arms in this area. However, ten years after the end of World War II. prosperity had again reached a high level.

As regards foreign policy, the Netherlands joined the United Nations after World War II. As it became increasingly clear that the traditional policy of neutrality could no longer be maintained against the threat to Europe from military, political and economic aggression. the large majority of the people subsequently supported adherence in 1949 to the North Atlantic Treaty organization. The Netherlands became in April 1951 party to the European Coal and Steel Community and in Oct. 1954 to the Western European union. It was hoped that the Benelux organization, formed in London on Sept. 15, 1944, for closer co-operation between Belgium. the Netherlands and Luxembourg, would show the way toward a greater integration of western Europe. According to the promise given by Queen Wilhelmina on Dec. 7, 1942, the former West Indian colonies. after long-drawn-out discussions, were granted autonomy on June 3, 1954. On Dec. 15, 1954, the new statute of the kingdom came into being. The kingdom includes the Netherlands, Surinam (Dutch Guiana) and the Netherlands Antilles. The two last-named delegate two ministers who decide with The Hague government all matters of common interest.

After the June 1956 election, in which the Labour party became the strongest in the second chamber. Drees remained premier of a coalition of the Labour and denominational parties after the most prolonged cabinet crisis in Dutch parliamentary history.

In Feb. 1957 the government started a policy of restricting investments.

Relations with Indonesia became worse as a consequence of the Indonesian claim on Dutch New Guinea, and led in Dec. 1957 to a crippling of the Dutch share in the Indonesian economy as well as to a large-scale emigration of Dutchmen from Indonesia.

In Dec. 1957 the parliament ratified the treaties on the European common market and on Euratom (European Atomic Energy Community). In Jan. 1958 the final treaty creating the economic union of Belgium, the Netherlands and Luxembourg was signed.

Juliana.—Queen Wilhelmina had returned to her country with the Allied armies in March 1945 but had had to relinquish her royal powers, because of ill-health, from Oct. 14 to Dec. 1, 1947, and from May 14 to Aug. 30, 1948. During these periods her daughter, Princess Juliana, was regent. On Sept. 4, 1948, Wilhelmina abdicated. Two days later Juliana was enthroned as queen of the Netherlands. (C. D. J. B.)

Colonies.—The colonial possessions of the Netherlands included before 1939 both East Indian and West Indian territories. The former, dating back to 1602, consisted of Sumatra, Java, most of Borneo, Celebes and western New Guinea, together with lesser islands.

After World War II, native leaders demanded that these possessions should become a self-governing entity, the United States of the Republic of Indonesia. Fighting between Dutch and native troops continued within the area for several years. In Dec. 1949 a settlement was reached whereby the sovereignty of all the East Indies except Dutch New Guinea was handed over to the nationalists. A Netherlands-Indonesian union was established under the crown of the Netherlands, whereby the two nations entered into a voluntary association as two independent and equal sovereign states. This union was abolished in 1954.

The Rest Indian territories, comprising the Netherlands Antilles and Surinam, date back to 1667. By a statute of Dec. 1954 the territories were given full autonomy in internal affairs.

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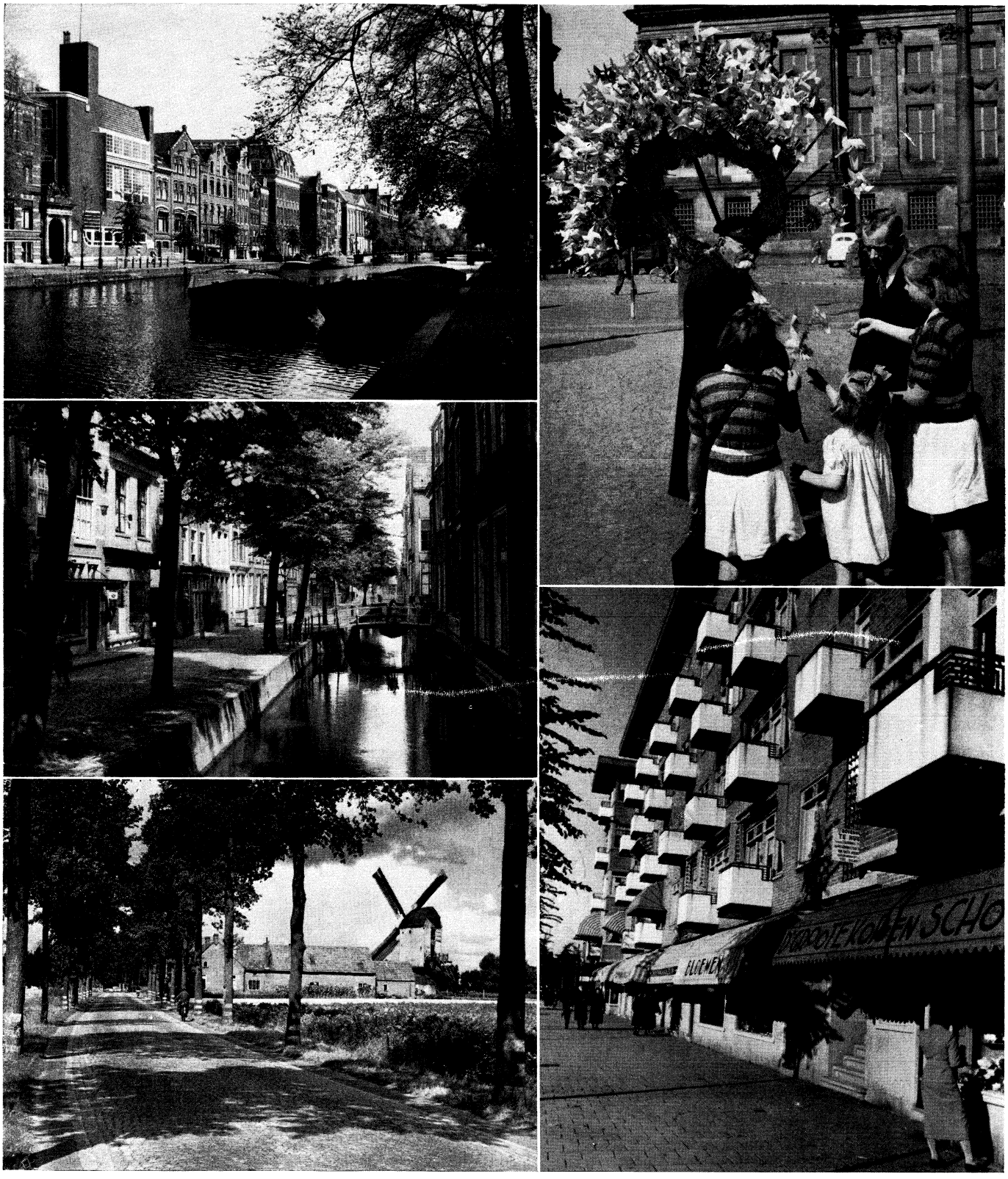
POPULATION AND SOCIAL CONDITIONS

The population of the Netherlands according to the census of 1947 was 9,625,499 (of whom 4,791,443 were male). According to the Jan 1. 1955 estimate it rose to 10,680,023, the average density being 852 per square mile. This high density was chiefly the result of an intense concentration within the two provinces of North and South Holland (1,920 and 2,337 per square mile). The distribution of this population according to habitat is shown in Table I.

Between the years 1830 (the date of the separation of Belgium from the Netherlands) and 1955, the population of the Netherlands rose by 8,066,725. The greater part of this increase took place during the 20th century, and its rate far exceeded that of any

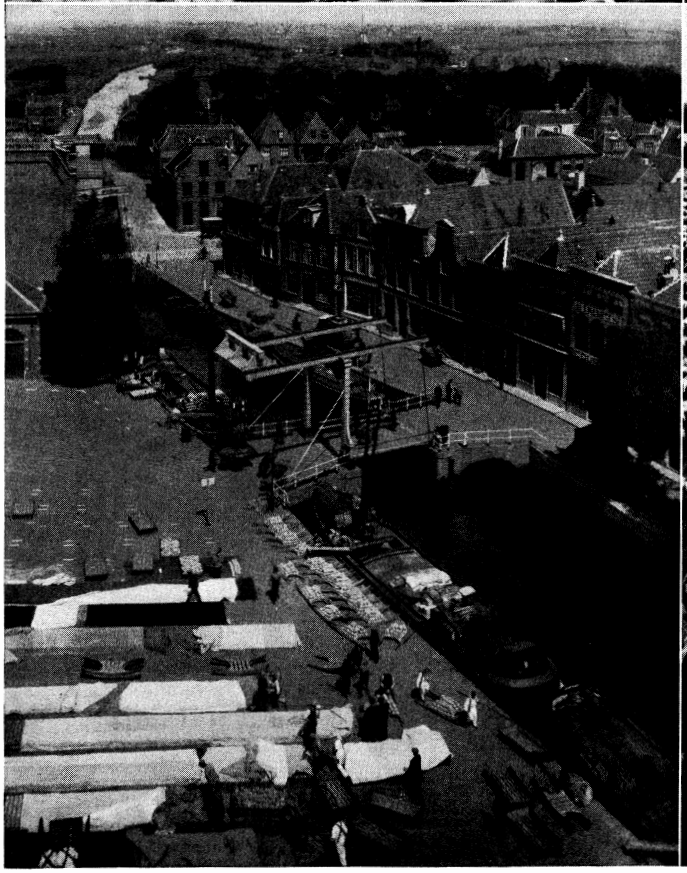


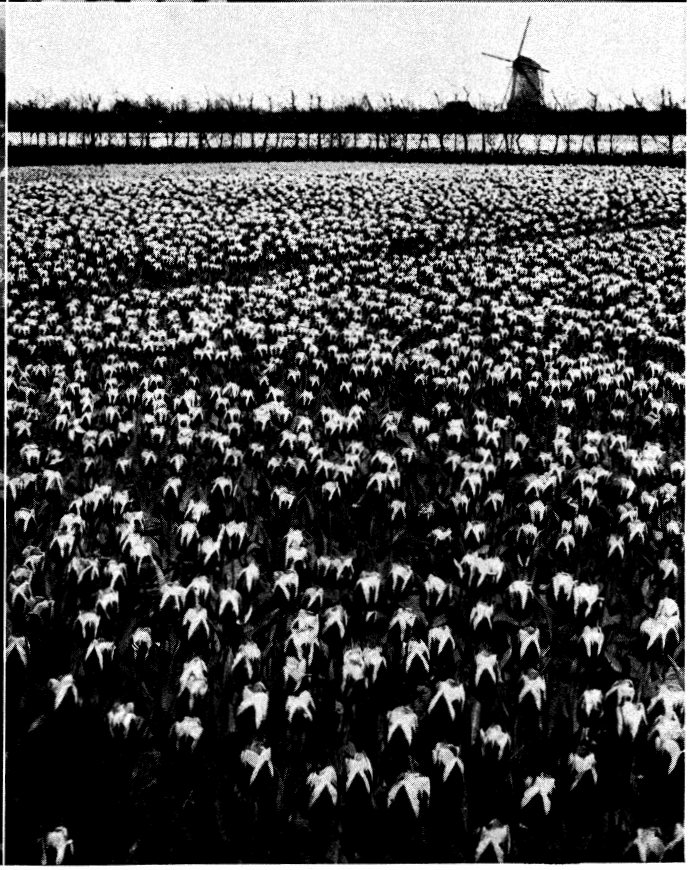
PHOTOGRAPHS, (BOTTOM RIGHT) THREE LIONS. (ALL OTHERS) REECE WINSTONE

SCENES IN THE NETHERLANDS

Top left: View along a picturesaue canal in Amsterdam
Top right: Seller of toy windmills in the sauare before the royal palace, Amsterdam
Centre left: Street along one of the canals in Delft, centre of the Dutch pottery industry
Bottom left: Typical country road north of Eindhoven
Bottom right: Apartment building in Amsterdam

HOLLAND





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COMMERCIAL ACTIVITIES IN THE NETHERLANDS

Top left: Fishing boats at Volendam. Herring is the principal product of the Netherlands' North sea fisheries

Top right: Diamond-cutting establishment in Amsterdam

Bottom left: Alkmaar, a centre of the Dutch cheese industry

Bottom right: Field of tulips. Bulbs are exported throughout the world


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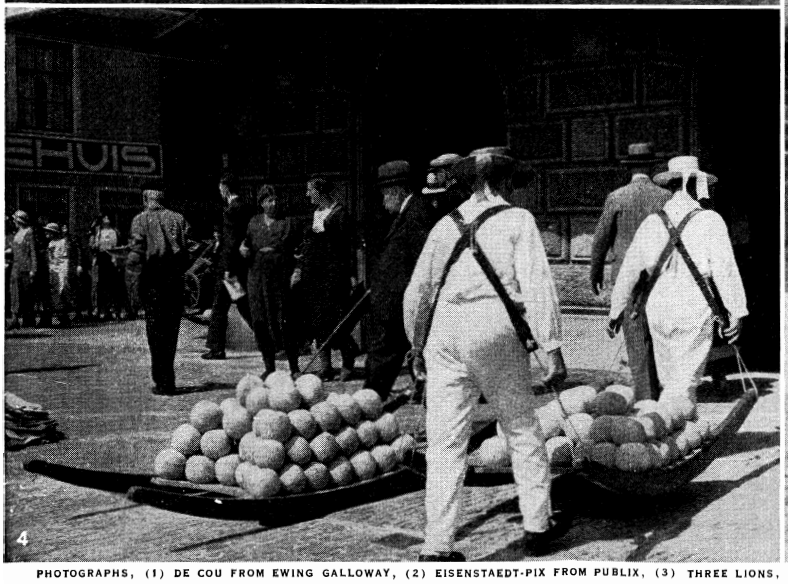

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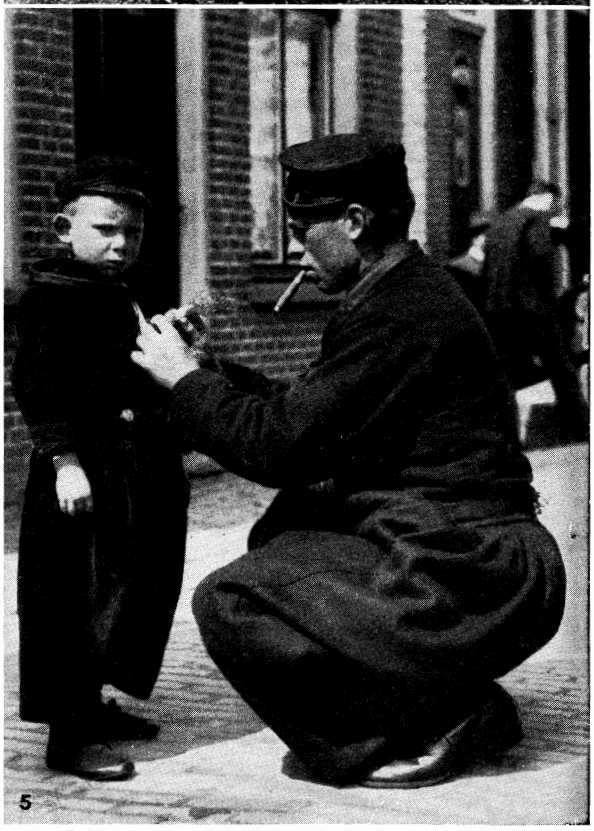
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PEOPLE AND COSTUMES OF THE NETHERLANDS

1. Small girl of Middelburg, with her hat of a design peculiar to that city
2. Mother and child at a football match between Dutch fishermen
3. A Dutch milkmaid with her cows
4. At the cheese market in Alkmaar. The cheese carriers have traditional white suits and straw hats with coloured ribbons dangling from the brims
5. Baggy pants are the typical dress of men and boys in the Dutch fishing viileges. This father is adjusting his son's necktie on the way to church

TABLE I.—*Population by Provinces*

Habitat	1947 Area (sq.mi.)	Pop. 1947 census	1955 Area (sq.mi.)	Pop. Jan. 1, 1955, est.
North Rrabant	1,894	1,180,133	1,894	1,354,363
Gelderland	1,921	1,028,127	1,932	1,166,465
South I-Tolland	1,085	2,284,080	1,086	2,537,647
North Holland	1,016	1,774,273	1,016	1,950,244
Zeeland	651	260,800	653	275,369
Utrecht.	511	549,566	511	618,077
Friesland	1,249	459,361	1,251	470,227
Overijssel	1,254	638,797	1,256	718,430
Groningen	867	449,862	867	465,301
Drenthe.	1,011	271,909	1,011	296,403
Limburg	840	684,105	857	801,135
IJsselmeer Polders	183	2,023	195	18,586
S o fixed abode	—	42,463	—	7,776
Total	12,482	9,625,499	12,529	10,680,023

other country in western Europe. (See Table II.)

Though in the years of the 20th century before World War II the birth rate, while considerably exceeding the death rate, fell rather more sharply than the latter, nevertheless the growth in

TABLE II.—*Population, 1830–1956*

Date	Male	Female	Total
Jan. 1, 1830	1,278,006	1,335,292	2,613,298
Dec. 1, 1869	1,764,118	1,815,411	3,579,529
Dec. 31, 1899	2,520,602	2,583,535	5,104,137
Dec. 31, 1909	2,899,125	2,059,050	5,858,175
Dec. 31, 1920	3,410,262	3,455,052	6,865,314
Dec. 31, 1930	3,942,676	3,992,889	7,935,565
Dec. 31, 1937	4,307,107	4,332,488	8,639,595
Dec. 31, 1950	4,998,251	5,028,522	10,026,773
Dec. 31, 1953	5,256,108	5,294,629	10,550,737
Dec. 31, 1956	5,320,759	5,629,213	10,949,972

population continued, rarely descending below 100,000 annually. In postwar years there was a large increase in birth-rate figures; *e.g.*, 228,609 in 1953 in comparison with 80,551 deaths. Between 1945 and 1956 it averaged approximately 1% of the population

TABLE III.—*Vital Statistics*

Year	Births per 000	Deaths per 000
1911–13	28.1	13.1
1921–25	25.7	10.4
1926–30	23.2	9.9
1931–35	20.2	8.9
1938.	20.5	8.5
1950.	23.0	7.5
1954.	21.8	7.5

yearly. Compared nith its western European neighbours the Netherlands had a greater proportion (37.4% in 1954) within the age group under 20

Figures for the birth rate and death rate per 1,000 between 1911 and 1954 are shown in Table III.

TABLE IV.—*Population According to Employment*

Occupation	May 31, 1947		
	Men	Women	Total
Manufacturing industries	1,241,299	186,620	1,427,919
Earthenware, glass, chalk, bricks	37,434	1,790	39,224
Diamonds, precious stones	1,700	181	1,881
Graphic industrial photography	31,170	3,462	34,632
Building trade	264,032	4,441	268,473
Chemical industrv	33,255	10,254	43,509
Industrial preparation of wood, cork, straw	65,366	1,742	67,108
Clothing and cleaning	62,811	97,004	159,815
Industrial arts	2,676	366	3,042
Leather,-oilcloth, rubber	49,388	6,101	55,489
Mining: peat exploitation	53,071	1,250	54,321
hfetals, shipbuilding, etc.	357,081	13,417	370,498
Paperindustry	19,763	4,807	24,570
Textile industrv	65,844	22,625	88,469
Gas, electricity, water pipeline supply	28,994	1,184	30,178
Foodstuffs, tobacco, sweets.	168,714	17,996	186,710
Agriculture	588,992	168,710	757,702
Fishing and yachting	12,108	356	12,464
Shops	125,767	131,505	257,272
Other trades, unspecified.	221,817	26,457	248,274
Traffic	284,501	56,356	340,857
Creditandhanking.	22,928	7,451	30,379
Insurance	28,673	9,015	37,688
Social services	279,488	124,862	404,350
School education	46,746	44,345	91,091
Religion	11,637	1,381	13,018
Domestic service	5,513	183,439	188,952
Profession unknown	53,373	3,106	56,479
Total	2,922,842	943,603	3,866,445

As a result of this increasing population (to which should be added immigration figures of 51.756 in 1956) and of accompanying postnar economic difficulties, emigration, which was only moderate before 1939, increased in postwar years (62,737 in 1956) and received official help from the state.

Industrialization began later in the Netherlands than in other western European countries, but during the 20th century there was an increasing drift into urban areas and in 1954 the 81 towns of more than 20.000 inhabitants contained about 55% of the population. The working population in 1954 numbered 4,091,000 or 3,119,000 male and 972,000 female Of these 42% worked in industry, 13% in agriculture and fisheries and 45% in other services.

The total population of the provinces of North and South Holland, and of Utrecht. the area of which is about one-fifth of the whole kingdom, represents half the national population. This concentration is a result of the fact that suitable positions for commercial centres. particularly in transit trade, coincided with the existence of a fertile soil or the opportunity to win such soil by the reclamation of lakes and marshes. There are to be found the largest towns in the Netherlands: Amsterdam, Rotterdam, The Hague, Utrecht, Haarlem. etc. (See Table V.) Most of these,

TABLE V.—*Population of Major Towns, 1912–55*

Town	1912	1926	1947	1955†
Amsterdam'	587,876	726,527	792,086†	863,802
Rotterdam.	446,897	562,991	643,712†	712,513
The Hague	294,693	408,034	597,087†	596,675
Utrecht.	122,853	151,055	231,642	243,884
Haarlem	70,491	89,502	195,312	166,154
Eindhoven	6,448*	65,888	127,386	151,742
Groningen	78,276	99,587	131,460	141,373
Tilburg.	53,498	71,387	106,949†	128,683
Nijmegen	58,390	76,069	108,073	118.432
Arnhem.	64.634	76.303	112,635	110,421
Enschede	36,029	46,748	80,346	115,227
Breda	27,572	30,670	81,422†	98,050

*1918. Eindhoven became a town in 1920. †Municipal population figure.

with the exception of The Hague, owe their greatness to commerce. but each also developed various industries. Apart from the towns, population varies within this area according to the fertility of the soil. Along the belt of sand dunes from the Hook of Holland to Den Helder, for example. it is thinly scattered, though in the south a strip of older sand dunes, where soil has been improved, supports a very heavy density, mainly relying upon the intensive cultivation of small holdinas. Market gardening. bulb growing and dairy production on the more recent and wetter polders and agricultural production on the older drying ones are the main occupations outside the towns.

A second well-populated area is the interfluvial belt of central Holland, where the population may reach 1,000 per square mile. The largest towns are Arnhem and Nijmegen in the east and Breda in the west. The productive diked lands of this area. more suited to pasture than cereals, concentrate on stock raising and animal fodders. A further relatively high density is to be found in southern Limburg, nhere the fertile loess plateaus and the exploitation of coal mines support a density up to 1 000 per square mile. Maastricht (67,976), Heerlen (35,001) and Kerkrade (18,-602) are chief centres of the mining and other industries. Of the other provinces or regions, Zeeland and its adjacent islands reach occasional densities of 1.000 per square mile, and towns are rarely above 10,000 in population. Arable and mixed farming are the main occupations of the more fertile diked lands.

In North Rrabant and northern Limburg, population varies from less than 130 per square mile in the sandy plains and heath or wooded regions to 1,000 in industrial areas around Eindhoven, Tilburg, 's Hertogenbosch (53 208) and Venlo (26,822). These towns and surrounding districts have numerous industries. Much of the rural area is devoted to cereals for cattle fodder. In Drenthe, Overijssel and Gelderland. where large areas remain infertile, the population rises from less than 130 per square mile to 1,000 in urban centres. Overijssel is one of the most highly industrialized provinces of the Netherlands. with a flourishing textile industry in such towns as Enschede. Zwolle (45,541), Hengelo (43.431) and Almelo (38,266).

Finally, the coastal belts of Friesland and Groningen, form-

ing one of the richest farming regions of the country, support densities up to 500 per square mile. There is little urban development with the exception of Groningen and Leeuwarden (57,923).

Unemployment was particularly severe during the economic depression of the 1930s. First affecting the luxury trades (particularly the diamond), it gradually spread to industries dependent upon foreign and transit trades. A peak was reached in 1936, with a total of 475,000 unemployed. After World War II an increasing population and economic difficulties brought about a little unemployment. In Sept. and Dec. 1956 figures were 20.000 and 43.800. the increase being chiefly due to seasonal fluctuation.

Racial Origins and Language. — The population of the Netherlands is a mixture of several racial elements. Few traces of the original Celtic inhabitants remain. An early Germanic settlement was absorbed by the Romans who. in their turn, were settling in different parts of the country, intermixed to form the basic elements of the modern population In the provinces north of the Rhine, particularly Friesland and Groningen, the physical features of the "Nordic" races predominate. In the southern provinces those of the darker, shorter Alpine type are to be found.

To speak generally, the Dutch are an independent and democratic race, with a tendency to conservatism. They are good businessmen and colonizers, hardworking, reliable and attached to domestic life.

Dutch, officially called Nederlandsch and more popularly *Hollands(ch)*, the standard language, developed from the dialect used in Flanders, Brabant and Holland during the 16th century. By that time it had become a cultured speech in this region and was increasingly used as the written language and the medium of politics, administration and the law.

The standard spoken language which finally evolved differs somewhat from the written. All educated people speak a standard version, but there are fairly numerous dialects, and in these there is also a certain amount of literary activity, particularly in West Frisian, various forms of Low Franconian in Limburg, Brabant and North and South Holland and Low Saxon in the provinces of the northeast.

Religion. — The principle of religious toleration was declared by William of Orange in 1564. It was reaffirmed later in the various constitutions of the country, though that of 1814 stipulated that the sovereign must be a member of the Dutch Reformed Church. In 1848 complete freedom was given to all religious bodies. This long-established liberty of conscience naturally promoted the appearance of many denominations. The chief of these are the various branches of the Calvinist. the most important being the Dutch Reformed Church (2,988,839 members [31.1%] in 1947), which for many years has been closely allied with the state. Various congregations seceded from this body in 1834 over questions of church discipline and doctrine and organized themselves in 1869 into the Christian Reformed Church. Later in the 19th century splinters of both these bodies united to form the Reformed Churches of the Netherlands. The confessional issue in the Netherlands remains a major source of disunity. Roman Catholicism survived the separation of the country from Spain, though it suffered various disabilities until 1798, after which its influence grew steadily. In 1947, with 3,703,572 members (38.5%), it was the largest single denomination. Persons without any acknowledged creed numbered 1,641,214 (17%) in 1947.

Education. — State interest in Dutch education began in 1806 under the French occupation. Legislation in that year aimed at secularizing all teaching, but this principle was resisted by both Protestants and Catholics. During the 19th century, despite the opposition of liberalism, state support was gained for the denominational or private (bijzonder) schools, and in 1889 they secured financial assistance on a considerable scale. By the Education act of 1920 complete equality between state (public) and denominational education was established. The Dutch system thus possesses a dualism in most grades and branches of education, and from 1920 denominational schools outnumbered state schools.

Administration is characterized by a high degree of decentralization. and much is left to local and private initiative. The ministry of education is thus largely concerned with supervision and co-ordination. The minister himself is assisted by an advisory council appointed by the crown. The central authority is also responsible for allotting the public funds voted for education and for keeping a watch on local expenditure. State expenditure naturally increased greatly; it was 35,000,000 guldens in 1913, 142,000,000 guldens in 1938 and 603,200,000 guldens in 1954.

Compulsory education was introduced in 1901 for children between 6 and 13 (later 14). Infant education in kindergarten schools (*bewaarscholen*) may precede this. Kindergarten schools in 1956 numbered 3,706 (mostly private). with 370,222 infants. Primary education can be continued for a further two years. The numbers of the two types of primary schools (public and private) with their attendance are shown in Table VI.

TABLE VI.—*Primary Schools*

Item	1930		1938		1956	
	Public	Private	Public	Private	Public	Private
Schools	3,325	4,114	2,564	4,457	2,523	5,172
Pupils	446,397	736,131	357,675	785,439	425,623	1,065,151

In 1956 there were 421 special primary schools with 43,532 pupils (16,834 girls). The total number of teachers employed in all primary schools was 45,297 (1955–56).

Secondary education is given in various types of schools. As in primary education, schools are both state and. private, and the latter tended to increase at the expense of the former. The older *Gymnasium* (or grammar school) has a more traditional and classical emphasis; the *hogere* burgerschol (or municipal secondary) has an essentially modern and scientific curriculum. A third type. the lyceum. was instituted about 1910 to give a compromise between the two former institutions; it provides an education in which a broad preparatory course is followed by one on the lines of the grammar or municipal secondary school. Most of the establishments are coeducational, but there are a number of girls' secondary schools. In addition, there are a considerable number of special schools, technical, agricultural. commercial, domestic, etc., devoted to vocational training; they are supplemented by part-time (usually evening) institutions. (See Table VII.)

TABLE VII.—*Secondary Schools, 19jj-j6*

Schools	Number	Teachers	Pupils	
			Total	Girls
Day, all types	1,385	14,083	278,352	126,702
Evening	141	1,309*	20,290	8,121
Agricultural	434	2,837†	27,452	138
Other vocational	1,190	13,536*	322,600	162,811

*1951–52. †1950–51.

There were also 87 teachers' training colleges with a teaching staff of 1,152 (1950–51) and 15,374 students including 7,722 women (1955–56).

There are six universities. Three are public: Leyden (founded 157j), Groningen (1614) and Utrecht (1636). Amsterdam has a municipal university (1632) and the Free university (Calvinist, 1880). A Roman Catholic university was also founded in 1923 at Nijmegen. There are two colleges for advanced education in economics, one for agricultural and one for technical training. Teachers are supplied by the universities or by the normal schools (*i.e.*, training colleges); the latter numbered 89, with 10,546 students, in 1950. The numbers attending these universities in 1955–56 were 21,863 (4,946 women). Figures for other institutions of higher education (college of engineering at Delft, agricultural high school at Wageningen and commercial high schools at Rotterdam and Tilburg) in 1955–56 were 7,779 students (206 women). The teaching staff in all institutions of higher education amounted in 1950–51 to 1,095.

Secondary school education has contributed much toward the middle-class culture that attained so high a level and so wide an expansion in the Netherlands, and the academic standard of the

universities is exceptionally high. Illiteracy is practically unknown.

GOVERNMENT AND ADMINISTRATION

The modern constitution of the Netherlands dates from the restoration of the country's independence in 1814. when the first fundamental law was promulgated. This created a monarchy possessed of considerable powers! with an upper house nominated by the king and a lower house elected by a restricted franchise together constituting the legislature, called the states-general. Successive revisions of the constitution, notably in 1848, 1887 and 1917, transformed the state into a parliamentary democracy. Later amendments in 1948 established the new legal status between the Netherlands and its overseas countries and made certain changes in domestic administration.

The sovereignty of 'the Netherlands is vested in the house of Orange-Nassau; succession, in default of a male heir, passes to the female. Queen Juliana succeeded her mother; Queen Wilhelmina, on the latter's voluntary abdication in Sept. 1948.

The executive power resides constitutionally in the monarch, who is unimpeachable. It comprises command of the armed forces; conduct of foreign relations. with the proviso that the assent of the states-general is necessary in making war or peace and in the ratification of treaties; the appointment of ministers (who are, however, responsible to parliament for their own and for the sovereign's actions); and the right to dissolve the two chambers. separately or jointly.

The constitution, which includes within its text provisions for provincial and communal administration, justice, religion, defense, education, etc., as well as central government, can be amended by the consent of both chambers and the crown. The existing legislature first passes the necessary legislation by a simple majority; a new states-general is elected and must endorse the change by a two-thirds majority of each chamber within 30 days of election.

The crown is assisted in its executive capacity by a council of state (raad *van* staat). presided over by the monarch. This is a permanent advisory body. which is consulted on administrative problems and on the introduction of legislation. A second body is the council of ministers (minister-rand). which is in effect the central executive. Its ministers do not remain members of the chambers on taking office. but can speak and attend in a consultative capacity within either. This tendency to divorce the executive from the legislative sometimes results in the formation of cabinets not based upon a majority within the states-general. Ministers are generally the heads of departments, but the appointment of ministers of state is not uncommon.

The states-general comprises a first (upper) and a second (lower) chamber. The first chamber is composed of 50 members elected by the assemblies of the provincial estates. Half of these members retire every third year and are replaced in turn by a group of provinces representing half of the electorate. Members of the first chamber must have attained their 30th birthday.

The second chamber numbers 100 members, all of whom must have attained their 23rd birthday, and is elected by all citizens of 23 and over through a system of proportional representation, voting being compulsory (see Table VIII). Its mandate runs for four years, unless it is dissolved. The second chamber alone, in addition to the sovereign on the advice of the council of state or of the appropriate minister. can initiate legislation. This the first chamber must accept or reject outright. The first chamber may, however. put forward proposals which do not take the form of bills.

TABLE VIII.—*Distribution of* Seats, Second *Chamber*

Party	Year of election								
	1922	1925	1929	1933	1937	1946	1948	1952	1956
Catholic	32	30	30	28	31	32	32	30	33
Labour	20	24	24	22	23	29	27	30	34
Antirevolutionary	16	13	12	14	17	13	13	12	10
Christian Historical	11	11	11	10	8	8	9	9	8
Liberal	15	16	15	13	10	6	8	9	9
Communist	2	1	2	4	3	10	8	6	4
Other	4	1	2	7	8	2	3	4	2

Legislation is in practice usually drafted by a minister or committee of experts, which sends it with an explanatory memorandum to the council of ministers. This body in turn seeks the advice of the council of state. and the measure proceeds by way of the sovereign to the second chamber. There it is studied by committees, which report on it to the minister concerned. The latter replies to their observations, and the chamber discusses the measure in detail and may amend it if it so nishes. It not rejected, the measure then passes to the first chamber, where a similar procedure (without the right of amendment) is pursued. Should it receive approval, it is usually given royal assent and becomes the executive responsibility of the ministry concerned.

Provincial and Local *Government.*—Until 1795 the Dutch republic consisted of seven provinces and an area in Brabant and Flanders governed by the states-general and known as the "Generality Lands." In 1813 the lands in Brabant became the province of North Brabant, while the Flemish districts mere incorporated within the province of Zeeland. 4 third area of Drenthe was also elevated to provincial status. Limburg was created a province in 1839, and the province of Holland was divided into North and South Holland in 1840.

BY COURTESY OF J. G. VAN AGTMAAL

THE BEURSPLEIN OR EXCHANGE SQUARE AT ROTTERDAM. STATUE OF DESIDERIUS ERASMUS (14669–1536). THE GREAT DUTCH HUMANIST, WAS ERECTED IN 1622. THE MAIN OFFICE OF THE ROTTERDAM BANK ASSOCIATION IS IN THE BACKGROUND

Each province possesses a legislative and administrative assembly called the provincial estates. Members are elected for four years to the body, which varies in numbers from province to province according to population (but not strictly in ratio; *i.e.,* South Holland had one member for about 24.000 inhabitants and Drenthe one for 6,000). The Catholic party had (1955), 186 seats of the 590 in provincial states; Labour, 180; the Conservative parties, 132; and the Liberals, 50.

The provincial estates are the highest regional administrative body in the province. Their responsibilities also include the supervision (particularly in financial affairs) of the municipal councils and the upkeep of roads, bridges and dikes. etc.. which are outside municipal or state authority. The executive power and routine administration are vested in a salaried committee of six members (usually), known as the deputed estates (*gedeputeerde staten*). Both the provincial and the deputed estates are presided over by a commissioner of the crown (*commissans* der koningin), and their decisions in certain matters (*e.g.,* provincial taxation) are subject to government control.

The basic unit of local government is the commune (*gemeente*), of which there were 1.015 in 1949, ranging from 624 with fewer than 5,000 inhabitants each (representing 14.6% of the population) to 11 large cities with more than 100,000 (representing

31.4%). They are all, however, administered according to a uniform pattern.

The chief executive officer is the burgemeester, and there is a body of aldermen (methouders) and a communal council (*gemeenteraad*). The latter body, varying in size according to communes. is elected and chooses from its members a number of aldermen. The *burgemeester*, appointed by the crown, holds office for six years and is responsible for public order; with the aldermen he forms a college which has executive authority. The council has legislative, administrative and taxative functions.

Law *and* Police.—The basis of the Dutch legal system is the constitution, and the principles of modern Dutch law are those of the Xapoleonic code. The individual is guaranteed by the constitution such fundamental rights as freedom of religion, education. speech and association. The laws are codified into civil, criminal and commercial, and procedure in civil and criminal cases.

Since 1934 courts of general jurisdiction have been graded into four types: the 62 canton courts (kantongerechten), in which a single magistrate deals with petty civil and criminal cases and from which there is generally right of appeal; the 23 district courts (*arrondissementsrechtbank*), usually presided over by three judges, which may also have juvenile courts presided over usually by a single magistrate; the 5 appeal courts (*gerechtshoven*), with three judges in certain towns appropriately distributed; and the supreme court (*hooge* road van *Nederland*) at The Hague, a final court of appeal which is also a tribunal to try high government officials and to administer special branches of law. No type of court has a jury, and the official prosecutor must present boih sides of the case.

In addition, there exist certain special courts for arbitration in social and economic legislation and courts dealing with taxation each with their courts of appeal.

The ministry of justice supervises the administration of the law, prosecutes through its representatives in criminal cases and controls the state police force. Before 1940 civil police were divided between local forces of the commune (of whom the burge*meester* was the chief) and the state police. In some cases the smaller communes shared forces. After 1945 the majority of the communal police were absorbed within the state police (*rijksveldwacht*). The larger towns, however, such as Amsterdam, retained their forces, which remained under the authority of the burge*meester;* within them were specialized sections (*e.g.,* criminal investigation and motor water police).

Amsterdam's force had in 1949 a strength of around 2,300. The state police, incorporating the forces of most communes, comprises both personnel for routine duties and specialized sections. In addition. there are the *rijksrechercheures,* who specialize in investigation under the instructions of the state prosecutors. Semicivilian organizations undertake frontier protection, customs duties, etc.

Defense.—By an act of 1922, service in the armed forces was made compulsory for males between 20 and 40, inclusive. Conscripts were chosen by lot, and their numbers (an intake of about 19,500 annually) mere supplemented by volunteers for the small regular element of the forces. The training for the conscripts varied from 8 months (navy) to 15 (cavalry) and was often done in stages. There mas in addition a small volunteer reserve.

On mobilization in 1940 the army had about 500.000 men, with trained reserves of 150,000; the navy had 4 cruisers. 8 destroyers and 23 submarines. with various other vessels; and the air force (mostly part of the army) had approximately 300 machines with a total staff of 600 men. In 1938 the Netherlands joined the Brussels treaty powers; in 1949 NATO; and in 1954 Western European union.

Aiter 1949 the armed forces were reorganized as a component element of the North Atlantic Treaty organization. A conscription period of 18 months was introduced, and all fit males of 20 and over were liable. This produces an average of 55,000 recruits a year. Volunteers supplemented the number of conscripts. Conscientious objectors had to serve in noncombatant units or posts or compulsory civilian labour organizations. New men might be distributed, according to their preference and suitability, among the various services: but the majority were directed into the army. About 10% were accepted for the air force, but flying crews had to serve for a minimum of three years. Men previously under arms were also recalled for refresher courses.

By the end of 19j7, land forces consisted of two active divisions with supporting elements (for European defense); the navy had 1 aircraft carrier, 2 cruisers! 24 destroyers and escorts, 6 submarines and 65 mine sweepers, together with auxiliary craft and planes. The air force by the end of 1955 had 9 fighter, 36 fighter-bomber and various reconnaissance and transport squadrons.

Political Parties.—Political parties in the Netherlands have long been numerous. but many of the smaller groups fail to secure representation in the chambers despite the system of proportional representation for elections. The three oldest parties are the Catholic, the Liberal (the party of the professional and commercial classes) and the Antirevolutionary (formed in opposition to the principles of the French Revolution and now mostly composed of Orthodox Calvinists). During the second half of the 19th century administrations were chiefly composed of Liberals or a weak coalition of the two "religious" parties. Toward the end of the 19th century the traditional party divisions under the influence of new political forces were broken by the emergence of splinter groups and factions. The Liberals lost their dominating position, chiefly because of the closer consolidation of the "religious" parties and the advent of socialism. Various schisms occurred within their ranks, which mere divided into radical and conservative factions. until, during the 20th century, liberalism as a cohesive political force ceased to have any significant power. By 1913 the Socialist party, founded in 1881. had secured 16 seats in the second chamber and held there the balance of power, with the Catholics on the whole the largest single group. Communism failed to secure any firm hold.

The division of strength between the parties, which remained remarkably constant, made coalition almost inevitable for the government after 1918. The right wing is composed of the Political Reform party, the Antirevolutionary party and the Christian Historical union; the centre of Liberals and Catholics; the left wing of Socialists, with Communists on the extreme left. Table VIII gives the chief parties' strengths in the second chamber, 1922–56; the political pattern of the first chamber usually follows that of the second very closely.

Trade Unions.—The trade-union movement in the Netherlands sprang from the desire of the working class to make good the lack of social legislation and to improve conditions of employment. In the middle of the 19th century associations of a nonpolitical character were in existence to provide mutual aid against sickness, accident and old age. In later years they had the additional objective of improving the conditions of the working classes through political action. The first national union to be formed was that of the printers in 1866. Aided by legislation in 1872, other crafts rapidly followed their lead. From the beginning the labour movement was influenced by denominational considerations.

Nonreligious unions became federated under the Dutch section of the International Labour secretariat in 1893. They were the more militant section of the Dutch labour movement, and as a reaction against their revolutionary nature the Federation of Labour Trades Unions was established in 1905, ultimately to become the controlling power of Socialist trade unionism. Like all Dutch labour organizations, it was abolished by the Germans in 1940. Renamed the Socalist National Trade union, it numbered (1954) 453.765 members.

Catholic unions tended at first to embrace cultural and spiritual interests as well as industrial. They were not divided according to trades but existed as local and diocesan associations and became federated in 1924. Within this movement developed sections based upon the various trades, which placed more emphasis upon industrial interests. After a period of friction the two elements were finally unified within the Catholic Labour Movement of the Netherlands. This had 346,792 members in 1954.

The creation of the Federation of (Protestant) Christian Unions was largely the result of a reaction against the syndicalist tendencies of the labour unions toward the end of the 19th century.

Its membership is mostly drawn from the Calvinist element of the country. In 1954 this federation had a membership of 191,120.

Other unions (including the Communists) had (1954) 167,000. That of the Communists was constituted by the syndicalist elements of former years on the liberation of the Netherlands in 1945. In addition, there were two fairly large independent trade unions: that of the mineworkers in Limburg, established in late 1944; and that of the transport workers.

The Council of Trade Union Federations was composed of equal numbers of representatives from the Catholic. Christian and Labour federations. Through it the individual federations attempted to integrate a common policy on various industrial problems.

Social Legislation. — Insurance against unemployment was not compulsory before World War II, though it was encouraged by an act of 1916 that introduced a system of state and municipal subsidies to increase the benefits paid out by voluntary associations. An act of 1901 had, however, initiated compulsory insurance against accident, which one of 1919 extended to disablement and old age; the Public Health act of 1930 provided for payment during a certain period (six weeks) in the case of sickness. Under the Sickness Insurance Funds decree of 1941 workers and their families became entitled to free medical treatment. which in 1951 was extended, on payment of a weekly contribution, to aged people. widows and seamen.

Legislation regulating employment was initiated by an act of 1874, which forbade the employment of children under 12 years of age. In 1889 a further act limited working hours for women and children under 16 years of age to 11 hours per day and banned night and Sunday working to them (except in agriculture). The minimum age for child labour was in 1911 raised to 13, the maximum time lowered to 10 hours per day and 58 per week. In 1919 the minimum age was raised to 14, and there was a general restriction on the working day to eight and one-half hours. In 1949 works and industrial councils of employers, norkers and experts were instituted to regulate social and economic affairs.

In July 1955 a bill was introduced into parliament to provide (with effect from Jan. 1. 1957) old-age pensions to all people over 65. Under it a yearly income of 1,338 guldens would be granted to a married couple and 804 guldens to single people. The estimated increased burden on the 1957 budget would be about 722 guldens.

ECONOMICS, ADMINISTRATION AND POLITICS

Agriculture. — The agricultural prosperity of the Netherlands probably owes more to the ingenuity and labours of its engineers and farmers than to the natural fertility of the soil. For centuries land has been reclaimed from the sea or from inland marshes, bogs and heaths; or it has been protected from inundation on the coast and in the river deltas. In addition, numerous devices such as drainage and the use of natural and artificial fertilizers have been employed to increase fertility.

By 1938 the total of farm and horticultural land was 2,322,500 ha.. or approximately 70% of the country's area; in 1953 it was 2,308,000 ha. Of this, 908,000 ha. was plowland, 1,296,000 grassland and 134,000 horticultural area. Reclaimed polder land from 1840 to 1940 amounted to 400,000 ha. (an addition of more than 20% to the total agricultural area). and the draining of the Zuider Zee progressively increased this total. Woodland covered in 1953 246,000 ha. and infertile regions 237,000 ha.

The agricultural area comprises the reclaimed polder lands of the coast from Zeeland to Groningen. Those of the southwest (*i.e.,* Zeeland and its adjacent islands, northwestern North Brabant and the islands of South Holland and along the Frisian and Groningen coast) are composed of heavy marine clays which, after preparation, give a soil that yields good grain and root crops. This area, together with the few colonies of northeastern Groningen and Drenthe is chiefly devoted to the production of cereals.

In the polder lands of North and South Holland arable farming is chiefly found on the surface of drained lakes. In general the rich pasture of reclaimed areas there and in western Utrecht was for many years the centre of the dairy and cattle industry. There is, however, an intensive cultivation, particularly in the south, with an emphasis, because of the proximity to large communal centres. upon market gardening. The polder areas of Friesland rival those of North and South Holland in cattle raising.

The clays of the central river deltas do not offer such good farming land as the marine clays, and the area suffers from infiltration of river water. Large districts are therefore devoted to grazing land, though where conditions are better there is mixed farming and horticulture. The region (especially the Betuwe) is also one of the principal orchard districts of the country.

BY COURTESY OF NETHERLANDS INFORMATION SERVICE

VILLAGE BUILT ON POLDERS IN THE PROVINCE OF SOUTH HOLLAND

The sands and gravels of southern and eastern Netherlands offer a somewhat poor soil. Much of the peat area in the higher districts has been reclaimed. Cultivation, through clearing, drainage and irrigation, has been considerably extended during the 20th century. The southern part of Limburg forms a district apart. Instead of sand, it possesses a high proportion of fertile loams which are roughly half arable and half pasture. The development of the region as an industrial area stimulated dairy farming and market gardening. Fruits and sugar beets are also important crops.

Many of the agricultural holdings are less than one hectare, though these are mostly worked by farm labourers or by people not permanently engaged in agriculture. But the country is on the whole one of small farms. Only about 1% are bigger than 50 ha. (125 ac.). and about two-thirds are less than 10 ha. Arable farming is also nearly always linked with some class of animal farming. Most of the grain is used for fodder, and even then some has to be imported. Bread grain like domestic wheat has to be imported in considerable quantities, as the local variety is not very suitable for flour.

The ratio of the area under pasture to that under cultivation varied little after the middle of the 19th century; pasture amounted to 57.6% of farmland in 1833, 57% in 1930 and 52% in 1953. Of the arable area the proportion devoted to cereals was 47.2% in 1928, 60% in 1938 and 70% in 1953. The principal cereals are wheat, with barley as a subsidiary (Groningen, Zeeland, North and South Holland); rye. grown extensively for cattle fodder (North Brabant. Drenthe. Overijssel and northern Limburg); and oats (over the same areas as rye and in Groningen). Between 1851 and 1890 the area sown to wheat stood around 86,000 ha., but between 1921 and 1930 it declined steadily to an average of 57,000. Within the next decade, however, it nearly doubled. The area under rye increased gradually, from 188,720 ha. (1851–60) to 218,000 ha. in 1934–38, because of

TABLE IX.—*Agricultural Production, 1934–56*

Crop	Area sown (in 000 ha)				Yield per hectare in kilograms				Production (in 000 metric tons)			
	1934–38	1948–52	1955	1956	1934–38	1948–52	1955	1956	1934–38	1948–52	1955	1956
Wheat	142	89	89	86	30.3	36.5	39.3	36.0	430	325		309
Rye	218	176	154	1	22.7	25.9	30.2	28.8	496	455		492
Barley	42	60	70	74	27.9	33.4	37.7	36.9	117	202	350	273
Oats	138	142	171	153	25.5	29.4	34.0	31.6	351	419	465	483
Sugar beet	43	62	67	69	38.1	41.9	44.7	38.0	1,637	2,508	2,984	2,625
Potatoes	144	186	153	144	...	...	...	...	2,823	4,679	4,082	3,462

more animal husbandry. Similarly, the area under oats increased from 84,03j ha. (1851–60) to 138,000 ha. in 1934–38. After World War II the area under wheat decreased, while the area under barley and oats continued to increase. (See Table IX.)

Of the other crops, potatoes are grown both for human consumption and for commercial preparations such as sage, glucose and dextrine. Sugar beets and fodder beets are grown particularly in the southwest. Such crops as madder and rapeseed, hemp and even flax were declining considerably by 1954, being supplanted by caranay, poppy, colza and chicory, though in the decade immediately preceding World War II the area devoted to flax had increased from 6,400 ha. in 1931 to 20,700 ha. in 1938 (*cf.* 6.000 ha. in 1953).

Horticulture.— Horticulture, long an important aspect of Dutch agricultural life, became in the 20th century a principal item in the export trade. The area under horticulture in 1938 was about 61,200 ha , to which should be added approximately 37.600 ha. of pasture orchards. In 19j3 the total area was 130,000 ha. Market gardening flourishes particularly in the southern part of North and South Holland, where it is favoured by a mild climate, suitable soil and ready markets. This area is also devoted to bulb and flower growing.

Cultivation of fruit has been developed considerably throughout the whole country. The pasture or arable orchard predominates in southern Limburg and the new districts of Gelderland. Orchards of apples. pears and plums, among uhich are various bush fruits, are found particularly in the west of North Brabant and in South Holland. The annual value of horticultural produce in 1929 was estimated at about 250,000,000 guldens, of which 145,000,000 guldens were exports, but in the 1930s foreign markets became scarce. In 1952–53 the total value of horticulture was about 611,000,000 guldens.

Animal Husbandry.—With the exception of Switzerland, the Netherlands had more livestock to the acre in the years before World War II than any other European country. Animal husbandry mas formerly devoted to the production of milk and its derivative products. There was also considerable breeding and export of dairy cattle, and beef cattle were fattened for the home markets.

The three principal breeds of cattle are the black-and-white Frisian, the white-faced black Groningen and the red-and-white river cattle; of these, the first named is the most numerous and is especially famous for its milk yield.

The oldest centre of the dairying industry is the pasture polders of North and South Holland and western Utrecht. Much of this area is given over to permanent grass. More important, however. are the small dairy farms of Friesland. whose farmers are, moreover. specialists in breeding and are also occupied in the raising of cattle for beef. The number of head in the Netherlands increased continuously, and the proportion of milch cows and cows in calf

TABLE X.—Livestock, *1939–57*
(in 000 head)

is usually high (more than 50%).

Pigs form an important subsidiary asset in dairy farming. They are of two kinds: the Dutch pork, bred chiefly for the home market, and the bacon pig for export. Their raising is most common in the mixed-farming areas of and North Brabant, in South Holland and to a smaller extent in the eastern and northern areas. Sheep raising declined considerably. Poultry raising, however, has been considerably developed, particularly in areas of poorer soil. (See Table X.)

Co-operative societies for the marketing of dairy produce are common in Friesland, North Holland, Korth Brabant and Drenthe. A proportion of the annual output of milk was devoted to the home market or fed to stock. The balance provided exports in the form of butter, cheese and milk. (See Table XI.)

TABLE *XI.* — *Dairy Produce, 1934–56*
(in 000 metric tons)

Product	1934–38	1948–52	1954	1955	1956
Milk	5,121	5,441	5,863	5,823	5,871
Butter	97	81	164	74	77
Cheese	121	129		158	154
Hens' eggs	127.2	112.7	206.0	217.0	...

Export value of arable crops in 1955 amounted to 1,238,000,000 guldens, that of animal produce to 1,848,000,000 guldens and of horticultural produce to 618,000,000 guldens.

In general in the 1950s Dutch agriculture was failing to keep pace with other sectors of the economy. and there was an increasing shift of labour to industry and commerce.

Fisheries.— Much of the Ketherlands' coast line is particularly suited to coastal fishery and, moreover, is conveniently near the rich fishing grounds of the North sea. From the middle ages herring fishing was a principal occupation of the Dutch. Their fisheries, however, in the face of competition (particularly from the British) and handicapped by wars, suffered many vicissitudes. During the 20th century, chiefly because the country failed to keep its fleet modernized, deep-sea fishery tended to decline; there was more concentration upon the North sea in preference to more distant grounds, so that in the 1940s about 99% of the total catch nas taken in it. Herring constitutes the chief catch. with plaice, sole, cod and mackerel less important. Chief fishing ports are IJmuiden, Scheveningen and Vlaardingen. Coastal fisheries concentrated mostly on mussels, oysters and eels; of the inland catches salmon is the most important.

About 16,000 people were engaged in sea and coastal fishing in 1930 and 12,400 in 1949.

Between 1938 and 1956 the total catch of fish rose from 256,200 to 298,100 metric tons. Landings of herring alone rose during the same period from 118,400 to 138.600 tons, while the catch of molluscs decreased from 69.300 to 60,700 tons. The total value of landings rose between 1938 and 1956 from U.S. $11,480,000 to $26,908,000. The greater part of landings was exported.

Industry.— The industrialization of the Netherlands, though retarded by a lack of native resources such as minerals and by a paucity of coal, grew steadily after the mid-19th century. An increasing population and limited land made imperative the exploitation of economic sources other than commerce and agriculture and the modernization of shipbuilding, textiles, paper production and pottery. As a commercial country, the Netherlands had an abundance of private capital. Moreover, the state was prompt to assist, as in the exploitation of coal, oil and salt deposits. Initially the emphasis was chiefly upon technical improvement of existing industries. Also, the pastoral resources of the Netherlands were adapted to more modern requirements; *i.e.*, by milk processing, margarine manufacture, matchmaking, strawboard production. Later, capital and scientific research were applied to technical industries which required a minimum of raw material, such as electrical and wireless equipment, synthetic fibres and aircraft and component parts.

At the beginning of the 20th century the introduction of heavier basic industries was initiated with the exploitation of the Limburg coal field and, later, of the salt beds in eastern Overijssel and in Gelderland, near Winterswijk and Hengelo. As a result the

coking, chemical and later iron and steel industries were developed. Various emergency industries that came into existence between 1914 and 1918 contributed to the country's industrial development. Postwar depression. however. severely affected most Dutch trades, particularly those of shipping and textiles. The home markets were maintained by heavy tariffs and government subsidies. but overseas markets, which were so vital to the Dutch economic system, were considerably curtailed.

During the German occupation of 1940–45, such industries as shipbuilding, electrical engineering, etc., which possessed a strategic value, were encouraged; others, like leather. paper and textiles, were to some extent starved. and those which depended upon colonial or overseas imports naturally declined considerably. In addition, during the last years of World War II the industrial plant suffered severe damage. By the end of the war 30% of the country's wealth had been lost through hostilities, a heavier loss than that sustained by any of the other Allies.

These disadvantages were aggravated by the virtual loss of Indonesia, by shortages of both dollars and sterling and a consequent restriction on purchases of capital goods and raw materials, and by a lack of skilled labour. Further industrialization of the country (necessary in view of the great increase of population) became more and more dependent upon a close integration of Dutch industry with that of western Europe and a comprehensive liberalization of trade, together with financial support from such schemes as the European Recovery program.

The percentage of population engaged in industry rose steadily from about 33.8% of the working population in 1899 (cf. 29.6% engaged in agriculture) to 38.8% (cf. 20.1%) in 1930, 36% (cf. 21%) in 1938 and 42% (cf. 13%j in 1954. Industrial production rose considerably after World War II and by 1954 stood 70% higher than in 1938. Similarly, labour productivity rose satisfactorily. With the year 1938 taken as 100, figures for the years 1946–53 were as follows: industrial production, 74, 94, 113, 121, 139, 145, 147 and 163; labour productivity, 70, 77, 82, 88, 93, 95, 98 and 107.

In 1954 the numbers employed in the chief industries were as follows (figures based on returns from undertakings employing ten or more): earthenware, glass. chalk, brick. 45,500; diamonds, precious stones, 900; industrial photography. 29,100; chemical industry, 50,800; industrial preparation of wood, cork. straw, 37.800; clothing, 56,900; laundry, 14,000; leather, oilcloth, rubber, 35,700; mining, peat production, 58,500; metals, shipbuilding, etc.. 293,400; paper industry, 27,200; textile industry. 119,600; foodstuffs, tobacco, candy. 134,200.

The Korean war caused a steep rise in prices of the raw materials on which the Netherlands was so dependent. In mid-1951 the country was in debt to the European Payments union for 267,300,000 guldens. Internal consumption was therefore seriously restricted. By the end of 1952 a surplus of 1,800,000,000 guldens was gained. By 1953 the Dutch government could inform the U.S. that it no longer needed economic aid.

Distribution.——The chief industrialized regions are North Brabant, Overijssel and southern Limburg, where approximately half the working population is engaged in various industries. In Brabant textile industries are found chiefly at Tilburg and Goirle (mostly woolens and linen), at Eindhoven (also specializing in electrical and wireless equipment) and at Geldrop, Helmond and Bokstel (cotton and mixed fabrics). Another industrial centre in this province is Breda, which specializes in engineering and synthetic fibres.

In Overijssel, Arnhem is the chief town of the Dutch synthetic fibre industry and possesses in addition engineering and shipbuilding works. Northward along the IJssel are smaller textile, engineering and foundry centres. The Twente region of Overijssel concentrates on textiles; cotton manufacture and the finishing trades are found there in most towns and villages, notably Enschede-Lonneker. Southern Limburg is rich in coal but lacks other workable minerals; the chief towns on the coal field are Heerlen and Kerkrade; Maastricht, the largest town of the province, has big glass, pottery and cement works.

The two other principal industrial areas are North and South Holland. On a central band across North Holland lie Amsterdam, Haarlem and Hilversum, the chief towns of the province. Amsterdam has the largest shipbuilding yards in the country and miscellaneous engineering trades and refining industries. Haarlem is a centre of shipbuilding and engineering, and Hilversum of textiles and wireless equiqment. An important concentration of industries. chiefly timber, rice milling and the refining of vegetable oils, is also found along the Zaan river, from Zaandam northward to Krommenie and Wormerveer. Around IJmuiden and Velsen are blast furnaces, coke ovens and chemical works. In South Holland the chief industries are shipbuilding, engineering and chemicals. Rotterdam is the most important centre. with varied industries; Leyden specializes in the woollen and printing trades and Utrecht in engineering and chemicals.

The basis of industry itself is largely one of medium-sized or small private undertakings. The government has long taken a share in sponsoring industry but tends to restrict its direct control to a relatively small number of large concerns. At the beginning of 1954 industry comprised about 10.400 undertakings (of ten or more workers) with a labour force of 903,600.

Fuel and Power.——Coal, one of the few mineral resources of the Netherlands, was first extensively worked at the beginning of the 20th century in the south of Limburg. Smaller and relatively undeveloped areas also exist in the Peel district of central Limburg, in the southeast of North Brabant and in the Winterswijk area of eastern Gelderland. Both the state and private enterprise share in exploitation, the latter obtaining its property as a concession from the state Technically the industry is well advanced. Output in 1900 totalled about 300,000 tons. In 1920 it was 4,502,000 tons. (See Table XII.)

TABLE XII.—*Industrial* Production, *1938–57*
(in 000 metric tons; electricity in 000,000 kw.hr; merchant vessels in 000 gross registered tons)

Industry	1938	1949	1954	1955	1956	1957
Coal	13,488	11,705	12,071	11,895	11,832	11,408‖
Lignite	171	205	172	255	270	283‖
Crude petrolenm	—	621	939	1,024	1,097	1,523
Electricity	3,688	7,417*	9,603	10,588	11,738	12,647
Pig iron	267	434	610	671	662	701
Crude steel	57	428	928	980	1,050	1,185
Cement	456	565	972	1,002	1,256	1,320
Sulfuric acid	525	396	676	678	709	702‖
Superphosphatest	570	947	836	842	873	880‖
Nitrogenous fertilizers‡	98.7	112.6	260.0	293.0	302.1	332‖
Merchant vessels	240	169	411	397	450	...
Cotton yarn	51.7	56.0	68.6	69.9	69.9	72.4
Wool yarn	9.7	27.0	27.7	28.8	29.8	29.7‖
Rayon filament yarn	9.3	19.2	29.5	31.2	30.4	30‖
Rayon staple	0.1§	10.1	11.7	12.7	12.4	11.8‖
Footwear (000 pairs)	14,966	20,376	25,201	25,500	26,500	27,800‖

*1950. †18% of P_2O_5. ‡In terms of nitrogen. §1937. ‖Provisional

The refining of petroleum was not very important in the Netherlands before World War II. Of a total oil import of 1,687,000 tons in 1938. about 433,000 tons were crude oil. In post ar years domestic production of this commodity was increased considerably, chiefly from the Schoonebeek oil field in Drenthe. In addition, more than 5,000 000 tons were imported. By 1955 the Netherlands had become the most important exporter, after Great Britain. of petroleum products in Europe. Its refineries produced in that year 2,378,000 metric tons of gasoline, 747,000 tons of kerosene, 7,984,000 tons of fuel oil and 68,000 tons of lubricating oil.

Metallurgy.—Despite the fact that the Netherlands' mineral deposits are negligible, the country built up during the 20th century a considerable metal industry. Between 1930 and 1950 workers rose by 95%. Iron smelting was begun in 1924 at IJmuiden with ore imported chiefly from Spain and Sweden. and steel is produced there and at Utrecht. Steel production nas low and incapable of covering the amount required by the shipbuilding industry; the metal was imported, therefore, from Belgium, Germany and Great Britain.

Of nonferrous industries, tin smelting was the most important in the Netherlands. Before 1939 the country treated one-fifth of the world's output and produced about 35% of European tin. In 1956 smelter production amounted to 28,680 tons. Zinc smelting

and the refining of imports chiefly from Belgium and Luxembourg amounted to 29,040 tons in 1956.

Shipbuilding.—Shipbuilding and repairing has long been one of the Netherlands' chief industries. Numerous shipyards are found along the rivers between Schiedam and Dordrecht in the south-west, at Amsterdam and, to a lesser extent, at Haarlem, Flushing and around Groningen. In 1938 Dutch shipyards launched the fourth largest gross tonnage in the world, 240,000 tons, and gave employment to about 45 000 workers. After World War II the industry recovered rapidly. In 1955 there were about 300 shipyards with a total labour force of about 50,000, and an equal number of ancillary trades. Orders secured up to 1957 and under construction amounted to 1,400,000,000 guldens. The allied trades of repairing and marine engineering were also important.

Engineering.—The Dutch metal industry has been created chiefly as an ancillary to shipbuilding and maintenance of the merchant navy. The later engineering industry specialized particularly in marine engines and in machinery for domestic and colonial industries and for public works, such as oil-well equipment, tin dredges, pumps. pontoons, etc. Rolling stock and heavy electrical and textile machinery were produced only on a restricted scale. as were internal-combustion engines. Lighter electrical and wireless equipment was flourishing before World War II, and by 1939 the Netherlands was the fourth largest exporter of such goods in the world. Chief centres were at Eindhoven and Nijmegen. After the war the aircraft industry, together with the manufacture of component parts and specialized technical equipment, was increasingly developed.

Chemicals.—The Dutch chemical industry developed substantially and was assisted in the supply of some basic minerals by the exploitation of salt deposits at Boekelo (Overijssel) and at Winterswijk (Gelderland). but potash, basic slag and nitrate of soda had to be imported. The industry possessed numerous large chemical plants, some very well equipped. chiefly at Amsterdam. Vlaardingen. Pernis, Utrecht, Sluiskil. IJmuiden and Boekelo. In the field of nitrogenous and phosphate fertilizers, coal derivatives, processing of refinery products, pharmaceuticals, etc., the industry was well established. Other expansion was begun in the extending of the processing chemical industries to paint, pigment and synthetic material manufactures. Fertilizers were the most valuable part of the industry. Sulfuric acid. mostly domestically produced, also went into the making of fertilizers. Value of the Netherlands' chemical output increased from 200,000,000 guldens in 1938 to 2,500,000,000 guldens in 1954. Nearly 30% of production was exported.

Textiles.—The manufacture of woollen cloth, especially at Rotterdam, Haarlem, Leyden and Dordrecht, was the Netherlands' most important mediaeval industry. It benefited from the immigration of skilled workers from Flanders and from France in the 17th century. Later the linen industry was developed in the Twente district of Overijssel. and at the beginning of the 18th century mixed fabrics of linen and cotton were manufactured there. In the same century the industry concentrated subsequently on cotton, and gradually Twente and North Brabant became the chief textile areas. The woollen and linen industries became established chiefly in North Brabant. Other textile trades were rayon, lace and carpets. A ready-made clothing industry existed in many towns, but much clothing was imported.

After World War II the Dutch textile industry aimed at small-scale extensions in specialized fields such as cotton yarns, worsteds, hosiery and rayon fibre. Modernization of much machinery was necessary to ensure that the industry as a whole could hold its ground. By 1930 about 88,000 people were employed in various branches of the industry. This figure had declined to 82,000 in 1939, hut reached 121,000 in 1953.

Other *Industries*.—Leather and foot\\-ear are produced mostly in the towns of North Brabant and also at Nijmegen in Gelderland; production after World War II was roughly adequate to support domestic demands. A timber trade, concentrated chiefly in the towns of North and South Holland, provided pulp and paper industries with a large export trade. This was supplemented by the production of strawboard from cereal straw. The rubber industry expanded after World War II, chiefly in the production of tires and manufactured articles. Food industries were principally concerned with sugar (manufacturing and refining), milk products and vegetable oils.

Foreign Trade.—Early in the 16th century the Dutch had developed a flourishing trade with Scandinavian countries and the Baltic area, which constituted the lifeblood of Amsterdam and even smaller centres. In the last decade of the 16th century, expeditions were dispatched to the East Indies, and in 1602 the Dutch East India company was formed with the official support of the states-general. Twenty years later a similar company was created to trade with the West Indies and America. During the first half of the 17th century the Dutch, in addition to planting numerous trading settlements overseas, had become the chief carriers of Europe.

Overseas expansion was reflected in industrial and commercial development and financial prosperity. The Netherlands developed such business innovations as trusts, joint-stock banks and bills of exchange. Amsterdam supplanted Antwerp as the great stock and money market of Europe. During the 18th century, entanglement in foreign wars. domestic dissension, the usurpation of its carrier trade and the lack of any compensatory industrial development led to a commercial decline.

Yet, after 1814, when most of its colonies were restored, its experience and skill in seafaring and commerce, together with the advent of an era of free trade, put the Netherlands on the way toward recovering its commercial prosperity during the later decades of the 19th century. Its progress, however, suffered a severe setback in M'0rld War I from the rigours of blockade. The subsequent dislocation of world trade was particularly harmful to its economic structure. The Netherlands nas the last European country to abandon the gold standard (Sept. 1936), but after this step its industrial production and trade improved.

After 1945 the Netherlands had to face numerous difficulties: industrial dislocation, lack of foreign currency and a continued adverse balance of payments. To these were added an increasing population and, in 1950, a financial strain from rearmament according to its obligations under the North Atlantic treaty. Attempts to solve its problems included a customs union (Jan. 1, 1948) and development of the economic union with Belgium and Luxembourg; bilateral trading agreements; diversion of production largely into exports and restriction of home markets; and a policy of industrialization, particularly in specialized fields.

Before 1940 the country's volume of foreign trade was the fifth largest in Europe and per capita the fourth largest; its visible exports covered imports by nearly 64% (in 1938 by 73%); and it derived a considerable revenue from foreign and colonial investments and from shipping and other services. Aiter World War II exports revived. to cover imports by 54% (1948), 72% (1949) and 68% (1950); but the value of invisible exports had shrunk considerably. In later years coverage was 75% (1952), 91% (1953) and 85% (1954).

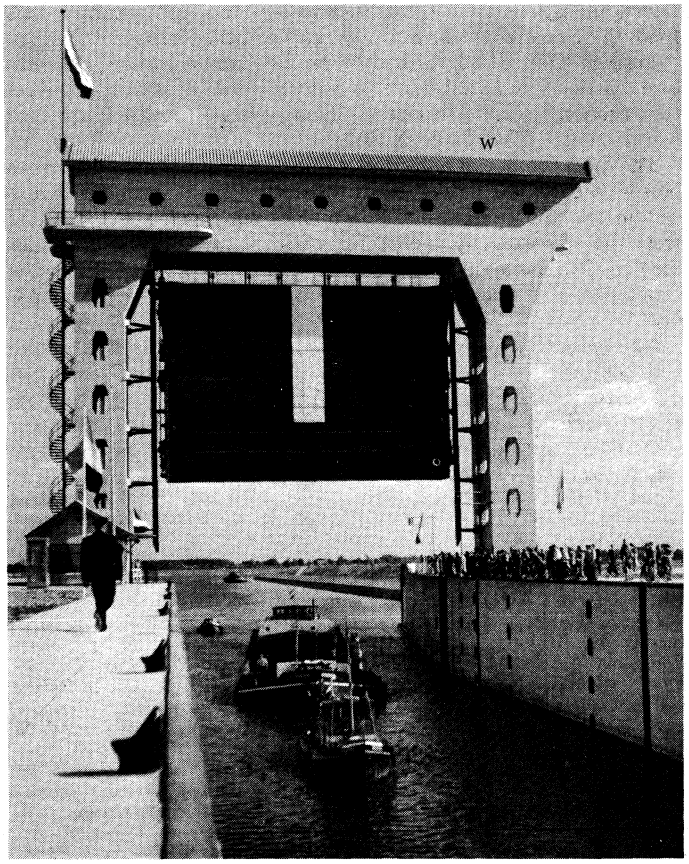
TABLE XIII.—*Value of Imports* and Exports, *1938–57*
(in 000,000 guldens)

Item	1938	1	1954	1955	1956	1957
Imports c.i.f.	1,559	4,964	10,860	12,189	14,105	15,597
Exports f.o.b.	1,006	2.717	9,172	10,211	10,875	11,770

TABLE XIV.—*Distribution of Trade*
(in percentages)

Areas	Exports				Imports			
	1937	1954	1955	1956	1937	1954	1955	1956
US and Canada	7	7	7	7	10	13	15	15
Latin America	3	5	5	4	9	7	6	7
Continental E.P.U.	43	49	51	53	43	46	49	49
Belgium-Luxembourg	12	14	14	14	12	17	18	19
German Fed. Rep.	15	16	17	18	21	16	18	18
Continental E.P.U. overseas territories	2	4	4	4	3	3	3	2
Sterling area	26	21	21	20	14	16	16	15
United Kingdom	21	12	12	12	9	8	9	8
Rest of the world	19	14	12	12	21	15	12	11

The prewar pattern of foreign trade had, particularly as regards



BY COURTESY OF CAS OORTHUYS

PRINCE BERNHARD LOCK AT TIEL ON THE WAAL RIVER AT THE SOUTHERN END OF THE AMSTERDAM-RHINE CANAL

imports, changed. There was a concentration upon the continental neighbours, France, Belgium, Germany and S itzerland. In 1954 Belgium-Luxembourg. the German Federal Republic, the United States and Britain were in that order the Netherlands' chief suppliers. Its exports went chiefly to west Germany, Belgium-Luxembourg, Britain and the United States. Tables XIII and XIV indicate the general trend and chief direction of trade.

Imports both in prewar and postwar years were largely made up of agricultural raw materials, particularly linseed, peanuts for chemical production, maize for fodder and wheat for human consumption; mineral raw materials and mineral oil and chemical raw materials; hides, raw rubber and rubber produce; wood, chiefly timber for constructional purposes; textiles and clothing; base metals, chiefly iron and steel, and finished machinery and rolling stock. Exports comprised agricultural produce, chiefly dairy products, vegetables, flowers, bacon, stock guts and oils; chemicals, chiefly coke and fertilizers; paper and wood products; tex tiles, chiefly cotton goods and rayon yarns; metal products such as ships, dredgers, instruments, radio and electrical equipment and tin.

Transport and Communications. — The artificial waterways were constructed originally for land drainage rather than for the carriage of goods. Later, with the considerable stretches of navigable rivers, they were found very suitable for carrying both domestic and transit goods. Open rivers and the main shipping canals were mostly state controlled, except in the northeast, where they were administered by the provincial authorities. The total length of trade-carrying waterways in Jan. 1956 was 6,918 km.; the length navigable by barges carrying more than 1,500 tons was 1,259 km.

Of the main systems that of the Rhine and its offshoots is the most important. Its ramifications are extensive, particularly in the west, and can carry barges with a capacity of 4,000 tons. It serves as communication between such large centres as Arnhem and Nijmegen in the east, Tiel, Gouda and Utrecht in the west centre and Rotterdam and Dordrecht in the west. A second system is that of the Meuse, the Juliana canal and the canals of North Brabant, which links central and western Netherlands with southern Limburg and the eastern Belgian system. Amsterdam is connected to the Rhine waterways, and from the capital there are extensions across North Holland to IJmuiden and the northern end of the province. In the eastern provinces are a great number of smaller canals which play an important role in the transport of agricultural goods, etc. These are connected to the eastern extremity of the Rhine system by the IJssel.

In the years immediately before World War II the Dutch inland fleet was the largest of western Europe, with around 20,000 craft (4,454,000-ton capacity). In 1954 it possessed about 17,000 vessels of about 4,328,000 metric tons. The waterways were responsible for more than 50% of the internal traffic of the country. They also played an extremely important part in transit trade. Rhine-borne traffic figures alone were 28,200,000 tons downstream and 27,600,000 tons upstream in 1938, to be compared with 4,900,000 and 3,600,000 in 1947 and 18,000,000 and 32,100,000 in 1955. Traffic originating in or bound for Dutch ports in 1938 and 1955 was approximately three-quarters of the totals.

The Dutch railway network is not so well developed as that of Belgium. Its total length in 1956 was 4,600 km. of which about 1,400 km. were electrified Services were chiefly devoted to passenger traffic, and little bulk freight was handled by rail. Freight traffic was 3,562,000,000 ton-kilometres in 1956.

The development of the road system in the country was handicapped in many areas by the nature of the land surface and by the existence of large rivers and estuaries. In the immediate prewar years considerable progress was made. however, in developing a national network. Roads in 1950 comprised about 2,774 km. of main state highways, 4,334 km. of secondary and 5,240 km. of third-class roads. Minor unclassified ones, many of them little more than tracks, totalled about 15,000 km.

In Dec. 1956 there were 327,466 passenger cars, 122,686 trucks and 7,378 buses registered.

The Dutch have long been a seafaring people, though during the Napoleonic wars their flag practically disappeared from the seas. A revival of their maritime importance began in the latter part of the 19th century, when several shipping lines were established. By 1905 the Dutch mercantile fleet was the ninth largest in the world. It suffered relatively severely but not excessively in comparison with those of other neutrals during World War I. Afterward tonnage reached a maximum of 3,178,000 in 1931, but had fallen to 2,854,287 in Sept. 1939. About half this total was lost during World War II. In postwar years a determined effort was made to re-establish the industry and in July 1956 the mercantile fleet had attained a record size, comprising 1,797 ships of 4,006,000 gross registered tons. Qualitatively the fleet mas not so good as before the war, because of the large percentage of older vessels. The earnings of the Dutch merchant navy were second only to revenue derived from investments abroad.

The chief Dutch ports are those with easy access to the Atlantic ocean; *e.g.*, Rotterdam, Vlaardingen, Hook of Holland, Schiedam (all situated on the estuaries of the Rhine and its branches), Dordrecht (at the junction of four important waterways) and the most important Dutch port of the middle ages, IJmuiden (at the western extremity of the North Sea canal). Amsterdam on the Zuider Zee lost much of its former trade to Rotterdam, but benefited from the cutting of the North Sea canal across the centre of North Holland. Of the remaining ports, Flushing (Vlissingen) on the island of Walcheren in the west, Harlingen and Delfzijl on the northern coast and Groningen several miles inland on the Ems canal were the most important.

In cargo traffic, Rotterdam overshadowed the other ports of the country, its chief rival being rather Antwerp than any Dutch port. Before World War II it handled four-fifths of the total sea-borne cargo and eight times as much as Amsterdam, its nearest Dutch competitor (in 1938 Rotterdam handled 42,300,000 tons, Amsterdam 5,600,000 tons). Through it passed also by far the greater part of transit traffic.

In 1955, 27,890 seagoing ships of 83,710,000 gross tons entered

Dutch ports. Total goods traffic by seagoing ships amounted in the same pear to 56,410,000 metric tons of imports (including 26,855,000 tons in transitj and 23,613,000 tons of exports (11,-270,000 tons in transit), excluding bunker fuel.

The Royal Dutch Airlines (K.L.M.) was founded on Oct. 7, 1919, with government aid as a private enterprise. The company had in 1955 a paid-up capital of 123,000,000 guldens, 95% of which was owned by the government. Its traffic increased rapidly and in 1955 it was the third largest air transport enterprise in Europe. These are the figures for 1955 (1938 in parentheses): kilometres flown 54,247,000 (10,609,000); passenger-kilometres 1,485,448,000 (59,758,000): cargo 50,991.000 (1,207,000) ton-kilometres; mail 9,081,000 (1,813,000) ton-kilometres.

The number of telephones in use on Jan. 1, 1957, amounted to 1,229,174. On Jan. 1, 1956, there were 2,092,459 radio sets. Television receivers totalled 92.867 on Dec. 1. 1956.

Currency and Finance. — The monetary unit, the gulden (*q.v.*) or guilder, also known as the florin, dates from 1798; it is divided into 100 cents. Gold and silver coinage was progressively withdrawn during the 20th century. and currency after World War II comprised solely notes and coins representing varying fractions of the gulden. The Netherlands was the last country to abandon the gold standard: on Sept. 19, 1936. There were 12.107 guldens to the pound sterling in the immediate prewar years, and 10.68 for several years after 1948. The gulden was devalued with the pound in Sept. 1949; its exchange rate in relation to the U.S. dollar fell from 2.65 guldens to 3.80, and in relation to the pound was fixed at 10.64 guldens.

The Netherlands bank. founded in 1814, was for long a private institution. It acted as the government's banker. and the state. in return for its privilege of issuing notes, shared in the profits. The bank was nationalized on Aug. 1, 1948. Note circulation totalled 906,834,000 guldens at the beginning of 1938, 3,052,000,-000 guldens by 1949 and 4,213,000,000 guldens on Dec. 31. 1956. Gold and foreign exchange holdings on Dec. 31, 1956, amounted to U.S. $1,072,000,000.

The Netherlands possessed numerous joint-stock banks, of which the larger were intimately concerned with industrial financing. These larger banks tended to absorb the smaller provincial ones.

The Budget. — Dutch budgets were divided into ordinary and capital services. both on the revenue and expenditure side. Until 1931 budgets usually showed a surplus. As a result of the economic depression of the earlier 1930s this was transformed into a small deficit. With the devaluation of the gulden in 1936, however, revenue began to increase, and in the years iinmediately after World War II a surplus was once more being recorded. In addition to the main budget there were various funds with separate accounts into which special taxes were paid and which also received allocations from the treasury; *e.g.*, the Agricultural Crisis fund: the Unemployment Subsidy fund and the Transport fund.

TABLE XV.—*Budget Accounts, 1938–57*
fin 000,000 guldens)

Item	1938	1952	1953	1954	1955	1956	1957
Total expenditure	909	5,045	5,692	6,019	6,940	7,274	6,885
Interest on public debt	119	489	456	496	477	503	532
Price subsidies	25	127	261	223	310	327	283
Social security, etc.	135	707	735	865	908	1,122	720
Education	142	458	503	593	710	861	980
Public health	3	32	40	38	46	52	61
Grants to provinces and municipalities	16	81	83	85	133	109	109
National defense	142	1,177	1,324	1,595	1,689	1,766	1,446
Other current expenditure	123	831	963	859	893	1,022	1,196
Real investment	105	243	258	288	384	463	497
Capital transfers:							
Private sector	—	431	455	487	803	489	282
Provinces and municipalities	12	90	343	230	197	221	208
Foreign countries	9	15	21	44	129	89	89
Loans and advances at home	78	346	220	202	241	207	449
Loans and advances abroad	—	18	30	14	20	43	33
Total receipts	843	5,712	5,879	6,221	6,752	6,498	6,711
Total taxes (net)	607	5,054	4,995	5,098	5,688	5,812	6,081
Other current receipts	189	496	696	752	539	430	433
Repayment of loans, etc.	40	38	96	140	247	93	103
Other capital receipts	7	124	92	231	278	163	94
Balance (+) or (−)	−66	+667	+187	+202	−188	−776	−174

Postwar Dutch budgets had to provide for increasing expenditure, particularly in subsidies to industry and agriculture, for reconstruction, social services, unemployment and, later, for rearmament. (See Table XV.)

The local provincial and in particular the communal authorities possess a considerable degree of financial autonomy and derive a certain revenue from taxation, which is supplemented by grants from the state and by the profits of local undertakings. Under the constitution, a chief responsibility of these local bodies is the maintenance of roads, etc., public health and education and police.

National Debt. — The national debt steadily increased after the 19th century.

The total national debt was 3,986,000,000 guldens on Dec. 31, 1938. At the end of 1955 the total national debt was 19,689,000,-000 guldens, including 2,013,000,000 guldens of foreign debt.

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(*J. D. L.;* X.)

HOLLAND, COUNTY AND PROVINCE OF. The beginnings of the history of the county of Holland are centred in Kennemerland, where a certain Rorik, of Norman origin, became a count in 862. His successor Gerulf, to whom the German king Arnulf in 889 granted some possessions and rights in the region between the Rhine and Swithardeshaga (probably a wood in the neighbourhood of Schoorl). may be considered as the first count of Holland, notwithstanding the doubt that may be felt about his being the father of Dirk I, whom tradition long held to be the first count. This Dirk I (the name is a shortened form of Diederic: German Dietrich, Latin Theodoricus) in 922 obtained from Charles III the Simple of France the church of Egmont in full possession. with all that belonged thereto from Swithardeshaga to Fortrapa (possibly Voortrap, otherwise 's Gravenpolder, on the island of Zuid-Beveland) and Kinnem (possibly a diked-in marsh on the island of Terschelling). His son Dirk II played a part in the troubles in the old duchy of Lorraine after its incorporation into the German kingdom by Henry I and Otto I: we find him, for instance, supporting Duke Giselbert of Lorraine in his revolt against Otto in 939; and later he seems to have supported the claims to Lorraine of King Lothair of France. from whom at any rate he got the wood Wasda (land van *Waes*) in 969. Eventually, however, he was won over to the side of the German kings; Otto III allowed him a considerable extension of territory (Maasland and Texel) in 985 and favoured his sons Arnulf and Egbert, the latter becoming chancellor of the German kingdom and then archbishop of Trier. Dirk II died in 988. Arnulf. Dirk's elder son of his marriage with the daughter of Count Arnulf of Flanders,

was born in Ghent and married to Liutgarde of Luxembourg, whose sister Kunigunde was to be the wife of the emperor Henry II. He was count till 993, when he was slain in battle against the West Frisians and was succeeded by his 1a-year-old son Dirk III. In his minority the boy was despoiled of almost all his possessions, except Kennemerland and Maasland. Afterward he made himself master not only of his ancestral possessions hut also of the district on the Meuse known as the Bushland of Merweda (*forestum* Merweda), hitherto subject to the see of Utrecht. In the midst of this marshy tract, at a point commanding the courses of the Meuse and the Waal, he built a castle (*c.* 1015) and began to levy tolls. Around this castle sprang up the town of Vlaardingen. The possession of this stronghold was so injurious to the commerce of Tiel, Cologne and the Rhenish towns with England that complaints were made by the bishop of Utrecht and the archbishop of Cologne to the emperor, who commissioned Duke Godfrey of Lorraine to chastise the young Frisian count. Godfrey invaded Dirk's lands with a large army, but was totally defeated with heavy loss (July 29, 1018). This victory of 1018 is often regarded as the true starting point of the history of the county of Holland. Having thus established his rule in the south, Dirk next proceeded to subject the Frisians in the north.

His son Dirk IV was one of the most enterprising of his warlike and strenuous race. His reign was marked by a notable victory over an imperial army which had occupied Zeeland (1047). It was in his time that the dispute between the counts of Flanders and Holland for the possession of Zeeland and Walcheren began. In 1049 he was killed in battle near Thuredrech (Dordrecht) against the forces of a coalition headed by the bishops of Utrecht, Liège and Metz. He was succeeded by his brother Floris I, who was murdered in 1061 at Nederhemert. At Floris's death his son Dirk V was still a child and so came under the guardianship of his mother, Gertrude, daughter of Bernard II of Saxony. William, bishop of Utrecht, saw his opportunity here and was in fact made liege lord over the young count by the German king Henry IV in 1064. However, the countess Gertrude married a younger son of Count Baldain V of Flanders, Robert the Frisian, who took his stepson's interests to heart, so that it was only in 1071 and with the help of Godfrey III of Lorraine that William of Utrecht was able to subdue Holland, Robert the Frisian being then occupied in disputes over the succession in Flanders and Hainaut. Even so. after Godfrey of Lorraine's death in 1076, Dirk V, now of age was able with his stepfather's help to recover his county from the bishop and to become the first count of Holland to hold the title officially.

Dirk V died in 1091 and was succeeded by his son Floris II the Fat. This count had a peaceful and prosperous reign of 31 years. After his death (1122) his widow, Petronilla of Saxony, governed in the name of Dirk VI, who was a minor. The accession of her half-brother, Lothair of Saxony. to the imperial throne on the death of Henry V greatly strengthened her position and that of her sons. Dirk VI tried to impose his rule on the West Frisians of the northern part of the later province of Holland, but they chose instead his brother Floris the Black as their count. The emperor Lothair settled his nephews' quarrel, and Floris the Black sought his fortune in Utrecht, where he was murdered.

Floris III (1157–90), Dirk VI's son, managed to subject the whole northen region down to the Vlie. He reversed the traditional policy of his house by allying himself with the Hohenstaufen. He became a devoted adherent and friend of Frederick I Barbarossa, whom he accompanied on the third crusade, in which he was a distinguished leader. He died of pestilence at Antioch in 1190. His son Dirk VII had a stormy but on the whole successful reign. Contests with the Flemings in western Zeeland and with the West Frisians, stirred up to revolt by his brother William, ended in his favour. The brothers were reconciled and William was made count of Friesland. In 1202 a war with the duke of Brabant broke out; Dirk was defeated and taken prisoner and had to purchase peace on humiliating terms. He died in Nov. 1203, leaving as his only issue a daughter Ada, aged 1*j* years. Her succession was challenged by William, count of Friesland, who became undisputed count of Holland after 1205. William I took an active part in the events of his time. He fought by the side of the emperor Otto IV against Philip II Augustus of France in the great battle of Bouvines in 1214 and was taken prisoner. Two years later he accompanied Louis, the eldest son of Philip Augustus, in his expedition against King John of England. William is perhaps best known in history by his part in the crusades He distinguished himself greatly in an expedition to Portugal and to Egypt, especially at the capture of Damietta (1219). and died in 1222. The earliest charters conveying civic privileges in the county of Holland date from his reign—those of Geertruidenberg (1213) and of Dordrecht (1220). His son Floris IV, being a minor, succeeded him under the guardianship of his maternal uncle Gerard III of Gelderland. He maintained in later life close relations of friendship with Gerard and supported him in his quarrel with the bishop of Utrecht (1224–26). Floris was murdered in 1234 at a tournament at Corbie in Picardy by the count of Clermont. Another long minority followed his death, during which his brother Otto, bishop of Utrecht, acted as guardian to his nephew William II (1234–56).

William II became a man of mark. Not only did several towns get their charters during his reign (Haarlem, Delft. Alkmaar, Middelburg), but moreover Pope Innocent IV, having deposed the emperor Frederick II, caused the young count of Holland to be elected king of the Romans (1247) William took Aachen in 1248 and was there crowned king; and after Frederick's death in 1250 he had a considerable party in Germany. He was on the point of proceeding to Rome to be crowned emperor when in an expedition against the West Frisians he perished, going down, horse and armour, through the ice near Hoogwoude (1256). Like so many of his predecessors he left his inheritance to a child.

Floris V (1256–96) was but two years old at his father's death; there were many difficulties with the guardianship before the young count came of age, 12 years old, in 1266. Soon there were other troubles: an expedition against the West Frisians failed, and the peasants in Kennemerland and Waterland rose against their lords and allied themselves to the democrats in the town of Utrecht. Floris overcame this danger by entering into a pact of neutrality with Utrecht and by giving a charter of rights to the Kennemer peasants (the latter act won him the quite undeserved name of der keerlen God, "the God of the common people"). In 1276 Floris restored the power of the bishop-elect John of Nassau in Utrecht. Thenceforth roles were reversed, and the influence of Holland over the bishops of Utrecht became ever greater. In his own county, too, Floris' power was steadily rising. He finally subdued the West Frisians; strongholds such as Alkmaar and Medemblik made revolts impossible for the future.

But his policy mas not limited to his own county and its neighbours. He allied himself closely with Edward I of England and secured great trading advantages for his people; the staple of wool was placed at Dort (Dordrecht) and the Hollanders and Zeelanders got fishing rights on the English coast. So intimate did their relations become that Floris sent his son John to be educated at the court of Edward with a view to his marriage with an English princess. In 1296, however, Floris forsook the alliance of Edward I for that of Philip IV the Fair of France, probably because Edward had given support to Guy of Dampierre, count of Flanders, in his dynastic dispute with John of Avesnes, count of Hainaut. Shortly afterward a conspiracy of disaffected nobles was formed against him, and he a-as murdered in the castle of Muiden (June 27, 1296).

With his son John I (1296–99), husband of Eleanor, daughter of Edward I, the first line of counts ended after a rule of nearly 400 years.

The House of Avesnes.—The first count of the new line, John II of Holland, was the son of John I of Avesnes. count of Hainaut, and Adelaide or Alida, sister of William II of Holland.

This succession brought Holland directly into connection on the one hand with the struggle between the house of Dampierre in Flanders and that of Avesnes in Hainaut and on the other with the war between the count of Flanders and the democratic Flemish towns and their suzerain Philip the Fair, ahose ally John of Avesnes was. One of the consequences was a revival of the old

conflict of Flanders and Holland over Zeeland west of the Scheldt. After the battle of Courtrai (Kortrijk, 1302) a Flemish army invaded Holland, but in the neighbourhood of Haarlem it began to withdraw. Zeeland alone stayed in Fltmish hands till a combined Flemish-French fleet was defeated near Zierikzee in 1304. The protracted conflict between Flanders and Holland over Zeeland west of the Scheldt was definitely settled in the reign of John's successor, William III the Good (1304–37), by the treaty of 1323, which granted full possession of western Zeeland to William, who on his part renounced all claim to imperial Flanders. The Amstelland with its capital Amsterdam, which had hitherto been held as a fief of Utrecht, was by William, on the death of his uncle the bishop Guy of Avesnes, finally annexed to Holland. William III did much to encourage civic life and to develop the resources of the country. He had close relations through marriage with the three principal European dynasties of his time: his wife was Joan of Valois, niece of Philip the Fair'; in 1323 the emperor Louis IV the Bavarian married his daughter Margaret; and in *1328* his third daughter, Philippa of Hainaut, was married to Edward III of England. By their alliance William III occupied a position of much dignity and influence, which he used to further the interests of his hereditary lands. He was succeeded by his son William IV, who was the ally of his brother-in-law Edward III in his French wars but was killed in battle against the Frisians in 1345. He left no children, and the question of the succession now brought on Holland a period of violent civil commotions. William IV's inheritance was claimed by his eldest sister, the empress Margaret, as well as by Philippa of Hainaut — in other words by Edward III of England. Margaret came in person and was duly recognized as countess in Holland, Zeeland and Hainaut but returned to her husband after appointing her second son, Duke William of Bavaria, as stadholder in her place. In 1349 Margaret uas induced to resign her sovereignty, and the stadholder became count with the title of William V. This time saw the formation of the famous parties in Holland, known as Cods *(Kabeljauwen)* and Hooks (*Hoeken*): the former, mostly the burgher party, were the supporters of William; the latter were as a rule the party of the disaffected nobles, who wanted to catch and devour the fat burgher fish. In 1350 the nobles invited Margaret to return to Holland. Edward III came to her aid, winning a sea fight off Veere in 1351; a few weeks later the Hooks and their English allies were defeated by William and the Cods at Vlaardingen — an overthrow that ruined Margaret's cause. Edward III shortly afterward changed sides, and the empress saw herself compelled (1354) to come to an understanding with her son: he was recognized as count of Holland and Zeeland, she as countess of Hainaut. Margaret died two years later, leaving William, who had married Matilda of Lancaster, in possession of the entire Holland-Hainaut inheritance (July 1356). But before the close of 1358 he showed such marked signs of insanity that his wife, with his own consent and the support of both parties, invited Duke Albert of Bavaria, younger brother of William V, to assume the functions of *ruwaert* (regent). William lived in confinement for *31* years. Albert died in 1404, having ruled the land for *46* years, first as *ruwaert,* then, from 1389, as count. During his reign the struggle between the partisans of the Cods and the Hooks was revived once more. He was succeeded by his son William VI in 1404. On his accession to power William upheld the Hooks and secured their ascendancy. His reign was much troubled with civil discords, but he was a brave soldier and was generally successful in his enterprises. He died in 1417, leaving an only child, his daughter Jacqueline (*i.e.,* Jacoba), who had in her early youth been married to John, heir to the throne of France.

The Burgundian Dynasty. — At a gathering held at The Hague (Aug. 15, *1416)* the nobles and representatives of the cities of Holland and Zeeland had promised at William's request to support his daughter's claims to the succession. But John of France died in April 1417 and William VI about a month later, leaving the widowed Jacqueline at 17 years of age face to face with a difficult situation. She was welcomed at first in Holland and Zeeland, but found her claims opposed by her uncle John of Bavaria, who was supported by the Cod party. Every one from whom she might have expected help betrayed her in turn: her second husband John IV of Brabant, her third husband Humphrey of Gloucester, her cousin Philip the Good of Burgundy, all behaved shamefully to her. She long struggled against Philip of Burgundy. whose hand was behind all the difficulties that she encountered, but in *1428* she was compelled to join in the so-called peace offering of Delft, by which treaty Philip became *ruwaert* over all her territories and she retained only a semblance of power. Five years later, after Jacqueline's marriage to Francis of Borselen, Holland, Zeeland and Hainaut were taken over altogether by Burgundy.

Under the Burgundian line of counts Holland's material prosperity increased continually. The herring fishery, rendered more valuable by the curing process discovered or introduced by Beukelszoon, brought increasing wealth, and the county's fishermen were already laying the foundations of its future maritime greatness. During the reign of Philip the Good's son Charles the Bold (1467–77) the Hollanders, like the other subjects of that warlike prince, suffered much from the burden of taxation. They were much aggrieved by the establishment of a high court of justice for the entire Netherlands at Malines (1474) which was regarded as a serious breach of their privileges. The succession of Mary of Burgundy led to the granting to Holland (as to the other provinces of the Netherlands) of the Great Privilege of March 1477, which restored the most important of their ancient rights and liberties *(see* NETHERLANDS). A high court of justice was established for Holland, Zeeland and Friesland, and the use of the native language was made official. (C. D. J. B.)

The Habsburgs and **the** House of Orange. — On the sudden death of Mary in *1482* her possessions. including the county of Holland, passed to her infant son Philip, under the guardianship of his father the archduke Maximilian of Austria. Thus the Burgundian dynasty was succeeded by that of the Habsburgs. During the regency of Maximilian the turbulence of the Hooks caused much strife and unrest in Holland. Their leaders, Francis of Brederode and John of Naaldwijk, seized Rotterdam and other places. Their overthrow finally ended the strife between Hooks and Cods. The "Bread and Cheese War," an uprising of the peasants in northern Holland caused by famine, was proof of the misery caused by civil discords and oppressive taxation. In 1494, Maximilian having been elected emperor, Philip was declared of age. His assumption of the government was greeted with joy in Holland, and in his reign the province enjoyed rest and its fisheries benefited from the commercial treaty concluded with England. The story of Holland during the long reign of his son and successor Charles II *(1506–55),* better known as the emperor Charles V, belongs to the general history of the Netherlands (*q.v.*). On Charles's abdication his son Philip II of Spain became Philip III, count of Holland, the ruler whose arbitrary rule in church and state brought about the revolt of the Netherlands. His appointment of William. prince of Orange, as stadholder of Holland and Zeeland was destined to have momentous results to the future of those provinces *(see* WILLIAM, *1533–84).*

The capture of Brill and of Flushing in 1572 by the Sea Beggars led to the submission of the greater part of Holland and Zeeland to the authority of the prince of Orange, who, as stadholder, summoned the estates of Holland to meet at Dordrecht. This act was the beginning of Dutch independence. From this time forward William made Holland his home. It became the bulwark of the Protestant faith in the Netherlands, the focus of the resistance to Spanish tyranny. The act of federation between Holland and Zeeland brought about by the influence of William was the germ of the larger union of Utrecht in *1579,* which by the fortunes of war was to be confined to the seven northern provinces. But within the larger union the inner and closer union between Holland and Zeeland continued to subsist. When after the solemn abjuration of Philip II as sovereign by the states-general in *1581* the sovereignty was offered to Francis, duke of Anjou. the two maritime provinces tried to safeguard their position by offering the countship to William. The matter was in an advanced state of preparation when William was assassinated *(1584)* and was then left in abeyance. In 1585, when the earl of Leicester had become gov-

ernor over all the provinces not yet reduced to obedience by Spain, William's son Maurice was appointed only to the position of stadholder.

Of these provinces, protected by the barrier of the rivers, Holland was the mainstay. More than half the burden of the charges of the war fell upon this one province; and with Zeeland it furnished the fleets which formed the chief defense of the country. Hence the importance attached to the vote of Holland in the assembly of the states-general. That vote was given by deputies, at the head of whom was the advocate (in later times called the grand pensionary) of Holland, and who were responsible to, and the spokesmen of, the provincial estates. These estates, which met at The Hague in the same building as the states-general, consisted of representatives of the burgher obligarchies (regents) of 18 voting towns, together with the representatives of the nobles, who possessed one vote only. The advocate was the paid minister of the estates; he presided over their meetings, kept their minutes and conducted all correspondence, as well as being their spokesman in the states-general. If, therefore, he was an able man he had opportunities for exercising a very considerable influence, becoming in fact a kind of minister of all affairs. It was this influence as exerted by the successive advocates — Paul Buys and Johan van Oldenbarneveldt — and grand pensionaries of Holland — of whom John de Witt was the greatest — that ensured the hegemony of Holland in the federation; in other words, of the burgher oligarchies who controlled the town corporations of the province and especially Amsterdam. This authority of Holland was. however. counterbalanced by the influence exercised by the stadholder princes of Orange; and the chief crises in the internal history of the Dutch republic are to be found in the struggles for supremacy betueen two, in reality, different principles of government. Whereas, however, the Holland party used to invoke the principle of provincial soxereignty, it would nevertheless be unfair to represent it as primarily and unalterably opposed to a strengthening of the federal government. The provincial principle was invoked as a means of defense against powerful stadholders who, basing themselves on the support of a majority of smaller and often corrupted provinces in the states-general, abused the unitary principle to further their personal foreign policy. Holland's preponderance in reality often served as an alternative factor to infuse some vigour into the all too loosely constructed federal government. In the 1780s the continuing conflict led to a state of latent civil war. The "Patriot" opponents of William V of Orange, originally sprung from the *staatsgezinden* (*i.e.,* the Holland magistracies, led by that of Amsterdam and not without allies in other provinces), came to develop democratic tendencies. When in 1795 the old republic was overthrown they welcomed the French as deliverers, not only in order to do away with stadholderships and the oligarchic system (which had lately become allies), but also to realize that unitary state which neither of the old parties had really been able to conceive. It was on this basis, in 1813, that the modern kingdom under the sovereignty of the house of Orange was founded.

Constitution. — The full title of the estates of Holland in the 17th and 18th centuries was De Edele Groot *Mogende* Heeren Staaten van Holland en *Westfriesland*. After 1608 this assembly consisted of 19 members, 1 representing the nobility (*ridderschap*) and 18 the towns. The "member" (*i.e.,* delegation) for the nobles gave its opinion first, followed by a spokesman for each town in a fixed order of precedence. The grand pensionary, acting as chairman, had in the end to embody the sense of the assembly, as apparent from 19 opinions, in a "resolution." The interests of the country districts (*het platte* land) were the peculiar charge of the member for the nobles. The nobles also retained the right of appointing representatives to sit in the college of deputed councillors, in certain colleges of the admiralty and upon the board of directors of the East India company and to various public offices. Each town (as did also the nobles) sent as many representatives as it pleased, but the 19 "members" had only one vote each. Each town's deputation was headed by its pensionary, who often acted as spokesman on behalf of the representatives. Certain questions such as peace and war, the voting of subsidies, the imposition of taxation, changes in the mode of government, etc., required unanimity of votes. The estates of Holland sat at The Hague in the months of March, July, September and November. During the periods of prorogation the continuous supervision of the business and interests of the province was, however, never neglected. This duty was confided to the college of deputed councillors (het kollegie der gekommitteerde raden), which was itself divided into two sections, one for the southern quarter, another for the northern. The grand pensionary presided over the meetings of the college, which had the general charge of the whole provincial administration, especially finance, the carrying out of the resolutions of the estates, the maintenance of defenses and the upholding of the privileges and liberties of the land. (P. GE.)

HOLLAND, a harbour city on Lake Macatawa, an inlet of Lake Michigan, in Ottawa county, Mich., U.S., 25 mi. S.W. of Grand Rapids. Advantages of the site for water transport attracted Rev. A. C. Van Raalte and his small band of Dutch settlers in 1847. Subsequently, this outpost became the destination of many Dutch immigrants who colonized western Michigan. Shingle making, tanning and woodworking were early industries. The city has industrial diversity including pharmaceuticals, furniture, metal crafts and machinery. It is renowned as a resort centre and is the hub of a fruit-growing, poultry and farming area. Holland State park is nearby, and the annual Tulip festival in May features Dutch provincial costumes, pageantry, wooden-shoe dances, and miles of streets and parks bordered by tulips. The Netherlands museum has exhibits of local history and Dutch folklore. Hope college (1866) and Western Theological seminary (1869) are institutions of the Reformed Church in America. Holland was incorporated in 1867 and the council-manager government, adopted in 1950, operates its own utilities, a community hospital and a civic centre. For comparative population figures see table in MICHIGAN: *Population.* (W. C. W.)

HOLLAND. A cloth so called from the country where it was first made. It was originally a fine plain linen fabric of a brownish colour — unbleached flax. Several varieties are now made: hollands, pale hollands and fine hollands. They are used for casement curtains, aprons, blinds, shirts, blouses and dresses.

HOLLAND AND LINCOLN VEHICULAR TUNNELS. Construction of the Holland tunnel, extending from Canal street in Manhattan, New York city, to Journal square in Jersey City, N.J., was started in 1920 under Clifford M. Holland, who died in 1924. The tunnel was opened to traffic on Nov. 13, 1927. The Holland tunnel consists of two distinct tubes, each having external diameters of 29½ ft., and each accommodating two lines of one-way traffic. The north tube is 9,180 ft. long, and the south tube 9,277 ft. A viaduct, costing $3,200,000, was completed at the New Jersey exit in 1951.

A second tunnel, known as the Lincoln tunnel, and essentially of the same design as the Holland tunnel, was started in 1934. It extends from Times square in Manhattan to Weehawken, N J. The south tube of the Lincoln tunnel was opened to traffic in 1937 and the north tube in 1945. The tubes of the Lincoln tunnel are each 31 ft. wide in outside diameter, or 18 in. wider than those of the Holland tunnel. The total length of the Lincoln tunnel is 3.4 mi.

Both tunnels are ventilated by fresh air forced through the spaces between the roadway and the bottom of the tube and drawn by fans through a similar space at the top. In this way, fresh air is supplied to all points throughout the tunnels and is not affected by the traffic or external wind conditions. The ventilating equipment, communications systems and other operating equipment of both tunnels are similar, with some technical improvements in the newer tunnel, developed as a result of experience. A feature of the Lincoln tunnel is the glass-tiled ceiling which provides improved lighting with less glare.

HOLLANDER, BERNARD (1864–1934), British physician and writer on medical subjects, was born in Vienna in 1864. He went to London in 1883 and was naturalized in 1899. He published in 1899 the results of his first investigation into the localization in the brain of the fundamental psychical functions. He wrote many papers for various learned societies, and was

well known for his studies of abnormal mental conditions and as an exponent of psychotherapy.

His many publications include *The Mental Functions of the Brain* (1902); *Scientific Phrenology* (1902); *Psychotherapeutics of Insanity* (1908); *The Unknown Life and Works of Dr. Francis Joseph Gall* (1909); *The Insanity of Genius* (1913); *In Search of the Soul atzd the Mechanism of Human Thought, Emotion, and Conduct* (1920); *Psychology of Misconduct, Vice and Crime* (1922).

HOLLANDS: *see* GIN.

HOLLAR, WENCESLAUS (WENZEL; in Czech. VÁCLAV HOLAR) (1607–1677), Bohemian etcher. whose work has always had great charm for connoisseurs; for mastery in working directly on the etched plate he had few—if any—peers. He was born in Prague on July 13, 1607. The earliest of his extant works are small plates dated 1625 and **1626.** In **1627** he was working under Matthäus Merian in Frankfurt. later moving to Strasbourg and then to Cologne in 1633. There he attracted the attention of the collector Thomas, earl of Arundel, who was on an embassy to the imperial court; and with him Hollar traveled to Vienna and Prague, arriving at last in 'England in 1637.

Though he lived in the household of the earl of Arundel he seems to have worked not exclusively for him, but to have begun that slavery to the publishers which was the normal condition of his life. During his first years in England he produced his view of Greenwich, nearly a yard long, receiving **30** shillings for the plate. The earl of Arundel left England in **1642** and Hollar passed into the service of the duke of York. With other royalist artists he stood the long siege of Basing house and there are about a hundred plates by him dated during the years **1643** and 1644. Taken prisoner, he escaped or was released and joined the earl of Arundel at Antwerp, remaining eight years, the prime of his working life, and produced the finest of his plates: his noble views, his miraculous muffs and shells. the superb portrait of the duke of York. In **1652** he returned to London and lived for a time with the engraver William Faithorne.

He illustrated many books. among them Sir William Dugdale's *Monasticon* (part i, **1655).** *Warwickshire* **(1656)** and *St. Paul's* (1658). After the Great Fire he produced some of his famous "Views of London" and it may have been the success of these which induced the king to send him to Tangiers in **1668** to draw the town and forts. During his return trip to England occurred the desperate and successful engagement fought by his ship the "Mary Rose" against seven Algerian men-of-war, an affair which Hollar etched for Ogilby's *Africa.*

Hollar lived eight years after his return, still working for the booksellers and retaining to the end his wonderful powers. He died in London on March 28. **1677.** in extreme poverty. his last recorded words being a request to the bailiffs that they would not carry away the bed on which he was dying.

Two catalogues of his etchings have been made, one in 1745 (2nd ed.. 1; 59) by George Vertue and a definitive one **(18**53) by Gustav Parthey.

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HOLLES, DENZIL HOLLES, BARON (1599–1680), English statesman and writer. second son of John Holles, 1st earl of Clare (c. 1564–1637), and Anne, daughter of Sir Thomas Stanhope. was born on Oct. **31.** 1599. He was in early youth the playmate and intimate companion of Prince Charles. In **1624** Holles was returned to parliament for Mitchell in Cornwall, and in 1628 for Dorchester.

On March 2. **1629.** when Sir John Finch, the speaker, refused to put Sir John Eliot's Protestations and was about to adjourn the House by the king's command, Holles with another member thrust him back into the chair and swore "he should sit still till it pleased them to rise." Meanwhile Eliot, on the refusal of the speaker to read the Protestations, had himself thrown them into the fire; the usher of the black rod was knocking at the door for admittance, and the king had sent for the guard. But Holles, declaring that he could not render the king or his country better service, put the Protestations to the House from memory, all the members rising to their feet and applauding. He, with others, was arrested and arraigned first in the Star Chamber and subsequently in the King's Bench.

When brought upon his *habeas corpus* before the latter court Holles offered with the rest to give bail, but refused sureties for good behaviour, and argued that the court had no jurisdiction over offences supposed to have been committed in parliament. On his refusal to plead he was sentenced to a fine of 1.000 marks and to imprisonment during the king's pleasure. Holles was confined. first in the Tower of London. and then in the Marshalsea. His resistance to the king's tyranny did not prove so stout as that of some of his comrades in misfortune. Having given the security demanded for his good behaviour, he was liberated early in **1630,** and retired to the country.

Holles nas a member of the Short and Long Parliaments assembled in **1640.** According to Laud he was now "one of the great leading men in the House of Commons." and he sought to find means of preserving his brother-in-law, Strafford, from execution. He was one of the chief movers of the Protestation of May 3, **1641.** He took up the impeachment of Laud to the House of Peers. supported the Londoners' petition for the abolition of episcopacy, and the Root and Branch bill.

Together with Pym, Holles drew up the Grand Remonstrance, and made a vigorous speech in its support on Nov. 22, **1641,** in which he argued for the right of one House to make a declaration, and asserted. "If kings are misled by their counsellors we may, me must, tell them of it."

After the failure of the attempt by the court to gain over Holles and others by offering them posts in the administration, he was one of the "five members" impeached by the king. Holles at once grasped the full significance of the king's action, and after the triumphant return to the House of the five members, on Jan. 11, threw himself into still more pronounced opposition to the king's policy.

On the outbreak of the Civil War *(see* CIVIL WAR, ENGLISH) Holles took a command in the field, fighting at Edgehill and at Brentford. But he soon returned to London, moderated his tone. and advocated peace and a settlement of the disputes by concessions on both sides.

He supported the peace negotiations on Nov. 21 and Dec. 22, **1642,** and his attitude led to a breach with Pym and the more determined party. In June **1643** he was accused of complicity in Waller's plot, but snore to his innocency; and his arrest with others of the peace party was even proposed in August. In November Holles and Whitelocke headed the commission appointed to treat nith the king at Oxford. He endeavoured to convince the royalists of the necessity of yielding in time, before the "new party of hot men" should gain the upper hand.

Holles and Whitelocke had a private meeting, not reported to parliament. with the king. when at Charles's request they drew up the ansner which they advised him to return to the parliament. Holles was also a commissioner at Uxbridge in Jan. 1645. As leader of the moderate (or Presbyterian) party Holles now came into violent antagonism with Cromuell and the army faction, and was one of those who sought to secure Cromwell's impeachment.

On June **16, 1647,** eleven members including Holles were charged by the army with various offences against the state, followed on the 23rd by fresh demands for their impeachment and for their suspension. which were refused. On the 26th, however, the eleven members, in order to avoid violence, asked leave to withdraw. They were recalled, expelled, imprisoned and again recalled.

Holles was one of the commissioners appointed to treat with the king at Newport on Sept. 18, **1648.** and was one of those who stayed behind the rest in order to urge Charles to compliance. On Dec 1 he received the thanks of the House. On the occasion of Prides Purge on Dec. **6** Holles absented himself and escaped to France.

From his retirement there he wrote to Charles II. in 1651, advising him to come to terms with the Scots as the only means of effecting a restoration; but after the alliance he refused Charles's offer of the secretaryship of state. In March **1654** Crom-

well sent Holles a pass "with notable circumstances of kindness and esteem." The date of his return to England is uncertain, but in 1656 Cromwell's resentment was again excited against him as the supposed author of a tract, really written by Clarendon. Holles appears to have been imprisoned, for his release was ordered by the council on Sept. 2, 1659.

Holles took a leading part in the Restoration, was one of the 34 commissioners appointed to try the regicides, and entered the House of Lords as Baron Holles in 1661. He was ambassador to France (1663–66), and an envoy at the peace with Holland at Breda (1667). He became with Halifax and Shaftesbury a leader in the resistance to the domestic and foreign policy of the court, and in 1676 was summarily dismissed from the council. In order to bring about the downfall of Danby (afterwards duke of Leeds) and the disbanding of the army, which he believed to be intended for the suppression of the national liberties, Holles engaged (1677–1679), as did many others, in a dangerous intrigue with Courtin and Barillon, the French envoys, and Louis XIV.; he refused, however, the latter's presents on the ground that he was a member of the council, having been appointed to Sir William Temple's new modelled cabinet in 1679. Barillon described him as at this period in his old age "the man of all England for whom the different cabals have the most consideration," and as firmly opposed to the arbitrary designs of the court. He showed moderation in the Popish Plot, and on the question of the exclusion of James, duke of York, followed Halifax rather than Shaftesbury. He died on Feb. 17, 1680.

The character of Holles has been drawn by Burnet (*Hist.* of His *Own* Times vi. 257, 268), with whom he was on terms of friendship. "Hollis was a man of great courage and of as great pride. . . . He was faithful and firm to his side and never changed through the whole course of his life. . . . He argued well but too vehemently; for he could not bear contradiction. He had the soul of an old stubborn Roman in him. He was a faithful but a rough friend, and a severe but fair enemy. He had a true sense of religion; and was a man of an unblameable course of life and of a sound judgment when it was not biased by passion."

See C. H. Firth in the *Dictionary of National Biography* and authorities there quoted.

HOLLOWAY, THOMAS (1800–1883), English patent-medicine merchant and philanthropist, was born at Devonport on Sept. 22. 1800. He began to sell an ointment in 1837 and it carried his name over the world. He soon added the sale of pills to his business. Advertising played a large part in making his business efiorts successful. He endowed two institutions, a sanatorium for the mentally afflicted of the lower middle class, which was opened in 1885, and a college for women which was opened at Egham in 1886. He attended carefully to the arrangements for establishment of these institutions prior to his death at Tittenhurst on Dec. 26. 1883. (H. J. Sg.)

HOLLOW WARE. Hollow ware is a term which may be used to describe all articles of concave shape employed for domestic, particularly culinary, purposes; but actually. according both to the popular and to the trade usage, it is applied only to those which are made of metal. Even with this limitation the term covers a wide variety of articles. which are produced by several distinct industries. Some account of the development of those industries mill show how the various branches of the manufacture grew up. It is not necessary to look back beyond the middle of the 18th century, since it was not till then that any considerable variety in the types of article in use began to appear. At that time the metal kitchen utensils, such as kettles, pans and ale warmers, were made of sheet copper, brass or, less frequently, iron; cast-bronze skillets, which corresponded to the modern saucepans, and caldrons were very common. Nonferrous-metal vessels of these various types were frequently tinned on the inside. The lighter domestic hollow ware, such as kettles, trays, jugs and cups, was occasionally made of tin plate and sometimes japanned, or coated with baked-on varnish. Articles of this material, besides being produced by tinsmiths in many different parts of Europe, were made in quantity in south Wales and south Staffordshire under the name of Pontypool wares. Further, utensils such as plates, bowls, dishes and cups were often made of pewter, while similar articles of a more expensive kind were of silver or silver plate.

Cast iron was employed only for the heavier and cruder types of hollow ware, *e.g.*, caldrons and mortars, because the charcoal-smelted iron, which was then the only kind available, ran too thick to be cast into light domestic utensils.

During the latter half of the 18th century important changes occurred. The use of coke in the blast furnace resulted in the production of an iron which was suitable for the manufacture of light cast pots and pans, and so foundries began to be established for this purpose in several British industrial centres, particularly in south Staffordshire, at West Bromwich and Wolverhampton. During the same period a process was introduced for coating the interior of cast- and wrought-iron hollow ware with tin. and this, since it obviated the danger of rust, greatly extended the use of iron at the expense of nonferrous articles. Further, a new alloy, known as Britannia metal, of which the constituents were copper, tin and antimony, came to be used for making tea- and coffee-pots, so that by 1800. in addition to the older types of copper. brass, sheet-iron, pewter, silver-plate and tin-plate and japanned hollow ware, there were tinned and "black" cast-iron and Britannia metal articles. Soon after 1800 stove-dried varnish began to be employed as an outside coating for tinned iron kettles and pans.

Introduction of Enameling and Galvanizing.— Before 1850, in addition to the improvements which were made in finishing processes, several new varieties of hollow ware came into existence. Processes had long been known for the coating of iron with vitreous enamel and, early in the century, they had been applied by continental producers. but it was not until about 1840 that an enameled hollow ware manufacture was established in Great Britain. From then on enameled ware began slowly to supersede tinned articles, chiefly because of the former's resemblance to glazed pottery and the ease with which it could be cleaned. A few years later the makers of wrought-iron utensils adopted a process for covering their goods with zinc, and so the galvanized-iron hollow ware trade came into existence. British producers in this branch of industry benefited greatly by the increased colonial demand which occurred after the middle of the century.

Meanwhile, the electroplating trade had risen to prominence after 1840 and began to produce teapots and similar articles which had before been made of pewter, tin plate, silver plate or Britannia metal. For a time this last material was used as a base metal in the manufacture of electroplate ware; but it was slowly superseded by German or nickel silver! which bore a considerable resemblance to it.

During the 1830s, moreover, the stamp began to come into use in the sheet-metal branches of the industry. particularly in tin-plate ware production in which thin sheets were employed, and, after this time, many articles such as dishes and pans, which had previously been made of separate. pieces of metal brazed together, were stamped out of a single sheet. There were, however, many kinds of tin-plate ware which still had to be made by the older methods; and the stamp was not used to any extent, even in the 1860s, for the production of heavier gauge cooking utensils of wrought iron.

Stamped Steel and Aluminum Ware.––Up to the 1870s, when most of these branches of the industry had come into existence in Europe and North America, only British manufacturers had developed a large export trade, and they then sent their goods to Europe and the U.S., besides supplying most of the hollow ware used in the colonies and filling a large proportion of the African. Indian and South American demands. During the next decade, a new form of wrought hollow ware, made of stamped steel, came into use. The change was associated with the rise of the German steel industry after 1880. Before basic Bessemer and Siemens-Martin steel came into use, most of the manufacturing operations in the wrought branch of the industry had been done by hand, as wrought iron did not lend itself readily to manipulation by presses and stamps. The new mild steel, however, being more

ductile, could be treated in that way, and it was therefore possible to produce machine-made steel articles which were much cheaper than either cast- or wrought-iron wares. Consequently, steel sheets superseded iron sheets as the raw material of the tinned, enameled, galvanized and "black" sections of the wrought trade; and since enameled stamped-steel hollow ware could be produced at a low cost, other branches of the industry began to suffer.

This decline continued up to the outbreak of World War I, and after 1918 the decay of the manufacture of cast-iron and of certain types of tin-plate wares was accelerated by the increasing use of aluminum hollow ware. Aluminum was first employed in this trade during the later 1890s, and up to 1914 the quantity produced was comparatively small. Germany was the first country to develop the manufacture, and most of the aluminum ware used in Great Britain during the years immediately preceding the war came from that source. The supersession of cast iron by enameled stamped steel and aluminum utensils after the beginning of the 20th century was stimulated by'the increasing use of gas and electric stoves for cooking purposes. In consequence of this development the greater strength of cast-iron ware was no longer such an advantage as it once had been; while articles made of that material mere less economical in the use of fuel than the lighter forms of hollow ware.

Manufacture of **Hollow Ware in the 20th** Century. — As may be inferred from the above historical account, the hollow ware in use in the 20th century may be classified into sections. The first group consists of cast-iron utensils which are either enameled, tinned, or "black." The "black" ware usually takes the form of Dutch ovens and large pots. The other wares, which are coated on the inside with enamel or tin and on the outside with stove-dried varnish. consist of frying pans, saucepans, kettles and other utensils employed for cooking. These articles are first cast from a special quality of pig iron and are then annealed. From the annealing ovens they go to be turned and polished on lathes, after which they are enameled or tinned. The handles are usually made of wrought iron and are riveted onto the body of the articles in the mounting shops. Finally, the wares pass to the stoving and varnishing departments.

The lids are usually made of tinned or enameled steel, or are pressed out of tin plate.

The second group covers wrought hollow ware, which is generally formed from mild-steel sheets and which may be either "black," tinned, enameled or galvanized. The first three varieties consist of similar types of articles to those produced by the cast section, but the enameled ware also comprises such things as jugs, colanders. bowls, buckets, cups, baths and plates, and thus covers a very wide range of domestic utensils. Many of these articles are fashioned under the stamp or drawing press, while some, *e.g.*, frying pans, are spun on the lathe. The later processes in this branch of the industry resemble those which have already been briefly described in connection with the various kinds of cast hollow ware. The latter are more durable and less likely to be adversely affected by heat; while the wrought wares have the advantage of being cheaper, lighter and more economical in the use of fuel.

Galvanized ware is more suitable for outdoor purposes or for uses not connected with food preparation, and it comprises such articles as dustbins, watering cans and coal scuttles. It seldom consists of articles similar to those which are enameled, though the two sections overlap at a few points — such things as buckets, bowls and water cans being common to both.

Galvanized ware is, of course, of a lower grade than the enameled variety.

Some of the more ornamental tin-plate and japanned wares, such as tea- and coffeepots, kettles, japanned coal scuttles, trays and traveling trunks, have, as already indicated, been superseded in Great Britain by other types; but a great quantity of hollow ware is still made of this material.

Aluminum hollow ware takes the form of a wide variety of utensils, such as are associated with the enameled and tin-plate ware trades and with the pottery industry, and it ranges from large cast pots for industrial uses to light saucepans, cups and plates.

The handles of aluminum articles are usually made of iron or steel, although sometimes a composition which is a nonconductor of heat is used.

Finally there remains to be mentioned the hollow ware made of brass, copper, electroplate and nickel silver. This is of an ornamental and expensive kind, and although copper and brass articles are produced in fair quantities, these types do not form, in the 20th century, a considerable proportion of what can be strictly regarded as hollow ware.

The term "hollow ware" is seldom used in the U.S. to describe this group of manufactured articles. These objects are referred to as enamelware, aluminumware and by various other names. These are discussed in the articles HOME EQUIPMENT; TIN PLATE AND TERSEPLATE; ALUMINUM; PORCELAIN ENAMELING; and in related subjects. (G. C. A.)

HOLLY (Ilex), a large genus of trees and shrubs of the family Aquifoliaceae, containing about 180 species. The genus finds its chief development in Central and South America: is well developed in Asia, especially the Chinese-Japanese area, but has few species in Europe, Africa and Australia. In Europe, where I. *aquifolium* is the sole surviving species, the genus was richly represented during the Miocene period by forms at first South American and Asiatic, and later North American in type. The leaves are generally leathery and evergreen, and are alternate and stalked; the flowers. commonly dioecious, are in axillary clusters and have a persistent four- to five-lobed calyx, a white, rotate four- or rarely five- or six-cleft corolla, with the four or five stamens adherent to its base in the male, and a two- to six-celled ovary, seldom more; the fruit is a globose, usually red drupe, containing two to eight one-seeded stones.


ROCHE

HOLLY (ILEX AQUIFOLIUM)

In North America about 12 native species occur, found chiefly in the southeastern United States. The American holly (I. *opaca*), very similar in appearance and uses to the European holly, is a slow-growing tree, sometimes 40 or 50 ft. high, with a trunk 3 ft. or more in diameter. It grows in moist woods, mostly near the coast, from Massachusetts to Florida, westward to Texas and northward in the Mississippi valley to Missouri and Indiana. Like the old world holly, it is much used for Christmas decoration. The dahoon holly (I, cassine), a shrub or small tree, sometimes 25 ft. high, with oblong, spineless and mostly toothless evergreen leaves, is found from Virginia to Florida and westward to Arkansas and Texas, and also in Cuba and the Bahamas.

The cassena or emetic holly (I. vomitoria), called also yaupon, Carolina tea and Indian black drink, because of its use by the Indians as an emetic and purgative, has nearly the same geographic range as the dahoon. It usually grows 10 to 15 ft. high and has small, minutely wavy-toothed leaves, about one inch long, and small fruits. Several North American species have deciduous leaves. Of these the best known is the Virginia winterberry or black alder (I. *verticillata*), a shrub, 6 to 15 ft. high, native to swamps from Connecticut to Wisconsin and south to Florida and Missouri. The foliage turns black and falls off in autumn, leaving bright-red persistent fruits which are used for winter decoration. Other deciduous species are the smooth winterberry (I. laevigata), native to swamps from Maine to Pennsylvania and Georgia; the deciduous holly (I. decidua), widely distributed in the southeastern states, and the mountain holly (I. montana) of the Allegheny mountain region.

The common European holly or hulver, I. aquifolium, is an evergreen shrub or low tree, having smooth, ash-coloured bark and wavy, pointed, smooth and glossy leaves, two to three inches

long, uith a spinous margin. The flowers. which appear in May, are ordinarily dioecious. as in all the best of the cultivated varieties in nurseries. Darwin says of the holly: "During several years I have examined many plants, but have never found one that was really hermaphrodite." Shirley Hibberd, however, in 1877 mentioned the occurrence of "flowers bearing globose anthers well furnished with pollen, and also perfect ovaries." The holly occurs in Great Britain, northeast Scotland excepted, and in western and southern Europe, from as high as latitude 62° N. in ~ ~ m to Turkey and the Caucasus and in western Asia. It is found generally in forest glades or in hedges, and does not flourish under the shade of other trees. In England it is usually small. probably on account of its destruction for timber, but it may attain to 60 or 80 ft. in height. Some of the trees on Bleak hill. Shropshire. are said to be 14 ft. in girth at some distance from the ground. The holly is abundant in France, especially in Brittany. It will grow in almost any soil not absolutely wet. but flourishes best in rather dry, sandy loam. The holly is propagated by means of seeds. which do not normally germinate until their second year, by whip grafting and budding and by cuttings from the matured summer shoots. Transplanting should be performed in damp weather. It is rarely injured by frosts in Great Britain. where its foliage and bright red berries in winter render it a valuable ornamental tree. There are numerous holly varieties. Some trees have yellow. and others white or even black berries. In the fruitless variety *laurifolia*, "the most floriferous of all hollies" (Hibberdj. the flowers are highly fragrant; the form known as *femina* is. on the other hand, remarkable for the number of its berries. The leaves in the unarmed varieties *aureo-marginata* and *albo-marginata* are of great beauty, and in *ferox* they are studded with sharp prickles. The holly is of importance as a hedge plant, and is patient of clipping. Evelyn's holly hedge at Say's Court: Deptford, was 400 ft. long, 9 ft. high and j ft. in breadth.

HOLLY (ILEX OPACA)

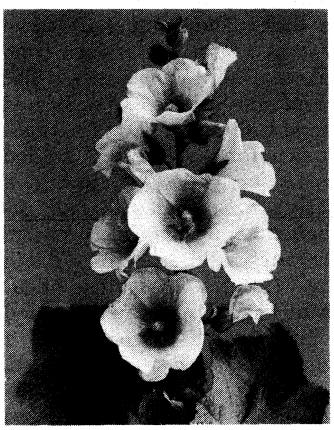
The wood of the holly is even grained and hard, especially when from the heartwood of large trees, and almost as white as ivory, except near the centre of old trunks, where it is brownish. It is employed in inlaying and turning and, since it stains well. in the place of ebony. as for teapot handles. When dry it weighs about 47½ lb. per cubic foot. From the bark of the holly birdlime is manufactured. The leaves are eaten by sheep and deer, and in parts of France serve as a winter fodder for cattle. The berries provoke in man violent vomiting and purging. but are eaten with impunity by birds.

The custom of employing holly and other plants for decorative purposes at Christmas is one of considerable antiquity. and has been regarded as a survival of the usages of the Roman Saturnalia, or of an old Teutonic practice of hanging the interior of dwellings with evergreens as a refuge for sylvan spirits from the inclemency of winter. A Border proverb defines a habitual storyteller as one that "lees never but when the hollen is green." Several popular superstitions exist with respect to holly. In the county of Rutland it is deemed unlucky to introduce it into a house before Christmas Eve. In some English rural districts the prickly and nonprickly kinds are distinguished as "he" and "she" holly; and in Derbyshire the tradition obtains that according as the holly brought at Christmas into a house is smooth or rough, the wife or the husband will be master.

See INKBERRY; MATE; WINTERBERRY.

HOLLYHOCK, *Althaea rosea,* a perennial plant of the Malvaceae. or mallow, family. A native of China, it is widely grown in North America and in Great Britain. The ordinary hollyhock is single blossomed, but the florists' varieties have all double flowers. of white, yellow, rose. purple. violet and other tints, some being almost black. The plant is in its prime in late summer. but by careful management samples may be obtained in blossom from July to autumn.

Hollyhocks are propagated from seed or by division of the root; also single eyes from woodshoots or cuttings from outgrowths of the old stock or of the lateral offsets of the spike may be planted out in rich sandy soil, in a close frame, with a gentle bottom heat. The seed may be sown in autumn under cover. the plants obtained being potted and kept under glass until the following spring. Or, if the seed is late-gathered, it may be planted in the open ground in early summer. the plants being transplanted in the autumn or the following spring. In many gardens. when the plants are not disturbed. self-sown seedlings come up in abundance in late spring. Seedlings may also be raised in February or March by the aid of gentle heat in a light and rich moist soil. They should not be watered till they have made their second leaves and, when large enough for handling. should be pricked off in a cold frame. from which they are subsequently transferred to the flower bed. Hollyhocks thrive best in a well-trenched and manured sandy loam. The plant is susceptible of great modification under cultivation. The forms now grown are the results of the careful selection and crossing of varieties. The most diverse varieties may be raised from plants growing near together.



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HOLLYHOCK (ALTHAEA ROSEA)

The young shoots of the hollyhock are very liable to the attacks of slugs and to a disease called hollyhock rust, caused by a fungus. *Puccinia malvacearum.* P. *malvacearum*, a native of Chile. reached Europe in 1869 and the United States in 1886; it threatened the extermination of the hollyhock. The fungus. which also attacks wild mallows. destroys the soft parts of the leaves, leaving only the veins. It is especially harmful to the plant in dry seasons. The disease appears on the leaves as minute, hard, pale-brown pustules. filled with spores which germinate without a resting period, but which. when produced late in the season. may last as resting spores until the next spring. Sulfur spray is useful in preventing rust. but the disease. once established. is difficult to control. In hot dry seasons. red spider injures the foliage very much. but may be kept at bay by spraying the plants frequently with water. Hollyhock is also susceptible to anthracnose, caused by the fungus *Colletotrichum malvarum.*

HOLLYWOOD, Calif., the principal seat of the U.S. motion-picture and television film industries. is situated about 8 mi. N.W. of the centre of Los Angeles (*q.v.*) to which it was annexed in 1910. Its district boundaries are Hyperion avenue and Riverside drive on the east. Beverly boulevard on the south, the foothills of the Santa Monica mountains on the north and the city of Beverly Hills (*q.v.*) on the west. Spanish annals referred to an unimportant way station on El Camino Real and the Cahuenga pass, the principal route between southern and northern California and back door to modern Hollywood. The first home, an adobe, in the area was built by Don Tomás Urquidez in 1853. It was not until the early farmers or homesteaders settled there in the 1870s that there arose an appreciation of the unique combinations of geography that influenced an unusually pleasant climate. The nearby Pacific ocean conditioned the temperature to a comfortable medium, while the desert stretching to the east helped to keep the atmosphere dry and clear. During the 1880s one of the settlers, Mrs. Horace H. Wilcox from Topeka, Kan.. gave the community the name Hollywood, which n-as derived from the summer residence of a friend in Chicago. By 1903 the colony had developed a pride in local achievements and a desire to control its destiny, and on Nov. 14 voted 88 to 77 to incorporate as the city of Holly-

wood. Because of its arid location! the new city's water supply was inadequate. To solve the problem, Hollywood (pop. then about 4,000) voted in 1910 to become a district of Los Angeles.

The pioneers of the motion-picture industry found southern California extremely well suited to their needs of maximum sunshine, mild temperatures, varied terrain and a labour market. In 1908 one of the first "story" moving pictures. *The Count of Monte Cristo*, begun in Chicago by William N. Selig, was finished in the Hollywood area by Francis Boggs. About this time the Motion Picture Patents company ("Movie trust") was formed in New York by producers licensed by Thomas Alva Edison to use his kinetoscope. A group of independent producers and exhibitors, using French cameras for which patent priority was claimed, threatened the trust's monopoly, resulting in a series of suits, injunctions and even street fights. The independents eventually moved to southern California. The trust companies followed, and studios, independent and trust alike, became centred at Edendale. Resultant overcrowding caused some producers to move a few miles westward into Hollywood. In 1911 David Horsley leased the northwest corner of Gower street and Sunset boulevard for his Nestor film company studio, the first actually in Hollywood. Before the end of the year 15 companies had located close by, to be followed by many others. The trust companies dwindled; the independents eventually dominated the industry.

In 1913 Cecil B. deMille, Jesse Lasky and Samuel Goldwyn combined to produce *The Squaw Man* in a barn just a block from the intersection of Hollywood boulevard and Vine street. The barn was subsequently moved to Paramount Studios and dedicated as a historical monument by the state of California. D. W. Griffith helped give Hollywood a start in the race for supremacy in motion pictures. Early films such as *The Birth of a Nation* (1915) helped set a standard of showmanship. Early stars included Mary Pickford, Douglas Fairbanks, Charlie Chaplin (*qq.v.*), Gloria Swanson, Rudolph Valentino. Harold Lloyd, Francis X. Bushman, William S. Hart, Lillian Gish and Tom Mix. Great studios arose under leaders such as Adolph Zukor, William Fox, Samuel Goldwyn and Louis B. Mayer. The 1920s saw Hollywood as the centre of a movie industry with a world-wide market. Real estate boomed, riches were extravagantly displayed and headline scandals periodically occurred. Censorship bureaus in many cities ordered the suppression of pictures or the deletion of suggestive lines and scenes. The producers responded by forming an organization that became known as the Hays office—a bureau for self-censorship, headed by Will Hays, former postmaster general, under the aegis of the Motion Picture Producers and Distributors of America, Inc.

The advent of the talking picture had a marked effect on the careers of many, Famous stars of the silent screen were forced into retirement. There was a demand for more resourceful directors and screen writers and for technicians with more varied skills to cope with the new sound medium. Film technicians, writers, directors and actors organized into guilds that acquired the status of trade unions.

The effect of television as a competitor to the movie industry began to he felt after the prosperous years of World War II. The Hollywood counteraction was a rash of new techniques involving new lenses, wider screens and stereophonic sound. Nevertheless, thousands of theatres stayed closed and millions of former movie patrons preferred the home television screen. An additional blow was a series of court decisions that the control of theatre chains by major producing companies constituted combinations in restraint of trade, which must be broken up. The major Hollywood studios joined their rival, selling great backlogs of films for televiewing and selling and leasing their facilities for television production requirements. The RKO studio was taken over by television producers. In the early 1960s about 80% of the three main television networks' evening programing originated from Hollywood. The financial structure of movie making underwent a radical change. The old studio giants were largely replaced by a conglomerate alliance of independent producers, profit-sharing stars, bankers, agents and investment counselors. The blocking of foreign currency and capital gains and income tax factors provided incentive for production of an increasing number of films overseas, and the cheap supply of extras and other help encouraged this trend. However, thousands of technically skilled artisans who have made Hollywood and its environs their home have to dome extent been absorbed into the television industry, with an equally vast inventory of equipment. The entertainment industry is so firmly anchored that it will hardly be uprooted. The Central Casting office maintains a file of thousands of bit players and extras.

Radio in Hollywood was a natural outgrowth of its supply of talent, and in pretelevision days Hollywood rivaled New York as radio centre for nation-wide programs. Columbia square, the Mutual Don Lee Broadcasting system studios and the National Broadcasting company studios stand as monuments to radio. The recording of songs written for movies, of radio and television programs and of other popular music is a thriving industry.

In 1919 the Hollywood Bowl, a 50-ac. natural amphitheatre owned by Los Angeles county, became a reality. The pool of artists who moved to the area in the ensuing years made possible the array of talent that attracts record-breaking crowds to the outdoor series of summer concerts known as "Symphonies Under the Stars." Other main points of interest are the outdoor Pilgrimage Play amphitheatre and Greek theatre, the Californian Art club and Barnsdall park.

Hollywood has grown from a country village concerned with the quality of its citrus fruits to a thriving community of more than 200,000, most of whom live in apartments. It has many churches It is known for the manufacture of cosmetics and is among the leaders in the creation of styles in both men's and women's clothes. In the 1960s a redevelopment program was under way.

See also MOTION PICTURES.

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(E. D. BR.)

HOLLYWOOD, a city of Broward county, in southeastern Florida, U.S., on the Atlantic ocean, 18 mi. N. of Miami. Until 1921 it was palmetto jungle with a few pineapple and tomato farms. Joseph W. Young, a developer from California (hence the name Hollywood), starting with 1,700 ac. in the present downtown section, made a geometrically precise layout for the town, which was to be bisected by a broad avenue (Hollywood boulevard) with three circular 10-ac. parks at regular intervals and a hotel at the east end. The city mas incorporated in 1926, but was hit hard by the hurricane and the real estate collapse of that year and grew but little until the 1950s when the population doubled. It shares ownership and benefits of Port Everglades with nearby Dania and Fort Lauderdale. Tourism and some industry. principally electronics, furniture, cement and shipping, with a winter vegetable-growing hinterland make up the economy. It adopted a council-manager form of government in 1926. For comparative population figures *see* table in FLORIDA: *Population*.

(C. W. TE.)

HOLMES, OLIVER WENDELL (1809–1894), **U.S.** physician, poet and humorist, was born in Cambridge. Mass., on Aug. 29, 1809. His father was Abiel Holmes. a minister in Cambridge and author of a creditable historical work. *The Annals of America* (1809). A childless widower upon his settlement in Cambridge, Abiel Holmes had chosen as his second wife Sarah Wendell, daughter of the well-to-do Oliver Wendell. Sarah Holmes was a good-humoured, sociable woman, beloved by her children, to whom she bequeathed the wit that leavened the sobriety of a Calvinist home. She lived to be 93; perhaps it was she who taught her son that "life is a fatal complaint, and an eminently contagious one."

Early Life. — Educated first at local schools, Holmes was sent to Phillips academy (Andover) for a year before entering Harvard in 182j Andover, the seat of a Calvinist theological seminary, was to Holmes a "dove's nest of Puritan faith" and very different from "our heretic college," as he described Harvard, which had become the centre of New England Unitarianism. The battle between the New England Calvinists and Unitarians would soon lead to a skirmish in his father's church. While Holmes, in his junior year, was making a reputation as student, poet and convivial club man. the town of Cambridge became embroiled in the schism in its principal parish. The tao-year battle between the orthodox and liberal groups ended a month before Holmes's graduation with the ousting of his father from the pulpit. For Holmes the blame rested not upon his mild-tempered father nor upon the liberals, but upon the Calvinists who had forced matters to a head. The quarrel left him with an ineradicable impression of "Machiavellian" deacons and contributed greatly to his later compulsion to attack Calvinist doctrines.

Outwardly, young Holmes was unaffected by the quarrel. His talents were recognized by his fellow students, who chose him as class poet, and by the faculty, which awarded him a commencement part. Although his ability was thus acknowledged. Holmes was too sensible to consider a literary career; his choice lay between law and medicine. Acting upon the American conviction

that law was the field for a gifted young man, he enrolled at the Harvard law school but. finding the work dull. he sought relief in writing verses. He was encouraged by five undergraduates who printed his verses in their periodical, *The Collegian* (Feb.–July 1830). These poems, of which the best known is "The Height of the Ridiculous." were reprinted and praised in the newspapers. Having tasted "the intoxicating pleasure of authorship." Holmes later confessed that "there is no form of lead-poisoning which more rapidly and thoroughly pervades the blood and bones and marrow than that which reaches the young author through mental contact with type metal." He was never able to cure the infection, although he tried to when he sought to become established in the profession of his final choice, medicine. Holmes began to study medicine in the fall of 1830, but he published "Old Ironsides" in September; he worked hard under James Jackson, but he published "The Last Leaf" (1831). Following Jackson's cases until he knew more of them than anyone else. he wrote "September Gale" and other well-wrought comic verses. Still scribbling. he nevertheless pursued assiduously the courses at the Harvard medical school and those given by a group of Boston physicians. In these two years he showed what Jackson called the "true zeal" and persuaded his parents that he deserved an additional two years! training in Paris. In France. Holmes forsook poetry and followed the teaching of Charles Pierre Alexandre Louis and others of the school of French clinicians known as therapeutic nihilists for their skepticism about the efficacy of the drugs then employed.

Medical Teacher and Author. — Returning home in Dec. 1833 and taking his medical degree at Harvard. Holmes was qualified to practise medicine, but from the first he desired to secure a professorship. Although he practised medicine for ten years, he also taught. becoming associated in 1838 with other physicians in founding the Tremont Medical School. Holmes's modest practice and two years as professor of anatomy at Dartmouth college, Hanover, N.H., did not interfere with his work at the Tremont school. Practice and teaching provided the income necessary for marriage. and in 1840 Holmes married Amelia Lee Jackson! daughter of Charles Jackson. justice of the supreme judicial court of Massachusetts. The first child, Oliver Wendell Holmes, Jr., who was to become a justice of the supreme court of the United States, was born in 1841; a daughter Amelia (1843) and a son Edward Jackson (1846) completed the family.

The professorship Holmes really sought came his way in 1847 when he became the Parkman professor of anatomy and physiology at Harvard; this post he held until his retirement in 1882. As a teacher he was distinguished for introducing the use of the microscope and for his ability to make his lectures amusing. At Harvard, during his 36 years of service. he was always assigned the one o'clock lecture hour. the last in the students' long morning, because he could keep attention with his. lucidity, wit and delight in the subject. Charles William Eliot. reforming president of Harvard, said of Holmes: "I never heard any mortal man exhibit such enthusiasm over an elegant dissection." Although Holmes did not wholly favour Eliot's reforms of the medical school, he helpfully led the older members of the faculty to accept them. Upon one matter of policy, Holmes was in advance of his colleagues, old or young; he always voted for the admission of women to the medical school.

Although in his medical writings Holmes offered no original discoveries, he employed his talent and knowledge in good causes. In his first medical essay. "Direct Exploration," which won the Boylston medical prize in 1836. he argued for a more frequent use of the stethoscope, which was then not extensively used in America. In the following year he won both Boylston prizes with an essay on neuralgia, competent but not important, and with a study of "Intermittent Fever in New England," described by an authority as the best regional study of malaria. The subject led Holmes into the deserts of Puritan theology. which he described as "more likely to cause a fever than to mention one." With his eyes on a professorship, Holmes published all three essays in 1837. dedicating the volume to C. P. A. Louis, who had taught him the techniques of medical scholarship.

In 1848 Holmes provoked controversy with a *Report on Medical Literature* (prepared for the American Medical association); here he urged his countrymen to produce original work instead of merely annotating English books, not sparing himself from censure for having similarly edited (with Jacob Bigelow) a work by Marshall Hall. Before 1848, however. Holmes had produced his most distinguished medical work, the essay on *The Contagiousness of Puerperal Fever,* 1843. Written at white heat in 21 days. the essay was evoked by discussions in the Boston Society for Medical Improvement. Persuaded by these discussions and by investigation of the literature that the disease was contagious and was transmitted from patient to patient by the obstetricians, Holmes directed all his talents to marshaling the evidence. His article met vigorous opposition from the leading American obstetricians. Although he did not suffer the martyrdom of the Hungarian Ignaz Semmelweiss who published similar conclusions in 1847, Holmes was roundly abused, until in 1855 he was urged to reprint his essay with additional and even more eloquent pleas that the facts be acknowledged, as shortly they were. Holmes's other medical writings, witty and intelligent though less important, show their author as scornful of quackery of all kinds *(Homoeopathy and Its Kindred Delusions,* 1842), insistent upon scientifically tested therapeutic practices (*Currents and Counter-Currents in Medical Science,* 1860), eager to see psychology recognized both in morals and medicine (*Mechanism in Thought and Morals,* 1871) and bold in defense of freedom of investigation (address, *The New Century and the New Building* of *the Harvard Medical School,* 1884). Holmes never devoted himself to pure science; he had not the mind for it: "I like nine-tenths of any matter I study but I do not like to lick the plate. If I did I suppose I should be more a man of science. . . ."

Poet, **Essayist,** Novelist. — His regrets for not having trained himself "to the exhaustive treatment of some limited subject" may be taken with a grain of salt. Distracting him was his delight in the flattering praise his countrymen lavished upon the man of letters, praise they were not disposed to give the labouring scholar. In the same year in which he won the first Boylston prize. Holmes published his first volume of verse *(Poems,* 1836); here he gathered his fugitive early pieces together with "Poetry, a Metrical Essay." In his preface. Holmes bowed himself off the literary stage, and for a time he held with some show of firmness to this "retirement," but he was easily persuaded to make public appearance, poem in hand. for the pleasure of Harvard classmates, fellow citizens, medical colleagues and innumerable visiting celebrities. He early became the unofficial laureate of Boston. As Ralph Waldo Emerson observed: "Holmes is the best example I have seen of a man of as much genius, who had entire control of his powers, so that he could always write or speak *to order:* partly from the abundance of the stream, which can fill indifferently any provided channel."

Holmes was also before the public as a popular lecturer; appearing sporadically on the platform in the 1840s, he became a regular performer in the 1850s. His firecracker wit delighted his audiences, provided he eschewed the slavery question. There his conservative views provoked the wrath of the abolitionists, upon whom he retaliated by diagnosing their complaint as "inflammation of the conscience" and treating them with the corrosive satire of "The Moral Bully." By 1857 Holmes's comic poems and witty lectures had made him famous in his own country and known also to English celebrities like Thackeray, who declared Holmes the best thing he'd seen in America.

In 1857 the literary group in Boston founded a new magazine; James Russell Lowell made his acceptance of the editorship contingent upon the publishers' securing Holmes as a contributor. It was Holmes who gave the magazine its name, *The Atlantic Monthly,* and according to William Dean Howells, its third editor, "he not only named but made it." Page 47 of the first number made the magazine notorious overnight, for it carried Emerson's provoking poem "Brahma" and the tantalizing opening lines of Holmes's *The Autocrat of the Breakfast-Table:* "I was just going to say when I was interrupted." The interruption had occurred 25 years before, when Holmes, after two numbers, abandoned the Autocrat papers published in *The New-England Magazine* (1831, **1832).** *The Atlantic Monthly,* founded in the midst of an economic

depression, owed its survival chiefly to Holmes's essays, and Holmes appears to have been regarded by successive editors as a good-luck piece, for each in his turn anxiously sought assurance that he mould have the doctor's contributions. Many of his poems, all three of the Breakfast-Table books. *Our Hundred Days in Europe, Over the Teacups* and the three novels were there serialized before book publication. *The Autocrat* of 1858 was followed by his alter ego *The Professor* in 1859. The second mas less popular than the first because, under fire from the religious press, Holmes became insistent on attacking Calvinism. His revulsion from Calvinism provided the theme for the novel *Elsie Venner* (1861). Serialized as *The Professor's Story* it brought down upon Holmes's unbowed head the accusation of "moral parricide" and the charge that he was no fit company for Harriet Beecher Stowe. also an *Atlantic* contributor. In writing the novel. Holmes had succumbed to what he astutely recognized as "the flattery of abuse."

A different kind of flattery, that of the *Atlantic's* second editor, James T. Fields, tempted him to try a second novel, *The Guardian Angel* (1867). Somewhat more plausible a story than *Elsie Venner, The Guardian Angel* has the same intention, that of demonstrating the limits of the human will and persuading readers to judge human behaviour from the standpoint of psychology rather than religion. Holmes's third novel, *A Mortal Antipathy* (1885), has a bold psychological theme, but it is ill-conceived and poorly executed; Holmes had undertaken to write it before recovering from the effort of composing a hiography of Emerson (1885). In love with his own planet, Holmes was not prepared to follow Emerson on his metaphysical flights. The best chapter in the biography is that on Emerson's poetry; it particularly pleased readers of the Civil War generation, for it helped them to understand the reverential regard given Emerson before the mar. Holmes's other venture into full-length biography, *John Lothrop Motley* (1879), is more affectionately loyal than informative.

Appraisal. — A mediocre biographer and novelist. Holmes was at his best in the Breakfast-Table chatter, which allowed free play to his wit. As a talker Holmes had his peers in Boston, but no superior. At the monthly meetings of the Saturday club, Holmes delighted in the rapid fire of talk in which his friends Motley and Lowell readily engaged him. According to a less loquacious member of this club of distinguished men, these three wits could all talk at once at high speed without losing the thread of the argument or repeating themselves or each other. While it was said that Holmes talked too much, it was never said that his talk was dull. The conversational form of the Breakfast-Table books, used also in *Over the Teacups*, was for Holmes the ideal medium of expression. Not so sparkling as *The Autocrat* nor so argumentative as *The Professor, The Poet* (1872) is the least pleasing of the four books because it is overweighted with too much serious blank verse instead of being garnished, as the others are, with a variety of poetic forms and moods. *Over the Teacups* (1891), written when Holmes was 80, shows no diminution in wit and no flagging of spirit. In it, the poem "The Broomstick Train" matched "The Deacon's Masterpiece" (in *The Autocrat)* and prompted Lowell to write Holmes that it was "a serious thing to have 'eclipsed the gayety of nations.' " Spontaneous and personal, these four books express Holmes's volatile personality in which, with characteristic candour, he admitted to being "intensely interested." Then too, they provide a record of their author's times, for Holmes's catholic mind touches lightly upon all subjects of current talk, and upon all subjects he flashed the lightning of his wit.

Closely attached to his native ground, Holmes lived all his life in Boston, spending even his summers in Massachusetts, first at Pittsfield and later at Beverly Farms. He contentedly admitted to being as provincial as any Bostonian who contemplated his own reflection in the Frog Pond. He maintained, however, correspondence uith many English friends and was finally. in 1886, persuaded to make his second trip abroad. He spent a triumphant 100 days chiefly in England, where he suffered the delights of a London season; received honorary degrees from Oxford, Cambridge and Edinburgh; and studied with interest Tennyson and Gladstone, who born in 1809 were his exact contemporaries. He managed a flying trip to Paris to make sentimental visits to the cafés he had frequented more than 50 years earlier and to pay a respectful call on Louis Pasteur. The book evoked by the trip is an extended thank-you letter to his hosts.

Surviving all those who had made New England the literary centre of the United States, Holmes fulfilled the expectation of the poem "The Last Leaf." He died on Oct. 7, 1894, and was buried from King's chapel, Boston, in Mt. Auburn cemetery in Cambridge.

BIBLIOGRAPHY.—The best edition of Holmes's works is the Riverside edition, 14 vol. (1891–92). The best edition of his poems is the Cambridge edition of *The Complete Poetical Works*, ed. by H. E. Scudder (1895). *See* also *Representative Selections*, ed. by S. E. Hayakawa and H. M. Jones (1939). The principal biographies are by John *T.* Morse, Jr., *Life and Letters of Oliver Wendell Holmes* (1896), and Eleanor M. Tilton, *Amiable Autocrat* (1947). *See* also *Holmes of the Breakfast-Table*, by M. *A.* DeW. Howe (1939); T. F. Currier's definitive *Bibliography,* ed. by *E.* M. Tilton (1953). (E. M. TN.)

HOLMES, OLIVER WENDELL (1841–1935), justice of the U.S. supreme court, is the only American jurist who competes with John Marshall for the superlative. He was born, a "child of fortune," in Boston, on March 8, 1841. His father was the famed poet-physician, Oliver Wendell Holmes; his mother, the daughter of Justice Charles Jackson of the Massachusetts supreme judicial court. The Olivers, the Wendells, the Jacksons and the Holmeses all played a part in the development of New England, whose intellectual life was being brought to flower during Holmes's youth. He was thus born an aristocrat in the only sense in which the United States has ever had an aristocracy. He was heir. not to great wealth, though he hardly represented the Horatio Alger tradition; nor to distinction. for he had to earn his own place in the firmament; but to an environment of thought in which his mind could be brought to full flower under the most favourable circumstances. His father's intimates included Emerson, Agassiz, Lowell, Longfellow, Prescott, Whittier and Hawthorne. Among his onn companions were Charles Francis, Henry and Brooks Adams and Henry and William James.

Holmes's schooling was that of his time and circumstances: a dame's school. iollowed by a boys' school conducted by a Unitarian minister, then preparation for Harvard college at a Latin school conducted by his future father-in-law, Epes Sargent Dixwell. Harvard college was—in the image of Oxford and Cambridge—a citadel of orthodoxy into which Holmes did not fit. His education was advanced despite his professors, not because of them. Philosophy was his first love and Emerson was his true mentor. Art was a second love. and this appreciation was intuitive; his college essay on Albrecht Durer remains unsurpassed. Writing and good talk were his avocations, and here his father was his master from whom these arts were well learned. Indeed there was a great intellectual debt due from son to father.

Religious orthodoxy, which was then the foundation of Harvard's curriculum, was anathema to Holmes. Dr. Holmes had deserted the strict tenets of his minister-father's Calvinism. His son would not tolerate even the unconfining doctrines of the Unitarian Church. The philosophic skepticism which Holmes developed as a young man and carried through his life was even preceded by a religious skepticism which he apparently got at his mother's knee. For him there were no answers except tentative ones.

The Civil War erupted during Holmes's senior year. Though he was not active in the abolitionist cause—he was never active in any cause—he enlisted immediately. When his battalion was not called up, he returned to Harvard to take his degree. He then secured a commission in the Massachusetts 20th Volunteers, a regiment which participated in the bloodiest battles of the war. Holmes was thrice wounded and three times returned to his regiment, seldom far from the immediate scenes of conflict. He returned to Cambridge when his commission expired before the .end of the war, physically and morally exhausted.

At the Harvard law school, which he attended at his father's instance, Holmes once again met with orthodoxy, this time the orthodoxy of the common law as the perfect legal system. Holmes was less openly rebellious at law school than he had been at college, but no less unwilling to accept the dogmas proffered to him.

After flirting once again with philosophy, he finally determined upon law as a career, but withdrew from law school before completing the course. After a short time in the offices of Robert Morse and John C. Ropes, Holmes set off on the first of many visits to England, which became for him his home away from home.

Europe, and especially England and Scotland, proved most congenial. In England he visited with the great: Gladstone, Roundell Palmer, Lord Houghton, Chancellor Cranworth, Jowett, Mill, Baron Parke, and the duke of Argyll. On this visit as on later visits he made fast and lasting friendships, some of which, as in the case of Frederick Pollock, were recorded in a remarkable series of letters.

When he returned to Boston, Holmes entered the offices of Chandler, Shattuck and Thayer. Of his intellectual debt to Shattuck, one of Boston's great trial lawyers, Holmes said: "I owe more to Mr. Shattuck than I ever owed to anyone else in the world." In Thayer he found a kindred spirit who was to express academically the same doctrines for which Holmes was to become famous as a jurist. Holmes continued to woo philosophy, with Charles Peirce and William James among others, but only as a sideline; he was now fully dedicated to the law. He was admitted to the bar on March 4, 1867, and became a contributor to the *American Law Review* and its co-editor in 1870. In 1869 he undertook the extensive job of producing the 12th edition of Kent's *Commentaries* which was published in 1873. Holmes's official biographer, Mark Howe, has attributed this total immersion in the law to "a Puritan's feeling that no moment should be wasted" (*Justice Oliver Wendell Holmes,* vol. i, Harvard University Press, Cambridge, Mass., 1957). Holmes's less charitable contemporaries regarded the spur as regard for place, for there were in Holmes strong traits of ambition and vanity.

In 1872 he married Fanny Bowditch Dixwell, a marriage which provided a remarkable man with a remarkable wife. Howe has written: "When New England breeds a woman of intelligence and reserve, it occasionally brightens those qualities with a dash of wit, and humor, and ashamed to admit it, softens them with sentiment . . . Cambridge had bred such a girl in Fanny Dixwell. . . ." (*Justice Oliver Wendell Halmes).* When she died, Holmes wrote to Pollock: "We have had our share. For sixty years she made life poetry for me." (Mark De Wolfe Howe [ed.], *Holmes-Pollock Letters,* 2 vol., Harvard University Press, Cambridge, Mass., 1941.)

The early fugitive writings of Holmes were systematized in his most important contribution to legal thinking, *The Common Law,* which was published in 1881 after first being delivered as a series of lectures at the Lowell institute. As Mr. Justice Frankfurter has said: "The book is a classic in the sense that its stock of ideas has been absorbed and become part of common juristic thought. . . . they placed law in a perspective which legal scholarship ever since has merely confirmed." (*Of Luw and Men,* Harcourt, Brace and Co., Inc., New Tork, 1956.) Its opening words set its theme much as do the opening notes of Beethoven's Fifth Symphony: "The life of the law has not been logic; it has been experience." (Little, Brown & Co., Boston, 1938).

The publication of this book led Harvard to offer Holmes the Weld chair at the law school, which he accepted on condition that he be free to take a judicial post were one to be opened to him. For him the ivory tower could only be a second choice: "The final test . . . is battle in some form. . . . It is one thing to utter a happy phrase from a protected cloister; another to think under fire—to think for action upon which great interests depend." (*Mind and Faith of Justice Holnzes,* ed. by Max Lerner, Little, Brown & Co., Boston. 1943.) Less than a year later he was a judge. Holmes served on the supreme judicial court of Massachusetts from 1883 until 1902, the last three years as chief justice.

In 1902 Pres. Theodore Roosevelt, looking for a "liberal" of his own pattern and mistakenly believing he had found him, appointed Holmes to the supreme court of the United States. On the Massachusetts court Holmes had written about 1,300 opinions, most of them resolving controversies between individuals. On the national court he had a different function to perform. But it was in this new arena, which called upon the actors to define the boundaries of governmental power, that Holmes established himself as a peer of Marshall. Unlike Marshall, however. Holmes espoused a doctrine of judicial restraint. And however important his many individual opinions may be, his view of the judicial function is more important: "While the courts must exercise judgment of their own. it by no means is true that every law is void which may seem to the judges who pass upon it excessive, unsuited to its ostensible end. or based upon conceptions of morality with which they disagree. Considerable latitude must be allowed for differences of view as well as for possible peculiar conditions which this court can know but imperfectly. if at all. Otherwise a constitution, instead of embodying only relatively fundamental rules of right, as generally understood by all English-speaking communities, would become the partisan of a particular set of ethical or economical opinions, which by no means are held *semper ubique et ab omnibus."* (*Otis* v. *Parker,* 187 *U.S.* 606, 608 [1903].)

Short of his 92nd year by only a few months, Holmes resigned on Jan. 12, 1932, writing "the time has come and I bow to the inevitable." He died on March 6, 1935, leaving the bulk of his estate to the United States of America. In a message to congress suggesting that these funds be put to an appropriate use, Pres. Franklin Delano Roosevelt said of Holmes that "for him law was an instrument of just relations between man and man. With an insight into its history that no American scholar has surpassed; with a capacity to mold ancient principles to present needs. unique in range and remarkable in prophetic power, nith a grasp of its significance as the basis upon ahich the purposes of men are shaped, Mr. Justice Holrnes sought to make the jurisprudence of the Cnited States fulfill the great ends our nation was eatablished to accomplish." The bequest was ultimately used to finance a history of the supreme court, an appropriate use and a fitting tribute to its great donor.

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(P. B. K.)

HOLMES, WILLIAM HENRY (1846–1933), U.S. anthropologist, was born in Harrison county, O., on Dec. 1, 1846. He graduated in 1870 from McNeely Normal college (Ohio) and in 1872 became an assistant in the U.S. geological survey. He was with the F. V. Halden survey in the Rocky mountain states for eight years, being assistant geologist 1875–80. In 1880 he was appointed geologist and continued his western explorations. From 1888 to 1894 he served as archaeologist with the Bureau of American Ethnology. After a brief period as curator of anthropology at the Field Columbian museum in Chicago (1894–97), he returned to Washington to become head curator of the department of anthropology at the U.S. National museum (1897–1902). After serving as chief of the Bureau of American Ethnology, 1902–10, he again returned to his position as head curator at the National museum, which he held until 1920. During 1908–20 he also served as curator for the National Gallery of Art, and in 1920 gave up his archaeological work to become director of that institution. He mas one of the pioneers in archaeological investigation in the southwest. His researches in aboriginal pottery greatly contributed to knowledge of the habitat and relationships of Indian groups and cultures.

His books include *Art in Shell of the Ancient Americans* (1883); *Ancient Pottery of the Mississippi Valley* (1886); *Pottery of the Ancient Pueblos* (1886); *Ancient Art of the Province of Chirique, Colombia* (1888); *Archaeological Studies Among the Ancient Cities*

of Mexico (1895–97); Aboriginal Pottery of the *Eastern* United States (1903). A complete bibliography of his writings to 1916 is found in *Holmes Anniversary Volume,* Anthropological Studies (1916).

HOLMIUM (symbol Ho, atomic number 67, atomic weight 164.94. stable isotope Ho^{165} [100%]), is one of the least abundant of the metallic elements belonging to the rare-earth group; the name is derived from Holmia, a Latinized form of Stockholm. It was discovered by J. L. Soret in 1878 and independently by P. T. Cleve in 1879. Holmium occurs associated with the other rare earths in the minerals gadolinite, euxenite, xenotime, samarskite, etc. It has usually been purified by the fractional crystallization of the bromates; the yttrium contained in this product is then removed by the fractional crystallization of the double sodium sulfates in a vacuum at 25°–30° C. From 1945 it was separated efficiently by means of ion-exchange columns. After 1953 kilogram quantities of very pure holmium oxide mere separated by this means. Holmium oxide! Ho_2O_3, is yellowish in colour and is generally soluble in acids. It forms orange-yellow salts which are paramagnetic. Solutions show strong absorption spectra. The metal is produced by the calcium reduction of the anhydrous fluoride. It is silvery in colour and becomes ferromagnetic at extremely low temperatures. At slightly higher temperatures it appears to be antiferromagnetic.

The metal crystallizes in the hexagonal close-packed system $a = 3.5773$ Å, $c = 5.6158$ Å, and has a calculated density of 8.799 g. per cubic centimetre. It melts at 1,500° C. and boils in the neighbourhood of 2,600° C. It has an appreciable vapour pressure at the melting point. See RARE EARTHS. (F. H. SP.)

HOLROYD, SIR CHARLES (1861–1917), English artist noted for the technical excellence of his etchings. was born at Leeds on April 9, 1861. It was intended that he should become a mining engineer, but after a false start at the Yorkshire College of Science, Leeds, he received an art education under Alphonse Legros at the Slade school. University college, London.

After obtaining a traveling scholarship he studied for two years (1889–91) in Italy. Except for that interval, he was assistant master at the Slade school from 1885 to 1893. He was an occasional portraitist and landscape painter, and for Aveley church, Essex, he painted a triptych altarpiece.

Holroyd was chiefly distinguished as an etcher possessed of profound technical knowledge. Among the best-known plates are the "Monte Oliveto," "Icarus," "Monte Subasio" and "Eve" series, together with "The Flight Into Egypt," "The Prodigal Son," "A Barn on Tadworth Common" and "The Storm." Holroyd was the first keeper of the National Gallery of British Art (Tate gallery), 1897–1906, and director of the National gallery, 1906–16. He was responsible for the acquisition for the National gallery of the Layard pictures, and for the proper display at the Tate of works by Alfred Stevens and Turner that lay neglected in store. He was knighted in 1903. He died at Weybridge on Nov. 17, 1917.

HOLST, GUSTAV (1874–1934), English composer, was born at Cheltenham on Sept. 21, 1874. His father came of a Swedish family, one branch of which had settled in England early in the century. Holst entered the Royal College of Music, London, in 1893, and was a pupil of Sir Charles Stanford for composition, in which branch he gained a scholarship after two years. He also studied piano, organ and trombone. In 1898 he left the college and for several years played trombone in an orchestra. As a teacher he became associated with the Passmore Edwards settlement (1904), Morley college (1907), Reading college (1909) and St. Paul's Girls' school, London (1905), and after 1919, taught composition at the Royal college. In 1918 he worked among the troops in Salonika, organizing music under the Young Men's Christian association. He visited the University of Michigan, Ann Arbor, in 1923 to conduct a concert of his own works. Holst's international reputation as a composer dates from the appearance of his largest symphonic work, *The* Planets (opus 32), in 1919. Next in importance are the Hymn of *Jesus,* opus 37, no. 1 (1917), for chorus and orchestra; the Choral Symphony, opus 41 (1923); the Vedic Hymns for voice and piano. opus 24, and for chorus and orchestra, opus 26. which, with the opera *Savitri,* opus 28. represent the eastern period in Holst's music; the opera: The Perfect Fool (1923); and the very charming examples of his lighter style —St Paul's Suite for string orchestra (written for St. Paul's Girls' school) and the medieval songs for voice and violin. Holst produced his choral effects with a sureness and ease that tell of long experience. He was particularly successful in writing for female voices. As an instance of his thoroughness it may be noted that he studied Sanskrit for the purpose of making his own translations for his songs, and himself wrote the libretto for *Savitri.* Characteristic of his idiom is the folk-song strain in his melody and the frequent use of unusual time signatures. His other works include Beni *Mora,* opus 29, no. 1, oriental suite for orchestra; suites for military band, opus 28, a, b; Japanese Suite for orchestra. opus 33; part songs for mixed voices, opus 34; choral folk songs, opus 36, no. 2; Ode to Death (Whitman) for chorus and orchestra; fugal overture for orchestra, opus 40, no. 1; fugal concerto for flute, oboe and string accompaniment, opus 40. no. 2.

HOLSTEIN, FRIEDRICH VON (1837–1909), from 1878 to 1906 counselor (Vortragender Rat) in the political department of the German foreign office, was the most important personality, after Bismarck. and equally with William II, in the political history of the German empire. Friedrich August von Holstein was born on April 21, 1837, of an old and noble, but untitled. Mecklenburg family. He attended the Gymnasium and the university in Berlin, and after passing his examinations in law entered the foreign office in 1860 as attaché. His first post was in St. Petersburg, under Bismarck, who was at that time Prussian ambassador. His most important secretarial post was in Paris after the war of 1870–71, first under Generals von Fabrice and von Waldersee, and later, after the re-establishment of the embassy, under the ambassador Count Arnim. He became secretary of legation in 1872, and in 1876. after Arnim's fall, was recalled to the foreign office, where the rest of his career was passed. At the Congress of Berlin in 1878 he accomplished excellent work, which was recognized by Bismarck, and was promoted Vortragender Rat.

After Bismarck's fall he appears at once as the "wirepuller in chief," whose extraordinary influence is known to all the initiated. Holstein was the only man in the foreign office who mastered the complicated principles of German foreign policy, and was able to lay down its course with an assurance which may have been real and in any case was apparent. This situation continued, contrary to expectation, even during Bülow's long years of office. The first time that Biilow acted independently was during the Moroccan crisis of 1905–06. Holstein thereupon tendered his resignation, as the most effective way of gaining his point; it happened, however, that both chancellor and the secretary of state succumbed to strokes in quick succession and the secretary of state's deputy, Tschirschky, submitted Holstein's proffered resignation to the emperor. who accepted it. Even after Holstein's dismissal, Biilow did not despise his advice in later difficulties. A long memorandum by Holstein. for example, exerted a decisive influence on the attitude of the German government in the Bosnian crisis of 1908–09. He died in Berlin on May 8, 1909.

Relations With Bismarck.— Bismarck kept in personal touch with his former attaché, whom he took with him ten years later to headquarters at Versailles, afterward appointing him to the embassy under Freiherr von Arnim. It was there that the first great scandal arose, which is characteristic of Holstein. Soon after Arnim's appointment to the embassy, Bismarck quarreled with him, and employed Holstein to spy on his chief. In the trial in which Bismarck broke the ambassador, Holstein was obliged to come forward as a witness and to admit that he had written letters to the chancellor about his chief, Count Arnim. Bismarck had unmasked the secretary of legation before all the world as an intrigant; and this earned Holstein's undying hatred. He believed that Bismarck had shamed him as a traitor in order to make him a degraded and unresisting tool. The passion of injured pride and vanity with which he reacted against this, the force of hatred, which was to endure nearly 20 years, are no less characteristic of Holstein than his secret collaboration with Bismarck against Arnim.

Prince Philip Eulenburg is the chief authority for the statement that Holstein was mainly instrumental in bringing about Bismarck's fall. But, he says, Holstein's tread was so soft and so

hidden his ways, that he himself failed to detect the secret method of this enemy. It is impossible to say how far Holstein was influenced by his old hatred, how far by boundless ambition, which could not bear even a Bismarck in its path. and how far by political conviction that Bismarck's policy had ceased to be sound. Any of these three motives may have been present.

Diplomatic Decisions. — Whether Bismarck, after the Congress of Berlin, did or did not utter the proud saying, "From now onward I will drive Europe four-in-hand in harness." the foreign office in Berlin was fully convinced that this was Germany's position in Europe, at least up to the Conference of Algeciras, and Holstein developed this conviction into a system. As England would never be able to reconcile its differences either with France or Russia. the triple alliance would always remain the dominating combination, even in the case, which hardly needed to be considered seriously, of Russia's joining France in the war against Germany. That was Holstein's basic idea. He therefore held the task of German statesmanship to be to play off England and Russia against each other, either placing them under an obligation by some service. or coercing them by threats if the counterservice was not rendered. He did not in any case want to start a war. That was to be left to the tao world powers which were described as the bear and the whale. and which, it was thought, must inevitably clash. This clash mould then give Germany its great opportunity.

This was the system on which Holstein based his policy. It began with the nonrenewal in March 1890 of the German-Russian treaty of 1887. It would have been consistent with Holstein's policy to keep the treaty, but the system also allowed him to ignore it. For Holstein did not believe that Russia could form an alliance with France nhich would stand the test of Mediterranean policy. The suggestion that a treaty with Russia, added to one with Austria, was an act of dishonesty toward the latter power, was incorrect. Both treaties nere defensive in their terms, and the aim of the double arrangement was not to let either of the two rivals in the Balkans act against the other and thereby against the peace of Europe. It is true, as Caprivi and others maintained, that this policy was more difficult to conduct than one which dealt uith Austria alone. But Holstein shunned rather than sought simplicity; the only explanation of his decision is therefore his hostility to Bismarck. Bismarck's fall was to be final, his return made impossible. Up to Bismarck's death, Holstein was always tortured by the nightmare of the possible return of the "Bismarcks." The danger of return would. however, have been greater on the renewal of the Russian treaty than at any other time. The following year saw Russia's political understanding with France, and 1892 the drafting of that military convention which was still in force in 1914. If it is remembered that at least up to 1908 Russia did not come into any sort of conflict, even with Austria. much less with Germany, it is clear that the one circumstance nhich drove the tsar into the arms of France was the nonrenewal of the treaty. which was accompanied by ostentatious advances by the emperor William to England, causing the tsar to fear an attack. Thus two days after Bismarck's dismissal, the superiority of the triple alliance. which had hitherto been indubitable. vanished. France emerged from its isolation, and a danger of war betneen the two European systems of alliance arose. The chief responsibility for this must rest on two men: the emperor and Holstein.

In the succeeding period Holstein's political path always led him nearer to Russia than to England. This attitude was largely due to his dislike of Lord Salisbury. The rebuffs experienced by Eismarck in 1887 and 1889 from the British foreign minister seem to have had a strong aftereffecton Holstein. Between 1893 and 1895 came England's refusal to agree to the Italian plan of redrafting the Mediterranean agreement of 1887 more closely and more favourably for Italy. Holstein had supported Italy's wishes, and felt the refusal as a personal rebuff. Again. after the Chinese-Japanese war, Germany joined the Russo-French note, while England refused at the last moment, making Germany's attitude conspicuous. Holstein believed that England had maneuvered him into a false position. Then, in 1895, the British prime minister sounded the powers regarding the partition of Turkey. Here Holstein conceived a fixed idea that British policy was aiming at bringing Germany into opposition with Russia and getting it to pull the chestnuts out of the fire for Great Britain. For Holstein assumed that Salisbury had conceived the whole plan in order to keep Russia quiet in the far east. Later, after the emperor had met Salisbury's suggestions with a sharp refusal, Holstein saw that the plan had accorded with Russia's interests, and altered the foreign office's recommendation, but too late.

Holstein is quite certainly the spiritual father of Germany's attitude toward the advances made by Chamberlain and Lansdowne in 1899–1901. In England itself. Salisbury consented only with reluctance to negotiations for a general understanding betneen England and Germany; and the idea immediately encountered the strongest opposition from Holstein. He feared that Germany was to be driven into a war with Russia and France and dropped at the decisive moment. He rightly saw that England would be unable to allow a fresh victory by Germany over France. But he failed to see that if England were bound to Germany by a general understanding, and the U.S. and Japan also joined this combination, as seemed possible. then Russia and France would never have dared risk a war with Germany, Austria and Italy. On the other hand. Holstein committed the error of considering England's differences uith France and Russia to be insuperable, although Chamberlain made it absolutely clear that England, if rebuffed by Germany, would seek and find a settlement of its differences with Russia and France, which must then necessarily bring it into opposition to Germany. The negotiations were dragged out so long at Holstein's orders, and made so difficult that at last the British government broke them off in Dec. 1901 after concluding the treaty with Japan.

When war threatened to break out between Russia and Japan in 1904, Holstein remained so conspicuously deaf to all warnings, particularly from Freiherr von Eckardstein. the well-informed councilor of embassy in London, that at this point the suspicion arises that financial motives influenced his attitude. During the war he adhered to his former policy of contact with Russia and strained relations dangerously with England by allowing Russian ships of war to take in German coal in the Baltic. If England had now joined Japan in its fight with Russia, and if France had supported its ally Russia against England and Japan, the continental alliance between Russia, France and Germany would have been formed. Without wishing for a war aith England, which would have entailed the sacrifice of Germany's mercantile marine, Holstein envisaged the possibility of this alliance; and there is proof that one of the motives behind the German naval program was the wish to enhance Germany's value to Russia as a potential ally. The emperor, indeed. when he afterward concluded the desired alliance with the downcast tsar at Bjorkoe on July 24, 1905, privately altered the foreign office draft and limited the obligation of active mutual assistance to Europe, evoking thereby Bülow's offer of resignation, which was as unexpected as it was unnelcome to him. Bülow could have nullified the effect of the treaty of Bjorkoe, which the Russian foreign minister. Count Lamsdorff, saw to be impracticable, without resigning; his threat of resignation must be therefore looked on as a successful attempt to curb the emperor's power—a typical Holstein maneuver.

The last time that Holstein determined German policy was over the first Morocco bargain with France. The Anglo-French entente had just been concluded and England had promised to support France in its action. which was irreconcilable with the 1880 Morocco convention of Madrid. Holstein had always declared the Anglo-French entente to be a dream, and wished to seize the opportunity to shatter it. If this artificial neb were only held to the light of the sun, he thought, the natural opposition of the two powers in Morocco must pulverize it. The emperor wanted Germany to remain disinterested in Morocco; but Bülow and Holstein sent him to Tangier against his will. There by a speech, not that drawn up for him by the foreign office, but one of his own—which gave Holstein a nervous shock—he drew on himself public disapproval of his personal interference. The French and British governments would have been glad to find a diploinatic

settlement for the matter. but Holstein insisted on a conference and was not even satisfied by Delcassé's leaving the French cabinet. He wanted to put forward and eniorce such unmistakable and decisive demands as to compromise the Anglo-French entente. As Russia was absolutely out of action at the moment, and the French government was consequently unable to risk an armed conflict; and as Germany also had international law on its side, which must place the British government in an embarrassing light, Holstein's campaign, which he planned with great energy, had every prospect of success. But here for the first time Bülow failed to follow his tyrannical adviser. Fear of possible war with Great Britain, which would annihilate Germany's trade, seems to have been his decisive motive. Holstein in consternation tendered his resignation for the 14th time, and this time, as said above, it was, contrary to expectation, accepted. Thus he relinquished the reins of policy, after holding them since Bismarck's resignation. Only once again, during the Bosnian crisis, had he an opportunity of affecting a great decision by his advice. Holstein believed that the issue of the crisis had been a victory for Germany, which repaired the defeat of 1906. This was a grave error. Far from loosening the entente. Russia's defeat over the Bosnian question in 1908–09 resulted in a reconstruction of the entente on lines of closer diplomatic co-operation, and in a determination to arm.

It was Holstein who by his share in the nonrenewal of the German treaty with Russia took the decisive step in making Germany dependent on Austria-Hungary. In trying to repair this fault by a *rapprochement* with Russia, he missed the hour in which Great Britain could have been won for the triple alliance, without being able to overcome the hostility of Russia, which dated from 1878 and had its roots in its rivalry with Austria in the Balkans. Finally, when England had composed its difficulties with France and Russia. consequent on which Italy also joined this group, Germany was left alone with Austria-Hungary. Possibly Holstein's Morocco policy would have been a more effective way of breaking the increasing menace of encirclement than Austria's war with Serbia in 1914. But it was due to Holstein's policy that the two central powers were isolated at all. (E. Fr.; X.)

HOLSTEIN, formerly a duchy of Germany, later incorporated in Prussia. Until about 1110 the county of Holstein formed part of the duchy of Saxony. and it was made a duchy in 1472. From 1460 to 1864 it was ruled by members of the house of Oldenburg, some oi whom were also kings of Denmark. By the treaty of Vienna (Aug. 1864) which concluded the Danish War. Holstein was ceded to Prussia and Austria jointly, but placed under the administration oi Austria, which. however, was forced to deliver it over to Prussia after the Austro-Prussian War of 1866. *See* SCHLESWIG-HOLSTEIN; SCHLESWIG-HOLSTEIN QUESTION.

HOLSTENIUS, LUCAS, the Latinized name of LUC HOLSTE (1596–1661), German humanist, geographer and theological writer. was born at Hamburg. He studied at Leyden university, where he became intimate with the most famous scholars of the age—J. Meursius. D. Heinsius and P. Cluverius. whom he accompanied on travels in Italy and Sicily. Eventually he went to Paris, and was recommended to Francesco Cardinal Barberini. papal nuncio and the possessor of the most important private library in Rome. He was appointed librarian of the Vatican by Innocent X. and was sent to Innsbruck by Alexander VII to receive Queen Christina's abjuration of Protestantism. He died in Rome on Feb. 2. 1661. Holstenius was the author of notes on Cluvier's *Italia antiqua* (1624); an edition of portions of Porphyrius (1630); notes on Eusebius *Against Hierocles* (1628). on the sayings oi the later Pythagoreans (1638), and the De *diis et mundo* of the neo-Platonist Sallustius (1638); *Notae et castigationes in Stephani Byzantini ethnica* (first published in 1684); and *Codex regularum, Collection of the Early Rules of the Monastic Orders* (1661). His correspondence *(Epistolae ad diversos,* ed. by J. F. Boissonade, 1817) is a valuable source of information on the literary history of his time.

HOLT, SIR JOHN (1642–1710), lord chief justice of England. remembered for the firmness with which he upheld his prerogatives in opposition to the authority of the houses of parliament. was born at Thame. Oxfordshire, on Dec. 30, 1642. He studied at Oriel college, Oxford, and at Gray's Inn, London. He was called to the bar in 1663. An ardent supporter of civil and religious liberty, he defended accused persons in many state trials. In 1685–86 he was appointed recorder of London. He was dismissed from this office about a year later after refusing to pass sentence of death on a soldier for desertion. He doubted whether the soldier's conviction in peacetime was good in law. As a legal assessor to the peers in the convention Holt took a leading part in the Glorious Revolution, and after the accession of William III was appointed lord chief justice of the king's bench. In judicial fairness, legal knowledge and ability, clearness of statement and unbending integrity he had few superiors on the English bench. In 1700 Holt was offered the great seal, but declined it. He died in London on March 5, 1710. (R. G. M. B.)

HOLTEI, KARL VON (1798–1880), German poet, playwright, novelist and actor who achieved success by his "vaudevilles" or ballad operas and by his recitations, was born at Breslau, Jan. 24, 1798. After studying law, in 1821 he married the actress Luise Rogée (1800–25) and was made official poet at the Breslau theatre. He soon went to Berlin where his two popular ballad operas, *Die Wiener in Berlin* and *Die Berliner in Wien,* were produced in 1824, and where he also wrote a number of plays for the Konigsstadter theatre, notably *Lenore* and *Der alte Feldherr* (both 1829). In 1830 he married the actress Julie Holzbecher (1809–39) and with her toured Germany and Austria. In Vienna in 1833 he created a sensation by his brilliant recitations, especially of Shakespeare, and was appointed manager of the Josefstadter theatre, where he remained until 1836. From 1837 to 1839 he was manager of the theatre at Riga, and then led a wandering life until 1847, when he settled at Graz, where he wrote several novels. The last years of his life were spent at Breslau, where he died, Feb. 12, 1880. As a dramatist his chief importance was that he introduced the "vaudeville" into Germany; as a poet. he was particularly successful in the Silesian dialect; as a reciter, he was unequaled, especially in his interpretation of speeches from Shakespeare. His lively autobiography, *Vierzig Jahre,* was published in 6 vol., 1843–50, with two supplementary volumes, *Noch ein Jahr in Schlesien* (1864); his plays appeared in 6 vol. in 1867, and his collected works in 39 vol. (1861–66).

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HÖLTY, LUDWIG HEINRICH CHRISTOPH (1748–1776), German poet, the most gifted lyric poet of the Gottingen circle, was born Dec. 21, 1748, at Mariensee, Hanover. In 1769 he went to Gottingen to study theology and became a close friend of J. M. Miller. J. H. Voss, H. Boie, the brothers Stolberg and others, with whom he founded (1772) the *Gottinger Dichterbund* or *Hain,* a group of young poets, mostly of peasant background, whose work drew inspiration from folk song and ballad. His poems appeared in the society's *Musenalmanach* and other collections. He died of tuberculosis at Mariensee. Sept. 1. 1776. His *Gedichte* were published by Friedrich Leopold zu Stolberg and Voss, 2 vol. (1782–84); an enlarged edition by Voss (1815). included a biography. There was a critical edition by W. Michael, 2 vol. (1914–18).

Holty was influenced by J. P. Uz and by Klopstock, but his love for the *Volkslied* and his real delight in nature preserved him from the artificiality of the one and the cloudiness of the other. A strain of natural melancholy, tempered by sincere religious faith, runs through his lyrics. His ballads are the pioneers of the rich ballad literature which, influenced by English models made available by the publication of Percy's *Reliques* (1765), sprang up in Germany in the late 18th century. He also translated from Anacreon. Ariosto, Tasso and the English poets.

See H. Ruete, *Holty, sein Leben und Dichten* (1883); *W.* Kayser, *Geschichte der deutschen Ballade* (1936).

HOLTZMANN, HEINRICH JULIUS (1832–1910), German Protestant theologian, was born on May 17, 1832. at Karlsruhe. He wrote on the Synoptics (1889), the Johannine books (1890) and the Acts of the Apostles (1901) in the series *Handkommentar zum Neuen Testament.*

Other noteworthy works are the *Lehrbuch der histor.-kritischen Einleitung in das Neue Testament* (1885, 3rd ed. 1892), and the *Lehrbuch der neutestamentlichen Theologie* (2 vols., 1896–97; 2nd ed., 1911).

HOLUB, EMIL (1847–1902), Bohemian traveler in south-central Africa, was born at Holitz, eastern Bohemia, on Oct. 7, 1847. In 1872 he went to the Kimberley diamond fields and practised as a surgeon. He undertook expeditions to the northern Transvaal. blashonaland and through Bechuanaland to the Victoria falls, making extensive natural history collections. In June 1886 he crossed the Zambezi west of the Victoria falls and explored the then almost unknown region between that river and its tributary the Kafue.

When the expedition was beyond the Kafue the camp was attacked by the Mashukulumbwe. and Holub had to retreat. He returned to Austria in 1887 with a collection of great scientific interest, of over 13,000 objects, now in various museums. Holub died at Vienna on Feb. 21, 1902.

His principal works are: *Eine Culturskizze des Marutse-Mambundareichs* (1879); *Sieben Jahre in Südafrika,* etc. (2 vol., 1880–81), of which an English translation appeared; *Die Colonisation Afrikas* (1882); and *Von der Kapstadt ins Land der Maschukulumbe* (2 vol., 1888–1890).

HOLY, sacred, devoted or set apart for religious worship or observance. It is a term characteristic of the sublimity and perfection of God, as the object of human reverence, awe and worship; and it is applicable to all that is held sacred or that excites awe, particularly, though not exclusively, to what is worthy of veneration or reverence on the ground of its moral worth; hence the term is transferred to those human. persons, who, either because of their devotion to a spiritual life, or because of their moral perfection, are considered worthy of reverence. *See* RELIGION.

HOLY ALLIANCE, the name given to a 19th-century organization of collective security for Europe after the French Revolutionary and Napoleonic Wars. The outcome not of a comprehensive general agreement but of a series of diplomatic acts and proceedings. it took its name from a treaty between Alexander I of Russia. Francis I of Austria and Frederick William III of Prussia. This treaty was signed in Paris on Sept. 26, 1815, while the members of the Quadruple alliance, namely Russia. Austria, Prussia and Great Britain. were negotiating a new peace treaty with France after the Hundred Days.

This treaty was supposed to inaugurate a community of the Christian nations of the world. without regard to the question of victory or defeat in the preceding wars. Though Great Britain steadfastly refused to accede to it, France was secretly admitted to the Holy alliance on Nov. 19, 1815, just before the signing of the second treaty of Paris between the allies and the restored Bourbon kingdom of France and the public renewal of the Quadruple alliance (Nov. 20). France's accession to the Holy alliance was made public at the congress of Aix-la-Chapelle (*q.v.*) in 1818.

For a long time historians regarded the treaty concluded on Sept. 26. 1815. as a sort of mystical union which the influence of the baroness von Kriidener (*q.v.*) had brought Alexander to sponsor. It seems, however, that Alexander was less preoccupied by evangelical exaltation than by a political design to create an international concert through which Russia could counterbalance the sea power of Great Britain by that of other maritime nations. such as the Netherlands, France. Spain (which all acceded to the treaty! and the United States (which however declined the invitation to accede). Such a concert would indeed have had an effect opposite to that of the Quadruple alliance. through which Viscount Castlereagh hoped to maintain a continental European balance of power favouring British interests. All the powers, however, mere at one in wanting to avoid another war and to continue that system of conferences and congresses which had preserved allied unity in the negotiations with France. Consequently at the congress of Xix-la-Chapelle in 1818 the Austrian minister Metternich was able to achieve some compromise between divergent aspirations of the participant powers. The general system that emerged from the compromise was manifested in the subsequent congresses of Troppau, of Laibach and of Verona (*qq.v.*) in 1820, 1821 and 1822.

Another consequence of the common desire to avoid a major war was that the powers sought to maintain the existing state of affairs. This concern explains the Austrian intervention in Naples and in Piedmont (1821j and the French intervention in Spain (1823); and it also explains to some extent the pressure brought by the other powers to prevent Russian intervention against Turkey over Greece (1821–23).

Castlereagh's diplomacy meanwhile succeeded in excluding from the series of congresses the maritime powers, such as Spain and the United States, which Alexander I would have liked to invite. The result was that the system of the Holy alliance was confined to Europe. Though both France and Russia tried to extend its operation to Latin America, the British minister George Canning and the U.S. president James Monroe together succeeded in limiting it to the North Atlantic seaboard; and France, authorized to intervene in Spain by Russia, Austria and Prussia at the congress of Verona, was deterred from carrying this intervention to South America, where the Spanish colonies were in revolt. Thereafter the French government, in order to protect its economic interests in America, had to seek a *rapprochement* with the liberally disposed nations of the Atlantic world.

With France's virtual secession, the general system fell to pieces. Thenceforward the Holy alliance was nothing more than the coalition of Russia. Austria and Prussia for the maintenance of the existing order in eastern Europe. Among the Atlantic powers the free-trade policy advocated from 1822 by the British board of trade became the basis of peaceful relations.

For further discussion of British foreign policy during this period see the biography of Castlereagh under LONDONDERRY, ROBERT STEWART, 2ND MARQUESS OF. For U.S. policy *see* MONROE DOCTRINE, THE.

See also references under "Holy Alliance" in the Index volume.

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HOLY CHILD JESUS, SOCIETY OF THE (S.H.C.J.), a teaching order of women religious founded in England in 1846 by Cornelia Connelly (*q.v.*). The general mother house is at Rome, and members number around 800.

See WOMEN'S RELIGIOUS ORDERS: *Since the French Revolution.*

HOLY CROSS, CONGREGATION OF, (CONGREGATIO A SANCTA CRUCE; C.S.C.), a Roman Catholic institute of religious. was formed in 1837 by Basil Moreau by uniting the Auxiliary Priests (founded by him in 1835) and the Brothers of St. Joseph (founded by James Dujarie in 1820) at Sainte Croix, Le Mans, France. In 1841 the Marianite Sisters of Holy Cross were founded by Moreau. There are a priests' society and a teaching brothers' society. both having nonteaching brothers, the same constitutions and top administration, but each is otherwise autonomous at the provincial level. Approximately 3.000 Holy Cross priests and brothers in 11 provinces are stationed in Haiti, Brazil. Chile, Ireland, France. Spain. Italy. Ghana. Liberia, Uganda. Pakistan, India, Canada and the United States. The generalate is in Rome, Italy. Best known of Holy Cross operations are St. Joseph's shrine. Montreal; the Family Rosary crusade: and the University of Notre Dame. founded in 1842 near South Bend, Ind.. by E. F. Sorin.

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HOLY DAYS OF OBLIGATION are religious feast days on which Roman Catholics are bound to attend Mass and refrain from unnecessary work. Although all Sundays are sanctified in this nay, the term "holy days" usually refers to other feasts that must be observed in the same manner as Sunday. The number of such days has varied greatly, since until the 17th century bishops had the right to institute new feasts for their dioceses. At that time Pope Urban VIII limited the number of holy days through-

out the church to 36. In 1918. taking into account the difficulty of observing religious feasts that are not civil holidays, canon law designated ten holy days: Christmas, Circumcision, Epiphany, Ascension. Corpus Christi, Assumption, Sts. Peter and Paul. All Saints, the Immaculate Conception, and St. Joseph. By papal permission this number is reduced in some countries. Thus the Immaculate Conception and St. Joseph are not observed in England and Wales; Epiphany, Corpus Christi, Sts. Peter and Paul and St. Joseph are not kept in the United States. Canada has the same holy days as the United States except that the Epiphany is observed and the Assumption is not. Scotland and Ireland keep all ten holy days, except that Ireland celebrates St. Patrick's day instead of St. Joseph. The various Eastern Catholic churches have their own feasts of obligation; which are generally more numerous than those of the western church. *See* also CHURCH YEAR.

(J. H. ZI.)

HOLY GHOST: *see* HOLY SPIRIT. THE.

HOLY GHOST, CONGREGATION OF THE (CONGREGATIO S. SPIRITUS SUB TUTELA IMMACULATI CORDIS BEATISSIMAE VIRGINIS MARIAE; C.S.Sp.), a Roman Catholic society of men, founded in 1703 in Paris, by a former lawyer, Claude François Poullart des Places. Originally intended only for the training of seminarians. the congregation gradually began to take an active part in missionary work. Suppressed by the French Revolution. it was restored under Napoleon, but recurrent persecution kept it weak until 1848 when the Congregation of the Immaculate Heart of Mary merged with it and Venerable Francis Libermann. a convert from Judaism. became its 11th superior-general. The congregation pioneered in the resumption of African missions in the 19th century. Xlong with missions (of which the African are still most significant) the Holy Ghost Fathers (Spiritans) staff many educational and social works. The general mother house is in Paris and members number about 5.000.

(V. F. G.)

HOLYHEAD, a seaport town and urban district in the Anglesey parliamentary division of Wales, on Holy or Holyhead Island at the western end of the county of Anglesey. Pop. (1961) 10,408. Area 1.1 sq.mi. It is a railway terminus and one of the main ports for Ireland. 263½ mi. by rail and 257 mi. by road N.W. of London. There are many traces of prehistoric and Roman occupation including a large hill fort on Holyhead mountain and the Roman fort of Caer Gybi. A fishing village. Holyhead was selected as a port for Dublin in 1801 and in 1815–19 T. Telford built the Shrewsbury–Holyhead road with the Menai bridge. A new harbour protected by a breakwater (1½ mi.) was opened in 1873 and enlarged in 1875–80. Steamers ply to Dun Laoghaire and Greenore, and as well as port activities there are quarrying and some light industry. The town is also a seaside resort. Holyhead mountain (720 ft.) is a heather-covered granite rock joined by a suspension bridge to South Stack. where there is a lighthouse. Thousands of sea birds breed on the surrounding cliffs.

HOLY ISLAND or LINDISFARNE, an island in the North sea. 2 mi. from the coast of Northumberland, in which county it is included. Except at high tide it can be reached on foot from the mainland. Area 2.1 sq.mi. Pop. (1951) 238. To the north are sand hills. noted for wild flowers. The south is fertile and under cultivation. There is a lake of 6 ac. in the northeast and three miles of sandy beach on the north shore. The village lies at the southwest angle, beside a small, natural harbour used by fishing boats and by yachts in summer. To the east is the castle. built on a basaltic rock rising about go ft. from the sea. and off the southwest shore is St. Cuthbert's Island. a flat grass-covered rock with traces of a chapel used as a retreat by St. Cuthbert and his monks, according to Bede.

The island's history begins with the arrival in 63j of St. Aidan. who came from Iona at the request of King Oswald. later saint and martyr, to preach to the Northumbrians. He made it the site of his church and monastery and the head of the diocese. The sixth bishop in succession was St. Cuthbert (685–687) who was buried in the place of honour on the south side of the altar. In 793 the Danes landed. burning the settlement and killing many of the monks. The survivors rebuilt the church but in 875, fearing a second invasion. they fled inland with St. Cuthbert's body, the Lindisfarne Gospels—a 7th-century art treasure—and other relics. They settled first at Chester-le-Street and eventually at Durham (995). In 1082 the prior and convent of Durham refounded the monastery of Holy Island as a dependent cell. Threatened again by invasion, the island was garrisoned toward the end of the 16th century. During the Great Rebellion the castle was held for the king until 1646. In the first Jacobite rising (1715) it was seized for the Old Pretender. The parish church of St. Mary, close by the village market place, grew from a Norman core. The southwest front may include part of the original building (1146) while the three Norman arches of the north arcade show the ornamental use of alternate red and white stones. Kearby are the picturesque red sandstone ruins of Lindisfarne priory (c. 1100) and the museum containing carved stones of the Viking period. A Celtic cross on the village green. designed by John Dobson, was set up in 1828 on the site of the old market cross. The castle. built *c.* 1500, was restored as a private residence by Sir Edwin Lutyens after 1900. Sir Edward de Stein presented it to the National trust in 1944. Inshore fishing and tourist traffic are the principal resources. The nearest railway station is Beal, opposite the island but 1¼ mi. inland. As early as the 1 jth century the inhabitants were governed by two bailiffs. There are coast-guard and lifeboat stations.

For Bibliography, *see* NORTHUMBERLAND. (E. M. Hw.)

HOLYOKE, a city in Hampden county, Mass., U.S., 8 mi. N.W. of Springfield, between the Mt. Tom range on the west and the Connecticut river on the east. The city's many hills and industrial canals give it a European character. The residents are mainly Roman Catholic and tend to group themselves into districts which are predominantly Irish, French, Polish and German.

Holyoke was first part of Springfield (*q.v.*) and was included in West Springfield when that town was incorporated in 1774. Holyoke was settled in 1725. Industrial development began with the building of a dam across the Connecticut river in 1828. The present dam at Hadley falls, providing waterpower for the paper mills, was completed in 1900 to replace the second one which was completed in 1849. Holyoke was incorporated in 1850 and became a city in 1873.

The city enjoys considerable cultural and economic autonomy (its public utilities are municipally owned). and is identified as part of the Springfield-Holyoke metropolitan area. Once regarded as "The Paper City," its industry became diversified after the depression of the 1930s. Manufactures include electric equipment, beer, fabricated steel. leather and synthetic fabrics; however, paper, printing and textiles remain the most important products. Mount Holyoke college (1837) is at South Hadley across the river. The census figure for 1960 of 52,689 is 13.7% below the 1920 peak population of 60,203. (GE. G.)

HOLY ORDERS, a grade or status in the ordained ministry of the Christian church, comprising the major orders of priest. deacon and subdeacon and the minor orders of porter (doorkeeper). lector, exorcist and acolyte. The term "order" (Lat. *ordo*, plural *ordines*) was adopted by the church from Roman civil life and was first used ecclesiastically by Tertullian to mean both clergy and laity. Gradually. however, it came to mean some office to which a person had been specifically admitted by a bishop and authorized to perform its duties. By the 6th century a bishop admitted young boys into his *familia* ("household"). giving them their first tonsure: after which they were trained to discharge minor duties in the church. This adoption rite included the verse Ps. xvi, 6. containing a reference to "inheritance" (Gr. *clerus*), meaning that the boy was now a clerk and a member of the clergy, having office in one of the four minor orders. Later he could be ordained by the bishop to the major orders of subdeacon. deacon, priest and bishop (at that time considered an order apart from the priesthood).

In the earlier centuries there is no evidence either that a clerk in a lower order was required to pass by regular steps to a higher order or that a layman could not pass directly to any office in the church. By the 9th century. however, there were cases of clergy being deposed from the higher orders because they had not passed through the lower. In consequence it began to become the rule that a clerk must progress from the lower to the higher order.

and that he should do so at regular intervals of time. These requirements are still observed; it is for instance not permissible to receive two major orders on the same day. Though early in the history of the church the office of bishop was regarded as completely separate from the other orders. later bishops and priests were classed together as *sacerdotes.* This usage was confirmed by the 23rd session (1563) of the Council of Trent. according to which archbishops, metropolitans and patriarchs are bishops who hold separate grades not of the episcopate but of the priesthood. Some eastern churches. however, notably the Nestorian, Syrian and Coptic, continue to recognize within the episcopate different grades. each of which is entered upon after a distinctive ordination.

Roman Catholic Church.—A candidate for holy orders must be a baptized man. not suffering under canonical impediment nho has a vocation, has reached the right age, has attained the appropriate academic standard. is of suitable character and has a specific clerical position anaiting him A candidate for the subdiaconate must be at least 21 years old for the diaconate 22. for the priesthood 23 for the episcopate 30. All persons in holy orders (which once given, have an indelible character) must be celibate and recite the divine office daily. The chief duty of both deacon and subdeacon is to assist the priest at high Mass, when the subdeacon reads the epistle and the deacon the gospel (though in practice tno priests normally act as deacon and subdeacon). The deacon is also allowed on occasion to baptize and to preach. The priest has authority to celebrate Mass. to pronounce absolution. to administer solemn baptism, to anoint the sick, to bless and to preach He enters upon his office through the sacrament of ordination. which is administered by the bishop. If appointed to a parish he has the cure of souls within that parish.

Bishops are either elected by the cathedral chapter or chosen by the pope from a list of names submitted by the chapter: in both cases the pope's approval is requisite. After taking an oath of fidelity to the holy see. undertaking to visit Rome at appointed intervals there to report upon the administration of his diocese, and making a profession of faith. the bishop elect is consecrated by at least three bishops. The bishop is normally the chief pastor in a diocese, where he alone has authority to ordain. to confirm and to bless the chrism for confirmation and oil for anointing the sick

Church of England.—In the 16th century the Church of England abolished the minor orders, the subdiaconate and the necessity for celibacy. The requisites for entering on holy orders are the same as in the Roman Catholic Church. save that the deacon must be 23 years old. All persons in holy orders are required to recite matins and evensong daily. The deacon assists the celebrant at the Eucharist by reading the epistle and administering the chalice; he may perform baptisms and is allowed occasionally to preach. He normally remains in the diaconate a year before being ordained to the priesthood by the bishop As a priest he celebrates the Eucharist, pronounces absolution and gives the blessing. As a "clerk in holy orders" he is freed from certain civil obligations and at the same time labours under certain disabilities in order to discharge his office more efficiently. Although holy orders are regarded by canon law as indelible, the Clerical Disabilities act of 1870 made provision for a member of the clergy to execute a deed of relinquishment of holy orders.

A priest is consecrated bishop by at least three other bishops, thereby receiving authority to consecrate. ordain and confirm. A diocesan bishop, who is appointed by the crown and elected by the dean and chapter after they have received the *conge' d'élire* (*q* v.). takes an oath of temporal allegiance to the sovereign before he enters into full possession of the temporalities of his bishopric

Other Episcopal Churches.—Some churches that are episcopally governed have no archbishops or metropolitans. The seven bishops of the Episcopal Church in Scotland elect one of their number as "primus" to have authority to convoke and preside at the Episcopal Synod. The Protestant Episcopal Church in the United States elects a presiding bishop to preside at the General Convention and the National Council of the church. Similarly, the chief bishop of the Polish National Catholic Church in the United States is known as prime bishop.

Orthodox Eastern Church.—A candidate for holy orders must fulfill the same requirements as in the Roman Catholic Church: save that celibacy as such is not required for the diaconate or priesthood. A priest may be a married man if he was married before his ordination but must not remarry if his wife dies after he is ordained. A priest unmarried at ordination must remain celibate. Only unmarried or widowed priests may be consecrated bishop. The functions of bishops. priests and deacons do not differ from those in the Roman Catholic Church save that the priest has authority to administer confirmation, which takes place at the same ceremony as baptism. There are only two minor orders (though this terminology is not used). lectors and subdeacons. and in practice these grades of the ministry have tended to lapse. A priest can divest himself of his orders, which are not indelible, and become a layman.

See also ACOLYTE; CLERGY; DEACON; EPISCOPACY; MINISTRY. CHRISTIAN; ORDINATION.

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(J. W. L.)

HOLY ROMAN EMPIRE is the designation commonly given to the varying complex of lands ruled over first by Frankish and then by German kings for ten centuries from the coronation of Charlemagne in 800 until its dissolution in 1806. In fact, the precise term *sacrum Romanum imperium* dates only from 1254, though the title "Holy empire" reaches back to 1157 and the term "Roman empire" was used from 1034 to denote the lands under Conrad II's rule. The term "Roman emperor" is older, dating from Otto II (d 983). This title, honever, was not used by Otto II's predecessors, from Charlemagne to Otto I. who simply employed the phrase *imperator augustus* without any territorial adjunct. The first title that Charlemagne is known to have used, immediately after his coronation in 800, is: "Charles, most serene Augustus, crowned by God, great and pacific emperor, governing the Roman empire." This clumsy formula, however, was soon discarded.

These terminological questions reveal some of the problems involved in the early history of the empire. It can be regarded as a political institution. or approached from the point of view of political theory, or treated in the context of the history of Christendom as the secular counterpart of a world religion. The history of the empire is also not to be confused or identified with the history of its constituent kingdoms, Germany and Italy, though clearly they are interrelated. The constitcent territories retained their identity; the emperors, in addition to the imperial crown. also wore the crowns of their kingdoms. Finally, whereas none of the earlier emperors from Otto I had assumed the imperial title until actually crowned by the pope in Rome, after Charles V none was actually emperor in this sense, though all laid claim to the imperial dignity as if they had been duly crowned as well as elected. Despite these anomalies and others, the empire, at least in the middle ages, was by common assent. along with the papacy, the highest and most important institution of western Europe.

Theologians. lanyers, popes, ecclesiastics, rulers, rebels like Arnold of Brescia and Cola di Rienzi, literary figures like Dante and Petrarch, and the practical men, members of the high nobility, on whom the emperors relied for support, all saw the empire in a different light and had their own ideas of its origin, function and justification. Among these heterogeneous and often incompatible views, three may be said to predominate: (1) the papal theory. according to which the empire was the secular arm of the church,

set up by the papacy for its own purposes and therefore answerable to the pope and. in the last resort; to be disposed of by him; (2) the imperial or Frankish theory. which placed greater emphasis on conquest and hegemony as the source of the emperor's power and authority and according to which he was responsible directly to God: (3) the popular or Roman theory (the '*people!' at this stage being synonymous with the nobility and in this instance with the Roman nobility): according to which the empire. following the. tradition of Roman law, was a delegation of powers by the Roman people. Of the three theories the last was the least important; it was evidently directed against the pope. whose constitutive role it implicitly denied. but it was also a specifically Italian reaction against the predominance in practice of Frankish and German elements.

It is also important to distinguish between the universalist and localist conceptions of the empire, which have been the source of considerable controversy among historians. According to the former, the empire was a universal monarchy, a "commonwealth of the whole world. whose sublime unity transcended every minor distinction"; and the emperor "was entitled to the obedience of Christendom." According to the latter, the emperor had no ambition for universal dominion; his policy was limited in the same way as that of every other ruler. and when he made more far-reaching claims his object was normally to ward off the attacks either of the pope or of the Byzantine emperor. According to this view, also. the origin of the empire is to be explained by specific local circumstances rather than by far-flung theories.

Origins of the Empire and Sources of Imperial Ideas.— There was no inherent reason why, after the fall of the Roman empire in the west in **376** and the establishment there of Germanic kingdoms. there should ever again have been an empire, still less a Roman empire, in western Europe. The reason why this took place is to be sought (1) in certain local events in Rome in the years and months immediately preceding Charlemagne's coronation in 800; and (2) in certain long-standing tendencies which made this particular solution of a difficult situation thinkable. These long-standing tendencies are to be regarded as preconditions rather than causes of the coronation; they do not account for it. but without them it is difficult to imagine how it could have taken place.

The first is the persistence, despite the fact that it was no longer a political reality west of Italy, of the idea of the universal and eternal Roman empire. The importance of this tradition may easily be exaggerated. After the establishment of the Germanic kingdoms. kings such as Clovis in Gaul and Theodoric in Italy were glad to accept Roman titles from the Byzantine emperor. who sought to maintain the formal unity of the Roman empire by treating them as his vicars and lieutenants; but this was a short-lived expedient. By the 8th century any sense of belonging to the empire, now confined to eastern Europe, had disappeared in the west.

Far more effective in the minds of the barbarian peoples of the west was the idea of the *imperium Christianum* or "Christian empire." which took shape after the conversion of Constantine (*q.v.*) the Great and the reconciliation between Christianity and the Roman empire. Sot only did the Christian church become a state church. including in its liturgy prayers for the empire and the emperor, but it also brought the Roman empire into the framework of Christian eschatology, as the last of the world monarchies whose end would mark the inception of the kingdom of God. Through Christian iconography and through the liturgy the church's view of the empire as a vehicle of God's will, for the Christianization of the world. became prevalent. It was expressed with peculiar force in the letters of Charlemagne's adviser Alcuin.

Apart from the persistence of the idea of a Christian Roman empire, a third precondition for the establishment of an empire in the west was the existence of a candidate of sufficient power and standing in the person of the Frankish king. The expansion of the Frankish kingdom until it comprised most of western Europe. particularly its acquisition of the Lombard kingdom in northern Italy in **773,** is described elsewhere (*see* FRANCE: History; also CAROLINGIANS); its impcrtance and the importance of the ties forged by Charlemagne's immediate predecessors with the papacy are obvious. Though it is scarcely true that Charlemagne's accession to the empire was simply a consequence of this expansion. his outstanding position was evidently a precondition of his elevation to the imperial throne.

When we turn from the preconditions to the causes of the events of 800 and from the realm of ideas to that of political facts, we enter another world. It is the world of the Roman. Eastern or Byzantine empire. of which the pope was a subject, confirmed in his bishopric like other bishops by the emperor. By the 8th century, however. the imperial position in Italy. centred in the exarchate of Ravenna (*q.v.*), was crumbling. Confronted by the power of Islam. the empire concentrated on the problems of the east and was unable to defend its Italian lands from the Lombards, who had entered Italy in **568.** Furthermore. the emperors of the Isaurian dynasty. of whom the first was Leo III (717–741), were estranged from the papacy by the iconoclast controversy. Hitherto fear of the Lombards had kept the popes faithful to the emperor and to the exarch in Ravenna. Now the situation changed. When the Lombards renewed their advance southward. taking Ravenna in **751** and driving out the exarch, the pope appealed in vain to the emperor, then turned to the Frankish king. Pepin, who invaded Italy, reduced the Lombard king Aistulf to

(TOP) EMPIRE OF CHARLEMAGNE ABOUT A.D. 800: (BOTTOM) EMPIRE IN THE 16TH CENTURY

submission (754) and then, returning in *756*, bestowed on the papacy the territories belonging to the exarchate. Thus was born both the temporal power of the papacy and the close alliance between the papacy and the Frankish monarchy.

Particularly significant of the anomalous position that had arisen in Italy was the action of the pope in conferring on the Frankish king the title of patrician, which could legally be conferred only by the emperor; in the form the pope gave it (*patricius Romanorum*), the title was meant to authorize its possessor to defend and support the Holy See against its foes. Even so. the papacy was reluctant to break its constitutional links with the imperial system. and this was particularly so under Pope Adrian I (772–795), after Charlemagne had in *774* defeated the last independent Lombard king. Desiderius, and taken his kingdom. As king of Lombardy the defender might become as dangerous to the pope as those against whom he had provided defense.

The events briefly related show. first, the growing estrangement between east and nest; second, the difficult position of the pope between the emperor and the Frankish king; third. the tenuousness of the imperial hold over Rome and central Italy. After the expulsion of the exarch in 751, the pope himself, now in de ***facto*** possession. probably hoped to become the emperor's successor in the west. Whether the document itself belongs to the *750s* or not. this was the sense of the forged Donation of Constantine. in which the emperor Constantine I is represented as having conferred on Pope Silvester I the imperial palace of the Lateran, the imperial insignia and "all the provinces, places and cities of Italy and the western regions" (*see* DONATION OF CONSTANTINE). Such ambitions, honever. proved illusory when Charlemagne became king of the Lombards. When it was even rumoured that Charles intended to depose Adrian and set up a Frankish pope in his place, it would have been folly for the pope to think of formal severance from the existing empire. Nevertheless, the empire's shadowy titles were unlikely to be respected long in Italy unless the emperor took action. From *781* papal documents mere no longer being dated by the emperor's regnal year, and the pope was minting his own coins.

Coronation of Charlemagne as Emperor. — By comparison with Adrian. Pope Leo III *(795–816)* was a man of inferior calibre. Where Adrian had tried to maintain independence by balancing the Byzantine emperor against the Frankish king. Leo from the first showed subservience to the latter. Both in Constantinople and in Rome the situation was unstable. In Constantinople. after troubles reaching back to *790*, the empress Irene had her son Constantine VI blinded and deposed *(797)* and took his place, the first woman to rule the empire in her own right. Her constitutional position was thus doubtful; Alcuin in the west. in *799*. regarded the imperial throne as empty. Meanwhile. in Rome, the hostile nobility exploited the opportunity to attack Leo. who fled across the Alps to his protector, Charlemagne, at Paderborn. This was in Aug. *799*. Though unfavourably impressed by the pope, Charlemagne was persuaded by Alcuin to send him back to Rome with a commission which adjudged the complaints against him false and arrested and deported his accusers. The situation, however, was still uncertain. In view of the plight of both pope and emperor, "the whole salvation of the church of Christ" now rested (so Alcuin wrote) in Charlemagne's hands. and in the autumn of 800 he set out for Rome "to restore the state of the church which was greatly disturbed." On Dec. 23 Leo solemnly purged himself of the charges against him. Two days later, on Dec. *25*, a large gathering assembled in St. Peter's, where the pope was to consecrate Charlemagne's son as king. Suddenly, as Charlemagne rose from prayer. Leo placed a crown on his head and. while the assembled Romans acclaimed him as "Augustus and emperor," the pope abased himself before Charlemagne, "adoring" him "after the manner of the emperors of old."

It seems clear that this coronation was the work of the papacy. not of the Frankish king, who is said to have been surprised and angry at it. The immediate beneficiary of the coronation was the pope, whose position henceforth was secure. Charlemagne was left to face its momentous consequences and, particularly, to secure that recognition from Constantinople without which his title was legally invalid. This, according to the chronicler Theophanes, he sought to do by offering marriage to the empress Irene, hoping thus "to reunite east and west." If so. a revolution in Constantinople and the deposition of Irene *(802)* brought the plan to nothing. In any case, the coronation of Charlemagne was an extra-legal, indeed an illegal and revolutionary proceeding. The pope had no right to make him emperor. Nor did the coronation create a new western by the side of the existing eastern empire A usurper in the eyes of the Byzantines. Charlemagne had not the least prospect of succeeding to the throne of the Caesars. The only imperial territories on which he laid hands were the duchy of Rome and the former exarchate. Otherwise he remained. as before, king of the Franks and of the Lombards. Since in *806* he made arrangements to divide his territories among his three sons, it is even doubtful whether Charlemagne's empire would have survived had not the two elder sons died before him, leaving the undivided inheritance in *814* to the third son. Louis I the Pious.

While the immediate context of the imperial coronation of 800 was limited, it had wider connotations. In the first place, the separation between east and west was now an accomplished fact in the political sphere; for, though the intention in *800* was not to divide the empire, this was the practical outcome. In *812*, after unsuccessful mar and wearisome negotiation, the Byzantine emperor Michael I recognized Charlemagne's imperial title. It was still a personal title, and Charlemagne was recognized merely as emperor, not as emperor of the Romans; in other words. the emperor in Constantinople maintained his claim to be the only true successor to the Roman Caesars. Furthermore, the recognition was grudgingly given. and later, when Byzantium was stronger and the Carolingians weaker. Michael's successors refused to extend it automatically to Charlemagne's successors. Thus the second consequence of the act of *800* was a rivalry with Constantinople which remained an important factor in imperial history at least until *1204*. In the third place, Charlemagne's coronation involved him and his successors ever more deeply in the ecumenical pretensions of the papacy. The relationship between the papacy and the Frankish rulers. close for nearly *50* years before *800*. was intensified now that the Roman see was the first metropolitan church of Charlemagne's dominions. Religious emperors and their ecclesiastical advisers would henceforward see as the main function attaching to their imperial dignity the promotion of Christian unity. Furthermore, the fact that the pope had crowned Charlemagne emperor — rightfully or not — could not but impress. It was the pope who had taken the initiative. Had he not, in fact, constituted Charlemagne emperor? In Innocent III's time it was to be argued that Pope Leo III had transferred the empire from the Greeks to the Germans and that his successors could transfer it elsewhere if they so wished. This was a later doctrine; but already to Charlemagne the dangers were evident. Hence when, in *813* after his agreement with Michael I. Charlemagne decided to associate his surviving son, Louis, in the exercise of imperial power, he framed his actions accordingly. The ceremony took place not in Rome but in the imperial chapel at Aachen; the pope was not present; the constitutive act was the acclamation of the gathered Frankish nobility; and Louis either received the diadem from his father or took it with his own hands from the altar. The contrast with the Roman ceremony of *800* was deliberate. Henceforward the conflict between the two contrary views or theories of the empire — the papal and the Frankish — was to be a dominant theme.

The Carolingian Empire. — Louis the Pious *(814–840)* was a man in every way different from his father. For him the word empire was to be the unifying idea holding together his various dominions, and accordingly he abandoned his separate royal titles. This was the underlying notion of the *Ordinatio imperii* of 817; by this, Louis made his eldest son. Lothair I, emperor with him. while the younger sons, Pepin and Louis the German, received subordinate kingdoms (Aquitaine and Bavaria). Louis I's ideas, however, aroused the conservative opposition of the Frankish nobility. and soon the Frankish lands were involved in civil mar. Furthermore, internal dissension helped the papacy, mhich increased its influence by favouring one party or the other. Already in *816* Pope Stephen *V* (IV) persuaded Louis to receive unction

at his hands. perhaps also to be recrowned. thus repairing the defect of 813; and though Lothair I had been raised to the imperial dignity in 817. as Louis had been in 813, without papal intervention. he also saw fit to strengthen his title by being crowned by Paschal I in Rome in 823. Thus the empire, instead of becoming an appendage of the Frankish kingship, was drawn back into the papal sphere Lothair's son Louis II was crowned by the pope in 850, to be sole emperor from Lothair's death in 855 to his own in 875; his uncle Charles II the Bald was emperor from 875 to 877; then Charles III the Fat was crowned emperor in 881. But the imperial title. without power to support it, was a mere name, and with the dislocation of the Carolingian realm, culminating in the deposition of Charles the Fat by the East Frankish magnates in 887. its decline was rapid. From 888 France, Germany and Italy were separate states, with the kingdom of Burgundy and Lotharingia (Lorraine) as debatable lands. Who, in these circumstances, was to be emperor? The nominee of the pope, himself a puppet of Italian aristocratic factions? Or Charlemagne s rightful heir, whoever he might be? Or simply the strongest ruler of western Europe? For the moment, the first solution prevailed, and there followed a series of emperors chosen from the Italian nobility, starting with Guy of Spoleto (891–894) and his son Lambert (892–898), in concurrence with the East Frankish king Arnulf. who was also crowned emperor in 896 (d. 899). But such men were of little use to the papacy, and the papacy, in the depths to which it had now sunk, was little use to them. Louis III, crowned in 901. was deposed in 905 by Berengar of Friuli, who was himself crowned by the pope in 915. but on Berengar's death (924) the powerful Roman family of the Crescentii, determined to keep authority in its own hands. stepped in and suppressed the imperial title. Thus the empire created in 800 disappeared. ineffective and unmourned.

The Ottonian Empire.--While in Italy the empire was in process of dissolution, north of the Alps imperial ideas persisted, but not in the form associated with the papacy. The Frankish tradition of empire looked back to Charlemagne; amid the divisions of the dying 9th century it reflected the notion of Frankish unity. It was also seen as the expression of power and hegemony and of rule—as Charlemagne had ruled—over a number of different countries Thus the West Frankish king Charles II the Bald had been proclaimed emperor and Augustus when he invaded Lotharingia in 869—six years before he was crowned emperor in Rome—because he was now ruler of two kingdoms. The first Saxon ruler of Germany. Henry I, was acclaimed emperor (the chronicler Widukind relates) because of his victory over the Hungarians in 933. as was his son. Otto I. after the battle of the Lechfeld in 955 This is a Frankish idea of empire which has nothing to do with Rome Indeed. the successor-states which we call France and Germany remained Frankish—the West Frankish and the East Frankish kingdoms, though the latter was now ruled by a Saxon. As such, it was their ambition to succeed to the Frankish inheritance. and it was inevitable, in view of the anarchic state of Italy, that the ruler of the one or the other, when strong enough. would cross the Alps. In fact, it was the East Frankish kingdom which recovered first from the 9th-century anarchy, not least because its kings knew how to use the Frankish church for their ends.

In this Otto I. who succeeded to the East Frankish throne in 936, was the true heir of Charlemagne; he made churchmen his ministers and established missionary bishoprics on the Elbe river to spread Christianity among the Wends. In the west the Carolingian Louis IV of France was his protege, and only Otto's support kept the young king of Burgundy, Conrad, on his throne. In 951 Otto descended on Italy, married the late king's widow and forced the new king. Berengar of Ivrea, to hold his kingdom as a vassal of the German crown. Ten years later, summoned by the pope when Berengar was on the point of taking control in Rome. Otto returned to Italy He was crowned emperor by Pope John XII on Candlemas day 962.

Once again, as in 800, it was the pope who took the initiative; his need for protection was the immediate cause of the coronation. But Otto's empire was more limited in scope than Charlemagne's, its pretensions less universal. In the intervening period the import of the title imperator *augustus* had shrunk, so that by Otto's time it scarcely extended beyond protection or "advocacy" of the Roman church. Likewise the extent of the empire, territorially, had decreased. Neither Otto I nor his successors made any claim, as heirs of Charlemagne. to rule over the West Frankish lands. Henceforward what came to be known as the empire meant simply a union of Germany and northern Italy (and after 1032 the kingdom of Burgundy) under a single rule. This was far from the ecumenical pretensions of Rome. and though, partly because of the extent of their territories, partly because of their special connection with the papacy, the Ottonian and Salian emperors enjoyed pre-eminence among the rulers of western Europe, they certainly did not seek to exercise world dominion. Nor did they seek to challenge the Byzantine emperors in their rule over the empire of the east. Nevertheless the problem of the relations of the two empires necessarily reasserted itself, for the Byzantine empire had made rapid recovery and was preparing, under Nicephorus II Phocas and Basil II, to embark on expansion and reconquest. Fears of Byzantine interference in Roman politics and conflicting claims in southern Italy soon brought the two powers into rivalry, and the conflict proved to be the spur for a major development—the romanization of the western empire. Whereas Otto I had laid no claim to the Roman title, Otto II (co-emperor 967; sole emperor 973–983), to bolster his claims against Basil II, proclaimed himself Roman emperor. From this it was only a short step to describing the empire itself as the Roman empire, and this change occurred in Conrad II's reign (1024–39; crowned 1027). It was reinforced, from 1040, by the introduction of the title "king of the Romans" for the emperor-elect before his coronation, or for the emperor's designated successor. It is noteworthy, however, that these formal changes were the result not of claims to the heritage of ancient Rome or of universal pretensions but simply of rivalry mith Byzantium.

In this development the reign of Otto III (983–1002; crowned 996) forms an interlude. The son of a Greek princess, imbued mith Byzantine traditions, Otto III drew on Roman, Carolingian and Christian strands to form a new synthesis combining the heterogeneous elements in the imperial idea Rome was to be his capital, the pope his lieutenant in the spread of Christian dominion. How much of this would have survived, if Otto had lived longer, remains doubtful. In fact. distance alone made unified imperial rule over Germany and Italy impossible. Otto himself lost Rome shortly before his death. What did survive, as the characteristic feature of the empire from Otto I to Henry III, was the close subordination of pope to emperor. Otto I deposed John XII and Benedict V; Otto III nominated his cousin. Gregory V, and his tutor, Silvester II; and after neglect of Italian affairs under Henry II (1002–24; crowned 1014) and Conrad II. Henry III (1039–56; crowned 1046) deposed Benedict IX and Silvester III and compelled Gregory VI to abdicate. This was not oppression or force but the fulfillment of the emperor's supreme duty—to watch over the welfare of the church. The iconography of the time shows the emperor, not the pope, as the representative of St. Peter and often standing alone as God's vicar on earth. The period from 962 to 1046, in fact, saw the empire at its zenith. No other kingdom of Europe was its match; while the papacy, except when under imperial protection, was the degraded tool of Roman factions. Morally, also, the empire had the support of the greatest reformers of the age—the abbots of Cluny, for example—who looked to the emperor rather than to the pope as the effective head of Latin Christendom.

Empire and Papacy.—From the middle of the 11th century the situation began to change. One cause was the rapid progress of European economic recovery, which brought shifts of power detrimental to Germany, More immediately important was the revival of the papacy, which the emperors had done so much to further. After Henry III's death in 1056 the initiative passed into papal hands. It was favoured by the long minority—till 1065—of Henry IV (crowned 1084; d. 1106), which enabled the papacy to act without fear of intervention from north of the Alps, and by the appearance of allies—particularly the Normans of the kingdom of Sicily, who for their own purposes supported the papacy against the empire. As they reached maturity the peoples of

Europe turned to the pope as leader of Christendom. Even within the imperial frontiers the emperor's power meant more to the Germans than to the inhabitants of Burgundy or of Italy, for nhom it betokened subjection to German rule Furthermore, only Otto 111—and he for less than four years—made Rome the seat of empire; all the rest, from Charlemagne onward, concentrated their efforts north of the Alps. In practice, therefore, the empire nas a very imperfect realization of the ideal of an *imperium Christianum;* and as soon as it was in a position to vindicate its independence. the papacy found many adherents. Under Gregory VII (1073–85) the papal theory of the empire, as formulated in the 9th century. was revived, but now on broader and firmer foundations The result was the conflict, from 1076 until 1122, known as the Investiture contest (see INVESTITURE CONTROVERSY). The real issue however, was not the investiture of bishoprics but the place of the emperor in Christian society and his relations with the papacy Only the pope, Gregory VII asserted, might use the imperial insignia; he might lawfully depose emperors, but should himself be judged by none (these lapidary statements are among the 27 included in the Dictatus *papae* of 1075 and were set down in Gregory's register). Thus the claim to independence turned rapidly into a claim to superiority In particular the sacred character of the emperor was challenged and his claim to be responsible directly to God. Instead, on the basis of the Donation of Constantine and a papal interpretation of the coronation of 800, it nas argued that it was for the pope to convey the imperial dignity and if he thought fit, to withhold or withdraw it. The Investiture contest was brought to a close by compromise in the treaty of Worms of i122 between Calixtus II and Henry V; but Gregory VII's claims nere taken up again by Alexander III, Innocent III Innocent IV and Boniface VIII, in a series of conflicts that shook the empire to its foundations.

The challenge thrown out by Gregory VII forced the emperors to seek new foundations for their position Gregory's great opponent Henry IV had still asserted the traditional rights of his father. His successors in the 12th century, Henry V (1106–25; cronned 1111), Lothair II (1125–37; crowned 1133). Frederick I Barbarossa (1152–90; crowned 1155) and Henry VI (1190–97; crowned 1191), shifted their ground. To counter the arguments of church lanyers they grasped the weapons provided by the revival of Roman law. A new and more exalted conception of the empire was the result Best knonn was the addition by Frederick Barbarossa, in 1157, of the word *sacrum* to the name of the empire. which non became the "Holy empire" as a counterblast to the *sancta ecclesia.* Equally characteristic mas the canonization of Charlemagne by Frederick's antipope Paschal III in 1165 In this nay Frederick emphasized continuity with the Frankish past and asserted his rights as Charlemagne's successor They derived, he argued not from conferment by the pope or by the Roman people but from Frankish conquest.

Unlike earlier emperors. who had based their position on their special relation with the church, the Hohenstaufen emperors emphasized its secular foundations Against Pope Innocent III's claims to confer the imperial crown. imperial lanyers asserted that "he who is chosen by the election of the princes alone is the true emperor, even before he has been confirmed by the pope" Nor is it surprising that, confronted nith the universal claims of the papacy the Hohenstaufen emperors asserted rights no less universal Though in day-to-day politics in their relations (for example) nith the kings of France or of England, there is no sign that they were seeking world dominion. nevertheless the new imperialism soon called forth protests from all sides—from England and France from Denmark and Hungary. "Who," asked John of Salisbury. "appointed the Germans to be judges over the nations?"

Meanwhile the conflict with the papacy and the desire to restore the territorial basis of imperial power, which the Investiture contest had shattered. dren the emperors more and more into Italy, where they encountered the same national reaction Unable to defeat the Lombard league. Frederick I patched up a peace at Constance in 1183. His ultimate sovereignty was recognized, but his power in Italy was fatally compromised. After his son. Henry VI. had married the heiress of Sicily, the power of the Sorman kingdom was used to restore the imperial position in Italy. It was a grandiose policy but overstrained. The papacy, fearing that Rome would be engulfed, reacted violently.

Innocent III, profiting from German dissensions after the early death of Henry VI (1197), played upon the German factions (Otto IV, not established as king till 1208, was crowned emperor in 1209). Henry VI's son Frederick II (1212–50; crowned 1220), by the *Privilegium* in *favorem principum ecclesiasticorum* (1220) and by the *Statutum* in favorenz *principum* (1232), made far-reaching concessions to the German princes in order to ensure their support for his Italian policy. but in vain. In spite of his striking victory at Cortenuova in 1237 Frederick failed to crush the Lombards and mas excommunicated in 1239 and deposed in 1245. His death in 1250 marked the effective end of the medieval empire. In Germany a long interregnum (1250–73) brought down the imperial structure. In Italy, to ensure that there could be no restoration. the papacy called in the Frenchman Charles of Anjou (see CHARLES I of Naples and Sicily). When Rudolf of Habsburg succeeded as German king in 1273, he was only the head of a federation of princes, while in Italy he abandoned all claims over the centre and south. retaining only titular rights in Lombard

The Empire after Frederick 11.—It is characteristic of the new situation that Rudolf of Habsburg, though he made a number of attempts, never achieved the imperial dignity. Hencefornard the title was largely in abeyance. For a century after Frederick II's death the only emperor was Henry VII (king from 1308 to 1313), who was crowned in Rome in 1312 by legates of the Avignon pope. Thereafter till the end of the empire there were in all only four emperors duly crowned: Charles IV. crowned by a legate in 1355; Sigismund. by the pope in 1433; Frederick III. in 1452; and Charles V, by the pope but at Bologna, in 1530 If the empire continued to exist, it was due partly to the force of tradition, partly to the exigencies of German politics, partly to fear of the dangerous conflict of interests which any plan for its abolition would involve.

The Germans. naturally, were unwilling to surrender hope of regaining something of the empire's former power: both Henry VII and Louis IV (king from 1314 to 1347; his Roman coronation in 1327 nas by representatives of the people) sought to revive the Italian policies of the Hohenstaufen. But the balance had swung against them. France was already striving for the imperial position which Napoleon was ultimately to secure and determined at least that the Germans should not recover it. Moreover, in Germany itself, civil war had undermined the power of the kingship. and the elective monarchy was effectively controlled by the princes through the college of electors (*q.v.*), definitely established soon after 1250. French pretensions to leadership in Europe provoked a last tardy revival of imperialist sentiment both in Germany (Alexander of Roes at the end of the 13th century, Engelbert of Admont at the beginning of the 14th) and in Italy (Marsilius of Padua and Dante), but Charles IV, a sober realist, drew the necessary conclusions. By now the axiom that "the king is emperor in his kingdom" was firmly established; it marked the end of any universalist dream. Charles set out accordingly to make the empire a specifically German institution. By agreement nith Pope Clement V, he formally abandoned Italy; he would only enter Rome on the day fixed for his coronation and leave again the same day. This he did on April 5, 1355. Then he turned to the definition of the German constitution, particularly the rights of the electors, in the Golden bull (*q.v.*) of 1356. The change nas reflected in the final evolution of the empire's title: *sacrum Romanum imperium nationis Germanicae* (the Holy Roman Empire of the German Nation). This title. which appears under Frederick III (king from 1440, emperor from 1452 to 1493), indicates clearly enough that the emperor's powers were limited to his German lands In 1508 Frederick's successor Maximilian I. unable to go to Rome assumed with papal consent the style "elected emperor" (*imperator electus;* Ger. *erwählter* Kaiser).

The Empire in Modern Times.—The history of the empire after the promulgation of the Golden bull may be treated briefly. because from that time it is essentially a part of German history. It is true that memories of an imperial past continued to have an

influence on German thinking and that in the Habsburg lands there was a sense of belonging to a multinational empire. A few emperors — Sigismund in the 15th, Charles V in the 16th century — may even have thought to recover part of the old imperial prerogative. It was also possible to make something of the empire's leadership of Christendom against the Turk. But institutionally the role of the empire was almost continuously whittled away. After the failure of the project of imperial reform sponsored in 1495 by the elector of Mainz, Berthold of Henneberg (*q.v.*), the hope vanished of endowing the empire with permanent institutions effective beyond the limits of the different principalities. The Reformation entrenched the princes firmly in their rights and accentuated their autonomy.

When Charles V, opening the diet of Worms in 1521, declared that "the empire from of old had not many masters, but one, and it is our intention to be that one," he was shutting his eyes to the realities. The extent of his dominions mas imposing. but they were a weak dynastic agglomeration; and though Charles championed the Catholic Church against the Reformation, his empire was neither in spirit nor in fact a revival of the medieval empire. When he accepted the peace of Augsburg in 1555 and abdicated in 1556, the change begun with the accession of Rudolf of Habsburg was completed. With Germany split into two religious camps, the emperor was little more than the head of a religious faction. Furthermore, the fact that after Sigismund of Luxembourg's death (1437), with one short intermission for Charles VII from 1742 to 1745, the imperial crown, though in theory elective, was hereditary in the Habsburg dynasty of Austria, produced a cleavage of interests between emperor and empire.

From 1556 until its end under Francis II in 1806 the empire meant little more than a loose federation of the different princes of Germany, lay and ecclesiastical, under the presidency of the house of Austria. After the Thirty Years' War, no emperor again attempted. as Charles V had done, to re-establish a strengthened central authority; and the treaty of Westphalia (*q.v.*) in 1648 marks its final organization on federal lines. Yet even at the end the empire had loyal adherents, particularly among the small knights and noblemen of western Germany. who regarded it as their safeguard against princely absolutism. and its role was not so entirely negative as is sometimes thought. Its loose structure still suited to some'degree the cosmopolitan spirit of the 18th century. But with the French Revolution, and the intensified nationalism which followed, it became an anachronism.

As far back as the end of the 13th century French kings had been scheming to annex the title as well as to absorb the outlying territories of the empire. With Napoleon this ambition came within reach. Posing as the new Charlemagne ("because, like Charlemagne, I unite the crown of France to that of the Lombards, and my empire marches with the east"), he resolved in 1806 to oust Francis II from his title and to make the Holy Roman empire a part of the Napoleonic "new order." He was anticipated, however, by Francis, who in 1804 had assumed the title "hereditary emperor of Austria" and who, resolving that no other should wear the crown which he was powerless to defend, resigned the old imperial dignity on Aug. 6, 1806.

So perished the Holy Roman empire. The extent and character of its influence will always be a matter for debate; but it left a deep imprint on Europe, Nor did it cease to be influential after its extinction. The debate about the medieval empire was an ideological background to the creation of the Second Reich or German empire in 1871, and even Hitler's Third Reich drew sustenance from memories, often thwarted and perverted, of Charlemagne and Otto the Great and Frederick II.

See further EUROPE: History; GERMANY: History; PAPACY; also AUSTRIA, EMPIRE OF; biographies of the individual emperors; see also references under "Holy Roman Empire" in the Index volume.

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HOLY SPIRIT, THE. In Christian theology, the Third in the divine Trinity (*q.v.*). The limits of this article allow only the briefest summary of the history of the doctrine. It has been marked by three great controversies, which have centred in turn about the divinity of the Holy Spirit; his relation to the Son and his distinct personality.

The Divinity of the Holy Spirit. — In the pre-Arian period, the doctrine of the Holy Spirit was not a matter of controversy. In the form of baptism and in the interrogations put to the neophyte. both of which derived from Matt. xxviii, 19, the Holy Spirit appears as sharing nith Father and Son in the one "name" of God and as being with them the object of Christian faith and the agent of the grace of regeneration. In early doxologies, the Holy Spirit is named along nith Father and Son as the object of praise and adoration. In the primitive creeds (simple developments of the baptismal formula and brief summaries of the apostolic rule of faith), belief in the Holy Spirit was professed in a distinct article, whose parallel structure to the articles on the Father and the Son indicates the essential place of the Spirit in the Trinity. Early interpretations of the creed keep this parallelism and, again after the fashion of the creeds. bring the Holy Spirit into close relation with the gifts of God in the new dispensation — the holiness and unity of the Church, the inspiration of its sacred writings, its guidance in the truth, the forgiveness of sins and the resurrection of the body. In certain pre-Nicene private theological speculations there is a tendency to subordinate the Holy Spirit to the Son, as the Son to the Father. Moreover, in a few writers of inferior authority, like the confused *Shepherd* of Hermas and the unorthodox Tatian. there is some uncertainty about the Spirit's personal distinctness. But the collective faith of the Church as such shows no traces of these errant tendencies. Its simplicity and definiteness appear, for instance, in the famous oath of Clement of Rome: "As God lives, and the Lord Jesus Christ lives, and the Holy Spirit, who are at once the faith and the hope of the elect" (*Epist* ad Cor. I. lviii. 2).

At first, Arianism put forward no more than a doctrine of the Word, as God in name only, quite other in substance than the Father, and created by him in time (see ARIANISM; ATHANASIUS, SAINT). Arius was apparently conscious of the consequences of his position. but he refrained from working out his theory of the "infinite inequalities" nithin the Trinity. The council of Nicaea was content to define the single point explicitly at issue, the consubstantiality of the Son. and simply added to its creed the traditional third parallel member: "And [we believe] in the Holy Spirit."

In fact, it was not until after 350 that a new phase of the Arian controversy was initiated in Egypt, whence Arianism itself had come. About 359 Serapion. bishop of Thmuis in the Delta. wrote to Athanasius. then in his third exile, that certain members of the Arian party, repelled by its irreverences, had returned to the Nicene doctrine of the Son, but rtfused to admit the

Godhead of the Holy Spirit, "affirming that he is not only a mere creature. but simply one of the ministering spirits, who differs only in degree from the angels" (Athanasius. *Epist.* ad *Serap.* I, i). The new debate was joined on the single issue of the Spirit's divinity; his distinct personality was universally assumed, save, of course, by Sabellians like Marcellus of Ancyra (d. 374). Athanasius called his new adversaries the "enemies of the Spirit" (πνευματόμαχοι), or the "trope-mongers" (Τροπικοί) from their habit of explaining away in terms of metaphor the scriptural passages on the divinity of the Holy Spirit. He makes short work of their orthodox pretensions: "This view is no different from that of the Arians. . . . If they think wrongly about the Holy Spirit, they do not think rightly about the Son" (ibid., ii). He makes it clear that their view had no scriptural inspiration, but derived from the same sort of rationalism (cf. ibid., xv, xvii; II, i; IV, i) that gave rise to Arianism itself, and that apparently had radiated from the school of Lucian of Xntioch (d. 312). The standpoint of his refutation is the customary patristic one: "This is not the apostolic faith, nor may a Christian at all tolerate such views" (ibid., I. xiv); and his arguments are from the common patristic sources—the Scriptures, and "the tradition and the teaching and the faith of the Catholic Church from the beginning, which the Lord gave: and the Apostles preached, and the Fathers defended" (ibid., xxviii). In 362, the important synod of Alexandria demanded of those who would share the Catholic communion the condemnation of "those who say that the Holy Spirit is a creature, and separate from the substance of Christ" (Athan., Tom. ad *Antioch.*, iii). In effect. this was to apply the Nicene *homoousios* to the Holy Spirit; at the first direct challenge, the Church was instantly conscious that such had always been her faith.

Meanwhile. the Semi-Arian bishop of Constantinople, Macedonius. exiled by Constantius in 360, was heading a similar school of thought, and gaining many adherents around the Hellespont, in Thrace and in Bithynia. The Macedonians, as they were called, ever. succeeded in deceiving Pope Liberius and in spreading their ideas in the west. But Damasus. Liberius' successor, saw more clearly and condemned Macedonianism with characteristically western definiteness (*Tomus* Damasi, Heinrich Denzinger, *Ench. Symb.* no. 58 *ff.*). The dispute in the east grew more violent when Eunomius, head of the radical Arian party, entered the lists on the side of the Macedonians, much to their distress. He was opposed by Basil of Caesarea (*q.v.*), the chief Catholic champion after the death of Athanasius in 373. Basil himself died on the eve of the final defeat of Arianism and its Macedonian offshoot: accomplished politically by the extreme repressive measures of Theodosius, and theologically by the council of Constantinople in 381. which reaiiirmed the faith of Nicaea and condemned explicitly all shades of Arian opinion. In the Nicene-Constantinople creed (almost certainly the work of the council of 381), the article on the Holy Spirit is expanded thus: "[We believe] in the Holy Spirit, the Lord, the giver of life, who proceeds from the Father, who with the Father and the Son is together worshipped and glorified. who spoke through the prophets" (Denzinger, no. 86).

The formulas reveal the customary reverence of the early eastern Church for scriptural language, when it sufficed for the purpose. The Holy Spirit is not explicitly called God; for the Scriptures do not explicitly call him God; but such a description is given of him that clearly forbids any thought of him as a creature; his action is divine, he shares equally with Father and Son in the honour due to God, and, above all, he proceeds from the Father—a formula that in the context clearly implies equality in divinity with the consubstantial Son, who is likewise from the Father, and that directly rules out the Macedonian idea of the Holy Spirit as the creature of the Son. Moreover, as at Nicaea the personal property (ἰδιότης) of the Son had been marked by calling him, not simply God, but "God of God," so at Constantinople the personal property of the Holy Spirit is indicated with the degree of clarity that the Scriptures permitted; he is described in relation to the Church as the cause of its unity, holiness, catholicity and apostolicity and of the gift of liie (regeneration and resurrection) found in her. By his function in the economy of salvation, in which he is considered as bringing to its term and perfection the life-giving work of Christ, the union of men with God and with each other, the place of the Spirit in the economy of the divine life itself is suggested: in him, as the Third Person, the divine life of completest unity comes to its term and its perfection.

As a matter of fact, the Arian controversy, especially perhaps in its Macedonian phase, illuminates the intimate unity in Catholic thought between the nature of God, as subsistent in Three who are coequally divine, and the nature of man's salvation, as consisting in a true deification (Θέωσις), whereby man individually shares in the nature of God (II Peter i, 4), and collectively, as gathered into the unity of the Church, somehow faintly reflects the unity of the divine life (John xvii, 20–26). Against the Arians, Athanasius had argued that if the Word Incarnate is not truly God by nature, he could not deify man (De Synod. li; et alibi). In his "Letters to Serapion" he uses a similar argument: "All of us are said to be sharers of the Godhead through the Spirit. . . . But if the Holy Spirit were a creature, no share in the Godhead would result in us through him; we would be joined simply to a creature, and be alien from the nature of God, in no respect sharing in it" (Epist. ad *Serap.* I, xxiv). The premise of the argument—man's deification, the gift that "comes from the Father through the Son by the Holy Spirit" (ibid., xx, xxiv, xxx, etc.)—is assumed to be an admitted commonplace of Christian faith. Its denial was seen by Athanasius, and by the Greek Fathers in general, as an intrinsic element of the Macedonian "impiety"; by separating the Holy Spirit from the inner life of God, they separated mankind from a share in that life and reduced Christianity to a bare naturalistic moralism, devoid of its proper supernatural character as gift and mystery.

The Procession of **the** Holy Spirit.—The second great controversy, which formally began with Photius' (*q.v.*) Encyclical *to* the Oriental *Thrones* in 867, revolved about the celebrated *Filioque;* at issue was the question of the Holy Spirit's origin from the Son. On this question, two modes of thought had long been current. The Antiochian school, scrupulously devoted to the letter of Holy Scripture and to the preservation of the intratrinitarian distinctions, described the origin of the Holy Spirit by the formula, "from the Father through the Son." The preposition "through" (διὰ) admitted that the Son was an active principle of the Spirit, but emphasized that he was such in his order as Son, who himself receives all from the Father. The Antiochians thought that this order, as well as scriptural usage (cf. John xv, 26) would be violated by saying that the Spirit is "from" the Son or that he "proceeds" from the Son. They kept strictly to the characteristically eastern, dynamic image of the Trinity, the straight line, which represents the divine life as originating in the Father, who has no origin, and as being communicated from the Father to the Son, and through the Son to the Holy Spirit. The formula, "through the Son," became exclusively legitimate in Byzantine usage. The Alexandrian school, following their master. Origen, likewise preferred this formula. However, more concerned with the sense than with the sheer words of Scripture, many Alexandrians felt no difficulty in using at times another formula, "from the Father and from the Son." as identical in sense. Alexandrian usage passed to the west in Hilary of Poitiers; then Augustine took the subordinate formula, ex *Patre* et *Filio*, and gave it dominance; it expresses more directly the reality of the Son's principiation of the Spirit. Behind it was what became the characteristically western, static image of the Trinity, the triangle, whose one perimeter (logically prior) encloses the three distinct angles (logically posterior).

Both of these formulas express, with variant emphases, the one common doctrine, that the Holy Spirit has a relation of origin to the Son. But their verbal divergence gave rise to disputes, which were themselves largely verbal, such as that between Martin I and the Byzantines in the 7th century, and in the 8th century the attack by the authors of the *Libri Carolini* upon the doctrine of the second synod of Nicaea. Photius seems to have had in mind the emphatic Caroline rejection of the formula, "from the Father through the Son." He does not himself use the formula, but he strongly denounced the "adulteration of the symbo!" by the addition of the Latin *Filioque*—an addition first made in Spain,

where it was current in the latter half of the 7th century, and whence it spread to Gaul and Rome, At the same time, he misunderstood the content of the formula, imagining that the Latins were asserting the procession of the Spirit from the Father and the Son as from two co-ordinate and distinct principles, to the destruction of the divine "monarchy." He himself held a view that was neither Greek nor Latin; its image would be neither a straight line nor a triangle, but a simple angle, whose apex was the Father, from whom alone in co-ordinate fashion the Son is generated and the Spirit proceeds. This was to exclude the Son completely as an originating principle of the Spirit. In the 11th century, under Michael Cerularius, there was a renewal of the full Photian theory, that the addition of the *Filioque* to the creed was illegitimate and opposed to Catholic truth, which asserts the procession of the Spirit from the Father alone. The Roman Catholic view is that the addition was legitimate and true (cf. Council of Florence, Denzinger, no. 691).

Today, even the Orthodox admit that the *Filioque* was by no means the cause of the eastern schism. But it did become central in the ensuing controversies, and it is still an obstacle to reunion. Up to the end of the 19th century, the Graeco-Slav churches held to rigid Photianism. After 1870, Orthodox contact with Anglo-Catholics and Old Catholics brought about some mitigation in certain quarters. Some favour as well as opposition was shown to the distinction of V. V. Bolotov, published in his 23 theses on the *Filioque (Revue internationale de théologie,* VI, 681–712 [1898]), between the dogma and the theology of the Holy Spirit: the dogma asserts only that he proceeds from the Father; whether he proceeds from the Father alone or from the Father and the Son is a matter of free theological opinion. Conceivably, this distinction might furnish the basis for union with Anglo-Catholics, but from the Roman Catholic standpoint it merely transposes the difficulty to another plane; for the Roman Catholic Church holds the *Filioque* as a dogma. From this standpoint, the hope for agreement lies in two facts: (1) Orthodox professions of faith and liturgical formulas, notwithstanding their customary Photian interpretation, themselves affirm only the procession of the Spirit from the Father as from the source (αἴτιος) of divinity; this assertion as such does not exclude his relation of origin also to the Son; (2) the truth of Bolotov's contention, in his seventh thesis, that the Photian view can find no support in either the Greek or the Latin Fathers, may come to be increasingly recognized.

The Personality of the Holy Spirit.— In modern times, the reversion to a dynamic type of Sabellianism within the liberal Protestant school brought about a fundamental reinterpretation of the doctrine of the Holy Spirit. As Macedonian views of the Spirit were an evolution of Arian views of the Son, so liberal Protestant theories of the Spirit were developed as a pendant to liberal Christology (see JESUS CHRIST). In so far as one may generalize about a group of highly individualistic writers, one may say that the liberal theory regards the doctrines of the Son and the Spirit as later interpretations of the primitive Christian experience of God in Christ. By a process of evolution similar to that which resulted in the diuinization of Jesus in the Christian consciousness, the Holy Spirit reached the status of a personification, first in St. Paul, more clearly in St. John, quite definitely in the form of baptism, which was later interpolated in the text of St. Matthew. Generally speaking. the essential liberal affirmation is that Christian experience is trinitarian; whether God is himself a Trinity is a question that, after Kant, came to be regarded as largely meaningless.

A fairly typical set of conclusions is reached by P. Feine, sufficiently in the main stream of liberal thought (*Theologie des neuen Testaments,* 2nd ed. [Leipzig, 1912]). He admits — what, of course, other liberals would deny — that St. Paul distinguished the Holy Spirit from the person of the believer, and also from God and Christ, over against whom the Spirit stands as a distinct person. But this is a simple personification, like that of Sin, the Law, Justice, etc. Actually, in speaking of God, Christ the Lord and the Holy Spirit. St. Paul by no means asserts that there are distinctions within the Godhead: "It is the theory oi the so-called economic Trinity that we find in him" (p. 410). God, Christ, the Spirit stand for theological projections of his own experience, which is somehow repeated in every believer. "The vital experience which Paul objectiiied in the doctrine of the Holy Spirit is at bottom nothing else but the consciousness that we, as believers, have achieved a share in the life of the Christ who died and rose again" (p. 411). H. Gunkel had put the same idea when he said that Paul's doctrine of Christ and of the Spirit were simply "two different interpretations of the same experience" (*Die Wirkungen des hl. Geistes . . .,* 3rd ed., p. vii [1909]). Consequently, "Christ" and "the Holy Spirit" are, indeed, distinct theological doctrines; but in reality, "the Holy Spirit" is (or better, means) "the risen Christ" as experienced by one who believes that Jesus is risen, just as "the risen Christ" is (or means) "God" as experienced by one who believes that in Jesus the redemptive power of God was realized.

Roman Catholic scholars find considerable value in the researches of rationalist exegetes on the workings of the Holy Spirit as portrayed in the Scriptures. In Roman Catholic theology, the action of the Spirit is studied in several connections. The treatise on divine grace, especially in the section on "the gifts of the Holy Spirit," deals extensively with the interior action of God on the soul, with primary reference to the normal ways of the Christian life. The action of the Holy Spirit through his gifts in the higher forms of prayer and tnystical experience is studied from both the empirical and the theological standpoint in treatises on ascetical and mystical theology. Again, the treatise on the Church develops the Spirit's relation to the Body of Christ, as its soul—its interior principle of life, growth, unity and holiness.

In the field of trinitarian theology, the question of what the Holy Spirit is within the Godhead and in relation to the Father and to Christ holds the primary place. However, the mode of approach to this question, so far as scriptural exegesis is concerned, is through what the Spirit does; for it has been commonplace since earliest Christian times that the person of the Holy Spirit has been revealed in and through his action, and not, as in the case of the Son, by an incarnation. From the more polemical point of view, the acute question is not so much whether the Spirit's personality is in the text of the New Testament (this is admitted by many liberal scholars), but rather how it got there. Is it simply a doctrinal creation of the Christian consciousness, speculat ng about its own experience of God, or is it a divine revelation in the traditional sense—a truth not created by the Christian community, but received by it from Christ, who was consubstantially the Son of God—a truth, therefore, whereby the believer is validly informed about the transcendental factor in all religious experience, which is the nature and inner life of God as he is in himself. This latter is the Roman Catholic position, with which Eastern Orthodoxy, Anglicanism and orthodox Protestantism agree.

From the more positive point of view, Roman Catholic exegesis sees its initial problem in tracing the steps in the progressive revelation of the Holy Spirit and in showing: first, the continuity between the Old and New Testaments (through the common concepts of "the spirit of God" as the divine energy operative in the world and in men and as the messianic gift); second, the distinctiveness of the New Testament revelation, in which the Spirit gradually emerges as personal, One truly divine and other than Father and Son: and third, the dependence of the revelation at every step upon the prior, clarifying revelation of the Son, in whom the Father himself is revealed. Roman Catholic theology, in dependence on patristic sources, further analyzes the scriptural appellations of the Spirit—Holy Spirit, the Gift, Love—as part of its search for some intelligence of the Spirit's mode of origin, his relations to Father and Son and his own distinguishing personal characteristics.

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(J. C. MY.)

HOLYSTONE, a soft kind of sandstone used by sailors for scrubbing and cleaning the decks of ships. The origin of the word is doubtful. Some authorities hold that it arose from the general practice of scrubbing the decks for Sunday service; while others think the name arises from the fact that the stone so employed is naturally porous and full of holes. A small flint or stone having a natural hole in it, and worn as a charm, is also called a holystone.

HOLY WATER, technically the water with which Christian believers sign the cross on their foreheads on entering or leaving church. The decretum of Gratian enjoins that it should be exorcized and blessed by the priest and sprinkled with exorcized salt. This rite is found in the Gelasian, Gregorian and other sacramentaries. In the east the water was blessed once a month; in the Latin Church it is now blessed every Sunday. In the 4th century in the east it was usual to wash the hands on entering

the church (see ABLUTION), In the early church water was not expressly consecrated for baptisms and other lustrations.

HOLY WEEK in the church year is the week between Palm Sunday and Easter (*qq.v.*); it is observed with especial solemnity as a time of devotion to the passion of Christ. In the Greek and Roman liturgical books it is called the "Great Week" not, as John Chrysostom remarks in his homily on Ps. cxlv, 2, that it contains either longer or more days than other weeks but because great deeds were done by God in it. The name "Holy Week" also is very old and was used in the 4th century by Athanasius and Epiphanius. Originally only Friday and Saturday, the nucleus of Holy Week, were observed as holy days: later Wednesday was added as the day on which Judas planned with the Jews to betray Jesus Christ, and by the beginning of the 3rd century the other days of the week had been added. The pre-Nicene church concentrated its attention on the celebration of one great feast. the Christian Passover (*pascha*), on the night beta-een Saturday and Easter Sunday morning, but by the later 4th century the practice had begun of separating the various events and commemorating them on the days of the week on which they occurred: Judas' betrayal and the institution of the Eucharist on Maundy Thursday (*q.v.*); the passion and death of Christ on Good Friday (*q.v.*); his burial on the Saturday; and his resurrection on Easter Sunday. The Holy Week observances in the Roman missal were revised in 1956 so as to take place at the correct time of day.

See W. J. O'Shea, *The Worship of the Church* (1957); H. Thurston, *Lent and Holy Week* (1904). (L. C. S.)

HOLYWELL (TREFFYNNON, "well town"), a town and urban district (established 1894) in Flintshire, Wales, lies on the left bank of the Dee estuary. Pop. (1961j 8.459. The holy well is that of St. Winifred (Gwenfrewi), who is said to have lived in the 7th century and to have been beheaded by her lover. Her head rolled down the hillside and when it rested water immediately gushed forth there. St. Beuno was believed to have restoied her to life. The site became one of the most famous well-shrines in medieval Britain and continues to attract both Protestants and Roman Catholics. The well itself is covered by a Gothic chapel founded by Margaret, mother of Henry VII. In 1870 a hospice for poorer pilgrims was built. The parish church (rebuilt 1769) has some remnants of an earlier building and a 15th-century embattled tower. About 2 mi. from the town are the remains of Basingwerk abbey. partly Saxon and partly Early English. It became a Cistercian house in 1131 and was dissolved in 1535. The district around had copper. lead and coal mines in the 18th century. while the town possessed chemical and textile works. Modern industries are a'ssociated with the north Wales coal field. (E. G. Bow.)

HOLZ, ARNO (1863–1929). German writer, was born on April 26. 1863. at Rastenburg. East Prussia, son of a chemist. His early lyric poetry attracted considerable attention: but his principal work, undertaken often in collaboration with J. Schlaf. was critical. He was in personal touch with many German naturalist writers. In *Die Kunst, ihr Wesen und ihre Gesetze* (1891) Holz really inaugurated the German impressionist school. In his *Revolution deu Lyrik* (1899) he rejected rhyme. strophe and rhythm and all verbal music, maintaining that poetry must live by its meaning alone. His two volumes *Phantasus* (1898–99) were written on this theory. Holz's original work exercised a notable influence on the entire current of German literature.

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HOMAGE, one of the ceremonies used in the granting of a fief and indicating the submission of a vassal to his lord. It could be received only by the suzerain in person. With head uncovered the vassal humbly requested to be allowed to enter into the feudal relation; he then laid aside his sword and spurs, ungirt his belt and kneeling before his lord; and holding his hands extended and joined between the hands of his lord, uttered words to this effect: "I become your man from this day forth. of life and limb, and will hold faith to you for the lands I claim to hold of you." The oath of fealty, which could be received by proxy. followed the act of homage; then came the ceremony of investiture, either directly on the ground or by the delivery of a turf, a handful of earth, a stone or some other symbolic object. The obligations involved in the act of homage essentially resembled the obligations undertaken toward a Teutonic chief by the members of his *comitatus* or *gefolge,* one of the institutions from which feudalism directly sprang. Besides *homagium ligeum,* there was a kind of homage which imposed no feudal duty; this was *homagium per paragium,* such as the dukes of Normandy rendered to the kings of France, and as the dukes of Normandy received from the dukes of Brittany. The act of liege homage to a particular lord did not interfere with the vassal's allegiance as a subject to his sovereign, or with his duty to any other suzerain of whom he might hold lands. (*See* FEUDALISM.)

HOME, EARLS OF; Alexander Home or Hume, 1st earl of Home (c. 1566–1619-1. was the son of Alexander, 5th Lord Home (d. 1575), who fought against Mary, queen of Scots, at Carberry Hill and at Langside, but was afterward one of her most stalwart supporters. being taken prisoner when defending Edinburgh castle in her interests in 1573 and probably dying in captivity. He belonged to an old and famous border family, an early member of which. Sir Alexander Home, was killed at the battle of Verneuil in 1424. Sir Alexander (d. 1491) was created a lord of parliament as Lord Home in 1173, being one of the band of nobles who defeated King James III at the battle of Sauchieburn in 1488.

Alexander, 6th Lord Home (d. 1619), was warden of the east marches, and was often at variance with the Hepburns, a rival border family whose head was the earl of Bothwell. Home accompanied James to England in 1603 and was created earl of Home in 1605: he died in April 1619.

His son James, the 2nd earl, died childless in 1633 when his titles passed to a distant kinsman, Sir James Home of Coldingknows (d. 1666). a descendant of the 1st Lord Home. This earl was in the Scottish ranks at the battle of Preston and lost his estates under the Commonwealth, but these were restored to him in 1661. His descendant, William, the 8th earl (d. 1761) fought on the English side at Prestonpans, and from his brother Alexander, the 9th earl (d. 1786): the present earl of Home is descended. In 1875 Cospatrick Alexander. the 11th earl (1799–1881), was created a peer of the United Kingdom as Baron Douglas, and his son Charles Alexander, the 12th earl (1834–1918), took the additional name of Douglas. The principal strongholds of the Homes were Douglas castle in Haddington and Home castle in Berwickshire.

HOME, JOHN (1722–1808), Scottish dramatic poet, was born at Leith. Graduating M.A. at Edinburgh university he mas licensed to preach by the presbytery of Edinburgh in 1745. In July 1746 Home was presented to the parish of Athelstaneford, Haddingtonshire. His first play, *Agis:* a *tragedy,* founded on Plutarch. was rejected by Garrick. The ballad of *Gil Morrice* or *Child Maurice* (F. J. Child. *Popular Ballads,* ii. 263) supplied him with the outline of the simple and striking plot of *Douglas,* on which he spent five years' labour. The play was rejected by Garrick. but n-as produced in Edinburgh on Dec. 14, 1756, with overwhelming success; in spite of the opposition of the presbytery. who summoned Alexander Carlyle to answer for having attended its representation. Home wisely resigned his charge in 1757, after a visit to London, where *Douglas* was brought out at Covent Garden on March 14. Peg Woffington played Lady Randolph, a part which found a later exponent in Mrs. Siddons. Gray said that the author "seemed to have retrieved the true language of the stage," but Samuel Johnson held aloof from the general enthusiasm. Home died at Merchiston Bank, near Edinburgh, on Sept. 5, 1808.

The Works of John Home were collected and published by Henry Mackenzie in 1822 with "An Account of the Life and Writings of Mr. John Home." Poems omitted from this edition are printed in vol. ii. of *Original Poems* by *Scottish Gentlemen* (1762). *See* also Sir W. Scott, "The Life and Works of John Home" in the *Quarterly Review* (June 1827).

HOME ECONOMICS. This is a phrase now widely used in the United States to describe a subject of study which would in the past have been called "domestic economy." The range of types of the teaching of home economics is wide, as the subject is

taught in elementary schools, high schools, vocational schools, private schools for girls, technical schools, colleges, universities and schools or colleges for teacher training. A further type of teaching is offered by the extension service of the U.S. department of agriculture, the home economics staff (women) doing their work through lectures, demonstrations, printed matter and the training of local leaders. This extension work is done chiefly in rural districts, but in some States there is similar work in cities. The vocational work is under the direction of the Federal board of vocational education.

In the institutional field the opportunities are many. Hospitals, sanitoriums, homes for the aged or for children, homes for the handicapped, such as the blind and crippled, employ "dietitians," "dietitian"-housekeepers or housekeepers trained in home economics. Private schools employ "dietitians," housekeepers and matrons so trained. All these positions are usually resident. Tearooms, cafeterias and restaurants employ many trained women in different capacities and are frequently owned by women. Many social welfare organizations, such as charity organization societies, have home economics departments, and these, as well as some hospitals, employ trained women as "visiting housekeepers." They are employed also in health centres, social settlements and other welfare enterprises.

Training for work as budget consultant is part of home economics, and such specialists are employed by banks, welfare organizations and a few department stores. A few are established privately as budget consultants Women's magazines and some newspapers have home economics workers, often specialists in one or another part of the field.

Those who have done advanced work in physiological chemistry, textile chemistry or some other branch of science with applications to home economics, may do laboratory or research work. Manufacturing and distributing firms whose product is food or household equipment employ trained home economics women as an adjunct to the advertising department. This staff plans the educational work of the firm, plans and prepares leaflets and matter for advertising pages, and co-operates with the advertising department to make sure that all information given to the public is accurate and helpful. Advertising firms sometimes employ a home economics woman for service to their clients, and this may include speaking over the radio, which is popular as a means of advertising foods and household equipment.

For the work described, professional training is necessary. Some women not so trained are now employed in some of the fields other than teaching, but the necessity for training is recognized more each year, so that it is increasingly difficult for a woman with inadequate or no training to secure and hold such positions.

(I. . L.)

HOME EQUIPMENT. During the 20th century home equipment developed from simple hand-operated tools for cooking, washing and cleaning into highly complicated mechanical appliances, many of them automatically controlled. There were a number of reasons for this development, one of the main ones being the near disappearance of the domestic servant. Equipment was therefore designed to save the housewife's time and energy and to take the drudgery out of housework. The demand for these new and improved appliances was increased by the growing number of married women gainfully employed outside the home, many of whom continued with paid work for the first few years after marriage in order to purchase equipment which later would make running of the home, with children, less burdensome.

This equipment included such basic appliances as ranges or cookers, refrigerators, washing machines, vacuum cleaners and hand irons. In addition, there was a growing market in the second half of the 20th century for such items as automatic dishwashers, garbage grinders, power mixers, electrically heated blankets and air conditioners. Also contributing to the increase in number of basic electrical appliances — as well as of such newer types of equipment as electronic cookers, electric frying pans and saucepans, etc.—in use was the extension of electric power to homes.

KITCHEN EQUIPMENT

RANGES AND COOKERS

The range is one of the most necessary items of home equipment. The four principal types of ranges, according to the fuels used, are gas (natural or manufactured), electric, kerosene (also gasoline and fuel oil in the U.S.) and solid fuel (wood, charcoal, lignite, bituminous coal, anthracite or coke). The following discussion of ranges will be limited to gas and electric types

Traditionally, regardless of the type of fuel used, surface cooking units and oven were combined in one frame; after about 1930, most of the models were 36 in. in height with oven and broiler or grill below the surface units. Later, however, particularly in the U.S., the divided range began to be popular, with the surface cooking units installed in a counter area while the oven, raised to waist height, was built into a wall in another area of the kitchen. The divided range has distinct advantages in use but requires more space for installation than does the conventional range. Moreover, installation costs are higher, since either gas or electrical wiring must be carried to two locations.

Gas Range or Cooker. — Four types of gas are used in the U.S.; natural gas, manufactured gas, a combination of the two and liquefied petroleum. The first three require piping from the gas mains to the home, but liquefied petroleum can be brought to homes in cylinders or placed in tanks under the ground in the home yard. These gases vary in composition and heating values.

Two types of gas are used in the United Kingdom: town gas and Calor gas, the latter much higher in calorific value. The former is supplied through pipes and is available in all urban areas; the latter is delivered in cylinders.

The efficiency, durability and safety of gas ranges have steadily improved. Most manufacturers submit their gas appliances for testing, in the U.S. to the American Gas association, in the U.K. to the Gas council. Minimum requirements agreed on by the A.G.A. and the British Standards institution include gauge of metals to be used in various parts; regulation of flues, valves, ovens, etc.; conditions of gas consumption; protection against gas leakage, carbon monoxide production and fire hazard; satisfactory distribution of oven heat; and thermal efficiency of top burners.

Approximately 75% of food cookery is done on the surface units. Although the burners differ in design, their principal parts include the mixer, mixing tube and burner head. The mixer carries an air regulator (shutter) and an opening, either fixed or adjustable, for the orifice (through which the flow of gas is controlled).

The ports or openings in the burners usually are drilled horizontally on the rim and at a 45° angle in the centre of the burner, so that they do not clog with spilled-over foods so easily as did earlier vertical ports.

Burner sizes usually range from $2\frac{1}{2}$ to $3\frac{1}{2}$ in. in diameter. The larger or giant burner is built for a heat capacity of not less than 12,000 B.Th.U. (British thermal unit) per hour, while regular burners take 9,000 B.Th.U. in the U.S. and 10,000 B.Th.U. in the U.K. Some ranges have separate simmer burners; in others the burners can be regulated so that only the centre ports function, providing heat as low as 500 B.Th.U. per hour. A later development on gas ranges was the thermostatically controlled burner. The control device,, centred in the burner, presses against the bottom of a utensil (only utensils with flat bottoms can be used) and, when the temperature of the utensil reaches that set on the burner valve, the flow of gas is automatically reduced and the gas flame controlled to hold the utensil at that temperature. This development served to simplify meal preparation, as the food being cooked could be left almost unattended without burning or overcooking.

When the burners are operating, gas flows from the main line through a horizontal pipe called the manifold. Burner valves, operated by hand, direct the flow of gas through the orifice and mixer of the burner at very high velocity. "Primary" air is sucked through the partly open shutter and mixed with the gas in the tube; this mixture of gas and air will not burn until it comes in contact with the "secondary" air surrounding the burner.

The range top usually consists of four burners with cooking

vessel supports arranged in various ways, the main arrangements being two behind two or all across the back. In some models, particularly in the U.K., a broiler or grill forms part of the range top, a space being provided for the broiler pan between the top of the oven and the range top. Another position for the broiler is above the range at eye level. In the U.S. the oven burner usually serves for broiling, with the broiler pan, often built in, being placed in a special compartment beneath the main oven.

Most ranges are equipped with automatic lighting by means of a small pilot flame which is kept constantly burning by gas released through a bypass line. As the burner is turned on, some of the gas-air mixture passes into a flash tube, is ignited by the pilot light and in turn lights the main burner.

The oven consists of a metal box heated by a burner, usually located at the bottom of the back wall. To minimize heat loss the oven is made with double walls, the space between being filled with insulating material. Slag wool was formerly used, but aluminum foil and glass fibre have come to be more generally employed, the former because it reflects radiant heat and the latter because it has low thermal conductivity and a high specific heat, thus preventing a sudden fall in temperature when a large quantity of cold food is placed in the oven. The surfaces of the oven are finished with porcelain enamel. A vent is provided for discharging the products of combustion of the gas and of steam evolved during cooking. Commonly the vent is located in the upper part of the back wall. where it leads into a pipe that discharges through the back panel of the range top over the burners. A constant oven temperature is provided by means of a thermostat, either rod or liquid type. The dial setting in the U.S. is by temperature and in the U.K. by number which corresponds directly to temperature. The time taken to reach a given temperature setting from cold varies in different models, but is generally about 15 min.

Special features include folding tops to cover burners when not in use; lighted back panels and oven lights; electrically controlled clock timers and minute timers; nontipping oven racks; rotating temperature guide; lock-position burner valve handles; motor-driven rotisseries; infrared lamps for warming oven; outlets for electrical appliances; chrome-lined ovens; pull-out towel racks; built-in meat thermometers and griddles.

Electric Range. — In the U.S. standards for performance and safety of electric ranges are determined by the National Electrical Manufacturers association, American Standards association and the Underwriters laboratories; in the U.K. by the British Standards institution.

Two types of units, the tubular or radiant and the solid plate, are available. In the U.S., the former is almost universal except on older models. In the U.K. the latter is most generally employed, but use of the first type is increasing. The tubular design consists of a tube of stainless steel or nickel-chromium-iron alloy into which coils of resistance wire are inserted and the tube filled with fused magnesium oxide powder. The tube is flattened on the top to allow for better contact and conduction of heat to the utensil. The solid type consists of a plate of a nickel-containing alloy of cast iron, grooved on the underside to house spiral resistance wire embedded in refractory cement. The upper side has a flat machined surface to ensure maximum contact with a cooking vessel placed on it. One type of tubular unit utilizes two tubes in spiral form to provide different heat patterns with different switch settings; for small utensils the inner coil alone may be heated. The second type of tubular unit uses a larger diameter tube with two or three inserted resistance coils, producing even heat over the whole system.

In the U.S. infrared units also have been developed. These consist of a gold-lined 1,550-w. infrared bulb mounted in a metal reflector and covered with a red glass cover. Infrared type units heat by radiation, whereas other electrical units heat mainly by conduction; because infrared heat is instantaneous, it is especially good for rapidly heating small amounts of liquid or foods. A range usually has only one top-surface unit of this type, but it is used extensively for broiling foods in restaurants and for exhibition purposes.

Most surface units are of two sizes: 8 in., with wattages of 1,600–2,100 in the U.S. and 1,800–2,000 in the U.K., and 6 in., with wattages of 1,100–1,600 in the U.S. and 1.000 in the U.K. (where, however, surface units with higher loadings similar to those in the U.S. are available and growing in popularity). Control of surface units is effected either by means of a 5- or 7-heat switch or by a timer giving an infinite number of heat settings. Many ranges have one or more surface units temperature-controlled by a thermostat.

Oven construction and finish in the electric range are similar to those in the gas range. Heating elements usually are located on the lower part of the two side walls (in the U.K.) or in the ceiling and floor (in the U.S.). They are of two types: the open coil. consisting of a continuous coil of high-resistance wire. which glows red when a current passes, and the tubular sheathed wire, which remains black when current flows. Oven control is by a thermostat, the settings given ranging up to 500° F

Special features include push-button controls and illuminated dials with different colours for each heat setting; thermometer for meat roasting with cable connections to a thermostat dial in the back panel; motor-driven rotisserie; vertical broiler with tno elements to broil on both sides simultaneously; electric filter in oven vent to eliminate smoke and odours from oven; divided oven doors which, as they open, automatically pull out shelves; specialized surface cooking units such as a deep-well cooker or a griddle that can be covered and converted to counter space when not in use; outlets for electrical appliances; and even radios.

Electronic Oven. — In this oven energy from the high-frequency radio band is used for cooking. The radio waves penetrate to the centre of the food and are absorbed evenly throughout, whereas in conventional methods heat is absorbed by the exterior only and transferred by conduction to the centre. Two outstanding features of the electronic method are very short cooking times (often measured in seconds) and complete absence of heat in the oven. The containers used are all made of glass, china, plastic or paper, which transmit the waves and themselves remain unheated. The metal walls of the oven reflect the waves and also remain cool. Electronic ovens were used by caterers in the U.S. for several years before domestic models became available in the 1950s. A magnetron is used for the generation of energy of 2,450 mc. and 12.7 cm. wave length. It has a normal output rating of 2 kw. and is suitable for a maximum operating demand of 5.23' kw.

The appearance of food cooked in this type of oven is diiferent from the conventional, and for foods. such as steaks, that require a brown exterior a conventional broiler must be used as well. This usually is incorporated in the electronic oven. As a safety precaution the oven is designed so that the unit will not function when the door is open. Microwave energy produces no effects on the body except those normally produced by heat.

Refrigerators and Freezers

Refrigerator. — The refrigerator is an appliance in which food and other materials are preserved at temperatures near freezing point (32" F.); in the freezer, food is frozen and preserved at 0° F. and lower. The period during which foods can be preserved in a refrigerator is limited to a few days; they may be preserved in a freezer indefinitely. The refrigerator usually contains a compartment maintained at a temperature considerably below freezing point where frozen foods can be stored, but unless the temperature is 0° F. or less frozen foods should not be stored in it for more than a few weeks. One reason for keeping foods at low temperatures is to inhibit the growth of microorganisms, which cause decay in food. The optimum temperature for the growth of yeasts, molds and bacteria is 70"–SO° F.; at 40°–50° F. the rate of growth, although not stopped completely, is slowed considerably. Practically no growth takes place below 10° F., but storage temperatures near 0° F. are recommended for frozen foods, to discourage ice crystal growth. In many foods the formation of large crystals causes rupture of cell walls and subsequent rapid deterioration of food on thawing. (See also **Food** Preservation [in the Home]; Food, Care **and** Storage of [in the Home].)

The first home refrigerator, made early in the 19th century, consisted of an insulated cabinet into the top of which a block of ice was inserted. Melt water was carried off by a drain pipe extending through the cabinet and out the bottom. The food stored in the section below the ice compartment was kept cool by cold air currents. The modern refrigerator, use of which gradually became widespread after 1918. is automatic, generally operating on one of two basic principles, namely compression and absorption (see REFRIGERATION). The advantages of the compression type are lower running costs and a greater reserve of cooling power, which in practice means that ice cubes can be made more rapidly. The main advantages of the absorption type are that it is completely silent and, because there are no moving parts, there is less possibility of defects developing in operation. Also, because heat is the source of energy used, it can be operated by gas or kerosene as well as electricity.

The automatic home refrigerator consists of a double-walled box with a hinged door, the space between the walls being filled with insulating material. The outer walls of pressed steel have an exterior finish of baked enamel (porcelain enamel may be used for the top surface if it is intended as a working area). The interior walls, when made of pressed steel, are finished with acid-resisting porcelain enamel. The door is also double-walled and insulated. A rubber gasket on the frame maintains a seal and prevents leakage of warm air into the box when the door is closed and locked by means of a latch, a friction locking device or magnets embedded around the frame. Polystyrene is used increasingly for both outer and inner walls, primarily because it can be molded in a complete whole without joints. Shelves and trays usually are made of anodized aluminum or of mild steel wire coated with tin, chromium or polyvinyl chloride.

The sizes of refrigerator cabinets available range from 3 cu.ft. to 16 cu.ft. in the U.S. and from 1½ cu.ft. to 10 cu.ft. in the U.K. The horsepower rating of motors ranges from ⅛ to ⅕ and heating units from 150 to 350 w. Temperature is thermostatically controlled by a dial that may be adjusted to effect changes as required. The setting must be related to the external temperature.

All foods should be as cool as possible when they are put into the refrigerator and should be wrapped or tightly covered to prevent drying out by the evaporator in the cooling compartment. In cold-wall models, however, unwrapped food does not dry because evaporation takes place in another compartment.

Special features include automatic defrosting; frozen food storage accommodation of 2–3 cu.ft.; rotating or adjustable shelves; automatic ice cube dispensers; and door racks and special compartments for foods such as butter, eggs, cheeses and fresh vegetables.

Freezer. — The food freezer is a cabinet or chest, maintained at a temperature of 0° F. or lower, in which fresh foods can be frozen and frozen foods can be stored indefinitely without deteriorating. In rural areas freezers are used for preserving fruit, vegetables, meat and poultry produced locally in excess of requirements and also for maintaining a store of commercially frozen foods for everyday use. In urban areas freezers are used mainly for storing commercially frozen foods.

All freezers are operated by the compression system, using motors ranging from ⅛ to ¼ h.p. In the chest type the evaporator coils are clamped to the sides and bottom of the inner wall; in the upright type they are attached to the walls and undersides of fixed shelves. Both types have a thicker layer of insulation than the average refrigerator, usually about 4–6 in. There are advantages in both types of construction. Foods are generally more easily removed from the upright type, which occupies less floor space.

The chest type is more economical in operation because when the lid is opened the cold air inside, being heavier than the warm air above, remains in the chest, whereas in the cabinet type the cold air falls out and is replaced by warm air when the door is open. Two sizes are generaliy available in the U.K., 4 cu.ft. and 9 cu.ft. In the U.S. the range is normally from about 5 cu.ft. to 18 cu.ft.

COOKING EQUIPMENT

Basic Utensils. — Saucepans. — Saucepans are made of cast iron or sheet steel with a protective coating of tin or porcelain enamel, and of stainless steel, sheet or cast aluminum, copper, brass, nickel, Monel metal and glass flameware. Desirable qualities of the material used for pans are durability; hardness to resist scratching, pitting, abrasion and percussion; strength to keep their shape under strain; a surface relatively easy to keep clean; resistance to moisture and alkalies; and high thermal conductivity. Choice, therefore, usually is governed by cost and the extent to which the material conforms to the above qualities. Stainless steel is one of the best materials, but it is expensive and, because it has a relatively low thermal conductivity, is not satisfactory for all types of cooking unless thickly clad on the base with copper, brass or aluminum. The other important feature affecting choice is design of the pan and cover. Balance, internal radius of the corners at the base for easy cleaning, shape, length, thermal insulation, efficiency of fixing and comfortable grip of the handle, general design of the cover for easy cleaning and the design of the knob for grip are all points to consider.

Casseroles. — Materials used for casseroles, in addition to those given for saucepans, include heat-resisting glass and ceramic materials. Enameled iron, stainless steel and some ceramic materials that can be used on a surface cooking unit as well as in the oven or on the table as a serving dish are especially popular.

Frying and Omelet Pans and Deep Fryers. — Materials used for frying and omelet pans are the same as those for saucepans, a heavy gauge being found more satisfactory because it does not buckle or warp in use. Deep fryers are made of iron, steel, stainless steel or aluminum. These are provided with a wire immersion basket for holding and draining food and a cover for use in case the fat catches fire.

Kettles. — The kettle for boiling water to make tea is an essential item of the kitchen in the U.K., but less common in kitchens in other countries. Materials used include iron; steel, with or without enamel; stainless steel; and aluminum.

Pressure Cookers. — Basically a pressure cooker is a saucepan with a cover that forms an airtight seal when locked in place and traps the steam that otherwise would escape during the cooking process. As the pressure inside builds up, the food is cooked at temperatures above those attainable in an ordinary saucepan. Safety valves are provided to vent the pressure before it can build up to an explosive level. Pressure cookers are especially useful at high altitudes, where normal cooking temperatures cannot be obtained with conventional saucepans.

Knives. — Many different sizes and shapes of knives are used in the kitchen, the two most useful being the chopping knife in different sizes and the vegetable paring knife. The blade is made of stainless steel or carbon steel, the latter, when of good quality, maintaining the best cutting edge if sharpened regularly. The rearward continuation of the blade, called the tang, should extend throughout the length of the handle, to which it should be firmly riveted. The handle should be of material which is impervious to water (hardwood, bone, plastic or laminated plastic) and be comfortable to hold firmly while in use. (See also CUTLERY.)

Baking Sheets and Cake Tins. — These are made of tinned sheet steel or aluminum, which should be of a heavy gauge that will remain rigid and flat in use and not buckle or bend. A surface that is easy to clean and not likely to cause food to stick, if used ungreased, is produced by coating with silicones and by anodizing aluminum.

Whisks. — These are made in many different sizes and shapes, the hat- or balloon-shaped type being used for simple, short operations and the hand-operated rotary egg beater for longer periods. Comfort and efficiency in use and cleaning are important factors which should influence choice.

Graters. — Graters are made in tinned steel, aluminum, stainless steel and plastic. When choosing it is important to consider efficiency in use and to check for jagged edges that will tear the fingernails.

Electrically Heated Utensils. — Individually heated and thermostatically controlled cooking utensils include skillets, fry-

ing pans and deep fryers, roasters and rotisseries, saucepans, kettles, pressure cookers, coffee makers, toasters, broilers, hot plates and sandwich grills, waffle irons, corn poppers and egg cookers. With a proper combination of these utensils, an entire meal can be cooked without the use of a range.

Motor-driven Appliances. — Another class of kitchen appliances are those small devices classed as motor-driven. These include ice crushers, beaters, juicers, blenders, coffee grinders, knife sharpeners, can openers and exhaust fans.

Washing, Mixing and Disposal Equipment

Sinks and Dishwashers. — Materials used for sinks include glazed fire clay. porcelain enamel, aluminum, stainless steel and plastics such as methyl methacrylate and glass fibre bonded with polyester resins. As the kitchen sink receives a great deal of hard wear and often rough treatment, it must be resistant to chipping, cracking, scratching and breaking.

A mechanical dishwasher consists of a porcelain-enameled compartment in which two wire racks are hung. The racks, usually plastic-coated. are designed to hold a given number of dishes, flatware and utensils. A device, usually located in the bottom of the compartment. forces water over the dishes by means of a fan-like impeller. which throws the water upward. or of a rotating perforated arm through which the water is forced up and around in the compartment. The amount of water used varies from seven to ten gallons and must be at a temperature of 150° F. or higher to ensure efficient washing and drying. Many machines are completely automatic. the length of each operation being controlled by a timing device. After the final rinse the dishes are dried in one of two ways: (1) by a sealed heating element. located beneath the racks or outside the tub, over which hot air is blown by a fan; (2) the cover or door opens automatically and the hot dishes dry because of the amount of heat they have retained. Dishwashers are available nith either top opening, pull-out drawer or front opening, the top opening being the least popular because it is less easily placed in the kitchen.

Food Mixers. — Beating, whisking and kneading are performed automatically by the basic model mixer, and attachments can be added for blending and making purées, mincing, coffee grinding, juice extracting, shredding and grating.

Three different systems are used for the basic operation: (1) a detachable beater or whisk is attached to a vertical spindle which rotates about a secondary axis concentric with the mixing bowl; (2) two whisks fixed to a central shaft rotate at high speed and in so doing cause a mixing bowl to revolve slowly; (3) a mixing bowl is electrically driven to revolve at a medium speed and the contents are beaten by a wooden dolly attached to an arm projecting over the bowl. The dolly also rotates by friction from the rim of the bowl with which the rubber-lined upper surface of the dolly is in contact. The apparatus is driven by an electric motor. usually portable, of $\frac{1}{16}$ to $\frac{1}{4}$ h.p. The motor is heavy and unwieldy to lift, however, and therefore frequently is kept permanently in the place where it is used. In one available model the motor is fixed immediately beneath a working surface and is provided with a projection to which the bowl and beater arm can be attached. This type has the advantages that only the lightweight bowl and mixer need be lifted and that the work area is free from obstruction when the mixer is not in use. Hand models of type (2) are generally available and useful for whisking eggs and beating potatoes, but they are not very satisfactory for longer operations, such as cake mixing. because they save only energy and not time. Most models with high-speed whisks are made with a detachable head for manual use.

Food mixers are generally satisfactory in operation but, when purchasing, it is advisable to ensure that they are simple to operate and that the motor in running is reasonably quiet.

Food Waste Disposer. — The food waste disposer or garbage grinder, designed to pulverize food waste, is fitted into a sink drain so that, with the aid of a continuous flow of cold water, the resulting material is flushed into the sewage system. It consists essentially of cutting knives of high-quality steel that rotate at high speed inside the food waste container, The electric motor driving the blades is generally $\frac{1}{4}$ h.p. for the small home model. Two different methods of control are used. In one, a switch starts the motor but the operator is responsible for turning on the water and feeding waste into the hopper. A hand guard usually is provided with this type. In the other, the top of the disposer is locked in place and, when the cold-water faucet is turned on, a small quantity of water is bypassed through a separate pipe, where the pressure trips a switch and starts the motor. This method ensures a good flow of water for flushing the drainpipe, The disposer will pulverize a great number of materials composing kitchen waste, but certain items for which it is not satisfactory include paper, tin cans and large bones. Stringy foods such as corn-husks, artichokes or celery are difficult to pulverize unless added with other foods and in small amounts.

LAUNDRY EQUIPMENT

Washing Machine. — This consists of a tub in which articles are agitated in soapy water by a mechanical device of which there are two main types, the agitator and the cylinder. In the former an attachment with blades or fins is fitted over a central shaft, which rotates first in one direction and then in another, in so doing moving the clothes in the water. In the latter a perforated drum revolves on a horizontal axis and carries the articles with it. Some types of small machines work by means of an impeller, a finned disk fitted in the side wall or base of the tub; rotation of the impeller causes the clothes to rotate in the water. Almost all washing machines incorporate in their designs a device for extracting water from the clothes. This device may be either a power-driven or hand-operated wringer or a rotating perforated drum revolving at high speed on either a vertical or horizontal axis. The tub is usually of aluminum. stainless steel, sheet steel lined with porcelain enamel or glass fibre bonded with polyester resin. The agitator attachment is normally made of aluminum alloy or reinforced Bakelite. Tubs are designed to hold 44–10 lb. of dry clothes and about 5–17 gal. of water. The motor is of $\frac{1}{8}$ or $\frac{1}{4}$ h.p. and energy is transmitted to the drum or agitator shaft by belt, gears or friction wheels.

Washing machines may be (1) fully automatic; (2) semiautomatic; or (3) hand-operated. In (1), after the articles have been placed in the tub, the controls adjusted and the current switched on, the washing cycle is completed without further attention by the operator. This cycle consists of filling the tub with hot water, washing for a set time, rinsing one or more times and extracting the water. In (2) the amount of attention necessary by the operator varies. This type always bas a power-driven device for washing and usually one for extraction and emptying of the tub, but in general each process must be started and stopped by the operator. In (3) the mechanical device for both washing and extraction of water is hand-operated. In many washing machines in the U.K. an electric heating element or gas burner is included so that water can be heated and articles can be boiled in the tub.

Spin Dryer or Extractor. — The spin dryer does not dry clothes but merely extracts water from them, the amount remaining being 33%–50% of the dry weight of the articles compared with 100%–150% for the conventional power-driven wringer. The method of extraction by rotation of a perforated drum on a vertical axis is similar to that used in some washing machines, but the speed of rotation is generally higher, ranging from 1,000 to 2,800 r p.m., and the percentage of water extracted therefore also is higher.

Clothes Dryer. — Cabinet dryers, heated by gas or electricity. can be used for drying clothes after washing or airing them after ironing. These appliances usually are made nith metal bars over which the clothes are hung.

The automatic dryer, sometimes called the tumbler dryer, is a power-driven device which, through heat and tumbling (with or without air flow), evaporates water from fabrics for a period of time determined by the operator. Although all dryers operate on the same principle of tumbling clothes in a cylindrical basket or drum, in the presence of heat, they fall into two general types, those that are time-controlled and those that are temperature-controlled. The former may have two dials, one to control drying

time, the other to set the degree of heat desired according to the fabric being dried; some have only one dial, for timing the operation, temperature being thermostatically controlled. Temperature-controlled dryers have a thermostatic control set for a desired temperature; when sufficient moisture has evaporated to cause a rise in temperature equivalent to the setting, the machine stops.

The capacity of the automatic dryer is rated as 8–9 lb. dry clothes or 16–18 lb. wet weight. Most dryers have a moisture removal rate of 8–12 lb. per hour.

Hand Irons and Power Irons. — Heat, moisture and pressure are necessary to remove from fabrics the creases acquired from washing and drying. When heated and damp, the fibre temporarily becomes plastic so that the pressure of the iron removes the creases. Before electricity was generally available irons were heated in the coal fire, on the range top or by gas or charcoal.

The electric hand iron consists of a sole plate of aluminum alloy, cast iron or steel plated with chromium, to which is attached a well-insulated cover and handle made of wood or plastic. Heating elements are of two types: In the herringbone, mica-insulated type the element is firmly clamped against the sole plate by means of a pressure plate; the efficiencyand life of the element depends to a great extent on the uniformity of this pressure. The later type, with a ceramic-insulated element cast into the sole plate, gives more uniform heating if well designed and has a longer life. The electric loading of hand irons ranges from 630 to 1,000 w. and the weight from 3 to 6 lb. Many irons are made with a thermostatic control, the settings being labeled in terms of the fabrics for which they are suitable. Temperatures widely recommended are as follows: synthetics, 300" F.; silk, 325"; rayon. 350"; wool, 375"; cotton, 425°; linen, 475°.

The steam iron, which became very popular in the second half of the 20th century, is a heat-controlled iron containing a reservoir of water which is heated in the iron and released as steam through holes in the sole plate. There are two major types of steam irons, the kettle and the flash boiler. The former holds one to two cups of water, all of which must be heated to boiling point before steam issues from the sole plate. The latter, which holds varying amounts of water, produces steam instantly when each drop of water comes into contact with the sole plate. Both types also can be used for conventional dry ironing.

There are two types of power irons, the flat plate or press and the rotary or mangle, both of which require practice to acquire the skill necessary to iron all types of articles. In the press, a hinged, thermostatically controlled, electrically heated, rectangular metal shoe, about 2 ft. x I ft., is lowered onto a padded ironing board on which the article to be ironed has been arranged. Considerable pressure (about 300 lb. per square inch) is exerted by the shoe on the article, thus producing a satisfactory finish on such articles as starched linen and cotton. The electrical loading is 1,350 kw. In the rotary type the article passes between a padded revolving roller and a concave polished metal shoe that presses firmly on the roller. The shoe, electrically heated and thermostatically controlled, may be located either above and slightly to the back of the roller or below and slightly in front of it. In the former, articles pass under the shoe and over the roller, which has one open end and is supported at the other end. In the latter, the articles pass over the shoe and under the roller, which may have one open end or be open at both ends. In the latter case it is supported by a wishbone-type frame. The electrical loading of the sole plate ranges from 1,250 to 1,600 w., and the roller is driven by a small electric motor of about $\frac{1}{8}$ h.p. These irons may be either portable or cabinet type. Some models also may be fitted to the washing machine as an alternative to the wringer.

CLEANING EQUIPMENT AND MATERIALS

Carpet Sweeper. — This is a hand-operated machine designed to remove surface dirt from rugs and carpets. It consists of a long-handled metal or wooden container on wheels. Inside the container is mounted a cylindrical brush that rotates when the appliance is pushed over carpets and other floor surfaces. The dirt picked up by the rotating brush is deposited in two pans alongside the brush.

Suction or Vacuum Cleaner. — This is an electrically operated machine consisting essentially of a high-speed fan, driven by an electric motor, which draws air through the machine. It is designed with a nozzle opening that, when placed on the surface to be cleaned, sucks up dust as air is drawn through the carpet material. Embedded dirt is difficult to remove by suction only, and brushes and other agitators to loosen it often are included in the nozzle.

There are two main types of suction cleaner; the upright and the canister. The former is a long-handled metal or plastic container in which is located the motor, the fan and the rotating cylindrical brush driven by a belt from the motor. When the current is switched on, the brush rotates and air is drawn over it through the container and into a bag suspended from the handle. The bag is made of either fabric or paper which permits the passage of air but not of dust, which is deposited in the bag. The canister type consists of a metal or plastic cylinder or sphere in which is located the motor, the fan and the bag in which the dust is deposited. A flexible hose attached to a tube with a nozzle end is fixed into a hole in the cylinder or sphere. When the current is switched on air is sucked through the nozzle; with it is carried dust, which is deposited in the bag. **A** brush and an agitator may be included in the nozzle.

Motors range in size from $\frac{1}{2}$ h.p. to $\frac{3}{4}$ h.p. and in speed from 6.000 to 16,000 r.p.m. and more. Canister types usually have larger motors, but the amount of suction depends primarily on the size, speed and design of the fan and the design of the fan chamber. Suction, and thus efficiency, is reduced as the amount of dirt in the bag increases, hence it should be emptied frequently. Where the design incorporates a paper bag, the bag can be removed and replaced by a new one.

Most suction cleaners are designed to be used with tools for other cleaning jobs. Such tools include a crevice tool and brushes for dusting and for cleaning upholstery, walls and bare floors. A spray device for paints, insecticides or other liquids. and a demothing device may be attached to a second hole on the reverse or "blower" side of the fan in most models.

Cleaning **of** Rugs. — Soil that sticks to and cannot be removed from rugs by regular vacuuming often can be removed by rug-cleaning powders made of sawdust or clay products and mixed with a spirit solvent. This mixture can be spread over and into the nap or loops of the rug with the floor brush attachment of a vacuum cleaner or with a broom. As the solvent evaporates, the soil becomes attached to the powdery material, which, when dry, is removed from the rug by the vacuum cleaner. This type of cleaning product is especially suitable for oily types of soil.

Another method of cleaning rugs is to use concentrated liquid synthetic detergents. Added to water, these may be sprayed or sprinkled on the rug and scrubbed with a stiff brush or broom until all lather has disappeared. When dry, the rug is vacuumed to remove residual soil and detergent.

Floor Polisher. — The floor polisher usually consists of one, two or three motor-driven disk-shaped brushes, with long stiff bristles, that revolve at high speed. The heat created by the friction of the brushes melts wax into the floor and gives a polish. The utility of these machines is increased by the attachment of steel wool pads, which may be used for soil removal instead of scrubbing; or sandpaper disks may be inserted for use in roughening surfaces before applying new finishes; or the brushes may be used for actual scrubbing with water. Felt disks also are available for high-lustre polishing.

Cleaning Materials. — Cleaning materials may be classified according to the general action they have, which may be one or a combination of two or more of the following: (1) Solvent; water and certain spirits used for grease removal are the main solvents. (2) Detergent; soap and synthetic detergents are used for clothes, dishmashing and for floor and general-purpose cleaning. (3) Abrasive: powders made up of particles of different sizes are used for their mechanical action in cleaning and polishing, those with fine particles of smooth shape being used on soft, easily scratched materials and powders with large, hard, sharp particles being used on harder materials. (4) Protective; waxes, silicones, oils and

plastic materials are used to form a protective layer on floors and furniture. (5) Bleaching and bactericidal.

HEATERS, WATER SOFTENERS AND AIR CONDITIONERS

Water and Space Heaters.— The fuels used for appliances for water and space heating are solid fuel (coal or coke), oil, gas and electricity, the first two being most generally used for central heating systems because of lower running costs. The heat generated in the home furnace is transferred to the rooms of the house either by hot-water pipes and radiators or by hot-air ducts. Underfloor heating also is employed, with either hot-water pipes or electric elements embedded in the concrete subfloor.

Piped hot-water systems may be either direct or indirect, the latter being used for combined central and water heating. Direct systems employ independently fired water heaters using gas or electricity and are sometimes used as auxiliaries of the indirect systems during the summer months when the main heating system of the house is closed down. Independent heaters are thermostatically controlled, water temperatures of about 140° F. being generally used to minimize heat losses and scaling, which increase rapidly at higher temperatures. (For a more complete discussion of heating systems *see* HEATING AND VENTILATION.)

Water Softeners.— From the gases in the air, minerals and organic matter on and in the earth's surface, water picks up matter that makes it coloured, cloudy, iron-contaminated and hard with calcium and magnesium salts. Water with as little as 4 or 5 gr. (1 gr. = $\frac{1}{2\,0\,0}$ oz.) hardness causes soap to unite with the minerals, forming insoluble soap curd and causes scaling in water pipes and heaters.

Water hardness can be reduced by the use of packaged chemicals or a mechanical water-conditioning appliance. Of the packaged chemicals, one type, the hexametaphosphates, leaves the minerals in solution but makes them inactive. Other types of phosphates generally precipitate out the minerals. These chemicals generally must be added manually to washer. dishpan or bathtub and are difficult to dispense in showers or dishwashers.

The mechanical softener, on the other hand, is plumbed directly into the water system and removes hardness minerals by a process known as ion exchange. A tanklike container holds a quantity of beadlike ion exchange resins, which have an affinity for the calcium and magnesium ions found in hard water and prefer them to the sodium ions with which they were originally saturated. Thus, if water containing calcium and magnesium ions passes through a bed of the resin which contains a high concentration of sodium ions, the calcium and magnesium ions in the water will be replaced by the sodium ions of the resins and the calcium and magnesium will combine chemically with the resins. Mechanical water softening cannot be a continuous process, however, since the resins eventually become saturated with calcium and magnesium ions and must be regenerated. This is accomplished by washing the resins with a salt brine solution, which causes the resins to give up their load of calcium and magnesium ions and reunite with sodium ions. Following the wash, the brine, which now consists of calcium and magnesium chlorides, is flushed out of the system through a special outlet. This process may be repeated over and over. While ion exchange resins are not designed to remove iron compounds from water, they do remove some iron. For high iron content waters, however, special filters are necessary. Phosphate feeders inserted in the water line will help, in some cases, to keep the iron in suspension and retard its deposition on fabrics, plumbing fixtures and the like. (*See* also ION EXCHANGE.)

Air Conditioners.— The term air conditioner commonly implies the appliance installed in a window for the purpose of cooling, dehumidifying and purifying the air in a given area, usually one room. A true air-conditioning system, however, is a central unit designed for both heating and cooling, which works interchangeably and automatically to condition the air and maintain it at a set temperature throughout the home.

The room conditioner is most frequently installed in a window or other opening in the outside wall. Such units are generally rated from $\frac{1}{2}$ to $1\frac{1}{2}$ tons, a "ton" being equal to the amount of cooling produced by the melting of one ton of ice in 24 hours. Larger conditioners usually are water- rather than air-cooled and require $1\frac{1}{2}$–5 h.p. motors. The motor of the ordinary room conditioner generally is about $\frac{1}{3}$–1 h.p. Any size over that requires a 240-v. circuit.

The mechanism of the room conditioner is the same in principle and similar in construction to that of the compression-type refrigerator. Air is drawn through a filter that removes dust, smoke and pollen; the clean air, which may also be moisture-laden during hot humid weather, then passes over the cooling coils, causing some condensation. The condenser fan throws the excess moisture onto the condensing coils, where it may all be evaporated or channeled to drain outside the conditioner. Heat from the condenser is dissipated outside the house, and cool air is blown through vents into the room by the fan. Adjustable vents allow for the air to be circulated in different directions — up, down or sideways — in the room to prevent drafts on the occupants. The air is usually about 15°–25° cooler than the temperature of the room would be without the conditioner. Some models are thermostatically controlled so that when the temperature of the room drops below that of the temperature setting the cooling unit shuts off and only the fan continues to operate, providing circulation without cooling. This feature is advantageous for nights when outside temperature may drop below that of early evening. Some models have to be manually set and operate until the user changes the control. Still other models have a heating element to warm the room on cool days. Certain models are designed only to cool and recirculate the air already in the room, others have a vent that can be adjusted to pull air in from outside or recirculate that in the room. The latter is advantageous on very hot days when it is easier to keep the already cooled air at the desired temperature than to cool that from the outside. If air becomes stale the vent can be opened to replenish it. Portable models that do not require permanent installation also are manufactured. To reduce noise, motors, compressors and fans are mounted on rubber. Since air conditioners can dry, cool and remove dust and pollen from the air, they are of aid to persons with hay fever and asthma. (*See* also HOUSE DESIGN; AIR CONDITIONING.)

(EL. K. W.; J. E. WA.)

SEWING MACHINES

Flat Bed and Free Lower Arm.--Most home sewing machines are the flat-bed type, on which it is difficult to sew or mend narrow tubular parts such as socks, elbows of a sleeve or knees of trousers. Free lower-arm machines have an enclosed lower portion over which tubular fabrics may be slipped.

Portable and Cabinet Styles.— Portable full-size heads of steel machines may weigh more than 30 lb. and are not easily carried; those made of aluminum are of course considerably lighter. Smaller-size heads weigh less, but they provide less free space for maneuvering fabric while sewing. It is more difficult to sew heavy or bulky fabrics on very small machines. Some carrying cases are designed to open to create a flat surface for the free-arm machine or double in use as a suitcase. Certain portable machines are made so that they can be locked easily into a cabinet or be removed by lifting a lever in the machine. Specially constructed tables, with a removable section in the top and a supporting base, into which portable machines may be set, provide a flat surface for sewing at a comfortable height.

Oscillating and Rotary Types.—It can be determined whether a machine is oscillating or rotary by noting the direction of the movement of the bobbin race (which is around the bobbin case) while stitching. Oscillating machines have a semicircular, backward and forward mechanical movement around the bobbin case, which clicks when the race starts to reverse itself. This knocking may cause wearing of parts. The mechanical movement in rotary machines is circular, continuous and smooth, with potentially greater speed and less vibration and noise during operation.

Stitching.— When a machine is evaluated, the stitch should be tested on several kinds of fabric — limp, thick and sheer. It should be noted if the machine stitches in the reverse position, for this is used in backstitching, for securing forward stitching and

for mending. The machine head or upper tension may obscure the stitching area, and a slant-needle type machine may provide greater visibility than the vertical-needle machine.

Home sewing machines do three types of stitches: straight lock stitch, chain stitch and zigzag lock stitch.

Straight Stitching. — The commonest machine stitching is a straight. flat stitch produced by the interlocking of spool and bobbin threads, which is fairly difficult to rip out. Straight lock stitch machines often have the reverse stitching feature and sometimes accommodate attachments that do limited kinds of zigzag stitches and make buttonholes.

Chain Stitching.—Chain stitching is produced by one thread which loops over itself, as in knitting or crocheting. The stitching, which may be seen on feed and sugar bags, can be readily unlooped and pulled out, and to be secure the stitched ends therefore must be completed properly. A chain stitch is more upraised than a lock stitch, and since bulky stitching generally is undesirable there is little demand for new chain-stitch machines.

Toy machines for children are the chain-stitch type, being easy to thread because no bobbin is inserted. Toy model machines are adequate for occasional mending.

Zigzag Stitching.—Zigzag stitching is a lock stitch of bobbin and spool threads which zigzag because the threaded needle shifts from side to side during sewing. A close zigzag stitch results in a satin stitch. Buttonholes can be made without attachments, but care must be taken to move the proper levers on the machine and a semiautomatic buttonhole attachment is available for some machines to decrease the probability of mistakes in machine adjustments. Buttons can be sewn on with the shifting needle. By inserting two threaded needles, two rows of stitching can be done at one time. Although all zigzag machines do straight lock stitches, on some models the straight stitching is not so regular as it might be. Attachments can be used on zigzag models as on straight-stitch machines. Zigzag stitching usually is demonstrated on stiff fabrics, but it should be tested on limp fabrics too. The overcasting stitch also should be tested by sewing the cut edge of fabric; if the overcasting draws, the tension should be readily adjustable to improve the stitching.

Semiautomatic zigzag models produce decorative zigzag stitches by means of a lever moved manually and rhythmically while sewing. The right hand, working the lever, cannot be used to control the fabric, and as the hand becomes tired the rhythm is changed, resulting in an irregular stitch. Automatic zigzag stitching is done with the insertion of special cams (disks) or by built-in cams. Machines with built-in cams are capable of limited design variations by adjustments in the width (bight) and length of the stitch, and some of these machines accommodate insertable cams for additional decorative stitching. Machines with insertable cams are more versatile because the manufacturer may continue to make cams with new designs and because, since some cams come in several parts, new designs can be created by interchanging the parts. The important thing to consider when comparing automatic zigzag machines is whether it is necessary to have an almost unlimited variety of designs. Ease in inserting the cams also needs to be considered. Zigzag machines vary in complexity of machine adjustment for each decorative stitch.

Speed *and* Vibration. — Electric home machines may vary in maximum stitching speed within the range of 700–1,400 stitches per minute. On some machines, the maximum speed can be controlled by a lever. The rapidity with which a machine starts and stops sewing is important, and time is wasted if the handwheel must be grasped in starting or stopping. On all kinds of machines, speed of stitching is controlled by the operator. A machine should be tested for amount of vibration when sewing at all speeds, for vibration is likely to be the fault of the machine head rather than of the table. Vibration makes it difficult to control the fabric.

Bobbin. — Ease of bobbin insertion is an important factor. Some machines have built-in bobbin cases; in others the bobbin first must be inserted in a removable bobbin case or shuttle, then placed in the machine. In some machines the bobbin must be inserted on a vertical plane, in others on a horizontal plane; the latter often provides easier insertion and better visibility. Some machines have a "nonjamming" bobbin feature that prevents the thread from clogging the bobbin race if stitching is done when no fabric is under the needle, or that makes it possible to remove a caught thread easily.

Attachments. — The hinged presser foot is useful for sewing over irregular surfaces and pins. Adjustable cording and zipper feet make it possible to stitch close to an upraised surface, such as the teeth of a slide fastener or cording. The buttonhole attachment, adjustable or automatic with the insertion of templates, is useful on lock-stitch machines. Templates are available for both keyhole (one rounded end) and straight buttonholes. Tuckers, hemmers, rufflers and darning and quilting feet are other attachments. Practice often is necessary for skillful use of attachments. They usually are demonstrated on stiff fabrics, and careful adjustment may or may not make it possible to work on limp or glossy fabrics. An automatic zigzag attachment is available for certain brands of straight lock-stitch machines.

Machine Operation. — Sewing machines are powered by a handwheel, a foot treadle or electricity. Nonelectric machines often can be electrified, and electric machines can be adjusted so that they can be operated by a handwheel or foot pedal. Electric machine stitching is regulated by knee or foot levers, some machines having both features. A knee lever located in the proper position for the user may be a better choice than a foot pedal, which is so easily shifted that it is annoying to relocate it after the foot is removed. Foot-pedal machines may be altered to operate with knee levers. Machines may operate with built-in gear drives or with the less expensive friction or belt drives. either enclosed or exposed. A stretched belt or worn-out friction drive usually can be replaced easily with little cost, but the replacement of part of the gear drive requires skill and is more costly. *(See* also SEWING MACHINES.)

For small sewing equipment, see SEWING! HOME: Equipment.

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(F. Ta.; M. L. BR.)

HOME OFFICE: see GOVERNMENT DEPARTMENTS.

HOMER (Ὅμηρος), the traditional epic poet of Greece. The name is especially applied to the author of the two great epic poems, the Iliad and Odyssey (ἡ Ἰλιὰς πόησις, ἡ Ὀδυσσείαπόησις), which were recited or performed by rhapsodes at the Panathenaea at Athens, every four years during the classical period. An analysis of their contents will be found under the title HOMERIC POEMS, together with an account of the rest of the Homeric cycle.

The great books which come from an age before literary record are sometimes anonymous, like the Eddas, sometimes attributed to famous figures in the tradition, as the Psalms in mass to David and the Pentateuch to Moses, sometimes to a definite but unknown person, as the Chanson de Roland to Thorold, sometimes to gods or mythical characters, like the poems in Book X. of the *Rigveda*. The special difficulty about Homer is that, whereas David and Moses have an independent existence, whether or no they wrote the works ascribed to them, Homer has not: he is nothing but the author of the Homeric Poems. The poems are facts and "Homer" a hypothesis to account for them.

Lives of "Homer." — There are indeed certain traditional "Lives of Homer." Eight are published in the Oxford text of Homer, vol. 5, together with the Contest oj *Homer* and Hesiod. The longest and best is composed in Ionic Greek under the name of Herodotus. The dates of these lives are hard to determine, particularly since the latest may contain nuclei of ancient tradition. But it seems likely that the demand for a life of Homer arose at least as early as the general interest in literary biography in Greece, *i.e.*, about the time of Aristotle; and that, when it arose, there was no material for satisfying it beyond romance and conjecture. The existing lives seem to be made up out of deductions from certain passages in the Homeric poems and from proverbs and popular verses. The Lives quote many of these, sometimes lines about particular places — Smyrna and Kyme (Epigr. iv.), Erythrae (Epigr. vi., vii.), Mt. Ida (x.), Neon Teichos

(i.), sometimes about particular trades or occupations—potters, sailors, fishermen, goatherds, etc. The verses are attributed to Homer, and occasions are invented for his uttering them. Similarly various characters in the epics, Mentes, Mentor, Tychius etc., are explained as real persons whom he rewarded or punished by putting them into his books. There is romance in the conception of the divine poet, blind, old and poor, wandering from city to city; and it may mell be real history which, amid the many varying stories, always brings Homer from Ionia, and almost always from that part of Ionia which was originally Aeolic.

Seven cities are recorded as claiming to be Homer's birthplace: "Smyrna, Chios, Colophon, Salamis, Rhodos, Argos, Athenae," but it is not always the same seven. Kyme, Ithaca, Ios, Pylos come in some lists, while Sparta, Egypt and Babylon also compete. Many of these fall away as obvious inventions; Sparta comes from the Lycurgus romance; Egypt and Babylon belong to the conception of Homer as "all-wise," full of the learning of the east. Smyrna and Chios have the most support, followed by Kyme and Colophon.

As to Homer's date, the pseudo-Herodotean Life puts his birth at 1102 B.C. Elsewhere the estimates vary from 685 B.C. (the historian Theopompus) to 1159 B.C. (certain authorities in Philostratus). Herodotus considers that "Homer and Hesiod" made the Greek pantheon "not more than **400** years before me": *i.e.*, about **830.** Aristarchus puts his floruit at 1044 B.C. These dates seem to be based on the date of the Trojan War and a conjecture of Homer's relation to it.

Sometimes one can place a poet's date and nationality by his dialect. But the Homeric dialect has no contemporary parallel by which it can be judged, and as it comes to us in the poems is clearly not a dialect that was ever spoken, but one created by the epic tradition, and even by the hexameter metre, for its own purposes. In the main it is an Ionic dialect, like an early stage of that written by Herodofus; hut the surface of the poems has been unconsciously Atticized, an inevitable result of the Panathenaic recitation and the Athenian book trade. When this surface corruption is removed we find many non-Ionic forms which have all the appearance of being Aeolic—the dialect of Thessaly, Lesbos and Aeolis. It is also clear that, where two forms are metrically equal, the Ionic form is generally preferred.

This would seem, by all analogy, to show that either the poem itself or at any rate the poetry which created the Epic dialect, had once been Aeolic, just as the people of Smyrna, Chios and the neighbourhood had. (The phenomenon is not uncommon in traditional poetry. Thus the English poem, Sir Degrevant, is shown to be taken over from a Norman original by the fact that, while the hero is normally called Degrevaunt, and of course remains so when required to rhyme with "avenaunt," "recreaunt," he becomes "Degrivauns" when he has to rhyme with "countenauns" and "Frauns." In Norman, "Degrevans" was nominative and "Degrevant" accusative.)

But beneath both the Ionic main stream and the Aeolic incidents there is an element of very old Greek, comprising many expressions which were not understood in classical or Alexandrian times, and many more which needed a commentary (*ἀμενηνὰ κάρηνα, διάκτορος ἀργειφόντης*). What is more remarkable, there are some forms (such as *ϝάναξ, πτόλις, κέραμος*) which are found in Cyprian and Arcadian, and nowhere else. That is, they belong to the ancient undivided language mhich survived in these two isolated and mutually remote dialects. The problem may be raised whether the Homeric dialect does not contain an element of the pre-Greek language of the Aegean, derived perhaps from pre-Homeric Minoan poetry. Doubtless there is such an element but it does not seem noticeably stronger in Homeric than in classical Greek (cf. Haber, *De Lingua antiquissimorum* Graeciae *Incolarum*, 1921.)

The Text of the Poems.—These observations, which seem at first sight so confusing, nevertheless yield a result. The man "Homer" cannot have lived in six different centuries nor been born in seven different cities; but Homeric poetry may well have done so. The man cannot have spoken this strange composite epic language, but the poetry could and did. Let us turn back therefore from the unknown man to the known book.

The works of Homer "and no other poet" (Lycurg, in Leocr. p. **209)** were recited at the Panathenaea in accordance with a law attributed variously to "our ancestors," Solon, Hipparchus or Peisistratus. The "works" were the Iliad and Odyssey. They had to be recited *ἐξ ὑποβολῆς* or *ἐξ ὑπολήψεως, i.e.,* by giving or taking a cue; there was a fixed order, so that where one man left off another began. The custom continued at least to the times of the author of the pseudo-Platonic dialogue *Hipparchus,* and seems to have started with the foundation or re-foundation of the Panathenaea by Peisistratus.

If there was a fixed order, there must have been something like a written text; and as a matter of fact we find in the scholia an accepted tradition, supported by certain corruptions in the text, that the poems were once written in the old Attic alphabet, an archaic and awkward script with no double letters or long vowels. This tradition has been considered incredible on the grounds that the new, or Ionic, alphabet was used in Athens for literary purposes from very early times, the old script being purely for official documents; that Homer must have come to Athens in Ionic script; and finally that several passages in tragedy which describe the writing of heroic times always take the Ionic script for granted. (Eurip. *Theseus,* fr. 382 N.; Agatho fr. **4,** Achaeus fr. **33,** Theodectes fr. 6.) The conclusion seems to be that, if the Panathenaic text of the Iliad and Odyssey was ever written in the old Attic script, it must have been an official document, drawn up by order of the state.

There is some evidence that this was so. A tradition which Wolf described as aox *totius* antiquitatis speaks of a text or an arrangement, or recension, of the works of Homer by Peisistratus, tyrant of Athens between 560 and 527 B.C. The oldest witness is one Dieuchidas of blegara in the fourth century B.C., to whom may perhaps be added the Aristotelian Dicaearchus and the grammarian Crates, who founded the art of *grammatike* in Rome. (He was detained there by breaking his leg when on an embassy from Attalus II. to the Senate.) The clearest are writers of the early Roman period and various scholia and lexica. Cicero puts it that Peisistratus *primus Homeri libros, confusos antea,* sic *disposuisse dicitur ut nunc habemus* (is reported to have been the first to arrange in their present order the books of Homer, which were previously in confusion); Josephus says that Homer left nothing in writing; the poems were afterwards put together from the varying memory of different places; Suidas, the Lives, Eustathius and the Townley Scholia explain that Homer sang his poems *σποράδην,* "in a scattered way," as he travelled about, and that Peisistratus afterwards collected them. Pausanias, Aelian, Diogenes Laertius, mention or assume the tradition; indeed one may say that it is the accepted view of the grammarians with the exception of Aristarchus, who held that Homer himself was an Athenian.

Such authority is of course not conclusive. But there is very little of our grammatical record that has more ancient credentials, and even if there were no tradition at all, it is hard to conceive how the Panathenaic recitation could have been established without some editing of the poems, under the orders, presumably, of Peisistratus or his artistic son, Hipparchus.

There must then have been an authoritative Athenian text in the second half of the sixth century B.C. That is the earliest solid fact in the record of the Homeric poems. The curious thing is that this text did not maintain itself. There is little evidence affecting the text of Homer in the fifth century, after the fall of the Peisistratidae, but as soon as quotation becomes common, in the fourth and third centuries, it is clear that the current texts varied considerably both from one another and irom our vulgate. Still more striking is the evidence of the early papyri, numbering about **zoo** which have been discovered since 1890. Eleven of these are earlier than 150 B.C.; the rest later. Roughly speaking those later than 150 B.C. generally agree with our present vulgate texts; of the eleven supposed to be earlier ten differ "wildly" from our vulgate and one (Pap. **Ox.** 1388), has proved to be later.

The Establishment **of the** Text.—Evidently something happened about 150 B.C. which reduced the current texts of Homer from disorder into order, and the grammatical tradition enables us to see what it was. It was about 150 B.C. that the famous Aristarchus of Samothrace, then head of the Alexandrian-library, published the edition, or rather the two successive editions, of the text of Homer which were afterwards recognized as authoritative. This fact was for long obscured by the language of the scholia, which dwell on Aristarchus's extreme "caution" (εὐλάβεια) in treating the text and often seem to be in doubt what his reading really was. When he does not "condemn" a spurious line, that normally means that it had not yet made its way into the text. But it is clear that his caution did not prevent conjectures and large condemnations; and the occasional uncertainty as to his reading only shows that the current texts a few generations afterwards were not infallible and could not be trusted without further question. It seems probable, especially after the recent work of Cauer, Wecklein and Bolling, that the present vulgate text was approximately, at any rate, the text of Aristarchus. It is still disputed how far he created that text, and whether it is really some old text—that of Peisistratus, or even of Homer himself—re-established by the great critic out of the mss. which he collected.

It seems clear that from the time of Aristotle and Aeschines on to that of the earliest papyri the texts of Homer were in an extremely fluid state. (Aristotle for example cites from Homer five completely unknown phrases or passages; he quotes many passages in a strange shape; he found several passages not where we have them but in another context; and in order to show how short a *resumê* can be he remarks that Odysseus' story to Penelope in *Od.* xxiii. "occupies only 60 lines," while in our texts it only occupies thirty-three.) The first great Alexandrian scholar, Zenodotus of Ephesus (b. 325) set himself vigorously to cope with this confusion. He rejected freely passages which he thought spurious, and probably he found mss. which were considerably shorter than ours. He had not reached the wonderful knowledge of Homeric idiom which was the distinction of Aristarchus; but he had the advantage of catching the text at an earlier stage, and thus was spared some interpolations which had not yet been made, while he preserved many ancient readings and forms (φὴ κύματα B 144, δαῖτα A 5, κυνύλαγμον Φ 575, ἀψ *drab* Φωκήων γ 307). His text must have been at least a thousand lines shorter than that of Aristarchus, and it was his vigorous pioneer work which made the "caution" of Aristarchus possible (see *infra*, "Study of Homer in Antiquity").

The Poems Before **Aristarchus.**—We find thus two stages of something like *terra firma* in the history of the Homeric text: the present vulgate, established (approximately) by a process which set in about 150 B.C. and was probably due to Aristarchus. Before that a long period of uncertainty, and then earlier, about 550 B.C., the so-called "Peisistratean recension," by which we can only mean the text in the old Attic script which was composed or used for the purposes of the Panathenaic recitation. This is the earliest stage of which we have any record; any suggestion about the previous history of the poems must rest on conjecture, and conjecture supported by little external evidence. Yet it is clear that the year 550 B.C. is an extremely late stage in the history of the Homeric poems, or at least of Homeric poetry. As in almost all departments of Greek literature only the latest growth was preserved; the last stage of the epic like the last of choric poetry, and the last of tragedy. We can at best try by different roads to pierce into this darkness.

1. Were the poems recited elsewhere before they came to Athens? It would seem at first sight probable. There certainly was a good deal of epic recitation; but of the *Iliad* and *Odyssey* no public recitation is recorded, and it is noteworthy that when Zenodotus and Aristarchus ransacked the Greek world for mss. they seem never to have lit on any fragment of a pre-Peisistratean ms. No Ionic *Iliad* or *Odyssey* seems to have been in existence in the third century B.C. This seems to show either that the poems had not been committed to writing before they came to Athens, or else that the poems written in Ionic, and recited for many generations at Ionian gatherings, were in some way completely outshone and driven out of the market by the Attic poems. At any rate there is no trace of an earlier written text of the *Iliad* or *Odyssey* as we know them.

2. For what occasion can the poems have been intended? As epics for reading they are wonderful, yet it seems certain that there was no large reading public in Greece in the sixth century B.C., much less in that far more remote period when Homeric poetry first took shape. As lays for ordinary recitation they are not suitable. A recitation ought not to last more than an hour or two, but the *Iliad* would last about twenty hours. And the poems are decidedly unities; they are not strings of separate lays or cantos. They absolutely refuse to fall apart into separate lays, as is proved by the subsequent history of Lachmann's famous attempt to make them do so. There were rhapsodes reciting Homeric poetry all over Greece in the sixth century; we hear of them at Sicyon, Sparta and Syracuse. But they can hardly have been reciting the *Iliad* and *Odyssey*. Those gigantic wholes must have been meant for some very great and rare occasion, such, for example, as the Panathenaea—the solemn gathering of all the Ionian cities to their Metropolis once every four years. If the poems were first written down in the time of Peisistratus it may well be that they first received their present form at that time. Indeed such would be the natural conclusion. For the rhapsode, at each performance that he gave, regularly drew both upon his memory and his invention. He knew the style, the language and the facts, and could begin his recitation from any point he chose, as bards in the *Odyssey* do. (τῶν ἀμόθεν γε, *Od.* i. 10, ἔνθεν ἑλών, *Od.* viii. 500.) For the new Pan-Athenian festival which he was founding Peisistratus would naturally have a special version or arrangement made.

3. Thus we cannot be certain that the poems in their present form existed before the sixth century, but we can be quite certain that everything but the form is vastly older. By form is here meant the selection and arrangement of the incidents. The subject matter, the language used in describing it, the poetical style, and above all the manners and customs of the society depicted belong to an age which can in part be dated and in part reaches back to the dimmest antiquity.

Internal Evidence.—In facing this problem the first thing to realise is that the poet is not naïvely describing the world as he himself knew it, but, like almost all narrative poets after him, describing with deliberate artistic purpose a long past age which he knew from earlier poets and from tradition. This is shown not merely by the occasional contrast between the heroes and "men as they now are" (οἷοι νῦν βροτοί εἰσι, cf *Il.* xii., 14 *sqq.* xx., 302 *sqq.*), but much more by the fact that a number of customs are mentioned in metaphors and similes which are carefully excluded from the narrative itself.

Thus in the narrative there are no trumpets, no garlands, no eating of fish (except by starving men, *Od.* xii. 331, iv. 368), fowl, vegetables, milk or boiled meat; but most of these things were evidently known to the poet and occur in similes or descriptions. Paintings are not mentioned, nor yet coins; a statue, and a sitting statue, is once implied but not directly mentioned (*Il.* vi. 303); the art of writing is left doubtful, but any direct mention of it is skilfully avoided and the scholiasts left to take divergent views (*Il.* vi. 168, vii. 175 with schol.). Cavalry is never mentioned (*Od.* xviii. 263) though riding is known: the use of cavalry was extremely old, but the chariot was more "heroic." In a similar archaizing spirit there is no mention of colonies, nor of the great "modern" Ionian trading cities like Miletus, just as there are no Dorians; yet the mask slips, for we hear of an old Sicilian woman (*Od.* xxiv. 211, 366, 389) possibly of a colony (*Od.* x. 108 ?Artakia), and a good deal about certain Heracleidae, who were the Dorian chieftains (*Il.* v., 628, ii. 653) and still more about their ancestor Heracles.

There are abundant "arts and crafts": a famous cup, brooches, belts, necklaces of amber and gold, stained ivory, ivory reins, and a shield from the divine smithy which surpasses the handi-

work of man, but is doubtless modelled on it. As to food, the scholiasts remark that "the heroes" took three meals a day, and each meal consisted of the roast flesh of the larger quadrupeds. The recurrent phrase "unspeakable flesh and sweet strong wine" (κρέα ἄσπετα καὶ μέθυ ἡδύ) betrays the admiration felt by a later generation for such heroic tastes. The dead are burned. The bale-fires make a vivid stain in the scenery of the epic. The Greeks had always the custom of burial, and had mostly not enough wood for pyres. The weapons are made of bronze (χαλκός).

Homer like Hesiod knows of a time when "black iron was not," except indeed as a material for tools, clubs, arrowheads and other easily workable objects. He knows, as Aristotle knew, that the classical Greek custom of the marriage-dowry was recent, and that in the old days "they bought their women" by giving bride-gifts (ἕδνα). It is wonderful how clearly these last three customs are realized, and how carefully the illusion is kept up. There is a slip in the use of a late proverb "iron of itself draws a man on" (Od. xvi. 294, xix. 13) where "iron" is used for "a weapon"; and once or twice the word ἕδνα is used as if it meant "dowry" (Od. i. 277, ii. 53,196). But in the main the picture of the heroic age is wonderfully well maintained. The schools of bards must have had a fine training in the tradition, though we must remember also that our present text has passed under the eyes of many jealous critics before its final revision by Aristarchus.

For the fact is that the Scholia, or remains of ancient commentaries, with which the Iliad is richly provided and the Odyssey not deficient, are more occupied with the distinction of the Homeric from the non-Homeric (or "more recent") than with any other problem. Aristarchus and his disciples have lynx eyes for subtle points of language, belief and custom. It is no exaggeration to say that modern scholarship had no conception of many subtle uses of words in Homer until the Scholia to the ms. called Venctus A were published by Villoison in 1788. (*E.g.*, that φόβος is "flight," δέος "fear," τρεῖν is "retire," not "to tremble," θῦσαι "to cense," not "to slaughter"; that φράζω is "to point out," not "to say," σῶμα is "a dead body"; σχέδον "near," not "almost," πάλιν "backwards," not "again," τάχα "quickly," not "perhaps," γράφειν "to scratch," not "write".) And the observation of customs was almost equally acute. The explanation seems to be clear. It is not to be supposed that either Peisistratus or Aristarchus had access to a flawless ms. many centuries old by which variations could be checked; but there were traditional texts and a traditional knowledge, both in the schools of bards and to a less extent among the critical public, by which all variations or new compositions could be tested and kept true to standard. It is most instructive to see how those remains of ancient epic which were not selected for the great recitation and thus fell into neglect break all the Homeric rules in language, verse and custom alike, while on the other hand they never approach, as many passages in Homer do, to the lyrical hexameters characteristic of the fifth century.

Study of Homer in Antiquity. — The critical study of Homer, that is, of the mass of epic literature concerned with the heroic saga, began in Greece, as Monro says, "almost with the beginning of prose writing." The first names recorded are those of Theagenes of Rhegium (6th century B.C.) and his pupil Metrodorus of Lampsacus. In the fifth century educated men from the impoverished islands and cities of Ionia sought a living in Athens by teaching literature and especially Homer. A typical instance is the adventurer Stesimbrotus of Thasos. From this time onward the study of Homer was a regular feature of Greek mousike.

It is noteworthy that, from the very first, exegesis took two forms: explanation of the glossae, or hard words, and allegorical interpretation and justification of the subject matter. The principle set out in the Homerica Problemata of Heracleitus (1st century A.D.) "If Homer used no allegory he committed all impieties" (εἰ μηδὲν ἠλληγόρησεν πάντα ἠσέβησεν) was, as one can see from Plato, accepted early, and regarded as a natural thing. On this system Hera was the Air (ηρ-α = α-ηρ), the adultery of Ares and Aphrodite was the combination in the world of Strife and Love, and so on.

The interpretation of glosses is mentioned in Aristophanes, Daitales frag. 222, where a father asks his son the meaning of κόρυμβα and ἀμένηνα κάρηνα. Many strange interpretations, recorded in the Scholia as coming from "the glossographi" serve to illustrate these painful beginnings of the science of *grammatike*. The phrase νέκρους κατατεθνηώτας ("the dead corpses") was objected to as tautologous. "No," said the glossographi, Νεκροι = νέρι, "young men," with κρ "added for euphony." Τοῖος was interpreted as ἀγαθός, a meaning of course which it sometimes implies (τοίου γε καὶ πατρός Od. iv. 206, and even τοῖο γέροντος as ἀγαθοῦ γέροντος *Il.* xxiv. 164). It is noteworthy that Aeschylus actually uses τοῖος as "good" (Suppl. 400), and so, it is said, did Callimachus.

Many individuals are recorded as having made a text of Homer. Probably it was a common thing for students and poets, such as Antimachus and Philetas, instead of buying a book from a shop, to write out their own text. We hear that Plato's library passed on eventually to the library at Alexandria, which may account for the close resemblance of the Homeric quotations in Plato to our vulgate. Aristotle makes many interesting criticisms on the poems from the aesthetic point of view, but seems to have had a text widely differing from ours. Among fourth-century critics was Zoilus Ὁμηρομάστιξ, who shocked public opinion by his attacks on Homer.

The first approach to a really scientific treatment of the poems was made by the great scholars of Alexandria, Zenodotus (d. 260? B.C.), Aristophanes of Byzantium (about 262–185) and Aristarchus of Samothrace, who resigned his post as head of the Alexandrian library in 137 B.C. The work of Zenodotus is still something hard to appreciate. We can see that the texts of Homer in his time fluctuated wildly and in order to establish a fairly "correct" text he had to cut his way boldly through a jungle. His rejections, as recorded in the scholia, are very extensive; his Iliad must have been very much shorter than the present vulgate. He frequently rejected passages for "unseemliness," διὰ τὸ ἀπρεπές (see below, "Expurgation"). We often hear of lines which Aristarchus or some later scholar doubted, but Zenodotus οὐδὲ ἔγραφεν. This used to be explained as a sign of his recklessness; but, as Professor Bolling of Ohio has pointed out, there has been, as far as our record reaches, a constant tendency to add lines to the Homeric text, and probably the statement that Zenodotus "did not even write" a line means that it did not exist in his day.

Zenodotus had nothing like Aristarchus's delicate and intimate knowledge of Homeric idiom: he thought that the dual (which had disappeared by his day) was merely another form of the plural; he was capable of such a metrical solecism as προφανείσας ἰδών (*Il.* viii. 378). On the other hand he seems often to have preserved ancient forms and readings which were rejected afterwards by Aristarchus (&# ἀπὸ Φωκήων Od. iii. 307; φὴ = ὥς *Il.* ii. 144, xiv. 499; ἐπεὶ κυνυλαγμὸν ἀκούσῃ 11. xxi. 575).

Our knowledge of Aristarchus comes chiefly from the rich scholia to the Venetus A, first published by Villoison in 1788. They quote largely from four scholars Aristonicus (Augustan era), Didymus (who wrote against Cicero De Republica), Herodian and Nicanor (2nd century A.D.). They are sometimes in doubt about Aristarchus's views, and evidently possessed no ms. which could be held as authoritative. We learn from them of his σημεῖα or signs, which frequently occur in the Venetus A itself. One would have expected, considering the very imperfect state of Greek γράμματα at the time, with no system of punctuation or even of dividing word from word, that any new "signs" would have been devoted to supplying this want; but Aristarchus's signs deal chiefly with the genuineness or spuriousness of particular lines. There was also a sign (diple, like a V on its side) to give the reference to a note; and another to call attention to mistakes of Zenodotus (*diple* with dots).

His critical material comprised many mss. κατὰ πόλεις and several κατ' ἄνδρα. The latter were the work of individual scholars, the former apparently those used by certain cities for the public official recitations. He never mentions the Athenian

recension, evidently because he assumes it as his basic text. He speaks of the "better" or "more careful" texts, and the "common," "ordinary," and of one as ἡ πολυστίχος ("of many lines"). He evidently had no access to any text or fragment of text earlier than the Athenian recension, and shows no sign of having any which went back to the sixth or even the fifth century. With this imperfect material and the help of Zenodotus' pioneer work Aristarchus produced a text which immediately won recognition as the classical recension of Homer in antiquity and was probably, though the point is still disputed, the foundation of our present vulgate. Certainly, of our existing papyri, those written before the time of Aristarchus (150 B.C.) differ widely, while those later are almost uniform.

Aristarchus did even more remarkable work in exegesis. He not only corrected the errors of the glossographi in explaining the obsolete words, he observed with great acuteness the peculiar Homeric uses of common words (see above). He distinguished dual and plural; he saw that in Homer 6 ἡ τό was a pronoun, and he rejected the theories of Homer's allegory of universal knowledge. On the other hand his grammatical explanations often betray the infancy of the science (the first Greek grammar was the work of his disciple Dionysius Thrax). For example he uses freely the theory of "enallage" or "change of case": Ἵπποτα is "the vocative instead of the nominative"; in τὸν δὲ σκότος ὄσσε κάλυψεν, τὸν is "instead of τοῦ."

The Heroic Age.—The poems, even as they stand now, approximately in the form fixed for them by Aristarchus, nearly a thousand years later than the events they profess to describe, have an almost entirely consistent style and phraseology and give an almost entirely consistent description of the age about which they write. Of course "consistent" is by no means the same as "true." Yet, though we have practically no direct information about the Homeric age, we can, by analogy from other literatures better supplied with contemporary history, understand its general character and see that the description seems to be based on fact. The poets described a society which they did not themselves know and could not well have invented, but which corresponds closely to a type known to have existed elsewhere under given conditions. It was easy, of course, for a romantic Greek bard to make his ancient heroes ignorant of iron weapons and the art of writing, or to imagine an idyllic princess washing the royal clothes in the river.

But there are other characteristics of the age which can hardly be inventions. The heroes of Homer belong to a *Wanderzeit*. The kings had, in general, no national territories and no strong ties of kindred; they depended on their "companions" (ἑταῖροι, *comites*) or personal followers, who were largely adventurers like themselves. They are untroubled by the sanctities and duties attaching to the tribe or to the buried tribal ancestors. They practise no arts but song and war. They carry their wealth about with them in the form of brooches, belts, rich armour, necklets and caparisons. They burn their dead, they build no temples but worship at altars in the open air: and they worship a collection of gods who are just like themselves, gods who feast and sing and conquer and utter judgments, but who never work, have never created a world—only conquered and divided it—and who are to an extraordinary degree rootless and international. They stand or fall by their personal qualities; their strength and courage, their faithfulness and military honour, and the fact that since they fear no one they never tell a lie.

The above picture needs qualification if we take account of details; *e.g.* the Odyssey is a romance of the return of the wanderer, and implies the existence of a real home; the catalogue of ships in Iliad ii. gives geographical kingdoms to all the heroes. But in the main it is true, and it corresponds to the type of society that we find in many parts of the world under particular historical conditions. It occurs where an old and rich civilization is in process of being broken up by barbarian conquerors. 'It is the type called by Professor Chadwick a "heroic age," and can be traced in northern Europe during the break-up of the Roman empire, in the Balkans during that of the Greek empire, and in other parts of the world that have produced heroic poetry. The description of Attila's camp by the Byzantine historian Priscus is curiously Homeric in its details. (See Gibbon, ch. xxxiv.)

Discoveries.—This discovery has changed the character of the problem of the Homeric age. We saw above that the poets were consciously describing an age long past and notably different from their own. We now see that they were not merely describing a sort of "youth of the world," remarkable chiefly for a rude idyllic simplicity in which the contrast is between "Homer" and οἱ νεώτεροι. Nor yet were they, as Schliemann's great discoveries first suggested, depicting the great age of Troy, Mycenae and Cnossus. It was a particular period in history, to be contrasted both with the rich decadent civilization that went before and the peculiar classic Hellenism which came after.

The first palaces of Crete must have been built about 2000 B.C., and not long after there are signs of that movement of the Aryan tribes which was to have such incalculable effects on human history. The second town of Troy was laid under seven feet of ashes; at Orchomenos, Corinth and Argos citadels were destroyed and rebuilt, apparently by Northern conquerors. The northern "megaron," or hall with a porch and central hearth, begins to be found in Greece. Hitherto the "Kefti" or Men of the Isles have been in close connection with Egypt, but about 1700, when the Hyksos dynasty largely cut that country off from civilized commerce, the Cretan cities begin to turn more to Greece. Argos learns to grow the vine and olive; it adopts the Cretan woman's dress and the Cretan frescoes, while it still keeps its northern beard and tunic and *megaron*. A century or so later perhaps the Aryan invaders, or Achaioi(?), take to the sea. They had first called the sea by an "Aegean" or pre-Hellenic word, θάλασσα; then they called it ἅλς, "the salt"; it may be significant that at last they used the name πόντος, a good Greek word meaning "path." It was a path that led both to Crete and to Egypt. About 1450, Phaestus and other Cretan palaces were destroyed. For some 50 years Cnossus ruled alone: then comes the destruction of Cnossus itself—a sudden attack, it would seem, in the midst of some great court ceremony—and the end of the Minoan empires. After about 1400 B.C. only Mycenean work is found in Egypt, not Cretan.

Achaioi from Mycenae seem to take the vacant place. In Crete the royal tomb becomes a common pit; portraits of chieftains wear the northern beard and moustache. New towns are called by Achaean names; there is a decline in art and a cessation of wall-painting. It is significant, too, that after this date there is no further mention of the Kefti in Egyptian records.

Civilization has gone back but is by no means destroyed. Writing remains and there are signs of abundant wealth and mass production for commercial purposes. Speculative historians have fancied that in the Tell-el-Amarna letters and other records of this period they find some of the great names of Greek saga, an Alaksandus of Uilusa who reminds them of Alexandros of Ilion, an Attarissyas of Ahhia or Ahhijava who sounds remotely like Atreus the Achaean. With much more probability we begin now to identify names of various peoples, or at least hordes of men, who are known to Greek tradition.

At the battle of Kadesh in 1290 the Hittites had in their motley host Iliouna, Dardanoui, Masa, Pedasa, Kerkisha, Loukki and Danaouna. If the terminations -na and -sha denote "peoples" or "hosts," as Egyptologists suggest, we can hardly be wrong in recognising at least the people of Ilion, the Dardanoi, Lukioi and Danaoi. About 1230 and 1225 Merneptah of Egypt defeats in the Delta "uncircumcised Akhaiusha" "from the sea-lands," "who fight to fill their belly daily." With them are Toursha, Shardina, Loukki and Shakalasha, wanderers who may have given their names afterwards to the Tyrseni, the Sardinians, Lycia and Sagalassus. About 1194 Rameses defeated a similar locust-like multitude advancing "by sea and land, with women and children in ox-carts." They had destroyed the Hittite empire and "no people had stood before them."

Troy.—Most of the cities they destroyed have perished without

record, but Greek tradition tells us that the great sixth city of Troy, Homer's Troy, was sacked about this date. It was sacked, after a long siege perhaps, by a host that may be called indifferently Akhaiu-sha or Danaou-na — Homer has also a third name, Argeioi—and who are led by a "king of men" who is "lord of many islands" and has doubtless gathered in his thousand or twelve-hundred ships a great force of "the peoples of the sea." (Greek legend also makes Agamemnon and Menelaus joint kings of Sparta, or one of Mycenae and one of Sparta; it also involves them in some ritual king myths; but it is perhaps not rash to detect an element of real history in the Homeric picture.) The fall of Troy seems to be the sign or cause of the final crash. About 1200 the infiltration of further West-Greek tribes becomes a regular invasion. The pirates, or "peoples of the sea" receive an increase both from new "Dorian" invaders and from the broken men of the old Minoan or Achaian kingdoms, but by now there is little rich plunder left. It is a time of *συνεχεῖς στρατεῖαι καὶ μεταναστάσεις*, "constant warfarings and uprootings" (Diodorus v. 80: *cf.* Thuc. i., 2).

Homer's narrative of the siege of Troy is doubtless related to the real siege much as the Norse or German or French poems are related to the actual brutalities of the age they describe. The facts have been idealised and transfigured by memory, and confused with abundant myth, folklore and fiction; but some of the truth can be descried, as in a palimpsest, beneath the poetry. We can see in the first book of the *Iliad* a plague-stricken army, or mob of mixed peoples under diverse leaders, pinned to the barren sea shore, the narrow space choked with dead dogs and mules, the piles of burning corpses, the best fighting force in mutiny because of a quarrel about a captured woman; and the various bands "fighting to fill their bellies daily" by raids on the exhausted neighbourhood. At the end of Book VII., on the arrival of a wine-ship, we see the soldiers selling all they have, bronze, iron, shields, cattle and captives, for liquor and lying all night long on the beach under a thunderous sky.

We can also see, not from direct statements in the Homeric poems, but from implications there and direct statements in the rest of the poetic tradition, that the fall of Troy was the beginning of a dark age. If Troy fell the rest of Achaian Greece fell with it, including Thebes, Argos and Mycenae. The great kingly houses disappear. The *epos* knows little of the after history of the Homeric heroes except a disastrous series of so-called "returns"; the conception belongs to a later age which conceived these wandering hordes as the armies of regular Greek cities. The sons of Agamemnon, Achilles and Ajax and Odysseus are just remembered, but after them there is darkness.

We are justified therefore in recognising the siege and destruction of the sixth city of Troy, about the year 1200 B.C., as forming the historical nucleus of the poems, just as the defeat of Charlemagne's rearguard by the Basques in the valley of Roncesveaux is the historical nucleus of the Chanson de Roland. The real Hrodland, count of the march of Britanny was killed in that battle on Aug. 15, 778; our existing *Chanson de Roland* was written soon after 1066, three hundred years later. But we know that songs or lays on the subject were soon composed: they are mentioned as widely known (*vulgata*) in a book written less than 60 years after the battle (Life of Louis I., in Pertz SS. ii 608). And an analysis of the existing *Chanson* shows, beyond question, that it is a re-treatment (*remaniement*) in large part built up out of previous poetic treatments of the same subject.

Using this comparison as it stands, we may observe that the gap between the fall of Troy and the earliest text of Homer known to us is much greater than 300 years: our present text probably dates from Aristarchus about 150 B.C., and even if we assume that that is in the main identical with the text of Peisistratus we only get back to the latter part of the sixth century B.C. and Troy fell at the beginning of the twelfth. There must have been, during those centuries of oral transmission, uncontrolled by any fixed record or any learned class, much reshaping of the poetry and much transformation of the historical facts.

Date of Composition. — Innumerable attempts have been made to fix some time and place at which "Homer" may have lived, or at which the *Iliad* or the *Odyssey* or both, in more or less their present form, may have been composed. All have failed, and it is well to consider the reasons for their failure.

In the first place, we do not yet know what question to ask, and until we do we can hardly expect the right answer. Yet, from the nature of the case, to know the right question implies an understanding of the whole problem which is at present beyond us.

Next, we have no contemporary record to guide us. Even the political history of Greece between 1200 and 600 B.C. is extremely scanty and unreliable; and the history of literature before the time of Peisistratus is practically non-existent. Callinus in the early seventh century is said to have mentioned the *Thebair*, an epic now lost, as the work of Homer. Herodotus (v. 67) tells us that, in the early sixth century, Cleisthenes the tyrant of Sicyon put a stop to the contests of rhapsodes because the Homeric poems "glorified Argos and the Argives."

This shows that there were recitations of Homeric poetry in Sicyon before the time of Peisistratus, but nothing of what that poetry was. Our extant *Iliad* and *Odyssey* do not glorify the Argives in any special sense, but they do use the word "Argives" for the Greeks as a whole, which may have been enough to disturb Cleisthenes. There is a general reference by Xenophanes, an early contemporary of Peisistratus, to the immoral stories about the gods in Homer and Hesiod. There is no other pre-Peisistratean evidence. It is indeed conjectured that the Simonides who quotes a line of the *Iliad* (vi. 126) as the work of "a man of Chios" was perhaps the old seventh-century poet from Amorgos; but both Plutarch and Stobaeus, who are our sources for the information, clearly meant the famous Simonides of Ceos, who belongs to the fifth century. One would like to know whether by "a man of Chios" he really meant the traditional Homer or was merely referring to some contemporary Homeric rhapsode, such as Cynaethus of Chios.

The Homeric Tradition. — The other early references chiefly use the name "Homer" as covering the whole heroic or epic tradition. Aeschylus is reported to have described his plays as "slices from the great banquets of Homer" — which is true if "Homer" means the heroic tradition, markedly untrue if it means the *Iliad* and *Odyssey*. Simonides refers to Homer as telling how "Neleager surpassed all the youths in spear-throwing across the wild Anauros"—which is not in our Homer: Pindar (Nem. vii.) says that Homer praised Odysseus — which may mean, but does not by any means prove, that Pindar read the *Odyssey* as we have it. He makes two other references to Homer, neither of them quite irreconcilable with our poems but certainly not sufficing to prove that he knew them. A late schoolmaster, Theodorus (see *infra*), made a sort of wall-picture which he called *τάξιν Ὁμήρου* —an arrangement of the events of the whole early heroic tradition, in which the *Iliad* and *Odyssey* form only a fragment. An "arrangement of Homer" of a different kind was needed for the great Panathenaic recitation, and took the form — so we have definite evidence—of our present *Iliad* and *Odyssey*.

The effect of the recitation and the published text which seems to have accompanied it was quickly seen. By the latter part of the fifth century, especially among Attic writers, the *Iliad* and *Odyssey* are well-known and often mentioned: they are accepted as the only canonical works of Homer, though other poems — epics, hymns, epigrams and the like — are occasionally mentioned. Herodotus for instance is doubtful about the *Epigoni* and is against the authenticity of the *Cypria* because in his time it differed from the *Iliad* in its account of the travels of Paris. (It was altered later and made to agree: *see* Proclus' epitome.) Aristotle treated the comic *Margites* as genuine. It may be noted, also, that Attic tragedy, which drew its material from the heroic saga, *i.e.*, from "Homer" in the old sense, carefully avoided the "Homer" that was recited at the Panathenaea. It never trespassed on the *Iliad* and *Odyssey*.

Lastly it is worth remarking that, while all early quotations from Homer are apt to vary considerably from our texts, the

non-Attic writers vary much more than the Attic. Hippocrates, the Coan physician, who lived chiefly in Ionia, has many quotations which do not occur at all in our Homer, including one which he says is "frequent"; the same is true of Aristotle, born in Stageira and trained in the Ionic tradition. And it is noteworthy that a speech of Syagrus the Spartan in Hdt. (vii. 159) not only quotes a hexameter line which is not in our Homer, but seems to quote a Homer who made Agamemnon a king of Sparta. In our Homer he is king of Mycenae, though traces of Sparta seem occasionally to cling to him (*e.g.*, *Od.* iv., 514ff). The "Homer" that was "sung in scattered bits" about Greece before the time of Peisistratus may well have been very different from the Iliad and Odyssey.

Thus one may be fairly sure from the external record that there existed before the time of Peisistratus masses of heroic poetry, reputed to be very old and to be in general the work of "Homer." As to its form we can say little. It probably consisted normally of lays, of a length suitable for recitation; the length perhaps of the Catalogue or the Doloneia (400–600 lines). Whether there were already any great epics, too long for ordinary recitation but suitable for some great "panegyris" such as the Panionia or the four-yearly gathering of the Ionians at Delos, we have no evidence. Many scholars have concluded that the Peisistratean recension provided the first written text of the Homeric poems. Certainly there is no record of any written text of the Iliad and Odyssey previous to that; yet it seems almost impossible that no lays at all should have beeen written down, and the composition of the two great'poems does at times seem to suggest the use of written sources.

A Crystallization of Tradition. — Thus while it seems probable that songs or lays about the siege of Troy and other achievements of the heroic age came into existence very soon after the events themselves, the first long epics in written form of which we have any knowledge appear in Athens in the sixth century, some 600 years later. The poems that we possess represent the last stage of epic creation, though, as far as we know, the most perfect. The history of epic poetry between 1200 and 550 is entirely obscure, and conjecturable only by indirect internal evidence. Some conclusions, however, can be drawn from the language, metre, subject matter and composition of the two poems. For example (1) it is clear from the composition that each poem is a unity, but a unity imposed on a variety of sources. The unity is made up by combining different lays or parts of lays and smoothing away the discrepancies. It is clear also that in the last shaping of the poems Athenian influence counted for much.

(2) The subject matter shows that the poems cannot be explained as creations of some one age midway between Troy and Athens. Some elements of custom, story and diction go back to remote antiquity, and some again are not earlier than Athens of the sixth century.

(3) The language shows traces of Attic, not only on the surface but also a little below; a great body of Ionic; traces of a definitely Aeolic dialect; and remains also of some very ancient Greek, not definitely assignable to any particular dialect and already unintelligible in classical Athens.

(4) The metre shows signs of long development, and has, to a degree perhaps unexampled in the history of literature, conditioned and almost created the Epic dialect. Many centuries of hexametric or at least dactylic composition must have preceded the present form of Homeric verse.

To take these points in detail: the old explanation of the poems (Hermann and Grote) as an original nucleus plus interpolations or late additions, and of the occasional discrepancies as due to the interpolators, must by now be given up. For example, there is the discrepancy between books ix. and xvi. of the Iliad, the Embassy and the Patrocleia. In xvi. Achilles, seeing the defeat of the Greeks, breaks into a splendid complaint that if only Agamemnon would seek his friendship and offer atonement, the Trojans would soon fly and choke the trenches with their dead. Yet the whole of book ix. has been occupied by Agamemnon's offers of princely atonement and Achilles' rejection of them. The discrepancy is manifest; but it is not well explained by supposing that a late poet invented Bk. ix. and interpolated it.

Why should he so upset the story? It is explained at once if we suppose that a poet engaged in building up the great epic out of old material found both the Embassy and the Patrocleia in existence, and, not liking to sacrifice either, wove them both in and smoothed out the more alarming difficulties. Similarly he found — so the Scholia tell us — Bk. x., the Doloneia, as a separate lay. It is somewhat foreign in style and it makes some little trouble, but it was too good to throw away. So again some parts of the Iliad imply the existence of a wall round the ships while others ignore it. It is much easier to suppose that the poet-editor found some lays with a wall and some without, and chose to combine them, than to imagine an "interpolator" who made gratuitous trouble by putting in a wall here and there.

Just so in the *Odyssey*, there is much confusion as to Odysseus' disguise: he is sometimes disguised and sometimes not. Also there are three incidents in which something is thrown at the disguised Odysseus by one of the suitors. The three do not form a climax or show any relation to one another (p 462, σ 394, υ 299). He is twice insulted by one of his own servants. In one place the offender is Melantho, daughter of Dolios (a, τ), in the other it is Melanthios, son of Dolios (p, υ, ϕ, χ). The Melantho part never mentions Melanthios, nor the other part Melantho — though it speaks of other wicked maidservants. Again, in the long story of adventure which Odysseus relates in the first person we find one interruption of third-person verbs (ι, 54, 55), and some passages which perhaps show traces of having been once written in the third person. In all such cases the hypothesis of "interpolations" or "late additions" is of little help. The probable explanation is that two or more different sources have been combined by the — shall we call him poet or editor? He is both; but the Greeks called him $\rho\alpha\psi\omega\delta\sigma\varsigma$, or "a stitcher of songs."

So far the divergent sources that we have considered have been merely different versions of the same body of saga. The Embassy was always an incident in the Wrath of Achilles — or some similar Wrath; both Melantho and Melanthios had a part in the adventures of Odysseus, or somebody very like Odysseus. But we also find in both poems lays or long passages of quite extraneous origin.

For example, the Catalogue of Snips in Iliad ii. is, by general agreement, an old document originally composed for a different context. It describes the mustering of the ships at Aulis, not their stations on the coast of Troy, and in various ways it shows signs of adaptation, and imperfect adaptation, to its present place. Further there are passages in Qdyssey iii. and iv. which give abbreviated accounts of the Homecomings, or Nostoi, of various Greek heroes. Presumably they are derived from the Epic (or collection of lays) called *The* Nostoi. There are fragments derived from some Heracleia, or poem on Heracles, and it seems likely that some of the Androktasiai or "slayings of men" by various heroes may contain faded memories of real fighting in different parts of the Aegean world. If this is so, we must not reject the possibility of further "liftings"; notably a strong case has been made out for the suggestion that the exploits of Diomedes in the Iliad are in part taken from those of his father Tydeus in the Thebais, and that Hector himself, whose grave was shown in Thebes, was originally the defender of Thebes, not of Troy. The business of the song-stitcher was to make a great epic for the Panathenaea or some similar great occasion, and he had all the riches of "Homer" to draw upon.

Subject Matter. — Most of the typical Minoan or Mycenaean objects seem to have disappeared from the mainland of Greece by 1400 B.C., some 200 years before the fall of Troy. Some of these Homer does not mention (*e.g.*, figure-of-eight shields, inlaid sword-blades, long rapiers), but he mentions elaborate palaces with bath-rooms ($\dot{\alpha}\sigma\dot{\alpha}\mu\iota\nu\theta\sigma\varsigma$, a pre-Greek word), Nestor's cup with the doves drinking (*Il.* xi. 633), a helmet with boar's tusks (x. 261–5) and the inlaid metal-work on the shield of Achilles. These are very ancient indeed but may be explained by traditional knowl-

edge helped out by actual relics. If we ourselves have seen a Mycenaean cup like Nestor's presumably a classical Greek may have done so. Even Euripides describes a Mycenaean inlaid swordblade (Electra 476, cf. Heracles 418). The big shield which took the place of body armour and is often called Mycenaean remained in use, as Herodotus tells us, till about 650. It is found in Tyrtaeus and in a relief representing Ionian or Carian mercenaries approaching Sennacherib (705–680). A rather similar problem is presented by the discovery among Minoan remains of thirteen rings from Thisbe; the genuineness is avouched by Sir Arthur Evans. These are engraved with scenes or motives which are prominent in the poems or in later Greek saga: a man clinging under the body of a woolly ram, like Odysseus in Od. ix., a young prince slaying a king in a chariot in a narrow defile, as Oedipus slew Laius; a creature like Scylla with many heads attacking a ship, as in Od. xii. 245; a young prince, like Orestes, killing two guilty lovers. In Cnossus itself we find repeatedly the motive of a siege of a city, the hardest work of ancient warfare, which took poetic shape in the Thebais and the Iliad.

The existence of such motives in very early pre-Homeric times gives no evidence as to the date of any particular treatment of them in poetry. On the other hand the *Iliad*, though not the Odyssey, also clothes the heroes in the bronze panoply which came in not long bkfore the time of Peisistratus, and often refers to the hoplite tactics which go with the panoply. More than that, Homer dresses both men and women, not in Mycenaean bathing drawers nor Bounces, but in the "old-fashioned Attic style." He describes—in a book remarkable both for "lateness" and for beauty—a procession taking a peplus to Athena in exactly the manner of the Panathenaean peplus; he makes Athena leave Odysseus and go home to the "strong house of Erechtheus," or Erechtheum, on the Athenian acropolis. It also seems significant that the adventures of Odysseus in the Odyssey are turned into a contest between Poseidon and Athena, with the latter victorious, one of the most characteristic local Athenian myths, while a sympathetic character who protects and helps Telemachus is called "Peisistratus" and made the son of Nestor, from whom Peisistratus of Athens claimed descent. One need not dwell on the supposed "Athenian interpolations" which were noted in antiquity. The omissions are equally significant. In the Catalogue, for instance, Thebes, Aegina, Megara are omitted entirely; Salamis is suppressed and Corinth belittled. Athens, and no other city but Athens, has reasons for just these suppressions. .Of course, the symptoms are never gross. The poems are as far removed from flattery or boastfulness as the rest of classical Greek literature.

Language.—Apart from problems of local dialect, the dialect of Homer is an early or "primitive" form of the language which we know as Greek in the classical age. This can be shown by comparing the grammatical formation and syntax of Homer with those of Attic. (The comparison of the vocabulary is in the nature of things less conclusive.)

1. The first aorist in Greek being a "weak" tense, *i.e.*, formed by a suffix (-σα), whereas the second aorist is a "strong" tense, distinguished by the form of the root-syllable, we expect to find a constant tendency to diminish the number of second aorists in use. No new second aorists, we may be sure, were formed any more than new "strong" tenses, such as came or sang, can be formed in English. Now in Homer there are upwards of 80 second aorists (not reckoning aorists of "verbs in p~," such as ἔστην, ἔβην), whereas in all Attic prose not more than 30 are found. In this point therefore the Homeric language is manifestly older.

2. While the whole class of "strong" aorists diminished, certain smaller groups in the class disappeared altogether. Thus we find in Homer, but not in the later language:

(a) The second aorist middle without the "thematic" ε or ο: as ἔβλη-το, was struck; ἔφθι-το, perished; ἆλ-το, leaped.

(b) The aorist formed by reduplication: as δέδαεν, taught; λελαβέσθαι, to seize. These constitute a distinct formation, generally with a "causative" meaning; the solitary Attic specimen is ἤγαγον.

3. It had long been known that the subjunctive in Homer often takes a short vowel (*e.g.*, in the plural, -ομεν, -ετε instead of -ωμεν, -ητε, and in the Mid. -ομαι, etc. instead of -ωμαι, etc.). This was generally said to be done by "poetic licence," or *metri gratia*. In fact, however, the Homeric subjunctive is almost quite "regular," though the rule which it obeys is a different one from the Attic. It may be summed up by saying that the subjunctive takes ω or η when the indicative has ο or ε, and not otherwise. Thus Homer has ἴ-μεν, we go, ἴ-ο-μεν, let us go. The later ἴ-ω-μεν was at first a solecism, an attempt to conjugate a "verb in pi" like the "verbs in ω." It will be evident that under this rule the perfect and first aorist subjunctive should always take a short vowel; and this is the case, with very few exceptions.

4. The article (6, ἡ, 76) in Homer is chiefly used as an independent pronoun (he, she, it), a use which in Attic appears only in a few combinations (such as ὁ μὲν . . . ὁ δέ, the one . . . the other). This difference is parallel to the relation between the Latin ille and the article of the Romance languages.

5. The prepositions offer several points of comparison. What the grammarians called "tmesis," the separation of the preposition from the verb with which it is compounded, is peculiar to Homer. The true account of the matter is that in Homer the place of the preposition is not rigidly fixed, as it was afterwards. Again, "with" is in Homer σύν (with the dative), in Attic prose μετά with the genitive. Here Attic poetry is intermediate; the use of σύν is retained as a piece of poetical tradition.

6. In addition to the particle ἄν, Homer has another, κεν, hardly distinguishable in meaning. The Homeric uses of ἄν and κεν are different in several respects from the Attic, the general result being that the Homeric syntax is more elastic, and that the less common combinations of the earlier period were disused altogether in the later.

7. In the vocabulary the most striking difference is that many words appear from the metre to have contained a sound which they afterwards lost, viz., English *W*, written in some Greek alphabets by the "digamma." This letter, however, died out earlier in Ionic than in most dialects, and there is no proof that the Homeric poems were ever written with it.

In many epics the nationality of the author, or of both author and scribe, can be fixed by the dialect. Thus the author of the *Chanson* de Roland was probably a native of the Ile de France, while the scribe was an Anglo-Norman. Similar conclusions may be drawn about many of the medieval German poems. But Homer's is no definite spoken dialect—it is a traditional dialect, regularly used for epic, shaped and twisted to an extent probably without parallel in literature by the needs and conveniences of the epic hexameter. In the main the poems are Ionic, with an Aeolic under-current. That suits the tradition, almost universal in antiquity, that the poems came from Ionia, and that "Homer was born" in Smyrna, Chios or Colophon, in regions where an Ionic population had superseded an Aeolic. We cannot however answer simply that the dialect is that of Smyrna or Chios at a given date; for it is clear that some process of transmutation has taken place. In general, Aeolic forms are left (Ἀτρείδαο, κεν, ῥοάων, Μυρμιδόνεσσι) where the Ionic form was not metrically equivalent; wherever the two are metrically equivalent. the Ionic is preferred. An exception like θεά is left because there was no Ionic θεή; θεός was the form used. Νηός has always its Ionic form because the older poetry did not, apparently, mention temples, but only altars. Other exceptions are due to various accidental causes. The attempt has been made to argue that these "aeolic" forms were not really dialectic at all, but merely belonged to an older form of the Greek language from which both Aeolic and Ionic afterwards developed. The digamma, for instance, ϝ, a w-sound which gradually disappeared from the Greek language like h in French or w in whom, wrong, in English, is practically a living letter in Homer. (Roughly 3,354 places imply the ϝ while 617 ignore it.) By the sixth century ϝ was dead in Ionic though alive in both Doric and Aeolic, and the ancients actually called it "the Aeolic letter"; but two centuries earlier it may well have been current in all forms of Greek.

This view however is disproved by the presence of new formations, which occur in Aeolic and in Homer, but are certainly not "Old Greek." There seems to have been some definitely Aeolic period in the development of the epic. On the other hand there is abundant evidence of "Old Greek," dating from a time prior to any Aeolic or Ionic of which we have written record. There are many phrases which were not understood in classical times, or at least had to be taught in school: *ἀμένηνα κάρηνα, διάκτορος ἀργειφόντης, νήδυμος, τοῖος* (*cf.* Ar. Fr. 222 Daitales). And, equally significant, there are words which, in ordinary speech, only occur in Cyprian and Arcadian, such as *ϝάναξ, πτόλις, κέραμος* (a prison). Arcadia, isolated in the mountains of the Peloponnese, and Cyprus, isolated among the Semites of the eastern Aegean, preserved in common fragments of the very oldest Greek, which had perished elsewhere.

We have here phenomena corresponding to the Mycenaean cups and primaeval motives; while on the other hand the Attic influence on the language is equally conspicuous. It occurs in two forms. First, there are numerous Atticisms which are shown to be wrong by the metre, and must therefore be simply mistakes by the Attic scribe. Some are unmistakable like *Ἕως ὁ ταῦθ' ὥρμαινε*, where *ἕως* must be a mistake for *ἦος*. Others are almost certain but not quite: *Τοῖς δ' Ἀγελέως μετέειπεν* offends against Homeric idiom and has probably supplanted *τοῖσ' Ἀγέλαος ἔειπεν*; *ἣν που ἐφεύρῃ* is pure Attic and is more likely to be the mistake of an Attic copyist or reciter for *αἴ κεν ἐφεύρῃι* than an original un-Homeric effort of a poet. But beyond a few clear cases we cannot be sure. If we remove drastically all the obvious "surface corruption" there remains a more deep-seated Attic element: *ἥλιος, ἀμοθεν* ye, *βεβῶσα, ἧντο, εὔσφορος* (as a dactyl *Il.* xxiii.) are isolated, but *ὅπως* (for Aeolic *ὄππως*, Ionic *ὅκως*), *ἕπεσθαι* (for *ὀπάζειν*) are common; and one has to remember that these Atticisms represent merely what has been left after generations of grammarians have gone over the text carefully to remove all that was not "Homeric."

Metre.—Lastly, this dialect has been re-shaped by the needs of the metre. To mention only a few of the instances: wherever three or more short syllables came together, or where a short came between two long, the word had to be changed before it could get into the hexameter; hence forms like *γεινόμενος, Τειρεσίας, εἰν ἀγροῖι, εἰνὶ θύρῃσι*, with *ει* for e; *ἀπειρέσιος* or else *ἀπερείσιος*; *ἰστίη, προθυμίῃσι, Ἀπόλλωνα, εἰλήλουθα*. Analogy of course plays a part in these changes, *e.g. τιθήμενος* in place of *τιθέμενος* because of *τίθημι, μαχειόμενος* from the rhythm of *μαχησόμενος*, contrasted with *ἠὲ περὶ πτόλιος μαχεούμενος ἠδὲ γυναικῶν* (w 113, λ 403) because of Σ 265 *ἀλλὰ περὶ πτόλιος* re *μαχήσεται ἠδὲ γυναικῶν*. Liberties are taken both with accidence and with syntax in order to obtain forms that are metrically convenient; especially conspicuous is the effort to obtain words or phrases which fill the final dactyl-spondee after the Bucolic diaeresis: *ἡνιοχῆα* acc. of *ἡνιόχος, Αἰθιοπῆας* of *Αἰθίοπες, Σαρπήδοντος* for *Σαρπήδονος, εὐρέα πόντον* (from *εὐρέι πόντῳ*); the alternation of singular and plural in such words as *ἱπποσύνης ἱπποσυνάων, νηπιέη νηπίῃσι, κονίῃ κονίῃσι*, that of active and middle in *εἰσορόωντες εἰσορόωνται, μητιόωντες μητιάασθαι* are to be explained thus. Similarly the gen. in *οιο* is prevalent in choriambic words *Ἀντιμάχοιο, ἡνιόχοιο, ἀτρυγέτοιο*, whereas for obvious reasons we always have *Ἀξίου, εὐξόου, ἑταίρου, κελεύθου*, and also *Μενελάου, ἐνιαυτοῦ, μεγαθύμου*. In spondaic words (*ἀγροῦ, οἴκου, σίτου*) *-ου* is much commoner than οιο.

Thus the metre both preserves ancient forms and invents new forms. As to contraction of vowels, Epic prefers the old uncontracted forms but admits the shorter forms, usual no doubt in contemporary speech, for special reasons. Metrical necessity produces *πελάγει, ἐφίλει* (and *φίλει*), *ἀγαπᾶς, φοβεῖται, πειρώμενος*, etc.: the convenience of having all the cases of a noun metrically identical has some effect (*Τυδείδεω, ἀπασεῶν, ἡμέας, ὑμέας*); while analogy also plays its part (*ἀναβῆι* for *ἀναβήῃι* from *ἀναβάς, ὑπέρθυμον Διομήδεα* from *ὑπέρθυμος Διομήδης*), sometimes assisted by an actual mistake: *πῶυ μέγ' οἰῶν* must have come from some rhapsode who pronounced Γ 198 *ὅς τ' οἰῶν μέγα πῶυ* wrong. Similarly a bard who said *τρεῖτ'* in *νίκην ἀλλ' αὐτοὶ τρέετ' ἄσπετον* (*Il.* xvii. 332) proceeded to say *τρεῖν μ' οὐκ ἐᾶ Ἀλλὰς Ἀθήνη* (*Il.* v. 256). The fact that the Greek language had thus to be stretched and twisted in order to satisfy the needs of the hexameter has led to the suggestion that the hexameter must be a foreign metre, made to suit a language other than Greek (Meillet, Origines *Indo-Européennes* des *Mètres* Grecs, 1923). The conclusion is not probable. After all no known language suits the hexameter half as well as Greek, and the variety of forms of words was satisfactorily explained by the ancients as due to the "singing" of early epic verse (Athenaeus xiv. p. 632d.), and Greek was spoken in the Aegean by 1400 B.C. (Buck, in Class Phil. xxi.).

The misuses of the old language by rhapsodes who were accustomed to something much later may be compared with *στεῦτο* for "stood" in Od. xi., 584 of *δεδουπότος Οἰδιποδαο* for "having died" (*Il.* xxiii. 679), of the misunderstanding of *ἕδνα* "bride-price" as if it meant "dowry" in *Od.* i. 278, ii. 194, or the introduction of the proverb "iron itself draws a man on" (Od. xvi. 294, xix. 13).

The Homeric Style.—These considerations may be thought to lead to a rather chaotic result, if not a purely negative one. Yet, though they do not encourage attempts to discover the age or birthplace of "Homer," they do help us to understand the great qualities of the Homeric style. If we compare the Homeric poems with the Aeneid or Paradise Lost we feel in them much more directness and vital force. They have the quality of the heroic age, of the Volsunga saga or of Beowulf. If we compare them with these latter, we feel them to be far richer in language, larger and closer in construction, nobler in artistic form. They unite, to a degree that is perhaps unique in literature, primitive force with artistic dignity and accomplishment Poems like Iliad vi. and xxiv., for example, are hardly conceivable except as the work of minds as civilized as that of Aeschylus on material as rude and fierce as the End of the Niblungs.

The same considerations throw light on another quality of Homer, which persists all through the higher Greek poetry. The grand style concentrates on the main subject, not on detail. It is not precise or realistic. It deals in types more than individuals. The main characteristics of the main characters, the main interest of the main story, are intensely clear, but the mass of not strictly relevant detail which contributes so much to the lifelikeness of modern fiction is mostly omitted. There are many ships described in Homer, and described vividly, but no one is ever distinguished from another. They are merely "black," "hollow," "swift," "well-balanced," "red-cheeked" or the like.

There are two quite distinct styles of fighting and of armour: first the classical battle of hoplites in phalanx with small bronze shield, breastplate and backplate, which has been introduced into many parts of the Iliad; and second, below this, the fighting of particular champions (*πρόμαχοι*) in Mycenaean style with the great leather shield, reaching from neck to ankles and making body armour unnecessary, while an ill-armed mob behind, with little protection beyond goat-skins (*λαισήια*) help with stones, darts and arrows. Yet the epithets seldom make clear what sort of shield is meant; the general descriptions often leave obscure what style of fighting. The same with the topography.

This quality enabled the bards freely to compose poetry about times and places of which they had no personal knowledge, provided only that they observed the traditional epic manner and were permeated by its spirit. A modern artist, especially a novelist, generally has two aims which seem to us normal, but which are entirely alien to the spirit of Homeric poetry. First, he aims at detailed descriptions of phenomena; while "Homer" aims straight at the emotional effect with a minimum of detail. For example, the similes taken from lions in the *Iliad* might always have been written by one who had never seen a lion, but never by one who had not been imaginatively thrilled by poetry about lions. Secondly, the modern artist is generally conscious of himself as opposed to his audience, and aims at producing something "original." The book he writes is printed

and preserves its sharp edges, whatever the taste of the reader may be.

But the ancient bard was, in the main, performing things already well known, the common possession of himself and his audience. An ancient bard could not be eccentric or go against the prevailing taste. A poem so written would simply not live. It would not fit its environment, and the next reciter would alter it. It is essential, in trying to understand ancient oral poetry, to realize this fact: the successful oral poem, like the speech of a popular orator nowadays, must be the joint product of the artist and his public. Thus a rhapsode describing Irhaca or Troy or Achilles must avoid any sharp clash with the public conception of those subjects. He must not contradict people's expectations and memories. The real facts, as they would appear in a modern book of reference, do not much matter, though, in order no doubt to avoid awkward clashes, he does generally abstain from precise detail. When there is detail it is still generic.

There is an oak on the plain of Troy; oaks are common on plains. There is a fig-tree growing in or beside the mall, making a place where the wall is climbable (*Il.* vi. 433). That may well be evidence for the existence of a poem describing the scaling of the wall by help of the fig-tree; it is no evidence that there was actually a fig-tree in the wall of historical Troy. The one detailed statement about the rivers of the plain of Troy, viz. that they meet (*Il.* v. 774), is rejected as geographically impossibleeven by those scholars, like Leaf and Robert, a-ho try to identify the local details. In the descriptions of Ithaca, some points can be found on the island, and doubtless could on other islands also; some seem to suit Eeucas but not Ithaca, while in some again the detail seems to be the remnant of a myth. The isle of Odysseus is described as "low down, farthest away in the sea toward the darkness: the others are separate, toward the dawn and the sunlight." That description is utterly unsuitable to the real geography, but sounds like a description of a mythical Isle of the Setting Sun, in the far west, which possibly lingered in the minds of poets and audiences from an older poem.

It is worth observing that this vagueness of detail, this use of the generic and typical rather than the hard particular, is characteristic of the higher Greek poetry in general, and is probably due to the same cause—the dependence of the poet on the tradition as known to, or accepted by, his audience. Thus Aeschylus in the *Agamemnon* makes his beacon-signals start from Mt. Ida, though in fact the top of Mt. Ida is some 30 miles in the wrong direction. He does so because Mt. Ida is always in tradition the mountain of Troy. Both audience and poet take it for granted. For somewhat similar reasons, the tragedians give no names to their subordinate characters: they are merely Servant, Messenger, or Nurse.

Historicity.—Far more precarious than the geographical identifications are attempts to extract history from the Homeric narrative. It is quite likely that there are hard nuggets of history preserved unchanged in the poems, but it is impossible to distinguish history from myth, folk-lore and fiction in such a slowly grown and beautifully welded whole. If Odysseus burns out the eye of a one-eyed giant, if he escapes from the cave by clinging under the belly of a ram while the Cyclops stops and feels the ram's back, one cannot say that such things never happened, but one should not forget that they occur in dozens of folk-taies. If Odysseus had 360 boars, one of whom died every night, one cannot but think of the sun or the year, as described in ancient riddles: one cannot help noticing with interest that the day on which Odysseus and Penelope met was the exact day in which ancient astronomers considered that the sun cycle and moon cycle coincided: the day called "the meeting of sun and moon" in Meton's *Eikosieteris* or 20 year cycle. Such solar material may quite well be blended with a story of real life. One must simply wait for the evidence.

Again, there is nothing at all impossible in the story that the cause or pretext of the Trojan War was the rape of a princess. Yet the fact that a statement is possible is no proof that it is true; and one must remember that Helen was, in historical times a marriage goddess in Sparta, and as such must herself go through the marriage ceremony, which comprised in Sparta the carrying off of the bride. Hence Helen in saga is constantly "carried off"—to Sidon or Troy by Paris, to Egypt by Hermes, to Deceleia by Theseus or the Apharetidae, to Parmon by "a robber." There is ritual significance also in the fact that she is generally restored by twins, either her brothers, the Dioscuri, or the *gemini* Atridae; and that, as with other marriage-goddesses, the story sometimes explains that it was not the true goddess but only an "image" that the ravisher seized.

There will be little difference of opinion as to the existence in Homer of real history, mixed up with fiction, folk-lore and myth; it is also clear that we have not at present any body of evidence by which to sift out the history. It would moreover be a great error of method to suppose that in such a combination there is always, or usually, a true nucleus and a fictional or mythical penumbra. In the Niebelunglied, for example, the myth seems to be the nucleus, which has attracted into it some historical figures like Atli and Dieterich of Berne (Attila and Theodoric). The same would hold of most historical novels.

Nor should much weight be attached to the fact that the incidents of the Iliad are generally of the possible sort; marvels and monsters are kept outside the story. That is purely a question of style. The Iliad is tragic, and serious. The Odyssey veers towards the fairy-tale in the Story of Odysseus (ix. to xii.) and comes back to reality in the later books. The *Argonautica* was τερατώδης, "full of marvels," throughout. On the other hand the actual names borne by the chief heroes may well be historical or at least derived from history. Atreus, Paris, Helene, Odysseus (or Olytteus) do not seem to be Greek words; Achilleus, Agamemnon, Menelaus look like non-Greek words twisted into a semblance of Greek. If so, they are probably not invented but derived from real persons who bore names more or less like them, while Diomedes (Zeus-counsel), Neoptolemus (War-new), Hector (Holder) and perhaps Priam (King) seem like pure Greek names which anyone could invent.

HOMERIC MORALITY

It is strange to read in old books that Homer has "no law and no morality." It seems so very contrary to the truth. Homeric law is the law of the heroic age: there is no code, but the king delivers judgments (θέμιστες), based no doubt on custom and public opinion. If they are unjust there is a general Nemesis, or Indignation, of men, and probably a punishment of all the land by the gods. In times of peace, as in the Odyssey, there is praise for "some blameless king, who in the fear of God rules among men many and strong, and upholds righteous judgments; to him the black soil bears wheat and barley, the trees are heavy with fruit, the flocks bring forth unfailingly and the sea provides its fish, because of his good leading; and the peoples prosper under him." (Od. xix. 111.) So Odysseus "had no evil thoughts, but was kind as a father to his people" (Od. ii. 230 sqq., v. 8 sqq., etc.) In war, of course, such as we have in the Iliad, there is not so much question of law or justice, though it is noteworthy that the *gerontes*, or elders, have some influence beside the king. In Troy this is natural, since the Trojans are still living at home among their native sanctities. Rut even in the Achaean camp Nestor carries weight in the council of chieftains on the ground of his age and experience.

In the main, as in other heroic ages, morality has gone back to first principles, to what Homer calls *aidôs* and nemesis. *Aidôs* is generally interpreted as "shame" or "sense of honour," nemesis as "righteous indignation." *Aidôs* is what you feel about your own actions: the honour that compels you, the shame that deters you, the ruth or remorse that haunts you. Nemesis, or "the nemesis of men," is what is felt by the onlooker about the act of another, done or contemplated. If you feel disposed to run away in battle, or if you continue to be angry after receiving atonement, think of the "nemesis of men"! When Helen is asked to go and let Paris make love to her when he has emerged with doubtful honour from a battle with Menelaus, she says roundly: "I will

not go. Νεμεσσητὸν δέ κεν εἴη; it would be a thing to feel *nemesis* at." The word *nemesis* soon passes away from the sphere of ordinary human blame. It becomes the haunting impalpable wrath of the earth and sun, the "innumerable *Keres*," the gods and the dead. The deeds that rouse it fall mainly into three categories; first, actions that imply cowardice. "*Aidôs*, ye Argives . . . will ye not stand? . . . I have *nemesis* against you in my heart." Secondly, perjury and lying. This never occurs in Homer, because the heroes never commit the action, except perhaps Pandarus, who is killed. But it is the most typical source of shame in the rest of the heroic tradition.

Thirdly, and much the most important, any wrong or treachery towards the helpless, the stranger, the suppliant, and the aged. The feeling often occurs in Homer, but the doctrine is most clearly expressed by a passage in Hesiod (*Works and Days* 327 *sqq.*). "It is all as one thing—the man who wrongs a suppliant or a stranger, the man who violates his brother's bed; the man who in heartlessness sins against orphan children; the man who reviles his old father on the bitter threshold of age: with that man Zeus himself is wroth." The parable of the prayers, Daughters of Zeus, in *Il.* ix. 502 illustrates the same feeling. They are prayers for mercy or forgiveness. Lame, and wrinkled and half-blind, they stagger after the footsteps of Ate (Blindness, or Evil) trying to heal the harm she has done. . . . And woe to the man who rejects them, for the daughters of God speak to their Father. Such a man would be Ἀναιδής.

Expurgations.— A saga, or a body of poetry, which lasts on in tradition from one age to another is almost certain to be altered to suit changes of taste, particularly if the standard is rising. The Northern epics were modified as their people became Christian. The books of the primitive polytheistic Hebrews were modified as the religion of Jehovah prevailed. The acting texts of Shakespeare changed most sensitively in the 18th and 19th century. In Homer, as Plato explains in the *Republic*, there are occasional passages which hurt the moral sense of a later age, and "we must beg Homer not to be angry if we delete them" (*Rep.* iii. p. 387b). Zenodotus and Aristarchus are recorded as having acted in this spirit after Plato, and other critics and poets had evidently done so before. Zenodotus mostly deleted what was ἀπρεπές, "unseemly"—abusive language, attribution of fear to the Gods or heroes, of a mean motive to Achilles or Agamemnon, of a list of amours to Zeus, and the like. These expurgations are recorded in the Scholia. So is the meditated parricide of Phoenix and a suggestion, by Ajax, of all people, that the Achaeans should "pray silently, so that Trojans should not hear."

There has been a complete expurgation of certain primitive vices, which were current in most parts of later Greece (Schol. on *Il.* xvi. 97 sqq., xx. 231 sqq. v. 266). The brother-and-sister marriage of Alcinous and Arete is turned into one between uncle and niece. (Schol. *Od.* vii. 55 *sqq.*) The torture of Hector before death has been turned into an insult to his body after death. In general, mutilation, stripping of the dead, torture and beheading have been either removed or softened down. Poisoned arrows are condemned, though it is clear that Homer's arrows, like those of Heracles in Hesiod, originally "had death on the tip and wept in drops" (*Aspis* 132). There has also been a vigorous and almost complete excision of human sacrifice. Homer says nothing of the sacrifice of Iphigeneia or Polyxena; "rightly," says Pausanias, "he omitted such a cruel and unlawful deed." The one human sacrifice which seems to have been too firmly fixed in the legend to admit of expurgation, viz., the sacrifice of twelve noble Trojans by Achilles at the pyre of Patroclus, is hurried over in a shamefaced line and a half, without even a principal verb, and is followed by the words: "Yea, he devised evil things in his heart." The *Odyssey*, which is in many ways less a mirror of chivalry than the *Iliad*, admits something very like torture for Melanthios and the treacherous bondmaids. After all, they were only slaves!

Each case needs separate consideration, but the fact of expurgation can hardly be denied. The real Akhaiusha who took Troy were probably a horde of savages. We can see the unexpurgated account of their doings in the fragments of the Epics that were considered "non-Homeric," *i.e.*, which never passed through the furnace of the Panathenaic recitation. But the "godlike Achaioi" of Homer have been made into ideals of manly chivalry, held up to the imitation of the young, and must not be described as practising the "beastly devices of the heathen." The true spirit of Homeric chivalry comes out in the parting of Hector and Andromache in *Il.* vi., the reconciliation of Achilles and Priam in *Il.* xxiv., or the words of Odysseus over his dead enemies: "Unholy it is to vaunt over slain men."

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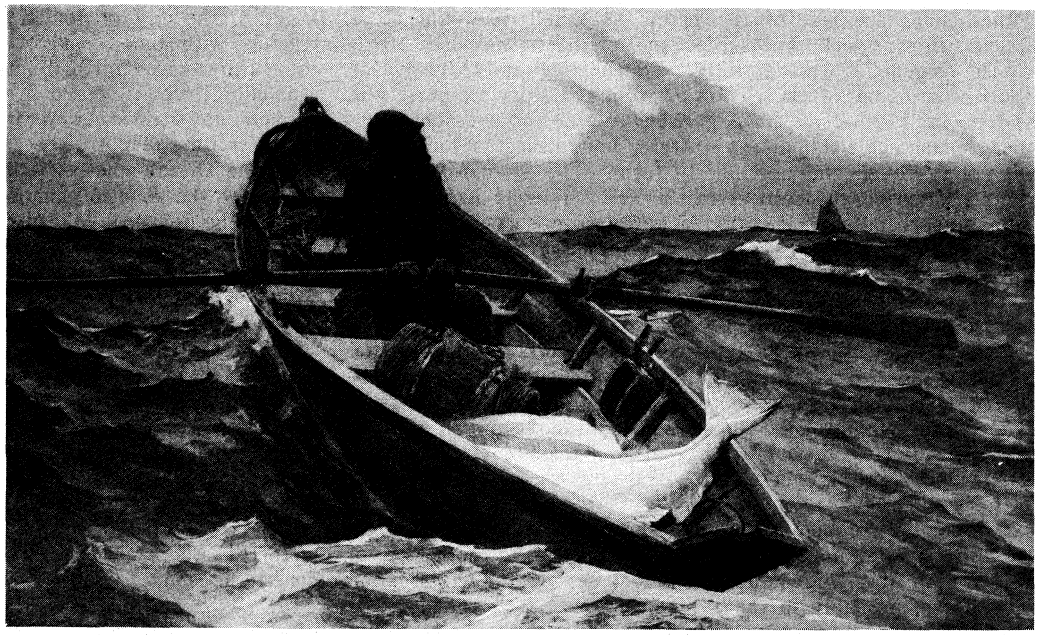

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"THE FOG WARNING" BY WINSLOW HOMER IN THE MUSEUM OF FINE ARTS, BOSTON

HOMER, LOUISE (1871–1947), U.S. operatic singer, was born Louise Dilworth Beatty in Pittsburgh, Pa. She studied music in Philadelphia and Boston and for two years in Paris. She made her debut in Vichy in 1898. The next season she appeared as Amneris in *Aïda* at Covent Garden. London, and the season thereafter she was with the Royal Opera in Brussels. She made her first appearance in New York city with the Metropolitan Opera company in 1900 and during her long career there developed her unusually rich contralto voice.

In 1920 she joined the Civic Opera company of Chicago. In 1923–24 she was selected as one of the 12 greatest living American women by the National Association of Women Voters. She was married in 1895 to Sidney Homer, the composer. She died May 6, 1947, in Winter Park, Fla.

HOMER, WINSLOW (1836–1910), U.S. painter, universally regarded as one of the greatest of American artists, was born in Boston, Mass., on Feb. 24, 1836. Apprenticed at 19 to a lithographer, he left on his 21st birthday to become a free-lance magazine illustrator. He moved to New York city in 1859 and during the Civil War attracted attention as a pictorial reporter for *Harper's Weekly.* He also began to paint during the war, his first important work in oils being "Prisoners From the Front" (1866; Metropolitan Museum of Art, New York city). His earliest water colours date from 1873.

Almost entirely self-taught and little influenced by other artists, American or European, Homer from the first painted with a freshness and clarity of vision which made him a pioneer of naturalism. In his early work, his favourite subjects were scenes of country life, both fashionable (*e.g.,* "Long Branch," 1869; Museum of Fine Arts, Boston) and rustic (*e.g.,* "Snap the Whip," 1872; Butler Institute of American Art, Youngstown, O.). But from the mid-1870s his interest shifted to more dramatic subjects, reflecting the rugged lives of Adirondack hunters and New England fishermen, as in "Huntsman and Dogs" (1891; Philadelphia Museum of Art) and "The Herring Net" (1885; Art Institute of Chicago). His art was never stagnant, however, constantly growing in depth of feeling and breadth of execution.

Homer traveled to Europe in 1867 and again in 1881–82, when he produced a series on sea subjects deriving from his two-year stay in Tynemouth on the northeast coast of England. In 1883 he made his permanent home at Prout's Neck on the Maine coast. There he spent most of each year, almost a recluse, leaving only on painting trips to the Adirondacks, Florida and the British West Indies, where he found inspiration for some of his finest water colours (*e.g.,* "Rum Cay," 1898–99; Worcester Art museum). At first hostilely received by critics; his work began to receive acclaim in the mid-1880s with "The Life Line" (Philadelphia Museum of Art), "Eight Bells" (Addison Gallery of American Art, Boston) and other dramatic sea pieces, culminating with "The Gulf Stream" (Metropolitan Museum of Art) painted in 1899. He did little painting after 1904 and died at Prout's Neck on Sept. 29, 1910.

See William Howe Downes, *The Life and Works of Winslow Homer* (1911); Lloyd Goodrich, *Winslow Homer* (1944). (D. H. W.)

HOMERIC POEMS. This title is commonly given to the whole cycle of the early Greek epics, including the Odyssey and the Iliad as well as the rejected epics.

In the article HOMER a full discussion is given of the "Homeric question." For bibliographical information also the reader is referred to the article HOMER. In the present article will be found merely (1) a discussion of the cyclic poems other than the Iliad and the Odyssey, (2) an analysis of the plots of the Iliad and the Odyssey.

The **Rejected** Epics.—As soon as the two great wholes, Iliad and Odyssey, were given exclusive rank as "Homer" at the

Panathenaea the rest of the heroic *epos* fell, it would seem, quickly into neglect. The subject matter indeed was used freely by the tragedians, who carefully avoid the *Iliad* and *Odyssey*, but though the names of many epics or groups of story are preserved, the poems themselves have perished utterly except for a few meagre fragments (about 120 scattered lines altogether) and those in a very rough and unscholarly form. The Homeric rules of metre, language and subject matter are carelessly ignored, presumably because the attention of scholars was concentrated on the two great poems. We hear much in later times of various '(cycles," "the Trojan cycle," "the Theban cycle," and "the Epic cycle" as a whole. The epic cycle is a "ring" or collection, covering the whole epic saga; the Trojan or Theban is that part of it which deals with Troy or Thebes. Thus a certain Proclus (presumably the Neo-Platonic philosopher, 5th century A.D.) in his *Chrestomatheia Grammatike*, or *Compendium of Literature*, included "an account of the so-called Epic cycle, beginning with the Marriage of Heaven and Earth, and . . . made complete out of various poets" till it ends with the death of Odysseus at the hands of his son Telegonus.

Among the *Tabulae Iliacae* in Jahn's *Bilderchroniken* (1873) there is a large relief (No. 1) illustrating scenes in the history of the Trojan War, drawn up for school use by the grammarian Theodorus, probably in the 1st century B.C. It is called *τάξις Ὁμήρου*, "an arrangement of Homer," and is duly "made up out of various poets." Thus the post-Homeric part of the "Trojan Cycle" is taken from "the *Aethiopis* according to Arctinus, the so-called *Little Iliad* according to Lesches of Pyrrha and the *Sack of Ilium* according to *Stesichorus*." Elsewhere we hear of the *Sack of Ilium* by (or "according to") Arctinus of Miletus. Evidently the Sack of Ilium is a fixed mass of legend, a traditional subject, which the cycle-maker could tell "according to" the version of any one of its successive composers, even at times preferring a lyric poet like Stesichorus to any of the epic writers.

The *Tabulae Iliacae* refer to a large number of these ancient poems, more indeed than we can identify from the fragments (*cf.* Jahn, No. VI.). Those poems whose names are known are attributed by Athenaeus and Pausanias. our earliest authorities, to various authors. Athenaeus refers to "him who made the *Titanomachy*, whether Eumelus or Arctinus or whatever name he prefers"; "him who made the *Cypria*, Hegesias or Stasinus or Cyprias"; but he generally leaves the author anonymous: *Ὁ τὴν Ἀλκμαιωνίδα ποιήσας*, *ὁ τοὺς Νόστους ποιήσας*. Occasionally we find a plural: *οἱ τὴν Ἡρακλείαν ποιήσαντες*, *οἱ τῶν Κυπρίων ποιηταί* (Eratosthenes *ap.* Strabo 688: Schol. v on *Od.* xvi. 57). This means, not of course "the committee which composed the Heracleia," but "the various poets or 'makers' who made versions of the Heracleia."

An epitome of Proclus' account of the poems which formed the sources of his Epic cycle is given partly in Photius' *Bibliotheca* (*c* 850 A.D.), partly in the Venetian scholia. The epitome gives a definite list of poems each with a definite author: the *Iliad* by Homer, *Aethiopis* by Arctinus of Miletus, *Little Iliad* by Lesches of Mitylene, *Sack of Ilium* by Arctinus, *Nostoi* or *Homecomings* by Agias of Trozen, *Odyssey* by Homer and *Telegonia* by Eugammon of Cyrene. This definiteness is apparently the result of epitomizing the longer and more doubtful accounts given by earlier authorities; and references to these same poems elsewhere show that they were far from definite wholes. The same incidents are quoted now from the *Sack* and now from the *Little Iliad*. Similarly an attempt to give definite dates to the separate poets breaks down on examination.

It is noteworthy that the poems about the *Sack of Troy* seem to be pro-Trojan or at least anti-Greek in sympathy. As in Euripides' *Trojan Women*, all possible cruelties and crimes are attributed to the conquerors. This may be due merely to the nature of the theme. Any poet telling of the sack of a town, whether he takes the romantic tone of the *Little Iliad* or the tragic tone of the *Sack of Ilium*, is fairly sure to make the most of the sufferings of the conquered women and children; but we may observe also that the alleged authors are mostly drawn from towns outside the traditional Homeric birthplaces; and that Miletus, for instance, the city of Ionian science and commerce, may have regarded with some feeling of opposition the barbarous glories of the old towns which it had outstripped.

It is not to be supposed that these poems of the Trojan cycle, in their late versions, were true representatives of the rejected epic literature. The true rock from which the *Iliad* was hewn is lost. The Theban epics, especially the *Thebais*, seem to have come nearest to the *Iliad* in general esteem, and to have been largely used in the final make-up of that poem; next to them in importance, perhaps, were Thessalian lays about the ship Argo (*πᾶσι μέλουσα*, *Od.* xii. 70) and Argive lays about Heracles. The *Titanomachies* and poems about the origin of the world belong to the Hesiodic group rather than the Homeric.

Plot of the Iliad.—I. (*Λοιμός. Μῆνις.*) Chryses, priest of Apollo, comes to the Greek camp with ransom, to buy back from Agamemnon his captive daughter, Chryseis. Scornfully refused, he prays to Apollo to avenge his daughter's wrong. Apollu sends pestilence on the host. After nine days Achilles calls an assembly, discovers the cause of the pestilence, and demands that Chryseis be restored to her father. Agamemnon consents, but takes instead Achilles' own prize, Briseis. Achilles renounces his allegiance. His mother Thetis persuades Zeus to make the Greeks rue the wrong done to her son.

II. (*Ὄνειρος. Βοιωτία, ἢ κατάλογος τῶν νεῶν.*) Zeus thereupon beguiles Agamemnon with a dream to begin a pitched battle. Agamemnon, to try the temper of his men, proposes to abandon the expedition; they, led by a demagogue, Thersites, are only too ready to do so; but Odysseus beats Thersites and rallies them. There follows a Catalogue of the Greek ships as they were marshalled at Aulis before starting to Troy (484–760), and of the Trojans and their allies (816–877).

III. (*Ὅρκοι. Τειχοσκοπία. Μενελάου καὶ Πάριδος μονομαχία.*) Paris challenges Menelaus to single combat for Helen; a truce is proclaimed. Helen and Priam watch the Greek army from the Walls of Troy. Paris is nearly slain, but saved by Aphrodite.

IV. (*Ὁρκίων σύγχυσις. Ἀγαμεμνονος ἐπιπώλησις.*) Athena, to injure the Trojans, persuades Pandarus, son of Lycaon, to break the truce by treacherously shooting Menelaus. Wrath of Agamemnon: he marshals the host and the armies join battle, the Trojans now involved in a curse.

V. (*Διομήδους ἀριστεία.*) Diomedes' day: he makes great slaughter of the Trojans, especially of the traitor Pandarus by a wound through the mouth (290–296). He wounds Aphrodite, who is protectirig her son Aeneas, and sends her weeping to Olympus. He is beaten back from Troy by Apollo. Ares helps the Trojans; the Greeks are failing, when Athena mounts in Diomedes' chariot and they charge and wound Ares, who flies with a shout like ten thousand men

VI. (*Ἕκτορος καὶ Ἀνδρομάχης ὁμιλία.*) Hector goes back to Troy to bid the women make a great procession and prayer to Athena. Meanwhile Diomedes and the Lycian Glaucus are about to fight, when they recognize one another as hereditary guest-friends, and part with gifts. Hector gives his message, says farewell to his wife Andromache and their child, who is frightened of his father's plume; he collects Paris and goes back to the battle never to return.

VII. (*Ἕκτορος καὶ Αἴαντος μονομαχία. Νεκρῶν ἀναίρεσις.*) Hector challenges all the Greeks; the lot falls on Ajax; the fight is indecisive and they part with gifts. In Troy Antenor urges that, since they now fight with a curse upon them, they give back Helen and her treasure and ask for peace. Paris will not give up Helen, but offers to restore the treasure and add more. This offer is sent next day to the Greeks and refused; a truce is made for the burial of the dead; the Greeks build a wall round the ships. A wine ship comes from Lemnos and the Greeks lie on the shore drinking.

VIII. (*Κόλος μάχη.*) Zeus, to fulfill his promise, commands the gods to keep away from the battle and himself comes to the top of Mt. Ida. He weighs the fates of Greeks and Trojans and drives the Greeks back with thunderbolts. Agamemnon and Teucer resist desperately; Poseidon, and then Hera and Athena, try again to help the Greeks, but are warned back. The Trojans bivouac on the

field and their fires surround the Greek camp.

IX. (Πρεσβεία πρὸς Ἀχιλλέα. Λίται.) At a secret meeting of the chiefs, Agamemnon again offers to abandon the expedition and set his followers free; Diomedes and Nestor insist on continuing. Watches are set lest the Trojans attack by night. Agamemnon next offers to make atonement to Achilles and implore his forgiveness, to return Briseis untouched, and splendid gifts with her. Odysseus, Ajax and Achilles' old tutor Phoenix go to beseech Achilles, who passionately refuses all their offers and declares he will sail for home on the morrow. Phoenix stays with him; the other envoys return.

X. (Δολωνεία.) Agamemnon and Menelaus call the chiefs to watch by the trench. Odysseus and Diomedes go out as spies. They capture and kill a Trojan spy, Dolon; by his information they surprise the camp of the Thracians, kill Rhesus, take his horses and escape.

XI. (Ἀγαμέμνονος ἀριστεία.) Agamemnon by desperate valour beats back the Trojans until he is wounded. Diomedes and Odysseus, rallying the Greeks, are both wounded; then Machaon and Eurypylus. Achilles, seeing the wounded hlachaon pass, sends Patroclus to enquire. Nestor urges on Patroclus that Achilles should either return to the war or send Patroclus with the Myrmidons.

XII. (Τειχομαχία.) The Trojans assault the Greek wall. Asius' chariot charge is defeated; Sarpedon tears down a turret; at last Hector breaks through one of the gates, and the Trojans rush in.

XIII. (Μάχη ἐπὶ ταῖς ναυσίν.) Poseidon, hidden from Zeus, encourages the Greeks. The two Ajaces and, above all, the grey-haired Idomeneus uphold the battle. The Trojans waver but rally.

XIV. (*Arbs* ἀπάτη.) Nestor and the wounded chiefs throw themselves again into the battle. Meantime Hera, having borrowed the magic girdle of Aphrodite and persuaded Sleep to help her, beguiles Zeus from his watch and sends him to sleep. Poseidon openly aids the Greeks; Hector is felled by a great stone and the Trojans driven back.

XV. (Παλίωξις παρὰ τῶν νεῶν.) Zeus awakes. At his bidding Poseidon retires, Apollo puts new strength into Hector and. bearing his aegis, leads the Trojans on past the wall and up to the ships. Patroclus returns to Achilles and implores him with tears to help the Greeks. Ajax with a great naval ramming-pole, leaping from ship to ship, is holding the Trojans back, when Hector brings fire to burn the ship of Protesilaus.

XVI. (Πατροκλεία.) At Patroclus' entreaty Achilles, though he will not himself fight till Agamemnon offers atonement. gives his chariot and armour to Patroclus and bids him drive the Trojans back but not go further, when once the camp is clear. Patroclus with the Myrmidons routs the Trojans, kills Sarpedon and many others, and pursues right up to the wall of Troy, where he is stopped by Apollo. He kills Hector's charioteer; then, dazed by Apollo, and wounded by Euphorbus, he is slain by Hector, while Automedon with the immortal horses of Peleus flies to the ships.

XVII. (Μενελάου ἀριστεία.) Hector strips Achilles' armour from the corpse of Patroclus. A desperate battle arises about the body Antilochus is sent to bear the news to Achilles. The immortal horses stand weeping for Patroclus and then return to the battle. At last Menelaus recovers the body, and bears it back to the ships while the Ajaces cover his retreat.

XVIII. (Ὁπλοποιία.) Antilochus gives the news: despair of Achilles. His mother Thetis rises from the sea to help. "Give me armour that I may slay Hector." "My son, it is written, that when Hector dies you die." "Would I were dead now, who failed to save my friend." So Thetis goes to beg Hephaestus to make her son new armour. The Trojans are pressing on to recover the body of Patroclus, when Achilles shouts his war cry from the trench and they stop. They encamp on the plain. The Greeks bring the body to Achilles' tent and prepare it for burial. The Shield of Achilles is described (356–617).

XIX. Achilles receives the arms. He calls an assembly, renounces his wrath and demands instant battle. Agamemnon confesses his fault and offers gifts of atonement. The army eat before battle, but Achilles will not eat till Hector is slain. He mounts his chariot and calls to the immortal horses: "Bear me safe through this battle; do not leave me dead as you left Patroclus." And the horse Xanthus speaks: "Yes, this one time; but never again. Your death is close." "I know it," he answers and drives with a shout into the battle.

XX. (Θεομαχία.) His promise fulfilled, Zeus now allows the gods to mix in the battle as they choose, while he watches from Olympus. Hera, Athena, Poseidon, Hermes, Hephaestus help the Greeks; Ares, Apollo, Artemis, Leto, Aphrodite and the river Xanthus the Trojans. Achilles on foot fights with Aeneas, who is saved by Poseidon to be hereafter king and father of kings to the Trojans; with Polydorus, whom he kills, and with Hector, who is saved by Apollo. He puts the Trojans to flight.

XXI. (Μάχη παραποτάμιος.) Achilles drives the Trojans, part into the city, part into the River Xanthus. He kills Lycaon, though a suppliant, and takes twelve youths to be sacrificed at the pyre of Patroclus. He kills Asteropaeus, and mocks at his River-ancestor. The river Xanthus, choked with dead, rises in flood against Achilles to beat down his shield and drown him. There is a battle of water and fire. The gods are again in strife on the plain. Then all vanish except Apollo who tempts Achilles away from the city till the fugitives are safe within the gates.

XXII. (Ἕκτορος ἀναιρέσις.) Hector alone stays outside, awaiting Achilles, while his parents implore him to come in. As Achilles comes he turns to fly, and is pursued three times round the city; then he stands. Zeus weighs the fates of the two men in his scales, and Hector's fate falls Apollo deserts him, while Athena, taking the shape of his brother Deiphobus, betrays him. When both have thrown their spears she sends that of Achilles back to him. Achilles kills Hector and refuses his dying prayer for burial. He drags the dead body behind his chariot to the ships, while Hector's parents and wife make lamentation on the city wall.

XXIII. (Ἆθλα ἐπὶ Πατρόκλῳ.) The Myrmidons make a procession round the bier of Patroclus, and hold a funeral feast. That night the ghost of Patroclus appears to Achilles: "Bury me quickly that I may cross the river; and let your bones lie with mine in the golden jar." Next morning a great pyre is built and the body burnt, with many victims, among them the twelve Trojan youths, "an evil deed." Funeral games in honour of the dead (257–897).

XXIV. (Ἕκτορος λύτρα.) For many nights Achilles has neither sleep nor food. Each day he drags the dead Hector behind his chariot round Patroclus' grave, but Apollo preserves the body from decay. By command of Zeus Thetis warns Achilles of the wrath of the gods. "My son, take food and sleep. Remember your own death is close Fear the gods, and give back Hector's body for burial." Iris sent from Zeus bids Priam rise from the dust, go to Achilles with ransom and ask for Hector's body. The old king starts by night with a chariot laden with gold, and guided by Hermes finds his way unseen to Achilles' tent. "Achilles, remember your own father; I am more wretched than he, and I have done what no man on earth has done before, lifted to my lips the hand that killed my son." Then the two enemies weep together in their common misery, and at dawn Priam takes back the dead Hector to Troy, where Andrornache, Hecuba and Helen lament over him, and a very great funeral is made.

Plot of the Odyssey. —I. (Θεῶν ἀγορά. Ἀθηνᾶς παραίνεσις πρὸς Τηλέμαχον.) It is the tenth year after the fall of Troy. Athena reminds the Gods in council of Odysseus, whom Poseidon —now absent— has plagued so long. He is now detained in the Isle of Calypso, while suitors beset his wife and plunder his substance. Zeus agrees that Hermes shall be sent to Calypso, while Athena goes to Ithaca and. in the form of Mentor, stirs up Telemachus to call a gathering of the people in protest against the suitors and himself to go in search for his father. In the hall Phemius sings of the sad homecoming of the Greeks from Troy.

II. (Ἰθακησίων *byoph.* Τηλεμάχου ἀποδημία.) In the gathering Telemachus demands the help of the people against the suitors. Antinous answers that as soon as Penelope gives her hand to one of them they will go. Telemachus demands a ship in which to search for his father, but Leiocritus, a suitor, dismisses the assembly. Athena, disguised as Mentor, gets him a ship. He collects provisions and, without Penelope's knowledge, starts at night.

III. (Τὰ ἐν Πύλῳ.) They come to Pylos and are welcomed

by the aged Nestor. He knows nothing of Odysseus, but tells of the homecomings of various chiefs, and the death of Agamemnon. Menelaus, who has just returned from great wanderings, may know of Odysseus. At evening the disguised Mentor vanishes and is recognized as divine by Nestor. Telemachus spends the night with Nestor, and starts next day with Peisistratus, son of Nestor, for Sparta. The first night is spent at Pherae.

IV. (*Τὰ ἐν Λακεδαίμονι.*) They find Menelaus celebrating the double wedding of a son and a daughter, and are led to his splendid palace. A mention of Odysseus reveals Telemachus to Menelaus, while Helen recognizes him at sight. They talk of Odysseus and are filled with grief till Helen gives them a nepenthe from Egypt. Next day Menelaus relates how Proteus the sea-god told him of the fates of Agamemnon and Ajax the Locrian, and how Odysseus was in the isle of Calypso. Meantime the suitors have learned of Telemachus' expedition and send a ship to ambush him at the isle of Asteris. Penelope hears of her son's voyage and of the plot against him, and weeps till Athena comforts her with a dream.

V. (Καλυψοῦς ἄντρον. Ὀδυσσέως σχεδία.) Hermes arrives at the isle of Calypso and gives the message of the gods. Calypso weeps but obeys, and helps Odysseus to build a flat-bottomed boat. The parting of Odysseus and Calypso. On the 18th day he is in sight of Scheria, the land of the Phaeacians, when Poseidon, returning from the Aethiopians, sees him and wrecks his boat. The sea-goddess Ino gives him a veil which bears him up till, naked and half-dead, he reaches a river mouth and, covering himself with leaves, falls asleep.

VI. (Ὀδυσσέως ἄφιξις εἰς Φαίακας.) Nausicaa, daughter of King Alcinous, comes with her maidens to wash clothes at the river mouth. While the clothes are drying they play ball, and their voices wake Odysseus, who comes out and begs for protection. They all run away except Nausicaa, who receives him and gives him food and raiment, and tells him the way to her father's house. As she returns he follows at a distance and at evening comes to a grove of Athena outside the walls.

VII. (Ὀδυσσέως εἴσοδος πρὸς Ἀλκίνουν.) Athena, disguised as a girl, leads Odysseus unseen into Alcinous' splendid hall, where he supplicates the queen, Arêtê. The king and queen accept him, and promise him gifts and a ship to take him home. He tells of his voyage from Calypso's Isle.

VIII. (Ὀδυσσέως σύστασις πρὸς Φαίακας.) A feast is held and games, in which Odysseus, being taunted, wins the discus throwing, though he will not otherwise compete. The bard, Demodocus, sings the loves of Ares and Aphrodite. In the evening gifts are brought to Odysseus. Demodocus sings of the taking of Troy at which Odysseus silently sheds tears, but Alcinous marks him and asks his name and race.

IX. (Ἀλκίνου ἀπόλογοι. Κυκλώπεια.) "I am Odysseus, son of Laertes. From Troy we came first to the Cicones, where in raiding I lost 72 men; thence to the land of the Lotus-eaters; then to the isle of the Cyclops, who killed and ate six of my men, but we blinded his one eye as he lay drunk. So we escaped.

X. (Τὰ περὶ Αἰόλου καὶ Λαιστρυγόνων καὶ Κίρκης.) "Thence to the isle of Aeolus, king of the winds, who gave me the winds, all tied up in bags, except the west-wind, which blew me homewards. But my men thought the bags held treasure, and opened them, so the winds rushed out and drove us away to the land of the Laestrygones, giants and cannibals. where I lost 11 ships out of 12. Thence to a beautiful wooded island, where we heard a goddess singing in the forest. She was Circe. and she turned into swine the men I sent out; but Hermes gave me a magic root, and when she struck me with her wand I defied her, and she was subdued to me. There we stayed a year. She told me that before reaching home I must go to the land of the dead beyond the ocean and consult the spirit of the seer Teiresias."

XI. (Νέκυια.) "I came to the dark land of the Cimmerians and made sacrifice. The ghosts gathered about the blood, but I would suffer none to drink till Teiresias came. The first ghost I saw was my comrade Elpenor, who had been killed by an accident just as we started; then came my mother, Anticleia. Teiresias told me of my future fates; my mother, who had died of grief for me, told me of home. Then I saw the beautiful women of the past, and the heroes; Ajax would not speak to me Then Minos and Orion, and those punished for sin, Tityus, Tantalus, Sisyphus and the shadow of Heracles."

XII. (Σειρῆνες, Σκύλλα, Χάρυβδις, *βόες* Ἡλίου.) "I returned to Circe, who told me of my future voyage, and warned me above all not to kill the oxen of the Sun. Thus I stopped my men's ears when we passed the sirens; though I listened myself, tied to the mast. Then we passed the Wandering Rocks and Charybdis the whirlpool, though Scylla took six of my men. Then a tempest held us on shore in Thrinacia for a month, and my companions, starving, at last killed the oxen of the Sun while I was asleep. Then, when we put to sea, came storm and thunderbolt; my ship and all my men were destroyed; I was driven back through Charybdis, and escaped clinging to the mast and keel to the isle of Calypso"

XIII. (*Ὀδυσσεὺς ἀνάπλους παρὰ Φαιάκων καὶ ἄφιξις εἰς Ἰθάκην.*) The story over, the Phaeacians give Odysseus their gifts, and the next evening the ship starts. It arrives before dawn at the harbour of F'horcys, near a cave of the Nymphs; and Odysseus is left asleep on the shore. The ship on its way back is turned by Poseidon into a rock. Odysseus wakes and does not know his own land, till Athena, disguised as a youth, explains to him. She disguises him as an old beggar.

XIV. (Ὀδυσσέως *apds* Εὔμαιον Ὁμιλία.) He finds the hut of his old swineherd, Eumaeus, and is welcomed as a stranger. They talk of Odysseus. He tells false stories, how he is a Cretan, and how he has seen Odysseus, who will soon return. Eumaeus thinks both Odysseus and Telemachus are dead, but remains true to them. The night is very cold, and Odysseus borrows a cloak.

XV. (Τηλεμάχου *apds* Εὔμαιον ἄφιξις.) Telemachus in Sparta is warned by Athena of the suitors' ambush. He returns with Peisistratus to Menelaus and to Nestor. There he leaves Peisistratus and takes with him Theoclymenus, an Argive seer now in exile. He escapes the ambush and lands in Ithaca far from the city. Meantime Eumaeus, the child of a prince, taken by slavers, has told Odysseus the story of his life, and discussed how Odysseus is to go to the city safely.

XVI. (Ἀναγνωρισμὸς Ὀδυσσέως ὑπὸ Τηλεμάχου.) Telemachus arrives at the hut, and sends Eumaeus to the city to tell his mother of his safe return. Alone with Telemachus, Odysseus —retransformed by Athena— reveals himself, and they discuss the battle against the suitors. The suitors' ambush-ship returns baffled. Eumaeus comes back to the hut.

XVII. (Τηλεμάχου ἐπάνοδος εἰς Ἰθάκην.) Telemachus returns to the palace and brings Theoclymenus as a guest. He tells Penelope what he has heard from Menelaus. Theoclymenus prophesies that Odysseus is alive. Odysseus arrives, disguised as a beggar; only the old dog Argus, lying neglected on the dunghill, recognizes him and dies. Odysseus is insulted by the goatherd Melanthius. At the feast he receives food from the suitors, though Antinous throws a stool at him. He promises to speak to Penelope at nightfall.

XVIII. (Ὀδυσσέως καὶ Ἴρου πυγμή.) The suitors incite another beggar, Irus, to drive Odysseus off the threshold. Odysseus almost kills him with a blow. Penelope rebukes the suitors for their unkindness to the beggar, and makes them bring her gifts, as suitors should. The handmaid Melantho insults Odysseus and Eurymachus throws a footstool at him.

XIX. (Ὀδυσσέως καὶ Πηνελόπης ὁμιλία. *Τὰ νίπτρα.*) Odysseus, with Telemachus, removes the weapons from the Hall. Melantho girds at him but Penelope calls him to her, and tells how she made the suitors agree to wait till she should have finished her web; but now they have found her undoing it during the night, and will wait no more. Odysseus tells her he is a Cretan: he says that Odysseus —whom he describes exactly— will return this very year on the day that ends one month and begins another (*i.e.*, on the morrow). The old nurse Eurycleia washes his feet and recognizes him by a scar on the knee; but he warns her to silence. Penelope arranges that she will agree to wed the suitor who can bend Odysseus' bow and shoot through the sockets of twelve axe-heads.

XX. (*Th πρὸ τῆς μνηστηροφονίας.*) Odysseus lies sleepless, listening to the weeping of Penelope, till Athena comforts him. The palace is prepared for the feast of Apollo and the new moon (the winter solstice at the end of the 19th year). The suitors conspire in the agora against Telemachus, but are deterred by bad omens, and return to feast. One throns a cow's foot at Odysseus. Theoclymenus the seer feels that there is sudden darkness on the hall, and blood and a sound of weeping. and ghosts hurrying toward the darkness. The suitors mock him, but he goes from them.

XXI. (Τόξου θέσις.) Penelope brings out Odysseus' old bow, and proposes the trial to the suitors. Eumaeus and the cowherd Philoetius weep at the thought of their master. First Leiodes the bard tries the bow in vain; then many others. Antinous bids the goatherd grease and warm it. Meantime Odysseus outside reveals himself to the swineherd and cowherd. Eurymachus tries the bou. Xntinous puts off further trial till after the feast. Then Odysseus begs to be alloned to try; the suitors refuse. but Penelope insists. Eumaeus gives him the bow; Eurycleia shuts the postern and Philoetius the other door of the hall Odysseus bends the bow and shoots straight through the holes in twelve axeheads. Telemachus, fully armed, leaps up beside him on the threshold.

XXII. (Μνηστηροφονία.) "Now for another target that none has ever struck!" He shoots Antinous through the throat, then Eurymachus. then others till he has no arrows left. Telemachus has brought spears and armour for four; and Odysseus. Telemachus, Eumaeus and Philoetius arm. Meantime the suitors have sent the goatherd, Melanthius. to bring arms for them; he has brought twelve sets. when the other herds catch him and tie him to a post. There is a great fight aith spears, while Athena watches in the shape of a swallow, and all the suitors are slain except the bard and the herald, who were innocent. Odysseus has the corpses removed, twelve guilty bondmaids hanged, and Melanthius mutilated and slain. Then he burns sulfur and purifies the hall.

XXIII. (Ὀδυσσέως ὑπὸ Πηνελόπης ἀναγνωρισμός.) Penelope is awakened from sleep by Eurycleia nith the news. She comes down to the hall. sees what has been done, but she cannot believe: "her eyes stay like horn or iron." Odysseus, much hurt, makes the men and the faithful handmaids dance and make merry. so that the slaying may not be known outside. When he comes back to Penelope she tests him by ordering that his bed be brought outside the chamber. "Now who has moved my bed. ahich I built on a stump of olive?" At that she knows him, and throws herself in tears into his arms. "Forgive me. All these years I have schooled myself not to be deceived by some stranger who should pretend to be you!" So they were rejoined, and came again to their ancient marriage-bed. Through the long night they lay and Odysseus told his story. In the morning he set off aith his son and the herdsmen to see his father Laertes.

XXIV. (Νέκυια δευτέρα. Σπονδαί.) The souls of the suitors, guided by Hermes to the shades, meet Agamemnon and Achilles, and tell their story. Odysseus meantime finds Laertes working in his orchard. in much poverty, and reveals himself. In the city the news of the slaying is known, and the kindred of the suitors come out to Laertes' farm for vengeance led by Eupeithes, father of Antinous. A battle begins and Laertes slays Eupeithes, but Athena stops the strife and makes an oath of peace between Odysseus and his enemies. (G. G. A. M.)

HOME RULE (MUNICIPAL). The major aim of municipal home rule in the United States is to enable cities to govern themselves without interference from state legislatures. The desirability of encouraging local authorities to assume responsibility for local governmental services has been recognized in most countries which follow the Anglo-Saxon governmental tradition and in a number of others, such as Germany and Switzerland. This was the prevailing view in the United States immediately after the Revolution.

During the 19th century, however. the legislatures, under one pretext or another, gradually extended their control over local affairs. The means used were usually either special acts granting or changing the charters for individual cities or general incorporation acts for classes of cities. Laws were even passed to change the names of municipalities, grant public-utility franchises and fix the pay of local employees.

This legislative control of cities was bad both for the cities and for the legislatures. It tended to sap the initiative and responsibility of local officials, to promote governmental extravagance and to decrease public interest in local government. Furthermore, the volume of local legislation was sometimes so great that it required much of the legislators' time, thus preventing adequate consideration of major issues of state policy.

As urban centres grew in importance, they became increasingly restive of legislative interference. Municipalities were generally underrepresented in the legislatures because of failure to redistrict after each census or of unwillingness to take account of the faster growth of cities. As a result urban centres had a proportionately decreasing voice in the legislatures that controlled them. It was natural that local officials should seek some means of redressing this political balance.

Beginning with Missouri in 1875, more than half the states by the second half of the 20th century had adopted constitutional provisions conferring some poaer of self-government on their cities; *i.e.*, giving them home rule. These clauses vary greatly. Some are very general, giving cities broad powers "to determine their local affairs and government" (Wisconsin, 1924). Others provide an enumeration of the powers cities may enjoy (Colorado, 1901). Some merely withdraw constitutional objections to a grant of home rule by the legislature (Utah, 1932), while others are so specific that they can be put into effect uithout further legislation (Oklahoma, 1907). Oregon in 1906 extended home rule to "every city or town." but many states limit it to cities of a certain size or even to a single city. A few states extended home rule to counties and townships, but usually not to special-purpose governmental units such as school or park districts.

The heart of any home-rule article is the power it gives to the cities. These grants of power do not interpret themselves. In practice the state supreme court must decide it any specific matter is one of local concern or if the state's interest is paramount. Because the supreme courts are state organs, they often tip the scales against local autonomy. To prevent this some states specify in detail the exclusive powers given to localities, thus creating a government within a government, or local sovereignty. If the state constitution can be amended easily (*e.g.*, by an initiative petition followed by a popular vote, as in California), a narrow judicial construction of local powers can be reversed by constitutional amendment. The campaign to obtain more precise statements of local powers also sometimes modifies judicial aversion to local self-rule.

After 1945 there was a tendency to veer away from tight constitutional formulas. It was proposed, for example, that cities be authorized to exercise any powers within their boundaries that were not denied to them by the state constitution or by statutes that applied throughout the state. These proposals also commonly included prohibitions against the passing of special laws for a limited group of cities and against the imposition of financial burdens on cities; *e.g.*, legislative salary fixing for city employees. Reliance was placed on political and financial responsibility for both cities and states rather than on constitutional fences erected around each level of government. This method of obtaining local autonomy was patterned on the federal-state relationships provided in the United States constitution, in which the residual powers rest by definition with the states. The Texas supreme court, exemplifying this approach, interpreted the home-rule action of that state's constitution consistently with these proposals.

See also CITY GOVERNMENT; LOCAL GOVERNMENT; MUNICIPALITY.

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HOMESTEAD, a borough of Allegheny county, in southwestern Pennsylvania, U.S., located on the Monongahela river, across from the southeastern edge of Pittsburgh. Homestead is part of a steel-producing complex which has long included several neighbouring communities. All are in the Pittsburgh (*q.v.*) standard metropolitan statistical area (for comparative population figures see table in PENNSYLVANIA: Population).

The borough developed with the growth of Andrew Carnegie's steel empire in the last quarter of the 19th century. Part of this development was the noted Homestead strike of July 1892, which occurred in the huge steelworks. now in Munhall borough, when company guards (Pinkerton detectives) hired by Henry C. Frick, a Carnegie associate, fought a pitched battle with the strikers who controlled the town. State militiamen were sent to quell the trouble. The strike directly influenced the presidential election of 1892 and retarded the unionization of steelworkers for more than 40 years. Homestead was laid out in 1871 as Amity Homestead and was incorporated and renamed in 1880. With Braddock (*q.v.*) it was the centre of the world's most advanced steel production in the 1890s. The steel mills are now chiefly located in adjacent communities. Industries include the manufacture of heavy mill machinery, tools, cement blocks and bricks. (P. R. J.)

HOMESTEAD AND EXEMPTION LAWS, enacted mainly in the United States, were based on the belief that the public domain belonged to the people and that each head of a family was entitled to a home or farm, the possession of which should be protected against seizure for debt. This theory developed gradually for half a century after 1785. The earlier laws were intended primarily to procure revenue for the federal government, and for several years before the financial panic of 1837 they mere successful in that regard. But up to that time the main result was encouragement of sales in large blocks for the benefit of speculators. In the original 13 states with their later subdivisions of Maine, Vermont and West Virginia, and in the trans-Appalachian states of Kentucky. Tennessee and Texas, the public lands belonged to the states and were not affected by federal land policy. In the rest of the original territory, and in new areas as they were annexed, the land not already in private possession constituted the federal public domain.

By 1835 the sale of these lands had extinguished the public debt, and thereafter there grew an increasing clamour for legislation to relieve the condition of tenant farmers and hard-pressed city labourers through the adoption of a general homestead law. Labour parties in the east were the first to urge that such legislation be adopted. to relieve the eastern labour market of a surplus that nas causing distress and to give both industrial and rural toilers the chance to work on their own land. The Pre-emption act of 1841 gave some relief to actual and prospective squatters on the public domain, but the continuation of a minimum price of $1.25 an acre defeated the main purpose of the advocates of free farms. Between 1845 and 1860 various homestead bills were introduced in congress, that of 1860 being vetoed by Pres. James Buchanan. Before 1856 the support for the measure came from the states west of the Appalachians, while the opposition centred in the Atlantic seaboard states. The contest was essentially between western farmers, seeking easy expansion, and eastern landlords and industrialists, eager to preserve high rents and cheap labour. But when the eastern Republicans of 1856, in order to cement relations with western Republicans, gave up opposition to a homestead law and combined free farms with the issue of antislavery expansion, the contest became one between north and south.

Homestead **Act** of **May** 20,1862.—This act secured easy adoption because of the secession of the southern states. It provided that any citizen or alien who had declared the intention of becoming a citizen, if 21 years old or the head of a family, or if a veteran of at least 14 days' service in the armed forces of the United States during an actual war, and if he or she had never engaged in war against the United States or assisted in such a war, on payment of $10 might file claim to not more than 160 ac. of the surveyed public domain. After having "resided upon or cultivated" this land for the following five years, and if by then a citizen, the settler could receive a patent on payment of additional fees. This homestead could not be seized by any creditor to satisfy any debts previously contracted.

In the next 40 years there were numerous amendments to the law. In 1866 the bar against former Confederates was dropped, Before long there was a prohibition against separate homesteads for both husband and wife. The choice between residence or cultivation for the first five years gave way to the requirement of both residence and cultivation. Also, in time. the various states provided that homesteads should not be seized for debts contracted after the land was patented. These are known as exemption laws, and they vary widely in their protective features.

Shortcomings of the Law.—The Homestead act failed signally in its purpose of relieving labour pressure in the cities. The bulk of fertile land with abundant rainfall was already in private hands. Such tracts as remained were far removed from the congested labour market, and there was no legal provision for free transportation to the land. Nor was there any offer of sustenance or training in successful farming practices during the dreary years of making a beginning. Day labourers and tenants could not even acquire the necessary capital for investments in housing, implements, fences and livestock necessary for successful ventures. Even practised farmers usually failed on their raw homesteads, and to 1890 only one in three of the homesteaders managed to remain long enough to get deeds to their farms. Also, the Homestead act did not put an end to the granting of land in large blocks to monopolists. By 1900 fewer than 600 000 farmers received patents, totaling about 80,000 000 ac , while railroad companies alone were given 183,000,000 ac . after all reductions for failure to live up to contracts. P. W. Gates (see **Bibliography,** below) listed many other forms of land monopoly. Furthermore, the "commutation clause" of the Homestead act made petty speculators of many of the homesteaders. Six months after settlement they could buy the land at $1.25 an acre. By acting as agents for persons nanting huge estates, many of them made a neat profit without ever becoming actual homesteaders. This reduced the number of bona fide homesteaders before 1900 to probably around 400,000 and the aggregate acreage of their farms to possibly 55,000,000. In the 40 years between the passage of the Homestead act and the beginning of the 20th century, about one new farm in ten in the United States was a free homestead, while many more were purchased from speculators.

Later Homestead Laws.—Later acts were less beneficial to settlers than nas the original act of 1862. In the west only the arid and semiarid lands were left for disposal by 1900 The Kinkaid act of 1904, applying only to aestern Nebraska, allowed 640-ac. tracts, which were enough for meagre subsistence at dry farming. But the Mondell act of 1909 gave only 320 ac. in the rest of the west. This mas just enough to lure farmers to their doom, unless they acted as agents for land monopolists. The same was true of the Stock-Raising Homestead act of 1916, which granted 640 ac in a region where one cow needed from 50 to 100 ac. of pasture and 10,000 ac. were barely enough for successful livestock raising.

In Alaska the Homestead act of 1898 limited claims to 80 ac. and required homesteaders to pay for their own surveys. The limit was expanded to 320 ac. in 1903 and reduced to 160 ac. in 1906. Leasing for fur farming was authorized in 1926 and for grazing in 1927.

By the second half of the 20th century about 250,000,000 ac. had been patented under the various U.S. homestead laws, but a good share of this had been turned over at a profit to the owners of large estates. The Taylor Grazing act of 1934 helped remedy the situation by removing nearly all the remaining pasture land of the far west from homestead entry and allowing its use only under lease from the government.

Canadian Laws.—Canada provided for the acquisition of homesteads on its public lands through the Free Land Homestead act of 1872. and the provinces adopted exemption laws similar to those of the United States. Homesteads were generally a quarter section (160 ac.), which claimants were required to reside upon and cultivate or otherwise improve; homesteaders meeting the

requirements became eligible to pre-empt a second quarter section. *See* also AGRICULTURE: *Gnited States;* LAND TENURE: ECONOMIC AND AGRARIAN ASPECTS: *The Gnited States;* NEBRASKA: *Hzstory;* SMALL HOLDINGS: *United States;* UNITED STATES (OF AMERICA): *History: Struggle for National Government, 1783–1865: Slavery and the Westward Movement. See* also LAND REFORMS.

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(F. A. S.)

HOMEYER, KARL GUSTAV (1795–1874), German jurist, born on Aug. 13, 1795 at Wolgast in Pomerania. He became professor of law (1827) at Berlin, and in 1854 a member of the council and of the upper house of the Prussian diet. He died on Oct. 20, 1874. His principal works are his edition of the *Sachsenspiegel* (in 3 vol., 1827, 3rd ed., 1861, containing also some other important sources of Saxon or Low German law), which is still unsurpassed in accuracy and sagacity of research; *Die Haus- und Hofmarken* (1870); and many papers contributed to the *Transactions* of the Berlin Academy: *Über die Heimat* (1852); *Genealogie der Handschriften des Sachsenspiegels* (1859); *Die Stadtbücher des Mittelalters* (1860); *Der Dreissigste* (1864), etc.

HOMICIDE, the general and neutral term for the killing of one human being by another. The nature of the responsibility of the slayer to the state and to the relatives of the slain has been one of the chief concerns of all systems of law from the earliest times, and it has been variously considered from the points of view of the sanctity of human life, the interests of the sovereign, the injury to the family of the slain and the moral guilt, *i.e.*, the motives and intentions of the slayer.

In England under the Norman system homicide became a plea of the crown, and the rights of the kindred to private vengeance and to compensation were gradually superseded in favour of the right of the king to forfeitures where the homicide amounted to a crime (felony). Though homicide was thus made a public offense and not a matter for private vengeance, it took long to discriminate between those forms of homicide which should and those which should not be punished. The terms in English law used to describe *criminal* homicide are murder, manslaughter and *felo de se* (or suicide by a person of sound mind).

After the Conquest, and for the protection of the ruling race, a fine (also called *murdrum)* was levied for the king on the hundred or other district in which a stranger was found dead, if the slayer was not brought to justice and the blood kin of the slain did not present Englishry, there being a presumption (in favour of the Exchequer) that the deceased was a Frenchman. After the assize of Clarendon (1166) the distinction between the killing of Normans and Englishmen gradually evaporated and the term murder came to acquire its present meaning of deliberate as distinct from secret homicide. In 1267 it was provided that the murder fine should not be levied in cases of death by "misadventure" *(per infortunium).* But at that date and for long afterwards homicide in self-defence or by misadventure or even while of unsound mind involved at the least a forfeiture of goods, and required a pardon. These pardons, and restitution of the goods, became a matter of course, and the judges appear at a later date to have been in the habit of directing an acquittal in such cases. But it was not until 1828 that the innocence of excusable homicide was expressly declared. The rule is now expressed in s 7 of the Offences against the Person Act 1861: "No punishment or forfeiture shall be incurred by any person who shall kill another by misfortune, or in his own defence, or in any other manner without felony."

The further differentiation between different degrees of criminal homicide was marked by legislation of Henry VIII. (1531) taking away benefit of clergy in the case of "wilful murder with malice prepensed" (aforethought). That phrase is still the essential element in the definition of "wilful murder," which is committed "when a person of sound memory and discretion unlawfully killeth any reasonable creature in being and under the king's peace with malice aforethought either express or implied" (3 Co. Inst. 47), and the penalty is death (Offences Against the Person Act 1861, s. 1). Attempted murder is a felony and the penalty penal servitude for life. In the case of conspiracy and incitement to murder, a misdemeanour, the penalty is penal servitude for ten years. The whole development of the substantive law as to murder rests on judicial rulings as to the meaning of malice prepense coupled with the extrajudicial commentaries of Coke, Hale and Foster; for parliament, though often tempted by bills and codes, has never ventured on a legislative definition.

The expression "malice prepense" or "aforethought" has given rise to much discussion, especially when used to include so-called "constructive" murder. It implies an intent preceding the act intended. Express malice is the positive possession of an intention, and implied malice the possession of an intention shown by the acts of the accused. And so malice is implied where knowledge exists that the act is likely to kill or do grievous bodily harm to any person; where a police officer is resisted in the execution of his duty; where a felony is attempted or committed and death results, certainly if death were likely to result.

As in the case of other crime, infancy and insanity are excuses for homicide. A child under seven years of age is absolutely presumed to be *doli incapax,* and between seven and 14 there is a presumption but it may be rebutted. Now by the Children Act 1908 a sentence of death may not be pronounced or recorded against a child under 16. A person who satisfies the rules in *McNaghten's Case* (10 Cl. and F. 200) must be found guilty but insane. Drunkenness which produces insanity may be an excuse within *McNaghten's Case,* but drunkenness which falls short of this is no excuse, as in *Beard's Case* (26 Cox, C.C. 573) where the accused, under the influence of drink, while ravishing a girl inadvertently suffocated her. That was held to be murder. Again, in cases of homicide, the death must occur within a year and a day after the act of the accused.

Justification and Excuse.—English law still retains so much of its mediaeval character as to presume all homicide to be "malicious, and therefore murder, unless it is either *justified* by the command or permission of the law, *excused* on the ground of accident or self-preservation, or alleviated into manslaughter by being the involuntary consequence of some act not strictly lawful or occasioned by some sudden and sufficiently violent provocation." The truth of the facts alleged in justification, excuse or alleviation is for the jury to determine: the question whether, if true, they support the plea for which they are put forward, is for the court.

In the administration of the English criminal law as to homicide the consequences of too strict an adherence to the technical definitions of the offences are avoided (a) by the exercise by the jury of their powers to convict of manslaughter only even in cases where they are directed that the offence is murder or nothing; *(b)* by the report of the judge as to the particular circumstances of each case in which a conviction of murder has been followed by the statutory sentence of death; *(c)* by the examination of all the evidence in the case by the Home Office in order to enable the secretary of State to determine whether the prerogative of mercy should be exercised.

Homicide is *justifiable* and not criminal when the killing is done in the execution of the law. The most important case of justifiable homicide is the execution of a criminal in due course of public justice. This condition is most stringently interpreted. The execution must be carried out by the proper officer or his deputy: any person executing the sentence without such authority, were it the judge himself, would be guilty of murder. And the sentence must be strictly pursued: to execute a criminal by a kind of death other than that to which he has been judicially condemned is murder.

Homicide committed by an officer of justice in the course of carrying out his duty, as such, is also justifiable; *e.g.,* where a felon resists a legal arrest and is killed in the effort to arrest him;

where officers in dispersing a riotous assemblage kill any of the mob, if the riot cannot be otherwise suppressed. In these cases the homicide must be shown to have been absolutely necessary. Again, homicide is justifiable if committed in the defence of person or property against forcible and heinous crime, such as murder, violent robbery, rape or burglary.

Homicide is *excusable* and not criminal at all when committed either by misadventure or in self-defence. In the former case the homicide is excused; where a man in the course of doing some lawful work, accidentally and without intention kills another, *e.g.*, shooting at a mark and undesignedly hitting and killing a man. The act must be strictly lawful, and death by misadventure in unlawful sports is not a case of excusable homicide. Homicide in self-defence is excusable when the slayer is himself in immediate danger of death, and has done all he could to avoid the assault. Accordingly, if he strikes and kills his assailant after the assault is over, this is not excusable homicide. But if the assault has been premeditated, as in the case of a duel, the death of either antagonist has under English law always been held to be murder and not excusable homicide. The excuse of self-defence covers the case in which a person in defence of others whom it is his duty to protect—children, wife, master, etc.—kills an assailant (*see* s. 7 of the Offences against the Person Act 1861 supra).

Manslaughter.— In English law the term "manslaughter" is applied to those forms of homicide which though neither justifiable nor excusable are attended by alleviating circumstances which bring them short of wilful murder. The offence is not defined by statute, but only by judicial rulings, and may be described as unlawful and felonious killing without malice express or implied. Its punishment is as a maximum penal servitude for life, and as a minimum a fine or recognizances to be of good behaviour. The quantum of punishment between the limits above stated is in the discretion of the court, and not, as under Continental codes, with fixed minima; and the offence includes acts and omissions of very varying gravity, from acts which only by the charitable appreciation of a jury fall short of wilful murder, to acts or omissions which can only technically be described as criminal.

There are two main forms of "manslaughter":—

1. "Voluntary" homicide under grave and sudden provocation or on a sudden quarrel in the heat of passion, without the slayer taking undue advantage or acting in an unusual manner. The substance of the alleviation of guilt lies in the absence of time for cool reflection or the formation of a premeditated design to kill. Under English law the provocation must be by acts and not by words or gestures, and must be serious and not trivial, and the killing must be immediately after provocation and while the slayer has lost his self-control in consequence of the provocation. The provocation need not be by assault or violence, and perhaps the best-recognized example is the slaying by a husband of a man found committing adultery with the slayer's wife.

2. "Involuntary" homicide as a result of rashness or negligence in respect of matters involving danger to human life, *e.g.*, in driving trains or vehicles, or in dealing with dangerous weapons, or in performing surgical operations, or in taking care of the helpless.

The whole question of criminal responsibility for negligence was considered by the court of criminal appeal in 1925 in *Rex.* v. *Bateman* (28 Cox C.C. 33) and it was there laid down that it was not a question of epithets, but that "in order to establish criminal liability the facts must be such that, in the opinion of the jury, the negligence of the accused went beyond a mere matter of compensation between subjects and showed such a disregard for the life and the safety of others as to amount to a crime against the State and conduct deserving punishment." In the criminal courts the amount and degree of negligence is the determining question, and there must be *mens rea.*

From the point of view of civil as distinct from criminal responsibility homicide does not by the common law give any cause of action against the person causing the death of another in favour of the wife or blood relations of the deceased. In early law this was otherwise; and the mer of the deceased came historically before the right of chief or State. But under English law the rights of relations, except by way of appeal for felony, were swept aside in favour of the Crown, on the principle that every homicide is presumed felonious (murder) unless the contrary is proved, and that in all cases of homicide not justifiable by law a forfeiture was incurred. Trial by battle or appeal for felony was abolished in 1819 by 59 Geo. III., C. 46 in consequence of the case of *Ashford* v. *Thornton* (1 B. and Ald. 405) where the right was successfully maintained. The rights of the relatives were also defeated by application of the maxim *"actio personalis moritur cum persona"* ("a personal action dies with the person") to all proceedings for injury to the person or to reputation.

In England the law was altered at the instance of Lord Campbell in 1846 (9 and 10 V. c. 93) so as to give a right of a claim by the husband, wife, parent or child of a person killed by a wrongful (or even criminal) act, neglect or default by another which would have given the deceased if he had survived a cause of action against the wrongdoer. The compensation payable is what the surviving relative has lost by the death, and under the Workmen's Compensation Acts (in all cases to which they apply) the employer is liable even without negligence to compensate the dependants of an employee killed by an accident arising out of and in the course of the employment; and in such cases even if the death was due to serious and wilful misconduct by the employee, compensation is payable.

In the Indian penal code the definitions of murder are so drawn as to limit the offences to cases where it was actually intended to cause death or bodily injury by the acts or omissions of the slayer, and the definition of culpable homicide short of murder is so drawn as to exclude the forms of unintentional manslaughter due to neglect of duty.

In European codes distinctions corresponding to those of the English law are drawn between premeditated and other forms of criminal homicide; but more elaborate distinctions are drawn between the degrees of deliberation or criminality manifested in the slaying, and the minimum or maximum penalty is varied accordingly.

The most notable difference between England and the United States in regard to the law on this subject is the recognition by State legislation of degrees in murder. English law treats all unlawful killing not reducible to manslaughter as of the same degree of guilt in law. American statutes seek to discriminate for purposes of punishment between the graver and the less culpable forms of murder. *See* CAPITAL PUNISHMENT; CRIMINAL LAW; MURDER; MANSLAUGHTER; FELO DE SE.

HOMILETICS, in theology the application of the general principles of rhetoric to the specific department of public preaching (Gr. ὁμιλητικός, from ὁμιλεῖν, to assemble together). It may be further defined as the science that treats of the analysis, classification, preparation, composition and delivery of sermons. (*See* HOMILY; PREACHING.)

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HOMILY, a simple religious address confining itself principally to the practical exposition of some ethical topic or some passage of Scripture. The Greek word ὁμιλία, from which homily is derived, means communion, intercourse and especially interchange of thought and feeling by means of words (conversation); it was early employed in classical Greek to denote the instruction which a philosopher gave to his pupils in familiar talk (Xenophon, Mem. I. ii. 6, 15). This usage of the word was long preserved (Aelian, *Varia Hist.* iii. 19); and the ὁμιλήσας of Acts xx. 11 may suggest a didactic character in the apostle Paul's discourse in the upper chamber of Troas, when "he talked a long while, even till break of day." The custom of delivering expositions or commerits more or less extemporaneous on the lessons of the day had become a regular part of the service of the Jewish synagogue; and this custom passed over soon and readily into the Christian Church, as may be gathered from the first *Apology* (lxvii.) of Justin Martyr, where we read that, in connection with the practice of rending portions from the collected writings of the prophets and from the memoirs of the apostles, it had by that tirie become

usual for the president (b προεστώς) to deliver a discourse in which "he verbally instructs and exhorts us to the imitation of these excellent things." This discourse was later regarded as a part of the regular duty of the bishop, but he could devolve it, if he thought fit, on a presbyter or deacon, or even on a layman. An early and well-known instance of such delegation is that mentioned by Eusebius (*Hist. Eccl.* vi. 19) in the case of Origen (A.D. 216). In course of time the exposition of the lesson for the day came more frequently to assume a more elaborate character; but when it did so the fact was as far as possible denoted by a change of name, the word ὁμιλία being reserved for the expository or exegetical lecture as distinguished from the pulpit oration or sermon. While the church of the 3rd and 4th centuries could point to a brilliant succession of great preachers, whose discourses were wont to be taken down in shorthand and circulated among the Christian public as edifying reading, it does not appear that the supply of ordinary homiletical talent kept pace with the rapidity of church extension throughout the Roman empire. In the smaller and remoter communities it not uncommonly happened that the minister was totally unqualified to undertake the work of preaching; and though, as is curiously shown by the case of Rome (Sozomen, *Hist. Eccl.* vii. 19), the regular exposition of the appointed lessons was by no means regarded as part of the necessary business of a church, it was generally felt to be advisable that some provision should be made for the public instruction of congregations. Even in Jerome's time (*De Vir. Ill. c.* 115), accordingly, it had become usual to read, in the regular meetings of the churches which were not so fortunate as to possess a competent preacher, the written discourses of celebrated fathers; and at a considerably later period we have on record the canon of at least one provincial council (that of Vaux, probably the third, held in A.D. 529), positively enjoining that if the presbyter through any infirmity is unable himself to preach, "homilies of the holy fathers" (*homiliae sanctorum patrum*) are to be read by the deacons. Thus the finally fixed meaning of the word homily as an ecclesiastical term came to be a written discourse (generally possessing the sanction of some great name) read in church by or for the officiating clergyman when from any cause he was unable to deliver a sermon of his own. As the standard of clerical education sank during the dark ages, the habit of using the sermons of others became almost universal. Among the authors whose works were found specially serviceable in this way may be mentioned the Venerable Bede, who is credited with no fewer than 140 homilies in the Basel and Cologne editions of his works, and who certainly was the author of many *Homiliae* de *Tempore* which were much in vogue during the 8th and following centuries. Prior to Charlemagne it is probable that several other collections of homilies had obtained considerable popularity, but in the time of that emperor these had suffered so many mutilations and corruptions that an authoritative revision was felt to be imperatively necessary. The result was the well-known *Homiliarium,* prepared by Paul Warnefrid, otherwise known as Paulus Diaconus (*q.v.*). It consists of 176 homilies arranged in order for all the Sundays and festivals of the ecclesiastical year; and probably was completed before the year 780. Though written in Latin, its discourses were doubtless intended to be delivered in the vulgar tongue; the clergy, however, were often too indolent or too ignorant for this, although by more than one provincial council they were enjoined to exert themselves so that they might be able to do so. Hence an important form of literary activity came to be the translation of the homilies approved by the church into the vernacular. Thus we find Alfred the Great translating the homilies of Bede; and in a similar manner arose Aelfric's Anglo-Saxon *Homilies* and the German *Homiliarium* of Ottfried of Weissenburg. Such *Homiliaria* as were in use in England down to the end of the 11th century were at the time of the Reformation eagerly sought for and destroyed, so that they are now extremely rare, and the few copies which have been preserved are generally in a mutilated or imperfect form.

The books of *Homilies* referred to in the xxxvth Article of the Church of England originated at a convocation in 1542, at which it was agreed to make certain homilies "for stay of such errors as were then by ignorant preachers sparkled among the people." After some delay a volume was published in 1547 called *Certain Sermons, or Homilies, appoynted by the Kynges Maiestie to be declared and redde, by all Parsones, Vicars, or Curates, euery Sōday in their Churches, where thei haue cures.* A second book of *Homilies* was issued in 1563, called *The Seconde Tome of Homelyes, of such matters as were promysed and Instituted in the former part of Homelyes, set out by the aucthoritye of the Quenes Maiestie: And to be read in eurey paryshe Churche agreablye.* Of the 12 homilies in the first book, Nos. 1 and 3–5 are by Cranmer, No. 6 by Bonner, No. 2 by Nicholas Harpsfield, No. 11 by Thomas Becon. The authorship of the rest is uncertain: 8 and 9 may be by Ridley and 12 by Latimer. Of the original 20 in the second book, Nos. 1–3, 7–9, 15, 16, 19 are probably by Jewel; No. 4 by Grindal; Nos. 5, 6 by Pilkington; others are derived from other sources; *e.g.,* 10 from Erasmus' *Paraclesis,* etc.; 14 from Tavernier's *Epistles,* etc. No. 21 was added by convocation in 1571. The two books were combined in *Certain Sermons or Homilies appointed to be read in Churches* (London, *1623). See* J. Griffiths, *The two books of Homilies* (Oxford, 1859); J. T. Tomlinson, *Prayer Book, Articles and Homilies* (London, 1897).

HOMMA, MASAHARU (1888?–1946), Japanese army officer. was born in Niigata prefecture. Honshu. He was convicted after World War II of permitting atrocities against prisoners under his command.

During World War I he was an observer with the British forces in France, and in 1921 he served as Japanese resident officer in India. In 1930 Homma was appointed military attaché in London, where he was decorated with the military cross of the British empire. In 1939 he commanded Japanese forces at Tientsin. China, when the Japanese army blockaded the foreign concession there.

In Dec. 1941, a few days after the Japanese air attack on Pearl Harbor. Homma, then a lieutenant general, led the Japanese invasion of the Philippine Islands. Although it was commonly supposed that Homma had been superseded by Gen. Tomoyuki Yamashita after the campaign had bogged down at Bataan and Corregidor, subsequent evidence suggested that Homma held the supreme command throughout the campaign. He also directed "mopping up" actions against stray U.S. and Filipino forces in the Visayas and Mindanao areas.

Homma, who arrived in Tokyo to surrender to U.S. forces on Sept. 14. 1945, was brought to trial in December. He was formally charged with having been responsible for the "death march" on Bataan, which occurred shortly after the Japanese conquest. It was estimated that more than 17,000 Filipino and U.S. troops died during the forced march. The trial opened in Manila. Jan. 3. 1946. with a military commission presiding. Convicted Feb. 11 for ordering the death march and for condoning other atrocities, Homma was sentenced to be shot. An appeal to the U.S. supreme court was rejected, and Homma was executed by a firing squad at Los Banos. Luzon. on April 3, 1946.

HOMOEOPATHY. A system of therapeutics based upon the law *similia similibus curantur,* which was introduced in 1796 by Samuel Hahnemann (*q.v.*), a native of Meissen, Ger. Some points of Hahnemann's system were borrowed from previous writers, *e.g.,* Hippocrates and especially Paracelsus (c. 1490–1541). The words *similia similibus curantur* occur in the Geneva edition (1658) of the works of Paracelsus, as a marginal heading of one of the paragraphs. The essential tenets of homoeopathy are that the cure of disease is effected by drugs that are capable of producing in a healthy individual symptoms similar to those of the disease to be treated, and that to ascertain the curative virtues of any drug it must be "proved" upon healthy persons — that is, taken by individuals of both sexes in a state of health in gradually increasing doses.

Another peculiar feature of homoeopathy is its theory of dose. Most homoeopathists believe in the action of minute doses of medicine. Many employ low potencies; *i.e.,* mother tinctures, first. second, sixth dilutions, etc.. while others use hundred-thousandths and millionths. However, the American Institute of Homoeopathy of the United States adopted the following resolution and ordered it to be published conspicuously in each number

of the *Transactions* of the society: "A homoeopathic physician is one who adds to his knowledge of medicine a special knowledge of homoeopathic therapeutics. All that pertains to the great field of medical learning is his by tradition. by inheritance, by right."

In the medical profession homoeopathy at mid-20th century remained under the stigma of being a dissenting sect. In the United States it was disappearing; there mere comparatively few practitioners and no medical schools emphasizing this approach to therapeutics. There was still an "official" homoeopathic compendium in the United States but it was 'official" only by virtue of its being included in the compendiums recognized in the federal Food. Drug and Cosmetic act. (A. E. SH.)

HOMOLOGY, in biology. is the similarity of structure, physiology. development and evolution of organisms based upon common genetic factors (see EVOLUTION. ORGANIC; GENETICS: VARIATION). It is contrasted with analogy. which is a similarity of function not based upon common genetic factors, but appearing independently in convergent evolution. Biological analogy should not be confused with chance resemblances.

Richard Owen (1804–92) is given the credit for defining both homology and analogy in precise terms. Confusion between the two is the largest source of error in modern systematic biology. Homologues and analogues may be present in the same structures or processes. The. two can only be separated by considering the relations of whole patterns and systemic units and discovering. comparing and statistically analyzing each similarity and difference.

Genetic Homology. — The complicated gene structure. consisting of large molecules bonded together in a pair of chains, can be modified (undergo a mutation). Homology is based upon the postulated identity both of units within the molecules in the chain and the linear arrangements of the molecular units in the larger chain. Parallel and independent identical mutations may take place within the same or different species, but the mathematical probabilities of independent origin of complex genetic patterns are slight.

Ontogenetic Homology. — Genetic factors determine the nature and sequence of many events beginning with the earliest stages of embryonic development and continuing throughout life. So there are homologues in the life histories of genetically related individuals. Special subcategories of homology are set up to cover cases where similar structures appear in the same individual (each of the arms of a starfish or the legs on each segment of a lobster), or in different individuals in a genetically related population (sexual homologues or castes of social insects).

Phylogenetic **Homology.**—Homologues in different species are theoretically inherited from a common ancestry and are presumably initiated by identical genes or gene parts. The number and complexity of such homologues indicate the degree of relationship between phylogenetic groups. Hence homologues are the foundation for "natural systems" of classification and form the basis for evolutionary theory and interpretation.

Because of gross evolutionary changes and analogous functions, homologues are not always apparent to the casual observer, particularly in cases involving vestigial organs and extreme adaptations. For example, dog's paws, bat's wings, whale's flippers and man's hands have many homologues in common. Study of embryonic development is often helpful in establishing obscure homologies in relatively unrelated branches of the evolutionary tree.

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HOMOPHONY, a musical term signifying literally "like voices." that is. voices or instruments in unison, but which in practice has come to signify music with one outstanding part, to which the other parts are subordinate, as opposed to polyphonic music, composed of a number of parts of more or'less equal importance.

HOMOSEXUALITY, also called SEXUAL INVERSION, is usually defined as the sexual attraction of a person to one of the same sex (from Gr. *homo-,* "same"; not from Lat. *homo,* "human being," "man"). This usually, but not necessarily always, leads to various physical activities culminating in orgasm or sexual climax. Female homosexuality is often referred to as lesbianism (*q.v.*). The term pederasty implies sexual relations between men and boys.

Contrary to the popular belief, homosexual behaviour can be seen not only in human beings but also in animals, sometimes in immature ones, but more often in those deprived of a normal sexual outlet. It is believed that conditioning may have a great deal to do with such behaviour, although much arises spontaneously.

Apes appear to pass through a stage of undefined sexual activity, and S. Zuckermann noticed mutual masturbatory activities which in humans would be regarded as overt homosexuality. R. M. and A. Yerkes state that heterosexual, homosexual, exhibitionistic and masturbatory activities occur in immature animals. Sodomy in apes has been noted.

Many human societies disapprove of homosexuality, but some. for example the ancient Greeks, accepted it as normal. C. S. Ford and F. A. Beach, who studied primitive societies, state that 49 out of 76 (*i.e.,* 64%) accepted homosexuality as being normal. In some of these, persons were allowed to wear clothes of the opposite sex and to form homosexual unions which were accepted as "marriages." In some cases this was related to shamanism, and the homosexual was considered as having magical powers. In other societies (the Siwans of North Africa, the Arunta or Aranda of Australia, the Keraki of New Guinea, etc.) men and boys indulge in anal intercourse. Homosexuality is then common and even universal. Sometimes it is related to initiatory rites.

Such behaviour in primitive societies occurs among females as well as among males and is usually confined to mutual masturbation, but an artificial phallus may be employed. It is probably not so common among females as males.

Lest it be thought that homosexuality appears in such preliterate societies because it is permitted, it must be pointed out that even in those where it is harshly repressed it still makes its appearance; the death penalty itself has failed to stamp it out.

Theories of Causation. — There appear to be four possibilities in the causation of homosexuality in human beings: (1) a genetic aberration; (2) an endocrine disorder; (3) a psychological condition; or (4) a mixture of two or more of these.

The view that homosexuality is a genetic aberration is frequently advanced. The homosexual often says that he was born like it and has been so as long as he can remember. Such genetically produced intersexuality (that is, male homosexuals regarded as more or less feminized males or as real male intergrades which are genetically female) has been worked out extensively. Thus in insects (butterflies, for example). it is possible to demonstrate series with males and females at the extremities, but with a very gradual transition between. Physical intersexuals can be found in practically all animals, and the condition is often due to disease of the adrenal glands. The possibility that the homosexual is a psychical manifestation of such a condition at once suggests itself. Unfortunately for those who hold this view, its application to human beings has not been confirmed. No one has ever been able to prove that it occurs, and homosexuals certainly do not show any physical signs of the concomitants which might be expected.

An endocrine causation has always seemed a likely one, but here again unfortunately there is no proof. Most homosexuals show no evidence of glandular disease. Castration does not cause the condition, nor does the injection of female hormones into the male (or vice versa) do so. In some cases the injection of male hormones in a male has increased his homosexuality (by increasing the sexual urge). The excretion of hormones in homosexuals is usually normal.

No discernible difference between the physique of the homosexual and that of the heterosexual has been shown by any recorded tests, microscopical, macroscopical, biochemical or endocrine.

There remains the psychological causation. A view is often advanced that homosexuality is pure degeneracy. This is used as a vehicle of abuse but has little scientific meaning. It has been suggested, for example, that the ancient Romans became degenerate and lost their world dominance through perverted sex, or alternatively that homosexuality was a symptom of their degeneration; but it is now thought that any deterioration in the Romans that cannot be explained by political or economic causes is better attributed to malaria than to perversion. Since homosexuality appears to be determined before puberty, the hypothetical degeneracy mould have to have set in very early, and usually no other evidence can be found either of physical or of intellectual degeneracy in homosexuals. In fact, some of them are fine creative artists and almost all are physically normal.

It is probable that sexual inversion goes much deeper than degeneracy and is related to development, This is suggested because it rarely appears by itself and is frequently associated with other paraphilias (*i.e.*, abnormal immature ways of obtaining sexual pleasure). Moreover, sexuality in the human being is not clear-cut but shades off. Thus A. C. Kinsey found that 35.5% of all individuals in a series of 1,058 males had had one or more homosexual experiences. He thought that between one-quarter and one-third of all males in any middle age group had had some homosexual experience and that in the course of a lifetime 50% would be involved in this behaviour. These statistics belong to the United States, and there are no comparable ones for Europe, but it is believed that a somewhat similar result could be obtained there.

It is generally accepted by psychologists that men who in normal circumstances will behave heterosexually and enjoy a normal life with women may become inverted if deprived of female company (in prison, in prison camps. in warfare, at sea and so on). The percentage of cases in which this occurs is not known.

The idea of psychological causation mas first developed by Sigmund Freud. who put forward the view that homosexuality was due to aberrations of the emotional development. He thought that the main factor was an overattachment of the boy to his mother and hostility to his father, which would result in his molding his personality too much on his mother and so acquiring too many feminine reactions and thus tending to behave as a woman. Freud's view is upheld by the fact that a large number of inverts give a history of an unhappy home in which the father has been unsatisfactory or else died when the patient was young (and so had not been available to shape his personality). Other views of Freud's regarding the development of the libido, or sexual interest, from oral through anal to phallic stages explain the behaviour of inverts u-ho indulge in oral and anal perversions. They explain, also, the association of homosexuality with other sexual abnormalities such as bisexuality, transvestitism (or the wish to dress as a member of the opposite sex) and transsexuality (the desire to change sex). Bisexuality is usually considered to be undeveloped sexuality, with the patient fixated between heterosexual and homosexual stages; transvestitism as somewhat similar but limited to an identification with the mother only as far as clothes are concerned; and transsexuality as a wish to be as like her sexually as possible. Unconscious fear of castration also plays a part.

Social Aspects.—Although medically inversion must be considered an illness, there is doubt that, particularly in large towns and cities, it becomes exploited as a vice. Thus homosexual prostitutes exist and maintain *souteneurs* much as in heterosexual prostitution. These exploit the less sophisticated and frequently blackmail them. This explains the fact that homosexuals sometimes sink down in the social scale as suggested by G. W. Henry and A. A. Gross.

Not all male homosexuals are of the outwardly effeminate type, and some can be dangerously violent. Crimes of jealousy, sometimes leading to murder, are caused by this abnormality. But other homosexuals have made valuable contributions to society, notably in the field of the arts, though it is improbable that it is the sole or even the main cause of genius, as some homosexuals assert. Freud suggested that inversion is the cause of paranoid insanity (in which the patient suffers from delusions of persecution).

A certain number of homosexuals are curable by psychological treatment, a fact which invalidates the view of its causation by genetic or glandular aberrations. Treatable cases are those who suffer from excessive timidity with members of the opposite sex or who have painful symptoms. Excessively feminine men are not suitable for psychological treatment.

Legal Aspects.—The code of laws discovered at Bogazkoy indicates that homosexuality may not have been universally forbidden among the Hittites. but only between father and son. Middle-Assyrian lams of the time of Tiglath-pileser I (12th–11th century B.C.), however, punished it by castration. There is some doubt about the attitude to the homosexual temple prostitute, or kadcsh, in the earliest period of Judaism, but by the time of the composition of the "Holiness code" any form of homosexuality was sternly forbidden among the Jews (Lev. xviii. xx); such practices were regarded as pagan, the way of the Chaldean, of the Canaanite or of the Egyptian, a form of idolatry. This Jewish prohibition was introduced into Christianity by St. Paul. The story of Sodom and Gomorrah, according to D. S. Bailey, has throughout the ages coloured the attitude of the church more and more. The institution of ecclesiastical courts made it possible to enforce laws based on it, and these were finally absorbed into English civil law. The medieval penalties were severe: ancient laws state that sodomists, for example, should be buried alive, burned alive or merely "put to death." Sodomy. hen-ever, was regarded as a sin and tried by the church until an act uas passed in the reign of Henry VIII. The death penalty remained until two acts passed in the 19th century (see below).

English Law in the *20th* Century.—Homosexuality provides three offenses against English law: (1) sodomy; (2) gross indecency between male persons; and (3) indecent assault.

Sodomy (*i.e.*, anal intercourse) is punishable under the Offences Against the Person act, 1861, s. 61 and 62, and also under the Criminal Law Amendment act, 1885, s. 11. Under the Offences Against the Person act the sex of the passive partner is immaterial since the behaviour is defined as against mankind (*i.e.*, any human being), and men have been indicted for offenses against women. These offenses are triable at the assizes, and the maximum penalty is imprisonment for life. The passive party, if consenting and over 16 years old, is also guilty.

Gross indecency between male persons is a misdemeanour under s. 11 of the Criminal Law Amendment act, 1885, and is defined as "an act of grossly indecent nature between male persons." This is usually mutual masturbation, either manual or intercrural, between two males. In the case of boys consent does not legitimize the offense. nor does the fact that puberty has been passed (as in offenses against girls over 16 years old). If over 16, the consenting party becomes equally guilty. Oral as well as masturbatory practices are covered by the act. When practised by those kt loco *parentis* the offense is regarded as aggravated. The influence of alcohol cannot be pleaded in mitigation. Gross indecency between male persons is a misdemeanour and, provided that a qualified chairman is present, may be tried at quarter sessions and is punishable with tno years' imprisonment.

S. 62 of the Offences Against the Person act, 1861, prescribes a punishment not exceeding ten years' servitude for any indecent assault upon a male person. The offense is not defined, but to constitute it there must be (1) an assault and (2) circumstances of indecency. Assault means not that violence must have been committed but that consent was not given for whatever took place. This is usually touching, undoing clothing and so on.

Statistics appear to show that homosexual offenses were increasing in the 1950s, but how much this was a real increase and how much caused by an increase in police prosecutions it is impossible to say. The report of the Departmental Committee on Homosexual Offences and Prostitution (the "Wolfenden report"; Sept. 1957) made various recommendations the chief of which were that homosexual behaviour between consenting adults in private should no longer be a criminal offense, that buggery (anal intercourse) should be reclassified as a misdemeanour and that, except for some grave reason, proceedings should not be instituted in respect of homosexual offenses incidentally revealed in investigating allega-

tions of blackmail. See also LESBIANISM; SEXUAL DEVIATIONS.

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HOMS (AL KHUMS), a town of Libya, Africa, lies on the Mediterranean coast at the foot of the northern spurs of the Jabal Nafusah. Pop. of Homs district (1954 census) 30,089, almost all Arabs. The seat of a prefecture, Homs has straight streets and well-kept public gardens. There are many Turkish buildings, mosques, a Roman Catholic church, schools and a modern hotel. Near the town is the military area, occupied in the mid-20th century by British troops. Local industries comprise the Sidi Muftah tunny-fish enterprise, a soap factory and the esparto paper factory. The district produces dates and olive oil, and the good sea fishing is well exploited.

The town of Homs was founded by the Turks and gained importance about 1870 when the British started the esparto industry there. In the environs are the ruins of several Italian forts from World War I. Less than 2 mi. to the east is the ancient city of Leptis Magna (Labdah), with its extensive Roman remains. *See* LEPTIS. (E. V. CI.)

HONAN (HO-NAN SHENG), one of the most densely peopled and historically one of the most famous of the provinces of China. Area 63,761 sq.mi. Pop. (1953) 44,214,594. Its name signified "south of the river," *i.e.,* of the Yellow river, but a part of the province lies north of the river. Honan comprises the southwestern portion of the great plain of north China, broken in the west by eastward extensions of the Tsinling Shan (*q.v.*) axis, which have a general elevation of about 3,000 ft. The northern section of Honan was separated in 1949 to form the short-lived province of P'ing-yiian which was abolished and restored to Honan in 1952. The southern boundary of Honan follows in part the crest of the Ta-pieh Shan (Huai-yang Shan) which divides the Huai Ho (*q.v.*) from the Yangtze basin, but in the southwest it includes the upper valley of the Han river which affords direct communication with the tricity conurbation of Wu-han (*q.v.*).

Honan was the chief centre for the spread and dispersion of early Chinese culture and civilization. The open lands above the marshy levels of the Yellow, Huai and upper Han rivers were not only valuable settlement sites but controlled the lines of movement either along the Huai-Yellow river watershed to Shantung province or by the Huai-Yangtze divide to the culture centres of the Yangtze valley. Honan was also the terminus of the corridor route from the west betneen the Shansi plateau and the easterly spurs of the Tsinling Shan. In earlier Chinese history sites along the right bank of the Yellow river, between the cities of Lo-yang to the west and K'ai-feng (*q.v.*) to the east, frequently served as political centres, these two cities often being the capitals. Hence, much of the political history of China prior to about A.D. 1200 focused upon the Honan area. An-yang, north of the Yellow river, has notable archaeological sites.

Honan is mainly rural in character, with more than 90% of the population living in villages and small towns. The chief urban settlements are located along the Lung-hai and Peking-Hankow railways. The densest grouping is in the eastern section on the higher agricultural land. A secondary focus of population occurs in the upper Huai basin with Nan-yang as its centre. Honan normally leads China in wheat production and ranks high in the production of cotton, millet, tobacco, soybeans, peanuts and sesame. But the danger of drought and flood (from both the Yellow and Huai) constantly menaces the countryside. The Chinese Communists have done much river reclamation work on the upper Huai system, building detention dams, canals and irrigation systems in an effort both to decrease flood dangers and mitigate drought problems.

The main earlier industrial development had been the growth of coal mining in northern Honan and the establishment of agricultural processing industries in the towns along the rail systems. After 1952 the old cities along the Yellow river, K'ai-feng, Cheng-chow (Cheng-hsien) and Lo-yang, began to expand industrially. Chengchow (pop., 1953, 594,700), at the intersection of the Lung-hai and Peking-Hankow rail systems, became the provincial capital in Oct. 1954 and is growing rapidly, a new industrial suburb taking shape in the western outskirts. Textile mills, machinery plants, power plants at dams along the Yellow river and added agricultural processing factories were either being built in the late 1950s and early 1960s or were projected. Some of these projects will serve both power development and flood-navigational control on the Yellow river. The 30-mi.-long People's Victory canal, a combined irrigation and communication project, links the Yellow river north of Chengchow nith the Wei Ho at Hsin-ch'iang (Sinsiang). Despite the new industrial developments, Honan's manufacturing patterns still continue to revolve chiefly around the processing of agricultural products, notably cotton, flour and oilseeds. If the current trend of industrialization continues, however, Honan is certain to show increasingly complex industrial patterns and a marked shift in population distribution through increased urbanism. (J. E. SR.)

HONDECOETER, MELCHIOR D' (1636–1695), Dutch painter who specialized in bird studies, was born at Utrecht. Old historians say that he was the grandson of Gillis and son of Gysbert Gillisz d'Hondecoeter, as well as the nephew by marriage of J. B. Weenix who certainly influenced his style. As to Gysbert and Gillis, however, it is uncertain that they were father and son, since both were registered as painters at Utrecht in 1637. Melchior lived at The Hague (1659–63) and at Amsterdam, where he married in 1663 and lived till his death on April 3, 1695.

Melchior d'Hondecoeter chose birds as his subject, perhaps because his father had painted birds or because his uncle Weenix taught him to study the feathered tribe. Melchior, however, began his career with a different specialty from that by which he is usually known. De Stuers affirmed that he produced sea studies. He acquired celebrity, however, as a painter of birds, which he represented vividly. Without the brilliant tone and high finish of Jan Fyt, his birds are full of action; and it was said that he displayed the maternity of the hen with as much tenderness and feeling as Raphael, the maternity of Madonnas. Few of his pictures are dated, though more are signed. Among the former should be noted the "Jackdaw Deprived of His Borrowed Plumes" (1671); "Game and Poultry" and "A Spaniel Hunting a Partridge" (1672); and "A Park With Poultry" (1686). Hondecoeter's earliest works are more conscientious, lighter and more transparent than his later ones. At all times he is bold of touch and sure of eye, giving the motion of birds with great spirit and accuracy.

Hondecoeter, in great favour with the magnates of the Netherlands, became a member of the painters' academy at The Hague in 1659. William III employed him to paint his menagerie at Loo, and the picture, acquired by The Hague museum, shows that he could overcome the difficulty of representing India's cattle, elephants and gazelles. But he is better in homelier works, with which he adorned the royal chbteaux of Bensberg and Oranienstein at different periods of his life.

HONDO, Central American stream with headwaters in British Honduras (Belize), northeastern Guatemala and southern Mexico. Its northeast or east-trending course marks the frontier between Mexico (Quintana Roo territory) and British Honduras. In the 30 mi. above its outlet on Chetumal bay (Caribbean sea) it is navigable for small craft. High-water navigation extends to the confluence of the Xmoscha and Azul rivers. (J. T.)

HONDURAS (REPÚBLICA DE HONDURAS), a republic occupying the central portion of Central America, with a coast line of 400 mi. on the Caribbean sea and a frontage of about 50 mi. on the Gulf of Fonseca, on the Pacific ocean. It is bounded on the north by the Caribbean sea, on the southeast by Nicaragua, on the south by the Pacific ocean and El Salvador and on the west by Guatemala. Area 43,277 sq.mi. Pop. (1950) 1,368,605.

The name is Spanish (translated "depths") and is explained with equal insistence as referring either to the deep waters found by Columbus offshore or to the deep, wavelike valleys and ridges that traverse nearly the entire country, excepting for the relatively narrow coastal plains. The country faces on the sea to the north and

shares frontage on the Gulf of Honduras with British Honduras and Guatemala, which has a short Caribbean coast line. The strategic Bay Islands (*q.v.;* Islas de la Bahia), about 30 mi. off the north coast, became part of Honduras in 18jg after a long dispute with Great Britain.

The easternmost extension of Honduras is Cape Gracias a Dios, where the Caribbean coast line of Central America turns abruptly southward. The frontier with Nicaragua, which was delineated in 1906 and reaffirmed by a decision of the International Court of Justice in 1960, runs through a sparsely inhabited territory along the Río Segovia (or Coco or Wanks). (See History, below.) The boundary continues south-weshard from an upper tributary of the Segovia across the continental divide to the eastern end of the Gulf of Fonseca. There, for a short distance, Honduras fronts on this great arm of the Pacific, holding sovereignty over the islands of Tigre (where its Pacific port, Amapala. is situated), Zacate Grande and Gueguensi. The boundary line with El Salvador starts at the mouth of the Goascorán river and follows an irregular line through the mountains, first in a northerly and then in a westerly direction, to a point directly west of Ocotepeque; there the boundaries of Honduras, El Salvador and Guatemala meet.

The boundary line between Honduras and Guatemala was in dispute from the early days of the Spanish regime until the 20th century. With the development of the banana industry, conflicting concessions by the two governments brought the issue to a head in 1927, but threatened hostilities were averted by United States mediation and an eventual arbitration by that country, Costa Rica and Chile.

This article is divided into the following sections:

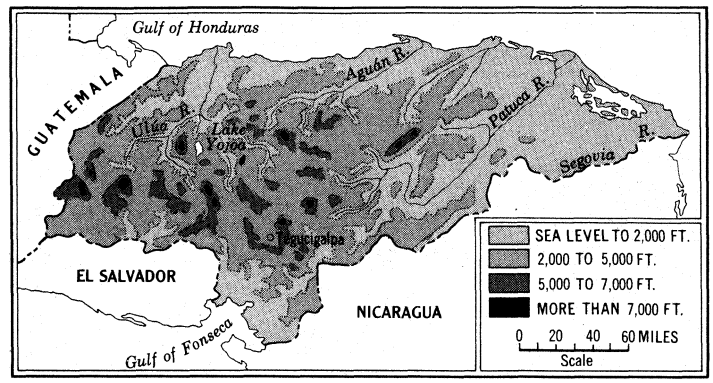
Further aspects of Honduras may be found in short articles on the departments and more important cities.

I. PHYSICAL GEOGRAPHY

The general aspect of the country is mountainous. Although the southern part of the country close to the Pacific is of volcanic origin, no active volcanoes exist. No clear-cut pattern of mountain trends is apparent. Some tendency for ranges in the northern part of the country to trend southwest-northeast is apparent, enveloping extensive valleys, but many transverse ranges also exist. In the southern part, mountains are prolonged commonly toward the north and northwest. whereas the central part is constituted in general by a dissected upland with numerous small peaks.

Geology. — In general the geological formations in Honduras have roughly an east-west orientation. Except for a narrow plain of Pleistocene alluvium, bordering the Gulf of Fonseca, the mountains of southnestern Honduras consist of alternating series of andesitic tuffs and lava flows of Tertiary age. From west of Tegucigalpa eastward are broad areas of Triassic and Cretaceous crystalline (granite) and metamorphic rocks, forming the many mountain ranges. The northern mountains, east of the Ulúa basin, consist of Pre-Cambrian, or possibly Paleozoic, crystallines with alternate bands of Cretaceous sedimentary rocks and Cretaceous granitic intrusions between ranges of older rocks. Northwestern Honduras has large areas of Tertiary andesitic tuffs and lavas, older Cretaceous sedimentaries and, in the sierras near Guatemala, Cretaceous granitic intrusions. Narrow stretches of northern coastal plains, the broad Ulúa-Chamelecón and Aguán valleys and the wide eastern coastal plains consist chiefly of Pleistocene sediments and Recent alluvium.

Relief and Drainage. — Flat to undulating plains comprise about 20% of Honduras. Bordering the Gulf of Fonseca, low piains, 10 to 25 mi. wide, are fairly well drained by many short streams and the Goascorán, Nacaome and Choluteca rivers, whose sources lie in high mountains. Narrow, poorly drained coastal

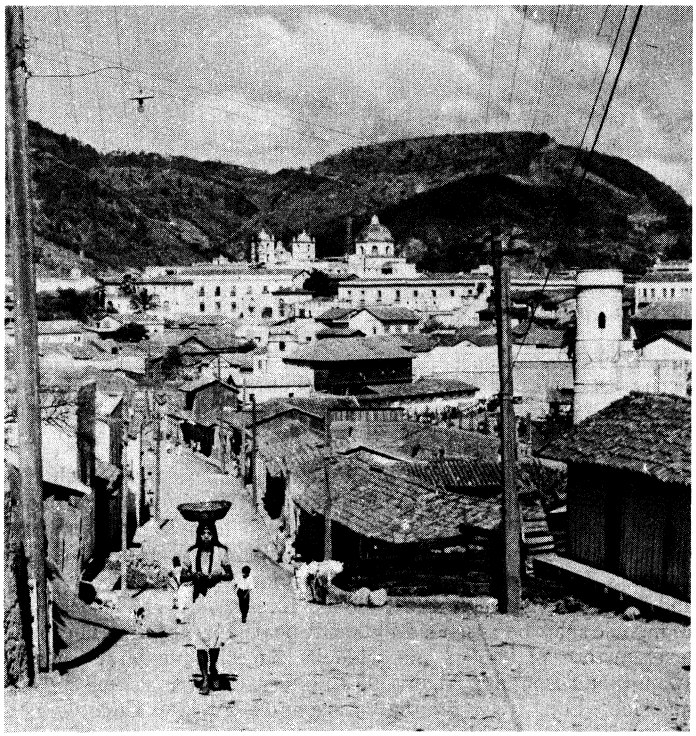


SURFACE FEATURES OF HONDURAS. THE COUNTRY IS CHIEFLY MOUNTAINOUS. WITH WIDE FRONTAGE ON THE CARIBBEAN SEA AND A NARROW PACIFIC OCEAN SHORE LINE

plains in the north, separated by mountain spurs that reach the ocean, merge with the alluvial plains of the Ulúa-Chamelecón, Comayagua and Aguán rivers. The Ulúa-Chamelecón plains, 30 mi. wide in the lower portion, extend 65 mi. inland. The Ulúa and tributary Jicatuyo, rising near El Salvador, are over 250 mi. long and navigable by light-draft boats for 150 mi. The Aguán-Mangulile may be ascended by small boats for 50 mi. The low-level eastern plains, 70 mi. wide in places, have large coastal swamps and lagoons; Laguna de Caratasca is 41 mi. long and 14 mi. wide. Long rivers are the Patuca and Segovia or Coco (*q.v.*); the latter, rising within 50 mi. of the Gulf of Fonseca and flowing eastward for 300 mi., is navigable by small vessels for 200 mi. Highlands, comprising 80% of Honduras, consist of many high mountain ranges, reaching 8,000 ft. in the west, and deep structural basins in which are canyonlike valleys and intricately ramifying tributaries — all contributing to the very rugged relief. Many basins, the largest being the Humuya, 32 mi. by 16 mi., lie 2,000 to 5,000 ft. above sea level.

Climate. — The climate is generally hot, with high humidity in the tropical coastal lowlands becoming modified by altitude toward the interior. Lowlands below 1,500 ft. have mean annual temperatures between 79° and 82° F. The north coast is occasionally affected from October to April by "northers" — cool northern winds of continental origin. Mountain basins and valleys, from 2,000 to 4,000 ft., have mean annual temperatures between 67° and 74° F. At Tegucigalpa, located on hilly terrain at an altitude of 3,200 ft., the rainy season starts in May and continues until the middle of November with temperatures sometimes reaching 90° in May and dropping to 50° in December, the coolest month. Around 7,000 ft., mean annual temperatures are about 58° F. In the northern and eastern coastal and alluvial plains and on adjacent mountains mean annual precipitation ranges from 70 to 110 in. or more, with a less rainy (but not rainless) season from March to June; these areas occasionally have summer hurricanes with strong winds and heavy rains. Pacific plains and mountain slopes get 60 to 80 in. of rain annually, but there the months December to April receive little or no rain. Interior sheltered mountain basins and valleys get 40 to 70 in. annually, with December to April having little rain. Interior higher mountains receive considerably more in a longer rainy season.

Vegetation. — In eastern Honduras the coastal and lagoon swamps have mangrove and palm forests, and west of these are low rainy sandy plains with pine-savanna (*Pinus* caribaea) forests, extending inland for 40 mi. or more. West of the pine-savanna forests, in low valleys and on lower mountains, rainy all year, and on the low rainy northern mountains, are broad belts of dense evergreen broadleaf forests with many species of large trees including mahogany, lignum vitae, Spanish cedar, balsa, rosewood, ceiba, sapota (yielding chicle used for the base of chewing gum), Castilla rubber, etc. The high rainy mountain slopes of highland Honduras support excellent oak-pine forests. The interior highland basins and valleys have open, dry deciduous woodlands and temperate grasslands. The Pacific plains and adjacent mountain slopes have deciduous tropical forest and savanna. Mangrove oc-



LANKS FROM BLACK STAR
STREET IN TEGUCIGALPA, **CAPITAL** OF HONDURAS

cupies the low coastal swamps.

Animal Life.—In the native animal life of Honduras insects, birds and reptiles are most numerous. There are many species of butterflies, moths, beetles, bees, wasps, spiders, ants, flies and mosquitoes, Most of these are beautifully coloured. Many species of land birds are common throughout the country. Waterfowl in large numbers inhabit the coastal areas. Crocodiles, snakes, lizards (giant iguana and others) and turtles are in the tropical forest areas. Bears, pumas, leopards and panthers are rarer but may be found in the hills. Fish and mollusks are abundant in lagoons and coastal waters, but the annual catch does not exceed 400,000 lb.

II. GEOGRAPHICAL REGIONS

Honduras may be divided into four distinct geographical areas: (1) the eastern lowlands and eastern mountain slopes; (2) the northern coastal and alluvial plains and coastal sierras; (3) the central highlands; and (4) the Pacific lowlands and lower mountain slopes.

The Eastern Lowlands and Eastern Mountain Slopes.—These are hot and rainy all the year and densely forested. This region embraces about 20% of the country's area but its population, all rural, comprises only 5% of the national total. It has no highways or railways, depending entirely on boat transportation on the rivers, lagoons and coastal waters. Chief economic activities are lumbering, forest gathering, primitive subsistence agriculture and fishing. The lagoons and coastal waters are the chief fishing grounds of the country.

The Northern Coastal and Alluvial Plains and Coastal Sierras.— The plains are artificially drained in part and the entire region embraces about 13% of Honduras. The coastal settlements are inhabited by about 20% of the nation's population. The three railways are confined to this north coastal region which has four of the five important ports of the country; Puerto Cortés, the leading port, is connected with the highlands via the Inter-Coastal highway. The coastlands with their productive clay loam and sandy loam soils produce all the bananas exported from Honduras and at least half the rice and cassava. The area is significant in the production of corn, beans, cattle, poultry and swine and manufactured articles. the last especially in San Pedro Sula (*q.v.*), the second city in Honduras.

The Central Highlands.— Extending northwest-southeast from Guatemala to Nicaragua, the highlands comprise about 65% of the national territory and have 70% of its population. This region consists of rugged mountain ranges and intermontane basins and deep valleys between 2,000 and 5,000 ft. in altitude. The population is concentrated chiefly in basins and valleys, many of which have fertile soils derived from lavas and volcanic ashes. There are road connections with both coasts via the Inter-Coastal highway. The region produces all the nation's coffee, tobacco, potatoes and wheat and the bulk of its corn, sorghum, beans, fruits, vegetables, cattle, poultry, swine, minerals, hardwood-pine forest products used in Honduras and manufactured commodities.

The Pacific Lowlands and Lower Mountain Slopes.—These comprise only about 2% of the national area and have only 5% of the population. The region, level to hilly, has fertile alluvial and other soils derived from lava and volcanic ashes. Although small, it produces all the country's sesame seed, the bulk of its cotton and small amounts of corn, sorghum and cattle, swine and poultry products. The Inter-American highway from El Salvador to Guatemala crosses the region and Tegucigalpa can be reached via the Inter-Coastal highway. (C. F. J.)

III. THE PEOPLE

Honduras is predominately a mestizo (mainly Spanish-Indian) country. According to the 1950 census, ethnic distribution was as follows: mestizos 91%; Indians 6%; Negroes 2%; and whites 1%. Although there is no racial discrimination of an institutional or governmental nature and very little in social relations, the ruling upper middle classes tend to be lighter skinned than the lower classes. The mestizos of Honduras are generally darker and more Indian in appearance than those of certain other Latin-American countries such as Chile, Uruguay and Argentina. Mestizos predominate in every department but Intibucb and the Bay Islands. The greatest concentrations of Indians live in Intibucá (about 30% of the national total) and La Paz (about 18%). These two departments, located in the southwest near the Guatemalan border. coincide roughly with the important Indian centres of the pre-Spanish period. There are small, isolated groups of non-Spanish-speaking Indians, such as the Jicaques, Mosquito, Zambos and Payas, but they are declining in numbers. The Bay Islands of the Atlantic coast are populated mainly by descendants of Negroes and Caribs and by white Protestants of English extraction, who dominate the political, social and economic institutions. Negroes, mostly from Jamaica, were introduced in the northern coastal area to work on the banana plantations, where English is now widely spoken. Their immigration is now illegal. There are very few Negroes in the urban centres of the interior. A pronounced shift in population took place in the early decades of the 20th century from the cool, pine-forested mountains and plateaus and fertile valleys of the interior to the hot, humid north coast where economic opportunities were afforded by the United Fruit company. In later years, shifts back to the area of more pleasant climate took place.

Roman Catholicism is the predominant faith, and freedom to all creeds is guaranteed by the constitution. No religion is state supported. See also INDIAN, LATIN-AMERICAN. (W. S. Ss.)

IV. HISTORY

Centuries before the white man came to the new world, Honduras was the original homeland, along with Guatemala, of the remarkable Maya people, the pioneers of higher civilization in the Americas. But when Columbus, on his fourth voyage, touched the Honduras coast (1502) the Mayas had deserted Copbn, Quiriguá and other Honduran sites for lands in the Yucatán peninsula, where the conquistadors found them a short time later.

Honduras, though largely unexplored, became a bone of contention between the Spaniards of Mexico and the Spaniards of Panamb. Hernbn Cortés (*q.v.*), conqueror of Mexico, considered that it lay within his sphere and when word came that Gil Gonzblez Dávila, acting under orders of Gov. Pedrarias Dávila of Panamb, was colonizing the area, Cortés countered by sending his lieutenant, Cristóbal de Olid, to expel the intruder. Olid arrived, bested Dbvila and then set himself up as independent of Cortés.

This brought Francisco de las Casas from Mexico. Then Cortés, fearing that Casas might succumb to a like temptation, made his memorable overland march to Honduras. After some exploration and looting he returned to Mexico the next year (1526). Spanish rule was inaugurated but settlements were soon engaged in rivalries for wider authority. Pedro de Alvarado (*q.v.*), another of Cortés' lieutenants, was sent in 1536 to restore order. He founded San Pedro Sula (*q.v.*) in the valley of the Ulúa, and later Comayagua (*q.v.*), the first capital of Honduras, was established in the Comayagua valley by Alonso de Cáceres. This period was marked by bloody struggles against Lempira, the Indian chieftain who for a time successfully resisted the Spanish advance into the interior. His name now designates the monetary unit of Honduras and is a national symbol of liberty and valour.

Colonial Period.——In 1539 Honduras, along with the four other provinces of the Central American strip, was incorporated into the captaincy general of Guatemala, and it remained a part of that administrative division of the Spanish Indies through the colonial period. In the 1570s a silver strike in the highlands brought a rush of prospectors which resulted in the rise of an important population centre at Tegucigalpa (*q.v.*). The coastal area along the Caribbean became a rendezvous for the pirates and buccaneers who preyed on the Spanish treasure ships and attacked the colonial ports. Later the region, with its fine logwood forests, attracted English cutters, who by the end of the 18th century controlled the Mosquito Coast (*q.v.*) from the San Juan river, in Nicaragua, to Belize, and also the Bay Islands offshore. The Spanish resented this trespass but were unable to oppose it effectively.

Independence.— In 1821 Mexico won its independence from Spain, and on Sept. 1j, 1821, the Central American provinces comprising the captaincy general of Guatemala also announced their independence. In 1822 they became part of the Mexican empire of Agustin de Iturbide (*q.v.*), but following the latter's downfall in 1823 they broke away to form the Central American federation. Manuel José Arce, the first president. faced an almost impossible task in trying to weld the five states (Honduras, Guatemala, El Salvador, Nicaragua and Costa Ricaj into a functioning unit. Serious unrest began to show as early as 1826 and in 1829 Arce resigned. In 1830 Francisco Morazán was elected to head the union. Morazán was a Liberal whose impact on his native Honduras and on the confederation was in terms of liberalism! one of whose principal goals was the curtailment of the power and age-old privileges of the church and the clergy. By the late 1830s the Conservative opposition proved too much for Morazán. The confederation collapsed and the Central American states assumed the status of independent nations. Honduras declared its absolute independence Nov. j, 1838. Rafael Carrera (*q.v.*) assumed the leadership in Guatemala; the Conservatives in Honduras took control under the leadership of Francisco Ferrera; who was inaugurated as the first constitutional president Jan. 1, 1841; Morazán, who had gone to El Salvador, finally withdrew.

The domination of the Conservatives; in Honduras and generally throughout Central America, lasted until the 1870s. The church was restored to its former commanding position. In 1861 the Honduran government signed a concordat with the Holy See, as Guatemala had done a few years before. The ascendancy of Justo Rufino Barrios in Guatemala (1871–85) influenced a return to liberalism in Honduras where Marco Aurelio Soto, a Liberal, assumed the presidency (1876). A new constitution (1880) sought to undo the work of the Conservatives. Five years later, Barrios attempted to revive the old Central American union but in resorting to force he overstepped himself. Liberals in Honduras and elsewhere proved to be nationalists first and blocked this attempt at domination by Guatemala. This resulted in a return to power by the Conservatives almost everywhere.

During the turbulent second half of the 19th century, Honduras was often disturbed by interference from Guatemala. In the first decade of the 20th century meddling came from another quarter, the current strong man in Nicaragua, José Santos Zelaya, who put Manuel Bonilla into the Honduran presidency. This interference led in 1911 and 1912 to something more serious than the periodic revolutions, Pres. William Howard Taft was pressured to send in marines to protect U.S. banana investments which by this time had grown considerably. The earlier Cuyamel company had been joined first by the Standard Fruit company and then by the Gnited Fruit company in exploiting this Honduran product; all three had made large capital outlays in the form of improved port facilities, railroads, workers' settlements and similar developments in the plantation area, the lowland region along the Caribbean coast.

In 1918 Honduras followed the lead of the United States and declared war on Germany but took no active part. Political upheavals continued after World War I. In 1932, after years of unrest, a strong man. Gen. Tiburcio Carias Xndino, was elected president. an office which he held until 1949. Carias dealt with several abortive revolutions during his term of virtual dictatorship.

Honduras declared war on Japan Dec. 8, 1941, and on Germany and Italy Dec. 13. Lack of shipping during World War II occasioned much economic distress. Export surpluses of bananas, coconuts and copra piled up, leading to widespread unemployment and consequent unrest. However, the government was able to maintain itself and promulgated some beneficial reforms. The United Fruit company increased wages for its employees and inaugurated several new enterprises, such as the planting of improved Hevea rubber trees and the raising of the tropical fibre-yielding plant abaci. Carias survived a revolution in 1947, but two years later the combination of two rival parties proved his undoing. Juan Manuel Gálvez assumed control and sought to restore constitutional guarantees.

Between 1954 and 1956 there was the short-lived dictatorship of Julio Lozano Díaz. A ten-meek strike among the workers of the United Fruit company was fomented quite openly by Communist elements. The reform interest. thus aroused, led to the formulation of a new labour code which gave the workers the right to organize and to bargain collectively. This labour relations program was the product of co-operation between the Inter-American Regional Labor organization the International Labour organization, the Honduras ministry of labour and a group of business leaders.

Despite impressive gains on the labour front. Hondurans were restive under the Lozano Diaz regime. He was unseated by a bloodless coup in Oct. 1956, and a three-man junta took control of the country. The junta, headed by Col Hector Caraccioli, quickly won the confidence and support of the people and very soon had the recognition of almost all other governments. Though there were several changes of personnel nithin the junta, it ruled with moderation and, according to its promise, took steps for the election of a constituent assembly. set for Sept. 1957. Earlier in that year there was a border dispute nith Nicaragua over rival territorial claims to an area north of the Segovia river mhich flows eastward to the Atlantic. Prompt and effective action by the Organization of American States prevented hostilities. A decision in 1960 by the International Court of Justice awarded the area to Honduras.

In the September election there was a minimum of official interference and a lack of disturbance throughout the country. The constituent assembly met in October, drafted a constitution and availed itself of the power, written into the constitution, to choose the first president. The Liberal leader. Ramón Villeda Morales. was elected. He took office on Dec. 21, 1957. His first official act was to proclaim the new constitution in force; this replaced the 1936 constitution, suspended in Dec. 1954. A minor revolt against the government was suppressed in May 1959. See also CENTRAL AMERICA: *Anthropology.* (J. F. BN.)

V. POPULATION

The official census of population of 1961 was 1.883.480, with a density of 13 5 persons to the square mile: in 1927 it was 892.887 and in 1950 it was 1,368.605. The rate of increase (doubled in 30 years) is more than twice that of the world in general. This population gronth is greater in the cities than in the rural areas. Tegucigalpa (*q.v.*), the capital, had a population (1961) of 133.-887. The second city is San Pedro Sula nith a population of 58.-126 Among the smaller cities are Puerto Cortés, Choluteca, La Ceiba Santa Rosa de Copán, Tela and Comayagua.

The liberal agrarian laws of Honduras encourage most of the

Departments of Honduras

Department	Capital	Area (sq.mi.)	Population	
			Census of 1950	Census of 1961
Atlántida	La Ceiba	1,641	63,582	92,832
Choluteca	Choluteca	1,626	107,271	149,205
Colón*	Trujillo	9,847	35,465	51,490
Comayagua	Comayagua	2,006	68,171	96,420
Copán	Santa Rosa	1,237	95,880	126,191
Cortés	San Pedro Sula	1,527	125,728	199,215
El Paraíso	Yuscarán	2,787	82,572	106,891
Francisco Morazán	Tegucigalpa	3,068	190,359	283,607
Intibucá	La Esperanza	1,186	59,362	72,981
Bay Islands (Islas de la Bahía)	Roatán	101	8,058	9,060
La Paz	La Paz	900	51,220	60,608
Lempira	Gracias	1,656	90,908	111,757
Ocotepeque	Nueva Ocotepeque	649	45,673	52,989
Olancho	Juticalpa	9,402	83,910	110,706
Santa Bárbara	Santa Bárbara	1,975	96,397	147,222
Valle	Nacaome	604	65,349	80,924
Yoro	Yoro	3,065	98,700	131,292
Total		43,277	1,368,605	1,833,480

*Includes the department of Gracias a Dios.

people (about 69%) to live in the rural areas and exploit subsistence farms or engage in small cattle-producing enterprises.

VI. ADMINISTRATION AND SOCIAL CONDITIONS

Constitution and Government. — Since acquiring independence, Honduras has been described constitutionally as a democratic, representative, unitary state with power divided among legislative, executive and judicial branches. The country has had 15 constitutions, the latest having gone into effect on Dec. 21, 1957. As in most Latin-American countries, there is frequently a wide gap between what the constitution says about government and politics and what happens in practice. Thus power has frequently been mobilized and changed by violent, undemocratic means. Peaceful methods have included *imposición* ("rigged election"), *candidato único* ("single candidate") and *continuismo* (continuing the president in power beyond his legal tenure). Although the legislature is given the power to pass laws, practically all important legislation is drafted by the executive and his assistants. The congress in theory has great authority to check the administrative activities of the president, but only in the period 1925–31, when several cabinet ministers appointed by the president were forced to resign through censure, was such authority effective. The election of Carias in 1932 re-established strong, centralized dictatorial government and the constitutions of 1936 and 1957 forbade congress to censure any cabinet member appointed by the president. Honduras has a single-house legislature with single-member districts based on a ratio of one deputy for each 30,000 inhabitants. The constitution of 1957 fixes the number of deputies at 58. The congress convenes each year on Nov. 21 for 100 days. The sessions can be extended to 150 days, and special or extraordinary sessions can be called. All men and women who are citizens and over 18 years of age are permitted to vote. and a national electoral council, created in the constitution of 1957, supervises elections. Suffrage was extended to uomen in 1955. The president is elected directly by popular vote for a period of six years with a second term prohibited (art. 199).

The justices of the supreme court are elected by the congress (art. 217) for six years. The supreme court exercises centralized control over the lower courts, including the appointment of the justices of the appellate courts, the judges of letters (courts of original jurisdiction), labour judges and others. The supreme court has original and exclusive jurisdiction to declare acts of the legislature unconstitutional (art. 237). The departments are subject to the control of the central government, but the constitution declares that the municipalities are autonomous. Although U.S. influence was strong in certain aspects of the early constitutions, Spanish influence has always been great.

By the 1960s Honduras, like most other Latin-American countries, had moved more and more in the direction of the "interventionist" or "welfare" state. There are a number of provisions in the constitutions of 1936 and 1957 which give the central government great power to direct and regulate social relations and the economic system. In Feb. 1955 the Honduran basic labour code came into effect. It granted the right to work, minimum wages, an eight-hour day and 48-hour week, freedom of unionization, collective bargaining, conciliation and the right to strike. The cost of living index (Tegucigalpa) rose steadily in the 1950s (1953 = 100. 1958 = 105).

Education. — The Honduran educational system follows the European model of centralized control through the ministry of education. According to law, education is free and compulsory for all children from ages 7 to 15. Efforts have been made to combat illiteracy, which in the 1960s was probably more than 60% for those 10 years of age and over. In the late 1950s there were about 400.000 children of school age and according to official statistics less than half were attending school. There were approximately 2,350 primary schools which had about 140,000 pupils and 4,500 teachers, and about 50 secondary, normal and technical schools with over 10.000 pupils and 1,350 teachers. The National university in Tegucigalpa (founded 1847) with six faculties (judicial and social sciences, medicine and surgery, physical and mathematical sciences, chemistry and pharmacy, economics, odontology) had an enrollment of about 1,000 and 130 faculty members. (W. S. Ss.)

VII. THE ECONOMY

Production. — The economy of Honduras is essentially agricultural. The two large U.S. banana companies (United Fruit — operating through its subsidiary the Tela Railroad company — and Standard Fruit company) on the north-coast plantations hold about 5% of the nation's agricultural lands, provide 20% of the national income. 50% of all agricultural production, 60% of all export value and 13% of government income. But Panama disease. affecting the roots, and Sigatoka (leaf spot) have hampered cultivation. The industry, perforce, is tied intimately to railways and ocean shipping.

Maize (corn and Kaffir corn) is the chief staple foodstuff grown by Honduran farmers and occupies more than one-half of all cultivated land. Sorghum, beans and rice are also common crops. Although wheat is grown in the highlands, considerable quantities of grain and flour are imported to meet domestic requirements.

Important export crops, other than bananas, are coffee beans, abacá fibre (Manila hemp), tobacco and coconuts. Pasture uplands are very extensive in the interior; exports of cattle and swine go principally to El Salvador. Large expanses of coniferous forest as well as other kinds of forest exist, but exploitation has been relatively small. Mahogany had been the traditional timber exported, but in the 1960s pine far exceeded mahogany in quantity and value. Largely unexploited mineral resources are considerable and include lead, antimony, zinc. iron, coal, mercury and copper. Production of silver and gold, however, has remained of some importance for many years.

Foreign Trade. — Exports in the late 1950s were valued at more than $70,000,000 (140,000,000 lempiras) annually. Imports were slightly less. About 73% of the exports went to the United States and Canada, while approximately 70% of the imports came from those countries. Bananas accounted for about 60% of the exports, coffee 19%, wood 7% and silver 2%.

Finance. — The Honduras monetary unit is the lempira, stabilized after 1934 at two to the U.S. dollar. The government has not made extensive use of exchange control. For fiscal 1958 estimated government revenues were 75,200,000 lempiras and estimated government expenditures 92,400,000 lempiras. The debt, in lempiras, amounted to more than 20,000,000 and, in foreign currencies, to the equivalent of almost 4,500,000 lempiras. Two private banks operate in Honduras: Banco de Honduras, locally controlled, and Banco Atlántida, which is U.S. capitalized. In 1950 two Honduran government banks, the Banco Central de Honduras and the Banco Nacional de Fomento, were inaugurated. The former centralized the financial operations of the state and became the only bank of currency issue. The Banco Nacional de Fomento was intended primarily to grant loans for agricultural development. In 1958 there were nearly 40,000,000 lempiras of currency in circulation and approximately 25,000,000 lempiras of deposit money.

Transport and Communications. — Honduras has only 63 mi. of public-service railroads. In the late 1950s the two fruit companies owned an additional 272 mi. of railroad trunk lines and about 72j mi. of branch lines, which are confined to the north coastal banana region and also provide some passenger transport facilities.

The Inter-American highway, running from El Salvador to Nicaragua, cuts across southern Honduras for about 100 mi.; a branch highway, not entirely in good condition, leaves it at Jicaro Galán and runs north through Tegucigalpa to the north coast.

Air transportation is of great importance within Honduras and is frequently the normal means of conveyance for passengers and freight. International service is provided by Pan American World Airways, Taca International (Transportes Aéreos Centro Americanos) and Transportes Aéreos Nacionales (TAIL'). (W. C. GN.)

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HONDURAS, BRITISH: *see* BRITISH HONDURAS.

HONE, WILLIAM (1780–1842), English writer and bookseller. was born at Bath on June 3, 1780.

Hone received no systematic education and was taught to read from the Bible only. His father having moved to London in 1783, he was placed in an attorney's office in 1790. After two and a half years in the office of a solicitor at Chatham, he returned to London to become clerk to a solicitor in Gray's Inn. But he disliked the law, and had already acquired a taste for free thought and political agitation. Hone married in 1800, and started a book and print shop with a circulation library in Lambeth Walk. He soon moved to St. Martin's Churchyard, where he brought out his first publication. Shaw's *Gardener* (1806). It was at this time that he and his friend. John Bone, tried to realize a plan for the establishment of popular savings banks, and even had an interview on the subject with the president of the board of trade. This scheme, however, failed. Bone joined him next in a bookseller's business; but Hone's habits were not those of a tradesman, and bankruptcy was the result. He was in 1811 chosen by the booksellers as auctioneer to the trade and had an office in Ivy lane. Independent investigations carried on by him into the condition of lunatic asylums led again to business difficulties and failure, but he took a small lodging in the Old Bailey, keeping himself and his now large family by contributions to magazines and reviews. He hired a small shop: or rather box, in Fleet street, but this was on two separate nights broken into, and valuable books lent for show were stolen.

In 1815 he started the *Traveller* newspaper, and endeavoured vainly to exculpate Eliza Fenning, a poor girl who was executed on a charge of poisoning.

From Feb. 1 to Oct. 25, 1817, he published the *Reformer's Register,* writing in it as the serious critic of the state abuses, which he soon after attacked in the famous political squibs and parodies, illustrated by George Cruikshank. In April 1817 three ex officio informations were filed against him by the attorney general, Sir William Garrow. Three separate trials took place in the Guildhall before special juries on Dec. 18, 19 and 20, 1817. The first: for publishing Wilkes's *Catechism of a Ministerial Member* (1817), was before Justice Abbot (afterward Lord Tenterden); the second, for parodying the litany and libeling the prince regent, and the third, for publishing the *Sinecurist's Creed* (1817), a parody on the Athanasian creed, were before Lord Ellenborough. Hone was acquitted on each count, and received a popular ovation.

Among Hone's most successful political satires were *The Political House That Jack Built* (1819), *The Queen's Matrimonial Ladder* (1820), in favour of Queen Caroline, *The Man in the Moon* (1820), *The Political Showman* (1821), all illustrated by Cruikshank. In 1826 Hone published the *Every-day Book,* in 1827–28 the *Table-Book,* and in 1829 the *Year-book;* all three were collections of curious information on manners, antiquities and various other subjects. These entertaining books are the works by which Hone is best remembered In preparing them he had the approval of Southey and the assistance of Charles Lamb, but they were not profitable, and Hone was lodged in King's Bench prison for debt. Friends rescued him and set him up in a coffee-house in Gracechurch street; but this, too, ended in failure. Hone became devout in later years, and used to preach in Weigh House chapel, Eastcheap.

He died at Tottenham on Nov. 6, 1842.

HONE, a variety of finely siliceous stone employed for whetting or sharpening edge tools, and for abrading steel and other hard surfaces. Hones are generally prepared in the form of flat slabs or small pencils or rods, but some are made with the outline of the special instrument they are designed to sharpen. Their abrading action is due to the quartz or silica which is always present in predominating proportion, some kinds consisting of almost pure quartz, while in others the siliceous element is mixed with aluminous or calcareous matter, forming a uniform compact stone, the extremely fine siliceous particles of which impart a remarkably keen edge to the instruments to which they are applied. In some cases the presence of minute garnets or magnetite assists in the cutting action. Hones are used either dry, with water or with oil, and generally the object to be sharpened is drawn with hand pressure backward and forward over the surface of the hone, but sometimes the stone is moved over the cutting edge.

The coarsest type of stone which can be included among hones is the bat or scythe stone, a porous fine-grained sandstone used for sharpening scythes and cutters of mowing machines. and for other like purposes. Next come the ragstones. which consist of quartzose mica schist and give a finer edge than any sandstone. Under the head of oilstones or hones proper the most famous and best-known qualities are the German razor hone. the Turkey oilstone and the Arkansas stone.

The hones yield on analysis 98% of silica, with small proportions of alumina, potash and soda and mere traces of iron, lime. magnesia and fluorine. They are white in colour, extremely hard and keen in grit, and not easily worn down or broken. Geologically the materials are called novaculites and are supposed to be metamorphosed sandstone silt, chert or limestone resulting from the permeation through the mass of heated siliceous waters. The finer kind is employed for fine cutting instruments, and also for polishing steel pivots of watch wheels and similar minute work, the second and coarser quality being used for common tools. Both varieties are largely exported from the United States in the form of blocks. slips, pencils. rods and wheels.

HONEGGER, ARTHUR (1892–1955), Swiss composer, was born at Le Havre. France, on March 10, 1892. He studied at Zürich before entering the Paris Conservatoire in 1912, where he studied under André Gédalge, C. M. Widor and Vincent d'Indy.

As one of the group of composers known as Les Six he must be classed with the modern French school and he undoubtedly owes much to Claude Debussy and Florent Schmitt. But there is a sturdy element in his music which recalls his true nationality and in the mass effects of his later oratorios he broke away more and more from French traditions. While some of his harmonic audacities were startling, the impetus of his rhythm was so strong that they fell into place.

His personal idiom became well established. The clashing of scale passages and rhythmic figures in contrary motion was a device which he used constantly with great effect. His respect for sonata form is shown particularly in his chamber music. The success of his biblical drama *King David* (1921) made him known to a wide public whose ear would normally have been shocked by atonality and modern counterpoint. The choruses are the outstanding feature of this work, which was completely revised as an oratorio in 1926.

After *King David,* Honegger's best-known work was *Pacific 231* (composed 1923), a brilliant example of modern program music which at once hit the popular taste. The two works represent the extremes of Honegger's style. In his opera *Judith* (1925, later adapted as an oratorio) the choruses are again the backbone of

the work. The form is more concise and the rhythm sharper and more syncopated than in King David.

Both here and in his later opera *Antigone* the solo parts tend to be dramatic rather than lyrical, his aim being to replace recitative by a melodic leading of the singing voice. which was to grow out of the text itself, to avoid dwelling on high notes (in the interests of distinct enunciation) and to be definitely noninstrumental. Honegger also wrote much incidental music to plays and motion pictures. His best-known symphony was the *Symphonie liturgique* (1946). He died in Paris on Kov. 27, 1955.

HONESDALE, an industrial borough in northeastern Pennsylvania, U.S., seat of Wayne county, is situated at the confluence of the Lackamaxen and Dyberry rivers, about 30 mi. N.E. of Scranton. An important hub of early turnpikes, it is located in a region noted for recreational facilities. Honesdale, named for Philip Hone, who pioneered construction of the Delaware and Hudson canal, was settled in 1827 and incorporated in 1831. From 1828 to 1898 it was the transfer centre for coal brought over the Moosic mountains by gravity railroads from the Lackawanna valley to the canal barges. The town is the site of one of the world's largest coal storage markets. In 1829 the "Stourbridge Lion," the first locomotive to run on rails in America, was initially tested there. Condensers, refinery equipment, knitted goods and shoes are manufactured. For comparative population figures see table in PENNSYLVANIA: *Population.* (A. D. S.)

HONESTY (*Lunaria annua*), a hardy biennial of the family Cruciferae, suitable for garden cultivation. It is an attractive everlasting plant tno feet to four feet high. with a silvery dissepiment The similar but less ornamental perennial honesty (L. rediviva) is also cultivated

HONEY is a sweet. viscid liquid obtained by honeybees from nectar secreted by plants. The nectar is ripened into honey by the inversion of the greater portion of the sucrose sugar of nectar into levulose (fructose) and dextrose (glucose) and by the removal of excess moisture. During the summer period, if plant nectar is not available, bees may also collect insect honeydew (see APHIDES).

This article deals nith the uses of honey, the forms in which it is marketed, its composition and physical properties and world production. Production practices and races of bees cultivated in various countries. and extraction, storage and handling of honey are discussed in the article BEEKEEPING.

Uses of Honey. — Honey was of great importance as an article of diet to the ancients. being almost their only available source of sugar. It was valued also for its medicinal virtues; was used for making mead (*q.v.*); and was mixed with wine and other alcoholic drinks. In Egypt it was valued as an embalming material; in India and other eastern countries for the preservation of fruit and the making of cakes, sweetmeats and other foods. Honey is mentioned in the Bible, *i.e.,* a land flowing with milk and honey (Ex. iii. 17; Kum. xiii, 27) and in the Koran, and is alluded to by Homer, Herodotus. Euripides and other ancient writers.

Honey still is used to sweeten and give special flavour to foods such as cereals, fruits, candies and baked goods. With candies, the tendency of honey to absorb moisture offers slight problems, but with bakery goods this hygroscopic property causes them to absorb and retain moisture for a long time and thousands of pounds of honey are used annually in making breads and cookies. Honey is used in ice cream manufacture to replace all or a part of the sugar. It gives further variety to flavours but has the slight objection of requiring a lower freezing and storage temperature. Honey is used as a vehicle for medicines, such as honey cough syrups. Under the advice of qualified physicians, honey with milk has been recommended for feeding infants, especially those suffering from rickets. scurvy, malnutrition. anemia. inflammation of the intestine and the effects of prematurity. For athletes and others undergoing strenuous physical labours honey has been uidely used: since the dextrose portion of honey is quickly absorbed into the blood stream and the levulose is largely changed in the liver to glycogen and then into dextrose, honey thus provides an immediate as well as an extended source of energy. This particular characteristic of honey is the background for its recommended use by some doctors for diabetics. Honey fortified nith particular pollens has been employed successfully in alleviating the symptoms of hay fever.

Honey has antiseptic properties and has been used in healing wounds. cuts. bruises, lacerations. sore nipples and burns. It has been used as a plant stimulant and for feeding animals. including fish and dairy cows (especially for the prevention and cure of acetonemia. a disease of cows at calving time). It also has been used as a facial pack in the beauty parlour. in hand lotions, in curing pipe bowls. in cigarettes, chewing tobacco and gums, as a spray adherent, as a centre for golf balls, as an antifreeze mixture for auto radiators and as a preservative for eggs in cold storage.

Forms of Honey Marketed. — Extracted or liquid honey, sometimes called strained honey, is produced in medium- to large-sized frames, provided with wired heavy wax foundations (medium brood), which are usually removed from the hive when 75% or more of the wax cells are capped. Extracted honey may be sold in the original liquid form or in a granulated form as creamed honey, spun honey and candied honey.

Comb honey, less common in the markets. may be found as section comb honey, bulk comb honey, cut comb honey and chunk honey. Section comb honey is produced in small lots weighing 11 to 1j oz., the original comb being contained in a square wooden frame. For bulk comb honey, a frame is provided with a thin surplus foundation. as also in section honey. When well capped, it is removed and sold as produced; or the contained comb may be cut up into parts and the individual pieces sold as cut comb honey; or one or more of these pieces may be placed in a jar and liquid extracted honey poured over it, the product being known as chunk honey.

Composition. — Honeys vary in composition according to floral source, environmental conditions (chiefly relative humidity), ripeness when extracted, methods used in processing and conditions of storage. A general idea of the variations in composition may be obtained from the table of the analyses of 92 U.S. honeys (U) and 106 California honeys (C) by C. A. Browne and by J. E. Eckert and H. W. Allinger, respectively.

Table I. — Major Constituents of Honey
(in percentages)

Constituent	Average		Maximum	Minimum
	U.S.	Calif.		
Water	17.70	16.50	U 26.88	U 12.42
Levulose (fruit sugar)	40.50	40.41	U 48.61	U 24.35
Dextrose (grape sugar)	34.02	34.54	U 46.40	U 24.73
Invert sugars	74.98	74.95	U 83.36	C 60.52
Sucrose (cane sugar)	1.90	2.53	C 11.00	UC 0.00
Dextrins	1.51	0.91	C 11.91	C 0.02
Ash (minerals)	0.18	0.21	C 1.14	C 0.02
Acid	0.08	0.16	C 0.45	U 0.04
Undetermined	4.9	4.72	C 7.51	U 0.04

Other substances occurring in honey in minute amounts are pollen; a partial source of vitamins. minerals and amino acids; beeswax (*q.v.*); proteins and related compounds such as amino acids, globulins, albumins, proteoses and peptones; and colour substances containing plant pigments, chlorophyll decomposition products. colloidal particles and tannic acid. Aroma and flavor substances contain essential oils, terpenes, aldehydes, methyl anthranilate, diacetyl and volatile and nonvolatile acids. Traces of higher alcohols include mannitol, dulcitol, etc. Sugars include maltose, melezitose, erlose, etc. In addition, honey contains other minute amounts of enzymes, vitamins, acetycholine and yeasts. Substances indicated by biological activities include a plant-rooting hormone. an estrogenic factor, a guinea pig antistiffness factor and antibacterial substances.

Table I shows the average mineral or ash content of the two groups of honey to range from 0.18% to 0.21%. Tables (by H. A. Schuette, et *al.*) of the average mineral content in groups of light and dark honeys list the followiug minerals: potassium, chlorine. sulfur, calcium, sodium, phosphorus, magnesium, silica (SiO_2), silicon (Si), iron, manganese and copper. One investigator, J. W. White, has listed the most plentiful ash constituents as calcium, magnesium, iron. manganese. copper, phosphorus, sili-

con, nickel, boron, aluminum and potassium.

Formic acid has been considered as the principal acid of honey, but modern investigators indicate it as relatively unimportant and name additionally acetic, malic, butyric, valeric, caproic, capric, lactic. tartaric, oxalic, succinic, citric, phosphoric, and in some honeys such as buckwheat, tannic acid, which in addition to giving a stringent taste is probably responsible for its dark colour. The vitamins in honey include minute amounts of A but more significant and nutritional amounts of various components of the B complex, several of which are involved in carbohydrate and amino acid metabolism. The amount of vitamin C (ascorbic acid) in honey seems to be quite variable, with indication of its decrease with age.

Among the plant pigments found in honey are carotin (yellow), xanthophyll (yellow) and some of unknown composition (bright yellow and dark green). A sugar derivative, anthocyanin, is thought to be responsible for the rose-red colour of white clover honey at high altitudes and the dark colour of willow herb honey of Alaska.

The enzymes of honey, present only in minute traces and not significantly important in human nutrition, do have a pronounced effect on the nature and character of honeys. They are commonly listed as invertase, diastase or amalyase, catalase and inulase. The presence of inulase in most honeys is questioned since it is not known to occur in higher plants, but is present in all monocotyledonous plants and in bacteria. yeasts and fungi.

The presence of an acid-producing enzyme, a phosphatase-hydrolyzing glycerophosphate and an enzyme which possibly oxidizes ascorbic acid may account for the general lack of vitamin C in honey.

Physical Properties. — The specific gravity and weight per gallon of honey are primarily dependent upon the water content which in turn is related to the degree of ripeness nhen stored by the bees and the atmospheric conditions to which later exposed. The specific gravity, water content and weight per gallon of honey can be determined by means of a hydrometer, by determination of the refractive index by means of a refractometer or by carefully weighing a given volume. Tables are available for converting a particular measurement to corresponding equivalents. The minimum weight per gallon of U.S. grade A or U.S. fancy and U.S. grade B is 11 lb. 12 oz. Consulting the tables for equivalents this weight is found to correspond to a moisture content of 18.6%, a Brix hydrometer reading of 79.8° at 68" F. (20° C.), a Baumé hydrometer reading of 42.29° at 60° F. (1j.j5° C.) and a specific gravity of 1.4129.

Heating honey is commercially used to control certain physical and chemical changes which may occur and may have a tendency to impair the quality of the product. These more or less interrelated changes are moisture absorption, granulation, fermentation, discoloration or darkening and loss of or masking of the original delicate flavour and aroma of the honey.

Granulation (crystallization or sugaring) of honey is that phenomenon in which the dextrose sugar is unable to stay in solution at a given temperature. The tendency of a honey to granulate is primarily dependent upon the concentration of its sugars in relation to its water content and the relative proportion of levulose and dextrose; *i.e.,* its L/D ratio. A water content of more than 20% seems to be sufficient to inhibit all but a trace of granulation in most honeys, but this is not a practical means of control. Original honeys with an L/D ratio between 1:0 and 1:2 usually crystallize rapidly, while there is much delay where the ratio exceeds 1:3. The temperature most favourable for granulation seems to be between 50° and 6j° F., with 55° to 57° F. suggested for most honeys. When the water content is above 21.5% rapid aerobic growth of honey-fermenting yeasts takes place. While fermentation of honey may be controlled by destroying the contained yeasts by heating to 145° F. for 30 min.. then straining and placing in containers while hot and sealing to prevent recontamination. it is evident that heating to higher temperatures to prevent granulation will also control fermentation. While the degree of heating varies with the L/D ratio, usually 155°–160° F. for 30 min. is suggested for quick granulating honeys, while a lower temperature will suffice for honeys with relatively high levulose content such as tupelo and most, fall honeys. Overheating tends to darken honeys and to impair or mask their original flavour and aroma due to the breakdown of the levulose content. A similar result occurs in storage at high temperatures and even at room temperature over a long period of time.

World Production. — In the second half of the 20th century the leading honey-producing countries were the United States. Canada, Australia and the United Kingdom. Annual production in the United States averaged about 100,000 metric tons and that in Canada about 10,000 metric tons. Annual production in the United Kingdom was also about 10,000 metric tons and in Australia about 15,000. Other producing countries in Europe, in order of quantity produced, included Spain, Poland. Italy, west Germany, France, Denmark and east Germany. Germany had been a leading producer before World War II. Countries producing lesser quantities included Yugoslavia, Czechoslovakia, Bulgaria, Austria, Switzerland and Greece. Honey also was produced in Brazil. Chile and Uruguay in South America; in Taiwan and South Korea in Asia; in Turkey (a major producer), Israel, Egypt and Syria and on Cyprus in the middle east; and in New Zealand, the British West Indies and Guatemala. Production in the U.S.S.R. and mainland China was not reported. Local consumption of honey produced by domestic and wild bees was important in many places.

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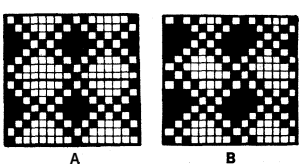
HONEYCOMB, a cloth so called because of the particular pattern made by the arrangement of the crossing of the warp and weft threads; these form cells somewhat similar to those of the real honeycomb. They differ from the latter in that they are rectangular instead of hexagonal. The bottom of the cell is formed by those threads and picks which weave "plain," while the ascending sides of the figure are formed by the gradually increasing length of float of the warp and weft yarns.



DESIGNS USED IN THE MANUFACTURE OF HONEYCOMB TOWELING
The pattern at left is known as the "perfect seven-thread honeycomb"; that at right is a modification of the "perfect honeycomb"

The figure shows two of the commonest designs which are used for these cloths, design A being what is often termed the "perfect honeycomb." In the figure it will be seen that the highest number of successive white squares, representing a weft thread floating or passing over warp threads. is seven, whereas the corresponding highest number of successive black squares. a warp thread passing over weft threads or picks, is five. Two of each of these maximum floats form the top or highest edges of the cell, and the number of successive like squares decreases as the bottom of the cell is reached when the floats are one of black and one of white (see middle of design, etc.). The ueave produces a reversible cloth, and it is extensively used for the embellishment of quilts and other fancy goods. It is also largely used in the manufacture of cotton, linen and union towels. B is, for certain purposes, a more suitable weave than A, but both are very largely used in the towel industry.

(T. W.)

HONEYDEW, a secretion consisting of exudations of sugar from the leaves of various trees under certain atmospheric conditions. It is usually the result of a superfluity of sap, but may also be produced by the puncture of certain insects (see APHIDES); the latter condition constitutes a form of plant disease.

HONEY EATER or HONEYSUCKER, any of numerous songbirds constituting the family Meliphagidae, confined to Australia, New Zealand, the Malay Islands and nearby Oceania. where they are common and conspicuous. They range in size from that of a warbler to that of a jay and have a curved bill and protrusible tongue for procuring nectar and insects from flowers. They may

be dull with black, brown?gray or olive or may have conspicuous marks and brilliant colours; the inconspicuous females, duller and smaller than the males, seem much fewer in numbers. They live in treetops, along forest edges and about plantations, building a cup-shaped nest of twigs, fine roots and fibres, usually high in the fork of a tree, and lay one to three eggs. Both parents, share the rearing of young. They usually have loud musical calls and good songs. Well-known species are the wattlebirds *(Coleia)* of Australia, especially C. *carunculata,* grayish-brown with thin white stripes on the upper parts and tail tipped white; they possess fleshy, pendulous ear wattles. The bellbirds of Australia (*Manorhina melanophrys*) and New Zealand *(Anthornis melanura),* the coldong or four-o'clock *(Tropidorhynchus corniculatus)* of Australia, also known as friarbird, and the rare stitchbird *(Nyctiomystis cincta)* of North Island, New Zealand, belong to this family. The crow honey eater (*Gymnomyza aubryana),* 16 in, long, black with red-orange or yellow wattles, is one of the largest. One of the smallest and most brilliant among the many species in Southwest Pacific islands is the cardinal honey eater (*Myzomela cardinalis),* four to five inches long. the male black with scarlet head. breast and middle back. There are about 160 species in the family, New Guinea alone having about 19 genera and 61 species.

(G. F. Ss.)

HONEY GUIDE, the name for a dozen species of small old world birds, grouped in two to four genera, constituting the family Indicatoridae, closely related to the barbets *(q.v.)* and placed with the woodpeckers in the order Piciformes. They are yoke toed and have short legs and short, stout! somewhat blunted bills. They are inconspicuously coloured, brown or olive gray, with considerable white in the tail. The largest (eight inches long) and best known is the black-throated honey guide *(Indicator indicator),* from Senegal and Ethiopia to the Cape except in tropical forests. It chatters loudly and guides natives. especially woodchoppers! and various animals (ratel, leopard, snakes) to bee trees, sharing in bee larvae and honey on which it lives almost exclusively. Other individuals nearby do not join the hunt. It lays its white eggs in the cavities of hole-nesting birds.

A number of other species are found in Africa, one in the Himalayas of northern India *(I. xanfhonotus)* and one in the Malay peninsula and Borneo *(I. archipelagicus).* The smallest is the sharp-billed or dwarf honey guide *(Prodotiscus insignis),* 4½ in. long, of Congo and west African forests, with the slightly larger *P. regulus* and *P. zambesi* in the grasslands of south Africa and the Cameroons. The lyre-tailed honey guide (*Melichneutes robustus)* and rare *Melignomon zenkeri* occur in the Belgian Congo and Cameroons forests.

(G. F. Ss.)

HONEY LOCUST, the popular name of a North American tree (*Gleditsia triacanthos),* of the family Leguminosae, native to fertile soils from western Pennsylvania through Ohio and Ontario to Michigan and Minnesota and south ard to Alabama and Texas, and also naturalized from cultivation eastward of this range. It reaches from 75 to 140 ft. in height with a trunk 2 or 3 or sometimes j or 6 ft. in diameter, and develops slender spreading branches which form a broad, flattish crown. The branchlets bear numerous simple or three-forked (whence the species name *triacanthos)* sharp, stiff thorns three to four inches long, at first red in colour, then chestnut brown; they are borne above the leaf axils and represent the undeveloped branchlets; sometimes they are borne also on the trunk and main branches. The long-stalked leaves are seven to eight inches long. Both pinnate and bipinnate leaves are usually found on the same tree. The former have from 7 to 1 j pairs of oblong leaflets and the latter, 4 to 7 pairs of pinnae. The flowers, which are of two kinds, are borne in racemes in the leaf axils; the staminate flowers in larger numbers. The brown pods are often 12 to 18 in. long, have thin, tough walls and contain a quantity of sweetish, succulent pulp between the numerous seeds; when drying they contract into spiral-like structures which are often driven by winter winds over snow for considerable distances before releasing their seed.

JOHN H. GERARD

SPINY BRANCHLETS OF THE HONEY LOCUST (GLEDITSIA TRIACANTHOS)

The tree was first cultivated in Europe toward the end of the 17th century by Bishop Compton in his garden at Fulham, near London, and is now extensively planted as an ornamental tree. The much smaller water locust (G. *aquatica*), with shining brown pods, one to two inches long and containing only one or two seeds, inhabits deep swamps in the Mississippi valley from Illinois southward, ranging also eastward to South Carolina and Florida. The name of the genus commemorates Johann Gottlieb Gleditsch (1714–86), a friend of Linnaeus and the author of one of the earliest works on scientific forestry.

HONEYSUCKLE, botanical name *Lonicera,* a genus of climbing, erect or prostrate shrubs, of the family Caprifoliaceae, so named after the 16th-century German botanist Adam Lonicer. The common British species is L. *periclymenum,* the woodbine; *L. caprifolium* and *L. xylosteum* are found in a few counties in the south and east of England. Some of the garden varieties of the woodbine are very beautiful and are held in high esteem for their delicious fragrance, even the wild plant, with its pale flowers, compensating for its sickly looks "with never-cloying odours." The North American subevergreen *L. sempervirens,* with its fine heads of blossoms, is commonly called the trumpet honeysuckle; the most handsome of all the cultivated honeysuckles, it is a distinct and beautiful species producing both scarlet and yellow flowered varieties. The Japanese *L. flexuosa* var. *aureoreticulata* is esteemed for its charmingly variegated leaves netted with golden yellow.

ROCHE

TRUMPET HONEYSUCKLE (LONICERA SEMPERVIRENS)

The fly honeysuckle, L. *xylosteum,* and *L. tatarica,* both European and both hardy shrubs of dwarfish, erect habit, are among the oldest English garden shrubs and bear axillary flowers of various colours, occurring two on a peduncle. There are numerous other species, many of them grown in gardens and well worth cultivating in shrubberies or as climbers on walls and bowers, either for their beauty or the fragrance of their blossoms.

There are about 175 species, widely distributed in the northern hemisphere. upward of 30 of which, together with numerous varieties. are more or less cultivated. About 25 species, inclusive of several naturalized from the old world, are found in the United States and Canada.

Honeysuckles *(Lonicera)* flourish in any ordinary garden soil. Pruning should be done about March, cutting out some of the old wood and shortening back some of the younger growths of the preceding year.

In the western counties of England the name honeysuckle is applied to the meadow clover, *Trifolium pratense.* Another plant of the same family (Leguminosae). *Hedysarzim coronarium,* a very handsome hardy biennial, is called the French honeysuckle. The name is moreover applied with various affixes to several other totally different plants. Thus white honeysuckle and false honeysuckle are names for the North American *Azalea viscosa;* Australian or heath honeysuckle is the Australian *Banksia serrata;* Jamaica honeysuckle, *Passiflora laurifolia;* dwarf honeysuckle, the widely spread *Cornus suecica;* Virgin Mary's honeysuckle, the European *Pulmonaria officinalis.* The West Indian honeysuckle is known as *Tecoma capensis,* which is also a name applied to

Desmodium.

HONFLEUR, seaport of France in the *département* of Calvados, 57 mi. N.E. of Caen by rail, on the Seine estuary opposite Le Havre, with which it communicates by steamboat. Pop. (1954) 8,054.

Honfleur dates from the 11th century and is 500 years older than Le Havre, which supplanted it in the 18th century. During the Hundred Years' War it was frequently taken and retaken, the last English occupation ending in 1440. In 1562 the Protestants took it after a siege of the suburb of St. Léonard; and though Henry IV captured it in 1590 he had again to invest it in 1594 after the rest of Normandy had submitted to his arms.

Early in the 17th century Honfleur was a centre for exploration; its colonists founded Quebec, and Honfleur traders established factories in Java and Sumatra and a fishing establishment in Newfoundland.

The most noteworthy building is the timber church of St. Catherine. The church tower stands on the other side of a street. Above the town is the chapel of Nôtre-Dame-de-Grâce, a shrine visited by pilgrim sailors; it was founded in 1034 by Robert the Magnificent of Normandy and rebuilt in 1606. The town has a tribunal and a chamber of commerce. The port consists of the tidal harbour and four floating basins. A reservoir affords the means of sluicing the channel and supplying the basins. The harbour was begun by Duquesne in 1668. Honfleur has regular steamship service for passengers to Le Havre, Southampton and London and bus service with Trouville.

Honfleur exports mainly to England and trades in poultry, butter, eggs, cheese, chocolate, baskets, shell work, vegetables, fruit, seeds and purple ore. Timber from Scandinavia, English coal and artificial manures are imported. There are important sawmills as well as shipbuilding yards, iron foundries and manufacturing of chemical manures, oil and shoes.

HONG KONG, a British crown colony off the Kwangtung coast of southern China, comprising the island of Hong Kong and adjacent islets, Kowloon peninsula and Stonecutters Island (Ngon Shun Chau) and the leased New Territories on the mainland with surrounding islands. The total area of the colony is 3984 sq.mi., of which Hong Kong Island is 29 sq.mi. and Kowloon, $3\frac{3}{4}$ sq.mi. Hong Kong Island is 11 mi. long and from 2 to 5 mi. wide, and lies 90 mi. S.E. of Canton and 40 mi. E. of Portuguese Macao. It is separated from the mainland by a channel which is about one mile broad between Victoria, the island's capital, and Kowloon, and $\frac{1}{3}$ mi, at its narrowest point. The harbour formed by the channel can take ocean-going ships up to 40,000 tons, and compares in size and beauty with any in the world.

PHYSICAL GEOGRAPHY

Geology, Structure and **Relief.**—Hong Kong and the New Territories are part of the great batholith of granitic rocks which covers southeast China from Chekiang to Cambodia. The age relationships of the major groups of rocks are associated with the intrusions and mountain building of the Jurasside, Laramide and Alpine revolutions. Apart from small areas of sedimentary rocks belonging to the Lias and Eocene systems, the rest of the colony (approximately 90%) is composed of acid volcanic, porphyritic and granitic rocks. The general structure of the region is that of an asymmetrical anticline which strikes northeast to southwest and is parallel in trend with the China coast. The axis of the monocline passes almost exactly through the centre of Hong Kong and is marked by a depression which is the Tolo channel.

Generally the area consists of numerous rugged and irregular islands with deeply dissected peninsulas. A general picture is that of an upland terrain which has been invaded by the sea. The uplands and mountains are eroded remnants of rock formations. Weathering is almost entirely caused by chemical action aided by the alternation of wet and dry seasons. As a result, decay to a mantle of laterite is common, often to depths exceeding 100 ft. The highest peaks and the most prominent ranges of hills are composed of either porphyries or volcanics. They are in contrast to the granite hills which occur generally at lower elevations but which have well-etched peaks and sharp ridge lines. The plains are all recent alluvial deposits. Benches, marking former sea levels up to 400 ft. or more, indicate the deep submergence of the whole region within recent geological times. Submerged weathered rock surfaces overlain by peat deposits have been discovered by boring in the harbour. The highest peaks are: Tai Mo Shan (3,140 ft.) and Ma On Shan (2,300 ft.), both on the mainland; Lan Tao peak (3,061 ft.) and Sunset peak (2,857 ft.), both on Lan Tao. and Victoria peak (1,805 ft.) on Hong Kong Island. There are many steep-sided slopes which, with the exception of those on the island, are barren or covered by a very coarse, scrub-like vegetation for the most part.

Soils.—In general the natural residual soils of Hong Kong are acid. The igneous rocks from which they are derived have a silica content higher than 65%. There is a wide variation in the natural soil types. Typical are a grayish sandy loam, yellow-gray loam, pinkish-brown loam and black clay-loam. Most soils have a ratio of silica to alumina which is less than two. By comparison with soils in more temperate climates, they are low in fertility and need the addition of lime, potash and superphosphates.

Climate.—Lying only just inside the northern tropic, the colony has a climate classed as subtropical. It has highly contrasting seasons which range from a hot, humid summer (June to August, mean 82° F.) to a cool, temperate winter (January to February, 60°). The climate is controlled by the northeast monsoon, which blows from October to April, and the southwest monsoon, from June to August; the area receives three-quarters of its annual rainfall during the latter period. In summer there are periods of bad weather caused by typhoons as well as strong winds and heavy rains caused by tropical depressions. The mean relative humidity exceeds 80% in the summer, but occasionally falls to as low as 20% in early winter. The average daily duration of sunshine ranges from three hours in March to seven hours in October. There is a wide range of annual rainfall: the average is 84.76 in., but in 1889, 119 in. was recorded, and in 1895, only 45.83 in. The Tai Lam Chung reservoir, completed in 1957, and a number of other reservoirs provide water during dry periods and help to prevent flooding during the monsoons.

Vegetation and Animal Life.—Centuries of exploitation through cutting and burning have removed all traces of the natural vegetation cover. Today, owing to intensive schemes of reforestation, the island is well wooded with a wide range of trees such as banyan, eucalyptus, cotton, camphor, acacia, olive, palm and coniferous species. Cultivated land, mainly for rice and vegetables, covers about 50 sq.mi. Marsh land with mangroves, coarse grassland which is of little use as pasture and bare, eroded badlands make up the rest of the area. Apart from snakes, lizards, frogs and a few wild deer, monkeys, boars and an occasional tiger or leopard on the mainland, the animal life of the colony is domestic, the stock comprising principally fowl, ducks, pigeons, pigs and cattle.

HISTORY

Archaeological remains of pottery, stone implements, rings and bronzes found on more than 20 sites throughout the colony are evidence of settlements in Neolithic times. One characteristic design found nowhere else in Asia, the double F, belongs to the 3rd century B.C. The earliest peoples in Hong Kong are thought to have come from north China on their way to Borneo, the Philippines and Formosa in the 2nd millennium B.C. The Cantonese appear to have begun to settle in the area about A.D. 500; later came the Hakka, and by the middle of the 17th century, the Hoklo, who maintained a reputation as pirates.

Hong Kong was also a scene of the last struggles of the dying Ming dynasty with the newly risen Manchus (mid-17th century). There are one or two relics that provide little but pointers to some bygone incidents, such as a Han dynasty tomb in Kowloon, and the Sung Wang T'ai, a granite boulder near the village of Ma Tau Chung, which commemorates the flight through the Kowloon area of the last emperor of the Sung dynasty late in the 13th century. In A.D. 964, about 8,000 troops were stationed at Tai Po in the New Territories to protect the pearl industry for the Sung emperor.

BERNADINE BAILEY

HONG KONG HARBOUR. SEEN FROM VICTORIA PEAK. SHOWING THE BUSINESS DISTRICT OF VICTORIA AND KOWLOON PENINSULA ACROSS THE BAY

Before the British occupation. Hong Kong Island was inhabited only by a small fishing population and was a notorious haunt of pirates. It was used as a base for British ships during the first Opium War of 1839–42 but its harbour had been used to shelter opium-carrying vessels since 1821. The great commercial and strategic significance of this deep, sheltered harbour, possessing east and west entrances and lying right on the path of the chief trade route to China, was quickly realized. Its cession in perpetuity to Great Britain in 1841, confirmed by the treaty of Nanking (1842), was one of the chief results of the war and Hong Kong grew within less than a century to be one of the world's greatest ports. *(See* CHINA: History.)

At the outset, however, Hong Kong was menaced because of its proximity to the mainland, where conditions were almost always insecure. **A** special source of danger was the Kowloon peninsula, which dominated the harbour and threatened Victoria. In 1860, by the convention of Peking, Britain obtained possession of part of Kowloon and Stonecutters Island. In 1898 Britain was granted a gg-year lease of the mainland known as the New Territories, which included Mirs bay and Deep bay (Hau Hoi Wan) and surrounding islands. Kowloon became an outlet for the overflow population of Hong Kong and a field for its industrial development, while the New Territories were a potential source of raw material for its trade and industry.

Hong Kong afforded an impartial refuge, both for persons and capital, during the internecine struggles which followed the inauguration of the Chinese republic in 1911. The emergence of nationalism was accompanied by hostility toward foreign interests and during 1925–27 a boycott excluded British trade from all the ports of south China. After the Japanese conquest of Manchuria, however, Chinese official relations with the British in Hong Kong became increasingly friendly. From 1937 Hong Konq was once more a refuge, hundreds of thousands of Chinese fleeing there before the advancing Japanese. With the outbreak of nar in Europe in 1939 the position of the colony became precarious. and when the Japanese opened hostilities on Dec. 7, 1941, they immediately attacked Hong Kong; after bitter fighting the colony was surrendered on Christmas day. It was liberated by British troops on Aug. 30, 1945, and civil government was re-established in May 1946, after which the colony made an astonishingly rapid recovery. Thousands of Chinese returned, producing a housing problem which was made more acute by the influx of refugees fleeing from the Communist armies in the Chinese civil war between 1948 and 1950. A survey made in 1954 for the United Nations estimated the number of Chinese refugees in Hong Kong at 700.000. The flow has since continued in fluctuating waves and the estimated number in Jan. 1959 was over 1.000.000.

POPULATION AND ADMINISTRATION

Population.—Of the total land area, 12 sq.mi. (mainly round the harbour) are developed for residential, commercial or industrial purposes; 50 sq.mi. are cultivated; and the rest is largely hillside or swamp which is unsuitable for agriculture and could not be developed for other purposes without an unwarrantably heavy expense. Thus the immediately usable land is 62 sq mi. From this area and the fishing grounds around Hong Kong about 850.000 people obtained a livelihood in 1931. By Dec. 1941, when the Japanese invaded the colony from the mainland, the population had increased to 1 600.000. On the British reoccupation in 1945 the number had decreased to about 600.000. By the end of 1946 it was again around 1 603.000; by 1955, 2,400,000, and by the 1961 census it was 3.128.044. Not all of the increase was immigrant population; much was due to natural increase.

Chinese comprise more than 99% of the population. The bulk are from Kwangtung, Cantonese being the largest group followed by Hakka, Hoklo and Tanka. Since 1949 many have come from Shanghai. At the end of 1958 the number of British subjects (United Kingdom and Commonnealth), excluding forces personnel, numbered about 15,000. Other nationalities were: Ameri-

can 2,147; Portuguese 1,630; Filipino 581; Japanese 359; Dutch 354; French 312; Italian 281. English is the official language. A great variety of Chinese languages and dialects are spoken in the colony, but Cantonese is the lingua franca. Others widely used are Hakka, Chiuchow, Mandarin and Shanghai. The main religion is Buddhism, but Christian denominations are well represented and there are small groups of Moslems.

Administration.—Hong Kong is administered, under letters patent of 1917, by a governor, an executive council and a legislative council; the two councils include Chinese members. An urban council has statutory responsibility for such matters as public health and sanitation. The New Territories are in the hands of a district commissioner aided by four district officers. Direct taxation on incomes and profits was begun in 1947 and the standard rate of tax has remained at 12½% since 1950. There are estate and stamp duties and entertainment, betting and sweepstake taxes.

Living Conditions.— The daily wage in 1959 was as follows: skilled workmen H.K.$ 7 to H.K.$ 12; semiskilled H.K.$ 4 to H.K.$ 8; unskilled H.K.$ 2.50 to H.K.$ 6. A bonus of one month's wages is normally paid at Chinese New Year. Some Chinese firms provide free food and accommodation for full-time employees. The average daily hours of work are 9 hours for men and 9½ hours for women. In European undertakings the 48-hr. week is standard. Because of the constant flow of refugees from China there is no shortage of labour, but the refugees have accentuated the housing problem. The majority of the population lives in overcrowded tenements along the fringing settlements of the harbour in Victoria and Kowloon. Domestic buildings damaged during World War II were replaced by 1950 and about 1,000 new buildings a year have been constructed. Rents are higher than in most other places in the world and the average workman pays from 25% to 45% of his wages in rent. There are many thousands of roof dwellers, squatters and street sleepers who cannot be housed. The results of a housing survey by the University of Hong Kong in 1957 showed that 79% of all households were sharing their accommodation with others; 95,000 households lived in cubicles; 43,000 in bed spaces; 8,000 in attics; and 4,000 on verandas. Out of the 267,000 households surveyed, only 20,400 had a living room not used for sleeping.

Welfare.— The voluntary welfare organizations and the government social welfare department co-operate closely. More than 40 voluntary organizations are federated in the Hong Kong Council of Social Service. In the fields of housing, education and public health great efforts have been made, but in the face of the high rate of population increase, the problem has remained a very formidable one.

The government controls or performs anti-epidemic and anti-malarial work, tuberculosis control, maternity work, infant welfare, social hygiene, public health propaganda, food and drug control and other health measures. It maintains and operates 12 general and special hospitals and many dispensaries, and provides grants to several others. There are also 19 private hospitals run by charitable and missionary institutions.

Justice.— The courts of Hong Kong include the supreme court, district court, magistrates' courts, marine court and tenancy tribunals. The laws of England with modifications for local conditions are used. The judiciary and the courts are independent of the government administration. The police force has an establishment of over 7,000. Only about 300 are British officers and the rest, except for a few Indians and White Russians, are Chinese. There is an auxiliary police force and villages are policed by locally selected village guards.

Education.— Since World War II education has made enormous progress. While in 1945 there were roughly 4.000 children in schools, by Sept. 1958 there were 418,546. The number of schools of all types is about 1,350. Private schools represent 65% of all schools in Hong Kong. All education is voluntary, but not free. It is controlled under the Education ordinance of 1952, amended by a 1958 ordinance. Schools run by missionary bodies receive grants, and vernacular primary schools, mainly in the rural areas, are subsidized. Postsecondary education has received attention, since most graduates from the secondary schools no longer return to China to study at university level. A Chinese colleges' joint council was set up in 1958 to further the growth of these colleges, and scholarships to them are awarded by the government. A professional teachers' training board controls teacher training. In all, 13,334 teachers were teaching in 1958.

The University of Hong Kong, founded in 1911, is an independent body, mainly supported by government grants but with some endowment funds. There are four faculties: arts, science, medicine and engineering and architecture. With students of the Institute of Oriental Studies and the social study course, there were 1,126 undergraduate and postgraduate students in 1958. The standard of teaching is that reached in the United Kingdom, and the minimum qualification for entry is the matriculation examination.

Local Forces and Civil Defense.— The colony's auxiliary services comprise the Royal Hong Kong defense force, the auxiliary police and the essential services corps. The latter is split into four autonomous services: essential services corps proper, civil aid services, auxiliary fire service and auxiliary medical service. All these services, which consist partly of volunteers and partly of persons enrolled since 1951 under compulsory service for locally resident citizens of the United Kingdom, are financed locally. Volunteer service in Hong Kong first began in 1854. In 1941 the Hong Kong volunteers proved their value by their gallant resistance to the Japanese.

THE ECONOMY

The foundation of Hong Kong in 1841 as a free port was the response of the government of Great Britain to the need of merchants for a trading centre on the China coast that could offer protection and safety. The only safe deep-sea anchorage between Shanghai and Indochina, Hong Kong became the entrepôt for trade throughout southern China and the western Pacific, with its own banking and insurance institutions; its prosperity depended on the freedom of trade. But the colony later added to its earlier function that of a manufacturing and industrial area. This movement received its first impetus during World War I when supplies from Europe were reduced; but the greatest impetus began about 1935, with the establishment of factories as a result of the disturbed conditions in southern China and of imperial preference (*q.v.*) under the Ottawa agreements. After World War II, industrial expansion continued rapidly. In 1949 refugees from China streamed in, with money, technical knowledge and new ideas. It was this that saved Hong Kong from financial disaster, since its position as an entrepôt had seriously declined. In 1950–51 Hong Kong further stifled its trading activity when it supported a United Nations' resolution and banned all exports to North Korea and the export to China of about 200 items of strategic importance. The switch from trade to manufacture was so rapid that few at first realized its significance. By the end of the 1950s locally manufactured goods accounted for approximately 40% of the entire value of the exports.

Agriculture.— Before Hong Kong became a British colony, agriculture, together with a little fishing, was its sole basis of livelihood; but trade and industries have almost obscured this aspect of its life. Rice, the chief crop, occupies about two-thirds of all farm land. Six to eight crops of Chinese vegetables are harvested annually and vegetables are sold through the government marketing organization. In the cool months cauliflower, cabbage, lettuce and tomatoes are grown in large quantities. Sweet potatoes, peanuts, taro, radishes, yams, sugar-cane and ginger are also grown. Fruit production is rapidly developing. In favourable locations there are plantations of pineapples, oranges, bananas, litchis, papayas, figs, pomelos, apricots and peaches.

Forestry.— The forestry division of the agriculture, fisheries and forestry department encourages forestry generally and is directly concerned with afforestation of water catchment areas, village forestry and scenic beauty. For nearly 75% of the colony, forestry is the only economic form of land development. In the New Territories about one-quarter of the entire area has been set aside for forestry reserves. The main species planted are of pine (*Pinus massoniana*), *Casuarina* and *Eucalyptus*.

THREE LIONS

STREET LIBRARY IN HONG KONG

Mining. — The chief economic minerals mined and worked are iron, lead, graphite, tungsten, kaolin clay, feldspar, sand and crushed granite. The most active concern is the iron mine at The Hunchbacks (Ma On Shan), and a monthly average of about 9,000 tons of ore is shipped, mainly to Japan.

Fisheries. — Marine fish is the main primary product of Hong Kong and its volume is the largest of any port in the colonies. The industry employs over 8.500 junks of various sizes and 20 Japanese-type trawlers. A government fish marketing organization (nonprofit) controls the landing and wholesale marketing. Fish is exported to other countries in the far east and to the U S.

Industries. — Heavy industries include more than 20 shipbuilding and repair yards. steel rolling and processing mills and cement factories. The following well-established light industries are responsible for about one-third of the entire value of the colony's exports: electric bulbs, canned goods, ceramics, cotton goods, enamelware, flashlights, matches, paint, plastics, rattanware, rope, rubber, shirts, shoes, sugar and textiles.

Trade. — From 1945 to 1948 trade expanded rapidly because of the general shortage of consumer goods. Trade with China improved in 1949 but after the imposition of the embargo on certain strategic articies in 1951 the tonnage of goods handled for China fell by 17½% compared nith the previous year. By 1957 when the embargo was modified, the Chinese government had begun to make bulk deals direct with foreign governments. The economic effects of the Korean War brought one compensation, however: the United States enacted in 1952 its Foreign Assets Control regulations whereby the importation of goods into the U.S. originating from China and North Korea was prohibited. Many Chinese-style products could still be imported by American firms and the market for these goods became extremely valuable to Hong Kong. Certificates of origin were instituted. Over 56% of the value of all exports was taken by six countries: United Kingdom (the most valuable customer), Malaya, United States, Thailand, Indonesia and China. Of the value of total imports, 64% came from China (the principal source). Japan, the United States and the United Kingdom. The main imports from China were foodstuffs, vegetable oils, Chinese medicines, glassware, tea, coal, cement, feathers, hides and silk.

Banking, Currency and Finance. — The unit of currency is the Hong Kong dollar, divided into 100 cents. Its exchange value fluctuated with the price of silver until 1935. Since then it has been tied to the English pound and an exchange fund has kept its value remarkably steady at 1s. 3*d*. (U.S.$ 0.17½). Besides locally incorporated banks there are also branches of many foreign banks, and insurance companies of international standing are well represented. There is a local stock exchange and facilities are also available for the buying and selling of stocks and bonds on the American and European markets.

Apart from the cost of external defense, to which a local contribution is made, Hong Kong is financially self-supporting. Since 1947 the budget has been balanced each year, often with a surplus, and at the close of the 1950s annual revenue and expenditure each amounted to between H.K.$ 589,900,000 and H.K.$ 629,300,000. The public debt in the form of repayable loans totalled nearly H.K.$ 85,000,000.

Transport and Communications. — Almost all the 479 mi. of roads in Hong Kong and the New Territories are of concrete or asphalt and are classified as first class. There are many motor vehicles of all types. A government-owned railway connecting with Canton and Peking runs from Kowloon for 22 mi. to the frontier. Ocean-going ships of all nations maintain regular services to the port, which is equipped with modern navigation aids. Ferries operate between Kowloon and Victoria and to outlying districts. The Hong Kong international airport at Kai Tak is located alongside the harbour on the mainland and a modern runway, constructed on a promontory extending into Kowloon bay, was opened in 1959. Letter and parcel post external services and efficient cable and radio services keep Hong Kong in touch with the world. Wired radio and television broadcast daily programs. Weather observation and forecasting is done by the Royal observatory.

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(S. G. D.)

HONITON, a market town and municipal borough in Devonshire, Eng. The centre of a dairy farming area, it lies among hills in the widening valley of the Otter river, 17 mi. E.N.E. of Exeter by road. Pop. (1951) 4,613. Area, 4.9 sq.mi. Honiton (Honetona, Huneton, meaning "Huna's farm" rather than the popularly accepted "Honeytown") was probably the site of an early settlement but it does not appear in history before the Domesday survey. It was then a considerable manor, held by Drew (Drogo) under the count of Blortain, who had succeeded Elmer the Saxon, with a subject population of 33, a flock of 80 sheep, a mill and 2 saltworkers. The borough was founded before 1217 by William de Vernon or de Redvers, earl of Devon, whose ancestor Richard de Redvers had received the manor from Henry I. In the 14th century it passed to the Courtenays and in 1698 Sir William Courtenay was confirmed in the right of holding court leet, view of frankpledge and the nomination of a portreeve, these privileges having been surrendered to James II. The borough was represented by two members in parliament in 1300 and 1311, and then not again till 1640, from which date it returned two members until disfranchised by the act of 1868, the returning officer being the portreeve, who was also the chief magistrate of the borough until its incorporation by charter of 1846. In 1221 Falkes de Breauté, then custodian of the borough, rendered a palfrey for holding a three days' fair at the feast of All Saints, transferred in 1247 to the feast of St. Margaret and still held under that grant. A market for corn and other produce is still held on Saturday by prescription. The wool manufacture flourished at Honiton in the reign of Henry VII, and it is said to have been the first town at which serges were made but the industry entirely declined during the 19th century. The town borders the wide main road for about a mile. The restored church of St. Michael, formerly a parish church about ½ mi. from the town. was built by Peter de Courtenay, bishop of Exeter, about 1482. It contains the black marble tomb of Elizabeth I's physician, Thomas Marwood. St. Margaret's

hospital, founded as a lazar house in the 14th century, is converted into almshouses. Honiton was formerly the centre of a famous lace industry, established by refugees from Flanders under Elizabeth I. The delicate fabric made by hand on the pillow was long in demand; its sale was, however, greatly diminished by the competition of cheaper machine-made goods. Genuine Honiton lace is still made in the neighbourhood, however, the craft being taught in the schools and fostered by women's institutes. The town gives its name to one of the parliamentary divisions of Devon. returning one member.

HONOLULU, capital and principal port of Hawaii and seat of the city and county of Honolulu, at 21° 18′ N., 157° 51′ W., is on the south coast of Oahu Island, 2,091 nautical miles S.W. of San Francisco. A modern city in mid-Pacific, with a special picturesqueness of its own, it is the crossroads of transpacific steamer and air routes, the centre of similar interisland services and the main port of trade with the U.S. mainland. During World War II and the Korean war it was a staging area of prime importance. Not only is the city the gateway to the other Hawaiian islands but is itself, along a-ith its suburbs of Waikiki and Pearl Harbor, a sight-seeing goal for thousands of tourists annually.

The city extends about 10 mi. along the Oahu shore and 4 mi. inland across a plain a mile wide and up ridges and valleys to a mountain range from 2.000 to 3,100 ft. high. Near the middle are the modern harbour, business section, civic centre and, a mile back. Punchbowl crater (500 ft., containing the National Memorial Cemetery of the Pacific); at the east end, like a lion couchant, stands Diamond Head crater (760 ft.); at the west end the lower Salt lake craters separate the city from the naval base of Pearl Harbor. With its ocean front; colourful vegetation and background of mountains and blue sky. Honolulu is considered one of the most beautiful of cities. Tempered by cool trade breezes, the plain has a temperature range of from 56° to 88' F., with a mean of 74.6°, while annual rainfall averages 28.6 in., the temperature decreasing and rainfall increasing with altitude.

The residential area spreads between mountains and sea and includes homes in a dozen architectural traditions. Business buildings rise near the busy harhourside. centre of trade and shipping for all Hawaii. The civic centre, a spacious park, contains or is bordered by the federal building. the territorial capitol (Iolani palace, the only former royal palace now under the U.S. flag). city hall, judiciary, library, archives. tax and armoury buildings, and the residence of the governor, Washington Place. The city has a stock exchange and a chamber of commerce and there are pineapple canneries, ironworks and a few light industries.

History. — Honolulu means "sheltered harbour." It mas overlooked by James Cook in 1778 and by other early explorers, and was not discovered until 1794. Thereafter it became a place of resort for vessels (especially whalers and sandalwood traders) and merchants from the beginning of the 19th century. Kamehameha I (the Great) lived there from 1803 to 1811. In 1820 the city became the principal residence of the sovereign and soon afterward of foreign consuls. but it did not become the permanent. capital until 184j.

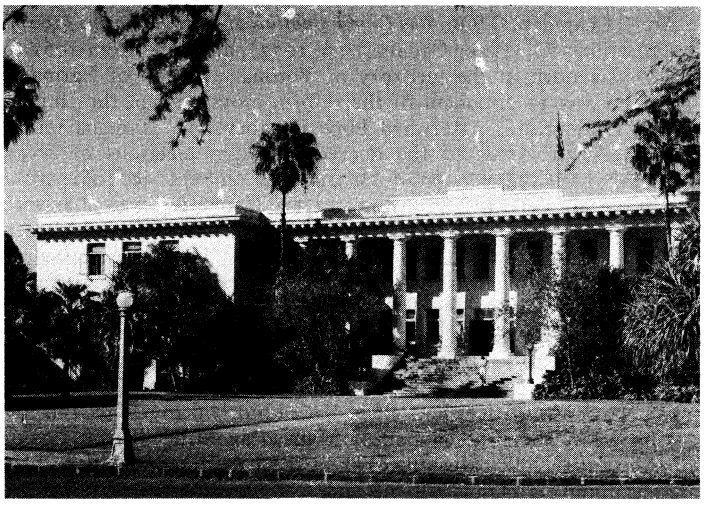
Russian forces arrived at Honolulu in 1816 and the city was later occupied by Great Britain (1843) and France (1849), but was returned to the independent kingdom of Hawaii each time. After about 1820 the city assumed first importance in the islands and its history is closely comparable with that of Hawaii as a whole. Honolulu continued as the capital city when Hawaii was annexed to the U.S. (1898) and when it became a state (1959).

The most critical day of the 20th century in Honolulu was Sunday. Dec. 7, 1941, when the city was under sporadic attack by Japanese planes. which bombed military installations on the island of Oahu, particularly the naval base at neighbouring Pearl Harbor. Civilian casualties in Honolulu numbered at least 57 dead and many injured. Thereafter Honolulu became the spear point for the steady attack against the Japanese forces in the Pacific during World War II. The Korean war lent further emphasis to the strategic importance of the city. In the second half of the century, Honolulu became an increasingly important centre for tourist travel and an expanding residential area, marked also by an expansion of light manufacturing.

Administration, Area and Population. — The centre of government for the executive, legislative and judiciary branches of Hawaii: Honolulu is also the seat of the city and county of Honolulu, set up in 1907 by the territorial legislature. The area of the city and county covers a total expanse of 540,000 sq.mi., in a roughly triangular region of the Pacific ocean running northwest almost to Midway Island and south to Palmyra Island. However, for most purposes the city-county area is that of the island of Oahu. Pop. (1960) city, 294,179; county (the standard metropolitan statistical area), 500.409. For comparative population figures see table in HAWAII: Population.

Transportation.—As the "crossroads of the Pacific," Honolulu is a main stop on all world steamer and air routes. Many bus routes connect with lines over the concrete and macadam roads of rural Oahu, and two tunnels through peaks of the Koolau range behind the city lend speedy access to the growing residential areas of the north shore. Honolulu and its hinterland are supplied with light and power, gas, water and sewer systems. The region is connected to the rest of the world by interisland telephones, ship-to-shore radio, transpacific cable and interisland and transpacific radio. The chief exports are sugar and pineapple products.

Cultural Activities. — The University of Hawaii is in Honolulu (see HAWAII). There are numerous civic. scientific: historical, literary, art, dramatic, musical, professional, industrial, religious and social welfare organizations. Churches include those of Christian and several oriental denominations. Periodicals are published in several languages. Honolulu had nine radio stations and three television stations and two daily newspapers in English in the latter 1950s. People of many cultural and racial backgrounds mingle freely and harmoniously in various activities.



BY COURTESY OF HAWAII VISITORS BUREAU

HAWAII HALL. UNIVERSITY OF HAWAII

Recreation. — There are many drives, parks and playgrounds, the largest parks being Kapiolani, between Diamond Head and Waikiki, and Ala Moana, along the shore. Much was done for beautification, including the elimination of billboards from roadsides. There is a profusion of introduced plants. particularly flowering varieties. Most mainland sports can be enjoyed 12 months of the year.

Waikiki, a beach resort 4 mi, from downtown Honolulu, is a centre ior water sports, surfboard riding and canoeing in particular. There rise many hotels, some of which are as high as 14 stories. Facilities include a yacht harbour and an aquarium.

Pearl Harbor, an important base for the U.S. navy for many years, adjoins Honolulu to the west, centred on a cloverleaf-shaped. improved harbour which is one of the largest and safest in the world. The right to use Pearl Harbor as a coaling and repair station was granted to the U.S. by the Hawaiian monarchy in 1887, but congress did not authorize funds for construction of a naval base until 1907. Ships may tie up at Ford Island or anchor in the arms of the harbour. There are fueling and repair docks,

dry docks, a submarine base, shops, supply depots and training centres. From 1947 Pearl Harbor was the headquarters for the unified command of the U.S. army, navy and air force for the Pacific area. See also HAWAII; WORLD WAR II. (A. G. DY.)

HONORIUS, the name of four popes and one antipope.

HONORIUS I (d. 638), pope from 625 to 638, a member of a distinguished Campanian family, was elected pope Oct. 27, 625. In his government of the church Honorius continued the policies of St. Gregory the Great. He sent missionaries to Anglo-Saxon England, admonished the Christian Celts to conform to the Roman rite and, in co-operation with several councils, reorganized the recently converted Visigothic Spain. He was less successful in his attempts to convert the Arian Lombards. He died Oct. 12, 638.

Honorius I was condemned in 681 by the third council of Constantinople as a heretic because in the Monothelite controversy he had assumed a conciliatory policy out of practical considerations. Leo II in 682 confirmed the condemnation, saying that Honorius had "permitted the faith to be stained." That Honorius was actually a heretic is open to question, for he seems to have misunderstood the point at issue and his language is quite unscientific. His lapse was much discussed at the time of the Vatican council (1870) in connection with the promulgation of the doctrine of papal infallibility; that doctrine, however, requires that only when a pope speaks ex cathedra is he infallible, and it has not been shown that any opinion of Honorius was an ex cathedra definition of faith or morals.

See J. Chapman, *O.S.B.*, ***The*** *Condemnation of Pope Honorius* (1907).

HONORIUS II (Peter Cadalus) (d. 1072), antipope from 1061 to 1072, was born in the territory of Verona. Bishop of Parma c. 1045, he mas an opponent of the reform movement in the church. When Hildebrand (afterward Pope Gregory VII) and his fellow reformers, in virtue of the decree on papal elections of 1059, brought about the election of Alexander II on Sept. 30, 1061, without imperial sanction, Agnes, regent for Henry IV, was able with the aid of Lombard and German bishops to have Cadalus chosen at Basel as Honorius II, on Oct. 28, 1061. He was installed at Rome by force of arms in April 1062. Duke Godfrey of Tuscany succeeded in persuading both contenders to await the imperial decision. Agnes in the meantime had lost the regency and Anno of Cologne, who succeeded her, ordered an investigation which resulted in a decision favourable to Alexander. Cadalus in May 1063 again established himself in Rome but had to depart the following year when the council of Mantua again decided in favour of Alexander. Cadalus lived in obscurity till 1072, apparently maintaining his claims till the end.

HONORIUS II (Lamberto Scannabecchi) (d. 1130), pope from 1124 to 1130, was born of a humble family at Fagnano near Imola, rose to be cardinal bishop of Ostia (1117) and was Calixtus II's legate to Germany. His pacific temperament helped to close the investiture (*q.v.*) controversy by the concordat of Worms (1122) and won him the good mill of the imperialists. In the conclave that met to elect a pope on the death of Calixtus, the Frangipani won the people for Honorius after Theobald had been chosen as Celestine II. When Honorius offered to resign. the cardinals renewed his election (Dec. 15, 1124). His reign, which was an era of peace and reform, saw the pope come to an understanding with the rulers of the period. As a result his position was greatly strengthened. Henry I of England accepted a papal legate; Louis VI of France settled his contests with the French hierarchy; Lothair of Supplinburg owed his election as emperor to papal support and paid his debt by deferring to the pontiff. Honorius was forced, however, to recognize the claims to Apulia of Roger II of Sicily. He died at Rome on Feb. 13, 1130.

HONORIUS III (Cencio Savelli) (d. 1227), pope from 1216 to 1227, nas a Roman aristocrat who became treasurer of the Holy See in 1188 and a cardinal in 1193. He was elected to succeed Innocent III as pope on July 18, 1216, and gathered the fruits of the reign of that great pontiff at least in the spiritual sphere. Under him, the Dominicans, Franciscans and Carmelites were approved and church life revitalized. Honorius resisted the emperor Frederick II, once his pupil, but avoided an open break in the hope that the emperor would take the crusade seriously. But Frederick outmaneuvered the elderly prelate in this as in other matters. The activities of Honorius, however, in the interests of justice and peace were felt throughout the west. He was, among other things, instrumental in securing the crown of England for the minor Henry III. He died March 18, 1227.

HONORIUS IV (Giacomo Savelli) (c. 1210–1287), pope from 1285 to 1287, was a grandnephew of Honorius III. Cardinal in 1261, he was elected unanimously on the first ballot (April 2, 1285) although aged, infirm and only a deacon. During his short reign he favoured the mendicant orders and promoted the study of Oriental languages in order to effect a union with the Eastern churches. He intervened against Aragon in the dispute over Sicily. He died at Rome on April 3, 1287. (J. V. HN.)

HONORIUS, FLAVIUS (384–423), son of Theodosius I, ascended the throne as "emperor of the west" in 39j. During the early part of his reign the west was attacked on all sides by barbarian hordes. Italy was saved by the exertions of Honorius' guardian and father-in-law, the Vandal Stilicho (*q.v.*), but Gaul was overrun by barbarians (winter 406–407) and in 409 the central government was forced to abandon Britain. After the murder of Stilicho (408), Italy was again invaded by Alaric the Visigoth and in 410 Rome was taken and sacked. Alaric died in the same year and in 412 Honorius concluded peace with his brother-in-law and successor Ataulphus (Adolphus), who married the emperor's sister Placidia and withdrew with his troops to southern Gaul.

A succession of usurpers arose (411–416) in Gaul and Spain, but were overthrown by Honorius' general Constantius, who was rewarded with a share in the government (d. 421). It was only as a supporter of the orthodox church and persecutor of the heathen that Honorius displayed any energy. In 399 the exercise of the pagan cult was prohibited and the revenues of the temples, which were to be appropriated for the use of the public or pulled down, were confiscated to defray the ekpenses of the army. Honorius was equally severe on heretics, such as the Donatists and Manichaeans. He is also to be credited with the abolition of the gladiatorial shows in 404 (although there is said to be evidence of their existence later), a reduction of the taxes, improvements in criminal law and the reorganization of the defensores *civitatum,* municipal officers whose duty it was to defend the rights of the people and set forth their grievances. Honorius at first established his court at Milan, but on the report of the invasion of Italy, fled to Ravenna, where he resided till his death on Aug. 27, 423.

HONOS, the Roman deified abstraction of Honour, particularly as a military virtue. The earliest shrine of this deity in Rome, not earlier than the 3rd century B.C., was located just outside the Colline gate. A double temple of Honos and Virtus stood outside the Porta Capena and another, built by Marius, was probably located on the Capitoline. See also VIRTUS.

(R. B. LD.)

HONOUR, a term which may be defined as respect, esteem or deference paid to, or received by, a person in consideration of his character, worth or position; also the state or condition of the person exciting the feeling or expression of such esteem; particularly a high personal character coupled with conduct in accordance with a discriminating sense of what is right and true and due to the position so held. Further, the word is commonly used of the dignities, distinctions or titles, granted as a mark of such esteem or as a reward for services or merit, and quite generally of the credit or renown conferred by a person or thing on the country, town or particular society to which he or it belongs. The standard of conduct may be laid down not only by a sense of what is due to lofty personal character but also by the usages of society; hence it is that debts which cannot be legally enforced, such as gambling debts, are called "debts of honour." Similarly in the middle ages and later, courts, known as "courts of honour," sat to decide questions such as precedence, disputes as to coat armour, etc. (see CHIVALRY); such courts, chiefly military, are found in countries where dueling has not fallen into desuetude (see DUEL).

In English the word mas spelled with or without the *u* indifferently until the 17th century, but during the 18th century it became fashionable to spell the word "honor"; Johnson's and Webster's

Dictionaries stereotyped the English and American spellings respectively.

HONOURABLE ARTILLERY COMPANY. On Aug. 25, 1537, Henry VIII granted a charter of incorporation to the Guild of Fraternity of St. George, a guild of archers and handgunmen. The wording of the charter, however, implies that a guild existed before the grant was made and that it was now receiving royal support. As a military formation it is probably the oldest regiment in the world. All kinds of archery being classified as artillery, this guild of archers soon became known as the artillery company. (It has, however, had numerous designations.) Under the charter the government of the guild was placed in the hands of four masters or rulers and they were charged, among other things, with the establishment of a perpetual fraternity of St. George for the general encouragement of the "Science of Artillery for Longe Bowes Crosbowes and Handgonnes, etc."

Under Edward III the chief resort of London archers for practice was in the open spaces at Finsbury and Moorfields, later known as the artillery ground or artillery garden, and in this neighbourhood the H.A.C. always had its headquarters, except for the first few years of its existence. During the early years following its incorporation the company was the training centre for the City of London when necessity demanded an augmentation of the forces, a notable occasion being the year of the Great Armada. On this occasion not only did it train the citizens of London in the science of small artillery, but many of its members went to several parts of the kingdom with the rank of officers to train the various trained bands.

The system of training inaugurated in London by the company stimulated the corporations of other towns to follow their example, notably in the early part of the 17th century. None of these provincial companies survived but an offshoot of the old company continued to flourish in the U.S. as the "Ancient and Honourable Artillery Company of Boston, Massachusetts," the oldest military body in the new world, whose original title was the "Military Company of Massachusetts." The original members of this American company were members of the London company who had migrated in the 16th century. They trained the citizens in the art of war and when the militia came into existence, its officers were drawn from the company.

The roll of the regiment contains the name of one of England's greatest poets, John Milton, who was entered on June 2, 1635. His military career was short but no doubt he gained an intimate knowledge of the pike or musket. Charles I took an interest in the company and sanctioned the enrollment of the prince of Wales, then only 11 years old, and his brother, James, duke of York, as members of the company. The elector of Palatine, a grandson of James I, became a member on the same day—June 1, 1641.

At the outbreak of the Great Rebellion the company represented the only efficient trained bands in the country and parliament regarded them as a reliable reserve. Of their number the name of Skippon is known to history. Capt. Philip Skippon was captain of the company in 1639 and became commander of the forces with the rank of sergeant major general in 1642. He joined the parliamentary forces and became chief of the staff to the earl of Essex.

In 1660 the duke of York was elected commander in chief of the company, he being the first and last holder of that title. His successor, William III, styled himself captain general and this title still survives, the reigning monarch being captain general of the company. In the middle of the 17th century the company was in great favour at court and many of the nobility and gentry of the royal household enrolled themselves as members; *e.g.,* Prince Rupert, the duke of Albemarle, the earl of Sandwich, Lord Craven, the dukes of Monmouth, Ormonde, Manchester, Anglesey and Buckingham. Other distinguished members of the company about this time were Marlborough, Christopher Wren the architect, Vauban the great French engineer, William, 2nd earl of Denbigh and Kirke, the notorious colonel of "Kirke's lambs." The company kept abreast of the times as regards developments in the military art and in 1714 added some grenadiers to the establishment. In 1860 a troop of horse artillery was added but this was disbanded in 1869.

This is the only regiment which has the unique distinction of having battle honours on its king's colour only. (T. J. E.; X.)

HONTHEIM, JOHANN NIKOLAUS VON (1701–1790), German historian and theologian, was born of noble family on Jan. 27, 1701, at Trier. He was educated at Trier, Louvain and Leyden, and after traveling extensively in Europe, spent three years in Rome, where he was ordained priest in 1728. Returning to Trier as canon, he became a professor at the university in 1732, but six years later went to Coblenz as official to the archbishop-elector. In 1747, broken down by overwork, he retired to St. Simeon's at Trier, and in May 1748 was appointed auxiliary bishop and vicar-general. He was consecrated at Mainz, in Feb. 1749, under the title of bishop of Myriophiri *in partibus*. The archbishop of Trier was practically a great secular prince, and upon Hontheim fell the whole spiritual administration of the diocese; this work, in addition to that of prochancellor of the university, he carried on singlehanded until 1778. Hontheim died on Sept. 2, 1790, at his château at Montquentin near Orval.

As a historian his reputation rests on his *Historia Trevirensis diplomatica et pragmatica* (3 vol., 1750) and his *Prodromus historiae trevirensis* (2 vol., 1757). The *Historiae scriptorum et monumentarum Trevirensis amplissima collectio* remains in manuscript at the city library of Trier. It is, however, as "Febronius" that Hontheim is best remembered. The character of his book on "the state of the church and the lawful power of the Roman pontiff" is described elsewhere (*see* FEBRONIANISM). The author of the book was known at Rome almost as soon as it was published; but it was not till several years afterward (1778) that he was called on to retract. The removal of the censure followed (1781) when Hontheim published at Frankfurt his *Justini Febronii acti commentarius in suam retractationem*, etc.

HONTHORST, GERARD VAN (1590–1656), Dutch historical, portrait and genre painter, born at Utrecht on Nov. 4, 1590, was brought up in the school of Abraham Bloemart. He then went to Italy, where he was influenced by the realism and chiaroscuro of the great Michelangelo da Caravaggio. Home again in 1622, he entered the Guild of St. Luke, becoming dean in 1625–26–28 and 1629. The queen of Bohemia, sister of Charles I and electress palatine, being an exile in Holland, asked him to teach her children drawing; and Honthorst, thus approved, was invited by Charles I to England. There he painted several portraits and a vast allegory, now at Hampton Court, of the king and queen of Bohemia as Diana and Apollo in the clouds receiving the duke of Buckingham as Mercury and guardian of the king of Bohemia's children. In his home at Utrecht Honthorst finished, in 1631, a large picture of the king and queen of Bohemia "and all their children." For Lord Dorchester about the same period he completed some illustrations of the *Odyssey;* for the king of Denmark he composed incidents of Danish history, of which one example remains in the gallery of Copenhagen. In 1637 he settled at The Hague, and became court painter (1641).

His most attractive pieces are those in which he cultivates the style of Caravaggio, those, namely, which represent taverns peopled with players, singers and diners. He shows great skill in reproducing scenes illuminated by candlelight (*e.g.,* "Christ Before Pilate"), and he liked to transmute every subject into a night scene. He died on April 27, 1656.

HOOCH, PIETER DE (1629–after 1683), Dutch genre painter noted for his interior scenes, was born in Rotterdam. He was a pupil of N. Berchem at Haarlem. From 1653 he was in the service of Justus de Grange, and lived at Delft, The Hague and Leyden. In 1654 he married a girl of Delft, Jannetje van der Burch. From 1654 to 1657 he was a member of the painter's guild of Delft, but after that date we have no traces of his doings until about 1667, when his presence was recorded in Amsterdam. His dated pictures prove that he was still alive in 1683. His work shows affinity with the painting of Vermeer, who was living at Delft at the same period as De Hooch. De Hooch only once painted a canvas of large size, and that unfortunately perished in a fire at Rotterdam in 1864. But his small pieces display perfect finish combined with great power of discrimination. Though he

sometimes painted open-air scenes, these were not his favourite subjects. He was most at home in interiors with the radiance of the day, in different intensities, seen through doors and windows. He thus brought together the most delicate varieties of tone. His simple household scenes, done while he lived in Delft, are considered his best works. After moving to Amsterdam he attempted more elegant scenes of society life that lack the homely charm and intimacy of his earlier works.

REPRODUCED BY COURTESY OF THE TRUSTEES, NATIONAL GALLERY, LONDON

"THE COURTYARD OF A HOUSE IN DELFT" BY PIETER DE HOOCH. IN THE NATIONAL GALLERY. LONDON

Over 320 works of De Hooch are located in European and American galleries.

HOOD, JOHN BELL (1831–1879), U.S. soldier, lieutenant general of the Confederate army. mas born at Owingsville, Ky., in **1831** and graduated at West Point Military academy in 1853. As a cavalry officer he saw service against Indians, and later he was cavalry instructor at West Point. He resigned from the U.S. service in **1861**, and became a colonel in the Confederate army. He was soon promoted brigadier general, and with the famous "Texas brigade" of the army of northern Virginia he served throughout the campaign of **1862.** At Gettysburg he commanded one of the divisions of Longstreet's corps, receiving a wound which disabled his arm. With Longstreet he was transferred in the autumn of **1863** to the army of Tennessee. At the battle of Chickamauga (Sept. 19–20) Hood was severely wounded again and his leg was amputated. He remained with the army of Tennessee as a corps commander. and when the general dissatisiaction with the Fabian policy of Gen. J. E. Johnston brought about the removal of that officer. Hood was put in his place. But in spite of skill and courage he was uniformly unsuccessful in the battles around Atlanta. In the end he had to abandon the place, but he forthwith sought to attack Sherman in another direction. and finally invaded Tennessee. His march was pushed with the greatest energy, but he failed to draw the main body of the enemy after him. and. while Sherman with a picked force made his "march to the sea," Thomas collected an army to oppose Hood. A severe battle was fought at Franklin on Nov. **30, 1864,** and finally Hood was defeated and his army almost annihilated in the battle of Nashville on Dec. **1j-16,1864.** He was then relieved at his own request (Jan. **23,** 1865). After the war he engaged in business in New Orleans. where he died of yellow fever on Aug. **30, 1879.** His experiences in the Civil War are narrated in his *Advance and Retreat* (1880).

HOOD, SIR SAMUEL (1 **762-1814),** British vice-admiral, entered the navy in 1776. His first engagement was the battle off Ushant in 1778, and he was present in the West Indies, under the command of his cousin Sir Samuel Hood, at all the actions which culminated in Lord Rodney's victory of April 12, 1782. After the peace, he spent some time in France, and on his return was given the command of a sloop, from which he proceeded in succession to various frigates. Early in **1793** the "Juno" went to 'the Mediterranean, and Hood distinguished himself by an audacious feat of seamanship in extricating his vessel from the harbour of Toulon, which he had entered in ignorance of Lord Hood's withdrawal. Soon afterward he was put in command of a frigate squadron for the protection of Levantine commerce, and in 1797 was given the "Zealous" **(74** guns), being present at Nelson's unsuccessful attack on Santa Cruz. He conducted the negotiations which relieved the squadron from the consequences of its failure. At the battle of the Nile the "Zealous!' put her first opponent out of action in 12 minutes, and Hood immediately engaged other ships. the "Guerrier" being left powerless. When Nelson left Egypt Hood commanded the blockading force off Alexandria and Rosetta. Later he rejoined Nelson on the coast of the two Sicilies.

In the "Venerable" Hood was present at the action of Algeciras, and the battle in the Straits of Gibraltar (1801) when his ship suffered heavily. A year later Captain Hood was employed in Trinidad as a commissioner and, upon the death of the flag officer commanding the Leeward station, succeeded him as commodore. Island after island fell to him and soon, outside Martinique, the French had scarcely a foothold in the West Indies. In command next of the squadron blockading Rochefort. Hood had a sharp action on Sept. 25, 1805, with a small French squadron which was trying to escape. On this occasion he lost an arm. Promoted rear admiral, Hood brought the operations against Madeira to a successful conclusion (1807) and a year later took part, in the "Centaur," in the war betn-een Russia and Sweden. Present in the roads of Corunna at the re-embarkation of the army of Sir John Moore, Hood thence returned to the blediterranean. where for two years he commanded a division of the British fleet. In 1811 he became vice-admiral. He died at Madras, Dec. **24,** 1814.

ALEXANDER HOOD (1 **758-98),** brother of Adm. Sir Samuel Hood, entered the navy in 1767, and accompanied Capt. James Cook in his second voyage round the world. Under Lords Howe and Rodney he distinguished himself in the \Vest Indies, and at the victory of April 12. 1782, was in command of one of Rodney's frigates. Under Sir Samuel Hood he then proceeded to the Mona passage, where he captured the French corvette "Cérès." It was not until 1797 that he went afloat again. His first experience was bitter; his ship, the "Mars," was unenviably prominent in the mutiny at Spithead. On April 21. 1798, occurred the famous duel of the "Mars" with the "Hercule." fought in the dusk near the Bec du Raz, in which. though successful, Hood lost his life.

HOOD, SAMUEL HOOD, 1ST VISCOUNT (1 724–1816), British admiral who served during the Seven Tears' War and the American and the French Revolutionary wars, was born on Dec. 12, 1724. He entered the navy on May **6.** 1741, served part of his time as midshipman with Capt. George Rodney in the "Ludlow Castle" and became lieutrnant in **1746.** In 1754 he was made commander of the "Jamaica" sloop, and served in her on the North American station. where in 1756 he was posted to the "Lively." He returned to England later in the year in the "Grafton." to which he had been appointed by Commodore C. Holmes. In 1757, while in temporary command of the "Antelope" (50 guns), he drove a French ship ashore in Audierne bay and took two privateers. In recognition of his services he was given command of the frigate "Bideiord." In 1; 59, when captain of the "Vestal" (32), he captured the French "Bellona" (32) after a

sharp action off Cape Finisterre. During the war his services were wholly in the English channel, and he was engaged under Rodney in 1759 in destroying the transports collected by the French for the proposed invasion of England. In 1760 he mas sent by his own request to the Mediterranean. In 1778, after further service in North America,. he became commissioner of the dockyard at Portsmouth and governor of the naval academy; and in 1780 mas promoted rear admiral and was sent to the West Indies as second in command under Lord Rodney (*q.v.*).

Hood joined Rodney in Jan. 1781. and remained in the West Indies or on the coast of North America until the close of the American Revolutionary War. The turn taken by the campaign of 1781 was largely due to Rodney's neglect of his advice. If he had been allowed to choose his own position, there seems to be no doubt that he could have prevented the comte de Grasse from reaching Ft. Royal with the reinforcements from France in April. When the fleet went on to the coast of North America during the hurricane months of 1781, he was sent to serve with Adm. Thomas Craves in the unsuccessful effort to relieve the army at Yorktown. When he returned to the West Indies he was for a time in independent command because oi Rodney's absence in England, and the British islands of St. Kitts and Nevis were attacked by the French admiral. De Grasse, with a force much superior to Hood's squadron. Hood's attempt to save it from capture. Jan. 1782, with 22 ships to 29, failed, but the bold movements by which he first turned the French out of their anchorage at ihe Basseterre of St. Kitts, and then beat off the attacks of the enemy, were the most brilliant things done by any British admiral during the war. He was made an Irish peer for his share in the defeat of De Grasse on April 9 and 12 near Dominica.

On the outbreak of the French Revolutionary War Hood was sent to the Mediterranean as commander in chief. His period of command (May 1793–Oct. 1794) was very active. In August he occupied Toulon on the invitation of the French royalists, and in co-oweration with the Swaniards. In December of the same year the allies. who did not work harmoniously together, were driven out. mainly by the generalship of Napoleon, and Hood now occupied Corsica: which he had been invited to take in the name of the king of England by Pasquale Paoli. Meanwhile the French at Toulon had recovered sufficiently to send a fleet to sea. In June Hood sailed in the hope of bringing it to action. The plan which he laid to attack it in Juan gulf in June may possibly have served to some extent as an inspiration, if not as a model, to Nelson for the battle of the Nile. but the wind was unfavourable, and the attack could not be carried out.

In October, Hood. who was now full admiral, was recalled to England. He ,held no further command at sea, but in 1796 he was named governor of Greenwich hospital, a post which he held until his death on Jan. 27, 1816. A peerage of Great Britain was conferred on his wife as Baroness Hood of Catherington in 1795, and he was himself created Viscount Hood of Whitley in 1796.

HOOD, THOMAS (1799–1845). British humorist and poet, the son of Thomas Hood. bookseller, was born in London on May 23, 1799. On the death of her husband in 1811 Mrs. Hood removed to Islington. where Thomas Hood had a schoolmaster who appreciated his talents. The boy earned a few guineas—his first literary fee—by revising for the press a new edition of *Paul* and *Virginia*. After a short period in a countinghouse. where the confinement threatened his health, he was transferred to the care of his father's relations at Dundee. On his return to London in 1818 he learned engraving. in n-hich he acquired a skill that enabled him to illustrate his own works.

In 1821 he became subeditor of the *London Magazine,* and thus came into contact with Charles Lamb, Cary, De Quincey, Allan Cunningham. Proctor. Talfourd, Hartley Coleridge, the peasant-poet Clare and other contributors to the magazine. He had married in 182j. and *Odes and* .Addresses—his first work—was written in conjunction with his brother-in-law J. H. Reynolds, the friend of Keats. The *Plea of the Midsummer Fairies* (1827), a book of verse written under the strong influence of Keats, and a dramatic romance. *Lamia,* published later, belong to this time. But reputation came to him not from his serious verse. but from the series of the Comic Annual, dating from 1830, which Hood undertook and continued, almost unassisted, for several years. He treated current events in a fine spirit of caricature: entirely free from grossness and vulgarity, without a trait of personal malice and with an undercurrent of true sympathy and honest purpose that gives these papers, like the sketches of Hogarth, a permanent value. Hood was an inveterate punster, and annoyed his more serious readers by his excesses in this direction. He defended himself in the couplet:

> However critics may take offence,
> A double meaning has double sense.

In another annual called the Gem appeared the poem on the story of "Eugene Aram," which first showed his full poetical power. Hood started a magazine in his own name: and conducted this work from a sickbed. To this period belong those poems, too few in number, but immortal in the English language, such as the "Song of the Shirt" (which appeared anonymously in the Christmas number of Punch, 1843), the "Bridge of Sighs" and the "Song of the Labourer," which pictured in moving verse the appalling condition of the industrial worker of his day.

Hood was associated with the *Athenaeum,* started in 1828 by J. Silk Buckingham, and he was a regular contributor for the rest of his life. Prolonged illness brought on straitened circumstances; and Sir Robert Peel allotted to him a small pension from the civil list, which was continued to his wife and family after his death on May 3, 1845.

BIBLIOGRAPHY.—The list of Hood's separately published works is as follows: *Odes and Addresses to Great People* (1825); *Whims and Oddities,* two series (1826 and 1827); *The Plea of the Midsummer Fairies, Hero and Leandcr, Lycus the Centaur and other Poems* (1827), his only collection of serious verse; *The Dream oj Eugene Aram, the Murderer* (1831); *Tylney Hall, a* novel, 3 vol. (1834); *The Comic Annual* (1830–42); *Hood's Own; or, Laughter From Year to Year* (1838; 2nd series, 1861); *Up the Rhine* (1840); *Hood's Magazine and Comic Miscellany* (1844–48); *National Tales,* 2 vol. (1837). a collection of short novelettes; *Whimsicalities* (1844), with illustrations from Leech's designs; and many contributions to contemporary periodicals.

The chief sources of his biography are: *Memorials of Thomas Hood, Collected, Arranged and Edited* by *His Daughter* (1860); his "Literary Reminiscences" in *Hood's Own;* Alexander Elliot, *Hood in Scotland* (1885). *See* also the memoir of Hood's friend C. W. Dilke, by his grandson Sir Charles Dilke, prefixed to *Papers of a Critic;* and M. H. Spielmann's *History of Punch.* There is an excellent edition of the *Poems of Thomas Hood,* 2 vol. (1897), with a biographical introduction of great interest by Alfred Ainger.

HOOD, a covering for the head. Some form of hood as a loose covering easily drawn on or off the head has formed a natural part of outdoor costume both for men and women at all times and in all quarters of the globe where climatic conditions called for it. In the middle ages and later both men and women wore it, but with men it tended to be superseded by the hat before it became merely an occasional and additional head covering in time of bad weather. For illustrations and examples of the hood as worn by men and women in medieval and later times see DRESS; as forming a distinctive mark of degree in academic costume see ROBES. The word is applied to many objects resembling a hood in function or shape, such as the belled covering for the head of a hawk trained for falconry, the endmost planks in a ship's bottom at bow or stern, and, in botany and zoology, certain parts of a dower or of the neck of an animal: which recall this article of dress.

HOOD MOLD, in architecture, a molding projecting from the face of the wall. immediately above an arch or opening whose curvature or outline it follows. It originated in the Romanesque period (see ROMANESQUE ARCHITECTURE) as a protection to the moldings below and to throw water away from the opening. and was later developed into an important decorative feature. It is almost universal over exterior arches in the Gothic work (see GOTHIC ARCHITECTURE) of France, Germany and Spain; in England it was. furthermore. common in interior work, especially in nave arcades. In profile. the hood mold has. usually, a downward sloping upper surface. and a hollow below to act as a drip; at its lower end, near the spring of the arch, it is either received upon the capital of a column or ends in a projecting. carved, ornamented boss. When used in a place other than an arch or opening, it is

known as a drip mold. *See* MOLDING.

HOOFT, PIETER CORNELISROON (1581–1647), Dutch poet and historian, was born at Amsterdam on March 16, 1581. His father was for some time burgomaster of Amsterdam. As early as 1598 the young man was made a member of the chamber of rhetoric De Eglantier, and produced before that body his tragedy of *Achilles and Polyxena*, not printed until 1614. In June 1598 he left Holland and proceeded to Paris, Venice, Florence and Rome, and in 1600 to Naples. During his Italian sojourn he made a deep and fruitful study of the best literature of Italy. He returned through Germany, reaching Amsterdam in May 1601. In 1602 he brought out his second tragedy, *Theseus and Ariadne* (printed 1614). In 1605 he completed his beautiful pastoral drama *Granida* (printed 1615). Hooft produced three other plays: *Geeraerd van Velsen* (1612, printed 1613); *Ware-nar* (1616), adapted from the *Aulularia* of Plautus; and *Baeto* (1625). He studied law and history at Leyden from 1606 to 1609, and in June of the latter year received from Prince Maurice of Orange the appointment of steward of Muiden, bailiff of Gooiland and lord of Weesp, a joint office of great emolument. He repaired and adorned the decayed castle of Muiden, where he lived for the rest of his life. There he entertained the poet Vondel, the scholar Barlaeus, Constantin Huygens, Vossius, Laurens Reael and others.

In 1618 he abandoned poetry for history. His prose works are *Hendrik de Grote* (Henry IV of France; 1626); *Miseries of the Princes of the House of Medici* (1638); *Nederlandsche Historien* (in 20 books, 1628–47), embracing the period from 1555 to 1585, a magnificent performance, to the perfecting of which he had given 1j years of labour. The seven concluding books were published posthumously in 1654. Hooft died on a visit to The Hague, on May 21, 1647, and was buried in the New church at Amsterdam.

Hooft is one of the most brilliant figures that adorn Dutch literature at its best period. He was the first writer to introduce a modern and European tone into belles lettres, and the first to refresh the sources of native thought from the springs of antique and Renaissance poetry. His lyrics and his pastoral of *Granida* are strongly marked by the influence of Torquato Tasso and Jacopo Sannazaro; his later tragedies belong more exactly to the familiar tone of his native country. But high as Hooft stands among the Dutch poets, he stands higher—he holds perhaps the highest place—among writers of Dutch prose. His historical style won the warmest eulogy, and his letters are the most charming ever published in the Dutch language.

BIBLIOGRAPHY.—Hooft's poetical and dramatic works were collected in 2 vol. (1871, 1875) by P. Leendertz. His letters were edited by B. Huydecoper (1738) and by Johannes van Vloten, 4 vol. (1855). The best original account of Hooft is given by G. Brandt in his *Leven van P. C. Hooft* (1677), and his funeral address (1647), edited together by J. C. Matthes (1874) There is an account of the Muiden circle in Edmund Gosse's *Northern Studies* (1879). *See* also P. Prinsen, P. C. *Hooft* (1922).

HOOGHLY (HUGLI), a town and district in the Burdwan division of West Bengal, India. The town, situated on the right bank of the Hooghly river, 24 mi. above Calcutta by rail, forms a municipality with Chinsura. Pop. (1951) 56,805.

HOOGHLY DISTRICT (area 1,217 sq.mi.; pop., 1951, 1,604,229) is flat, with a gradual ascent to the north and northwest. Along the Hooghly outside the towns a series of orchards and gardens, villages and temples are interspersed with the factories. Baidyabati, Champdani, Bhadreswar, Serampore and Rishra and Konnegar are all mill towns on the river. The principal rivers besides the Hooghly are the Damodar and the Rupnarayan. The highest land lies nearest the rivers, and the lowest levels are found midway between two streams. There are in consequence considerable marshes.

Rice and jute are the principal crops.

HOOGHLY (HUGLI), a highly important waterway in West Bengal, India, giving access to Calcutta (*q.v.*) from the Bay of Bengal (go mi.). It was formerly the most westerly of the channels by which waters from the Ganges reached the sea. It originated as the lower part oi the Bhagirathi, a distributary taking off from the main Ganges 7 mi. S.W. of Suti, hlurshidabad district, and it is given the name Hooghly at Nabadwip, about 120 mi. from the sea. But like other deltaic distributaries the Bhagirathi and the channels it receives on its left (east) side were subject to sudden changes and silting. and they carry little, if any, Ganges water to the Hooghly. The main outflow now comes from several rivers rising to the northwest on the Chota Nagpur plateau, the Ajay, which joins the Bhagirathi at Katwa, 40 mi above Santipur; below Calcutta, the Damodar, location of the large power and irrigation project in the 1950s; the Rupnarain and the Haldi. For 40 mi. above Calcutta the Hooghly is silted up, yet it was there that all the famous ports of Bengal once stood. Navigation up to Calcutta is kept open only by dredging and the scour of a bore that rushes up at high tide. The channel, well buoyed and lighted, is safe for large ocean-going vessels. From Calcutta the Hooghly flows west and south till it meets the Rupnarayn estuary; then twists east, south and southwest, entering the Bay of Bengal in 21° 41′ N., 88° E. Places of note on the Hooghly include Hooghly town, headquarters of the district of the same name; the former French settlement of Chandernagore; Serampore, site of the first university college in India (1818); and Howrah, opposite Calcutta all on the right bank. On the left bank, in addition to Calcutta are Barrackpore, important in the 1857 mutiny, Kidderpore (docks) and Diamond Harbour.

HOOGSTRAETEN, SAMUEL VAN (1627–1678), Dutch painter oi interiors and religious subjects, was born in Dordrecht, hug. 2, 1627. He studied first under his father Dirck and then, after his father's death in 1640, under Rembrandt. From 1651 to 1654 he traveled in Germany, Austria and Italy, staying for some time in Rome and Vienna. His name appears in The Hague painter's guild in 1668. In 1671 he bought a house in Dordrecht, where he died on Oct. 19, 1678. As a painter Hoogstraeten produced biblical and classical subjects, portraits, landscapes, genre and still life. His style was not profoundly influenced by Rembrandt, although an exception is the fine early head of a youth. His genre pieces are probably his most successful works, but he is best known for his ingenious perspective and *trompe l'oeil* (deceptively realistic) designs. In the latter class is "Peep Box: Dutch Interior," at the Detroit Institute of Arts.

Hoogstraeten also wrote on painting techniques.

(R. E. W. J.; X.)

HOOK, THEODORE EDWARD (1788–1841), English author, was born in London, spent a year at Harrow and subsequently matriculated at Oxford, though he never resided at the university. His father. James Hook (1746–1827), the composer of numerous popular songs, took great delight in exhibiting the boy's extraordinary musical and metrical gifts, and the precocious Theodore became "the little pet lion of the green room." At the age of 16, in conjunction with his father, he scored a dramatic success with *The Soldier's Return*, a comic opera, rapidly followed by a series of more than a dozen sparkling ventures, the instant popularity of which was hardly dependent on the inimitable acting of John Liston and Charles Mathews. Hook gave up ten of the best years of his life to the pleasures of the town, winning a foremost place in the world of fashion by his matchless powers of improvisation and mimicry, and startling the public by the audacity of his practical jokes. His unique gift of improvisation eventually charmed the prince regent into a declaration that "something must be done for Hook," and Hook was appointed accountant general and treasurer of the Mauritius with a salary of £2,000 a year. For five delightful years he was the life and soul of the island, but in 1817 he was arrested and brought to England on a criminal charge. A sum of about £12,000 had been abstracted by a deputy official. and for this amount Hook was held responsible.

During the tardy scrutiny of the audit board he lived obscurely and maintained himself by writing for magazines and newspapers. In 1820 he launched the newspaper *John Bull*, the champion of high Toryism and the virulent detractor of Queen Caroline. Witty incisive criticism and pitiless invective secured it a large circulation.

He was arrested for the second time because oi his debt to the state, which he made no effort to defray. In a sponging house,

where he was confined for two years, he wrote the nine volumes of stories afterward collected under the title of *Sayings and Doings* (1826–29). In the remaining 23 years of his life he poured forth no fewer than 38 volumes: besides numberless articles, squibs and sketches. The best of his many racy novels are *Maxwell* (1830), *Love and Pride* (1833), the autobiographic *Gilbert Gurney* (1836), *Jack Brag* (1837), *Gurney Married* (1838) and *Peregrine Bunce* (1842).

Hook died on Aug. 24, 1841.

HOOKE, ROBERT (1635–1703), English experimental physicist who discovered the first law of elasticity for solid bodies, known as Hooke's law, was born July 18, 1635, at Freshwater. Isle of Wight. After 1655 he was employed by Robert Boyle, who used his skill in the construction of his air pump. On Nov. 12, 1662, he was appointed curator of experiments to the Royal society, of which he was elected a fellow in 1663, and filled the office during the remainder of his life. In 1665 he was appointed proiessor of geometry in Gresham college. He was secretary to the Royal society between 1677 and 1683, publishing in 1681–82 the papers read before that body under the title of *Philosophical Collections.* He died on March 3, 1703, in London.

Hooke's scientific achievements would probably have been more striking if they had been less varied. He originated much, but perfected little. His optical investigations led him to adopt in an imperfect form the undulatory theory of light. He was the first to state clearly that the motions of the heavenly bodies must be regarded as a mechanical problem, and he approached in a remarkable manner the discovery of universal gravitation. He invented the wheel barometer, discussed the application of barometrical indications to meteorological forecasting and originated the idea of using the pendulum as a measure of gravity. He is credited with the invention of the anchor escapement for clocks, and the application of spiral springs to the balances of watches (1676).

See WATCHES.

His principal writings are *Micrographia* (1665); *Lectiones Cutlerianae* (1674–79); and *Posthumous Works,* containing a sketch of his "Philosophical Algebra," published by R. Waller in 1705.

See M. 'Espinasse, *Robert Hooke* (1956).

HOOKED RUG, a rug made by pulling narrow strips of wool or cotton cloth or wool yarn, with a tool roughly resembling a buttonhook, up through a basic material of coarse linen or burlap. The loops, approximately a half inch high, and the width of two, three or four mesh openings in the basic material, are often clipped. Frames of various designs hold the basic material taut. Frequently the rug is made by pushing, instead of pulling, the loop through the basic material, the instrument used being then generally a large threaded needle.

The origin of the hooked rug is obscure; beginning perhaps in the Scandinavian countries, the art was brought to America, by way of Great Britain, for its highest development. It has thrived best in New England and Canada. Early American examples show considerable variety in colour in a generally crude floral, animal or geometric design.

HOOKER, JOSEPH (1814–1879), U.S. general?was born in Hadley, Mass., Nov. 13, 1814. He was educated at West Point (1833–37), and entered the 1st U.S. artillery. In the war with Mexico (1846–48) he rose to the rank of lieutenant colonel. In 1853 he left the service but at the beginning of the Civil War he was commissioned brigadier general of volunteers, and major general on May 5, 1862. In the engagement of Williamsburg (May 5) he received the sobriquet of "Fighting Joe."

In the Maryland campaign (September) he was at the head of the 1st corps, army of the Potomac. forced the defile oi South Mountain and opened the way for the advance of the army. The 1st corps opened the battle of Antietam, and in a sanguinary fight with Confederates under "Stonewall" Jackson, Hooker was severely wounded. He was commissioned brigadier general in the U.S. army Sept. 20. 1862, and in the battle of Fredericksburg he commanded the centre grand division. When Burnside resigned the command Hooker succeeded him, and effected a much-needed reorganization in the army. In this task, as in subordinate commands in battle. Hooker was excelled by few. But his grave defects as a commander in chief were soon to be obvious. By a well-planned movement. he placed himself on the enemy's flank, but at the decisive moment he checked the advance of his troops. Lee turned upon him, Jackson surprised and destroyed a whole army corps. and the battle of Chancellorsville *(see* WILDERNESS), in which Hooker was himself disabled. ended in retreat. The second advance of Lee into Union territory was resisted by Hooker. who followed the Confederates only a day behind them, until. finding himself distrusted. he resigned the command.

When Rosecrans was besieged in Chattanooga, two corps of the army of the Potomac were sent over by rail. and Hooker went with them in command. He won the "battle above the Clouds" on Lookout mountain. He took part in all the battles and combats of the Atlanta campaign of 1864. When General McPherson was killed before Atlanta. the command oi the army of the Tennessee fell vacant. Hooker was entitled to receive it, but Sherman feared to commit a whole army to a man of Hooker's temperament, and the place was given to Howard. Hooker thereupon left the army. He retired on Oct. 1j, 1868, and died at Garden City, Long Island, on Oct. 31. 1879.

HOOKER, SIR JOSEPH DALTON (1817–1911), English botanist, noted for his botanical travels and studies on geographical distribution and for his encouragement to Charles Darwin. was born on June 30. 1817 at Halesworth, the son of Sir William Jackson Hooker (*q.v.*). He took his M.D. at Glasgow university in 1839 and then joined Sir James Ross's antarctic expedition as assistant surgeon. On his return in 1843 he published *Flora Antarctica* (1844–47), *Flora Novae Zelandiae* (1853-jj) and *Flora Tasmanica* (185j-60). His next expedition was to the northern frontiers of India (1847–j1), where he made a survey of previously unexplored regions. In 185j he was appointed assistant director of Ken- gardens and in 1865 succeeded his father as director. He was president of the Royal society from 1873 to 1878. It was to him that Darwin first imparted his theory of natural selection in 1844. and he. with Sir Charles Lyell, induced Darwin to make public his views on the origin of species (1858) after A. R. Wallace had communicated similar ideas.

Hooker's works. in addition to those already mentioned. include *Outlines of the Distribution of Arctic Plants* (1862); a standard *Student's Flora of the British Isles* (1870); a monumental work. the *Genera plantarum* (1862–83). in collaboration with G. Bentham; and *Flora of British India* (1855–97). Among other honours he was awarded the Order of Merit in 1907.

He continued his botanical studies until his death at Sunningdale, Berkshire, on Dec. 10, 1911.

See L. Huxley, *Life and Letters of Sir J. D. Hooker,* 2 vol. (1918), with list of works; W. B. Turrill, *Pioneer Plant Geographer* (1953).

HOOKER, RICHARD (1554–1600), Anglican divine. author of *The Laws of Ecclesiastical Polity* and aptly known. in his own time and since, as the "judicious Hooker," was born of middle-class parents at Heavitree, near Exeter, in March 1554. Educated at Exeter school. he secured the patronage of John Jewel, bishop of Salisbury, through whose influence he entered Corpus Christi college. Oxford. Elected a foundation scholar in 1573. Hooker became a fellow in 1577. In his earlier years he was not without some Puritan sympathies, since his patrons — Jewel. and his uncle John Hooker — had been fellow-exiles in Mary's reign. In 1584 he vacated his fellowship for the benefice of Drayton Beauchamp. Buckinghamshire, but in the next year became master of the Temple. His appointment created a difficult situation. since Walter Travers, a popular preacher. was already established as reader; the master was loyal Anglican, the reader firm Presbyterian. so that on Sundays "the pulpit spake pure Canterbury in the morning and Geneva in the afternoon." The inevitable partisanship "turned to his extreme grief," for Hooker was of gentle disposition; also Travers' brother had married Hooker's sister. He sought release in order to examine in peace and quiet the principles underlying the establishment of the Church of England. In 1591 therefore he accepted the living of Boscombe in Wiltshire and a prebend in Salisbury cathedral. But he probably continued to live in London and there wrote the first four books of his

imperishable *Of the Laws of Ecclesiastical Polity* (published 1593). He had married Joan Churchman in 1588 and probably lived in her father's house till appointed to the rectory of Bishopsbourne, near Canterbury, in 1595. The legend, repeated by Thomas Fuller, John Gauden and Izaak Walton, that Joan was an unpleasant shrew of a wife, was accepted until disproved by C. J. Sisson in 1940. Hooker died at Bishopsbourne on Nov. 2, 1600, and was buried in his own chancel.

The *Laws of Ecclesiastical Polity* was planned to include eight books. There is evidence that Hooker completed these manuscripts: William Covell, writing in 1603, says that Hooker told him so. After his death they were entrusted to Dr. John Spenser, president of Corpus Christi college, who bequeathed them in 1614 to the bishop of London; about 20 years later George Abbott, archbishop of Canterbury, placed them in the Lambeth library. The fifth book had been published in 1597, but the last three books did not appear in their author's lifetime. Of these the present book 6 (which seems not germane to Hooker's general purpose) and book 8 (on the royal supremacy) did not appear until 1648; while book 7 (devoted to an examination of episcopacy) remained unknown until published in 1662, by Gauden, the unscrupulous bishop of Exeter.

This long delay in publication has aroused doubt about the authenticity of the last three books. Izaak Walton on hearsay evidence 40 years old alleged that Puritan friends of Joan mutilated the manuscripts. It is equally reasonable to assert, with Henry Hallam and Coleridge, that the enemies of Puritanism tampered with the two books on episcopacy and the royal supremacy, for in book 7 particularly the necessity of monarchical episcopacy is much more strongly urged than in the earlier books.

The Laws of Ecclesiastical Polity, a masterpiece of Elizabethan literature for its balanced, dignified style, is of great importance in theology, in political philosophy and as an exposition of the Tudor constitution. Hooker set himself to defend the Elizabethan settlement in church and state against Roman Catholics and Puritans. The safety of the realm demanded unity among its subjects, and as "Religion is the chiefest stay of the Commonwealth," Hooker's basis and outlook are theological. His most important single contribution was to affirm the Anglican tradition as that of a threefold cord not quickly broken—Bible, Church and Reason. Roman Catholics put Bible and tradition on a parity, while Puritans looked to Scripture as sole authority. Hooker avoided both extremes, allouing to Scripture absolute authority where it spoke plainly and unequivocally; where it was silent or ambiguous, wisdom would consult the tradition of the church in an interpretative role; but he insisted that a third element in religion lay in man's reason, itself part of the universal law and illuminated by God, which should be obeyed whenever both Scripture and tradition needed clarification, or failed to cover some new circumstance. Thus he not only avoided the "either-or" of Scripture *versus* tradition, but introduced a third and new element, human reason.

Consistently, therefore, Hooker distinguishes between "things necessary" in religion (*i.e.*, the great Christian truths contained in or deducible from Scripture, which must be believed) and "things accessory and dependent," which merely must not be contrary to Scripture. Thus, as an orthodox believer defending some ancient Catholic doctrines and explaining Anglican teaching—*e.g.*, finding auricular confession "profitable"—he resists the excesses of earlier reformers. But on the inflammatory though "accessory" topics of church polity, rites and ceremonies, he held that as Scripture prescribes no particular form of church government, reason permits that "the public society of God" in any land is free to erect its own polity and choose its own rites, for the church is an organic institution, in which the Holy Spirit still leads men into further truth by the light of reason. Thus, for example, while the Church of England has retained episcopacy, Hooker cannot deny validity to those reformed churches which reject it.

The core of Hooker's arguments on the relations of church and state is unity, the great concept of medieval thinking. In his view, the Puritans adupted an impossible position; they claimed to be loyal to the queen while repudiating the queen's church. "When they strike at the State Ecclesiastical, they secretly wound the Civil State." By law and by reason an Englishman must be an Anglican, pledged to serve Elizabeth as the supreme magistrate of his country and the supreme governor of his church. Both offices came to her through the wisdom of God and the laws of parliament, representing the authority of the whole realm. The church is the same society as the state, organically one, differing only in function. To preserve that identity and consequent unity—the alternative is division and ruin—there must be a supreme head over both; and Scripture, history and reason teach that this must be the sovereign. The church is not less divine by being organically bound with the state, but more so, because the state itself is of divine origin existing to a divine end (*i.e.*, to make "good" citizens).

Hooker's thesis necessarily introduced the question of authority and obedience, and these may only be harmonized by law.

> Of Law there can be no less acknowledged, than that her seat is the bosom of GOD, her voice the harmony of the world: all things in heaven and earth do her homage, the very least as feeling her care, and the greatest as not exempted from her power.

Thus, law is far from being mere command; it emanates from God and so is apprehended by man through reason. This natural reason directs individual men how to order their lives; and thus when men come to live together in a political society or commonwealth (itself natural as guaranteeing the satisfaction of human needs and fellowship) reason dictates that commonwealth must be inspired by law, which must establish government, or anarchy would prevail. Thus authority and obedience in society are natural as partaking of divine law.

It is not surprising that Sir W. S. Holdsworth declares that the *Ecclesiastical Polity* provides the best summary of the actual state of the law of sovereignty in the 16th century, and that in it the theory of the English state in that century can most clearly be seen. It is, therefore, of great historical interest because it is the only book which not only describes Tudor polity in church and state but also explains its underlying principles; while its constitutional importance is enhanced because the results of the controversies of the 17th century were to give practical effect to the theory of the state outlined in it.

Yet Hooker's apology is not wholly consistent: at one moment he asserts the sovereign's supremacy, at another the necessity of the subject's consent. Consequently people in opposite camps have cited him. Thus in 1932 and 1933 studies of his teaching on the Tudor state appeared in Italy and Germany, while in England republican writers such as Milton, Sidney and Locke have accepted his emphasis on the supremacy of the law as above prerogative rule, and have drawn from him the doctrines of the original freedom of man, of the contract by which he conditionally surrendered his freedom and of the resultant necessity for his real consent to proposals for law and of government: but conservative Hooker denies what they logically affirm, man's right to resist tyranny in the sovereign power.

BIBLIOGRAPHY.—The standard edition of the *Laws of Ecclesiastical Polity* is that *by* John Keble, 3 vol. (1836; rev. ed. by R. W. Church and F. Paget, 1888), to which is prefixed Izaak Walton's *Life*, written in 1665 to correct the *Life* by John Gauden in his 1662 edition of the *Works*. An account of Hooker's life is also prefixed to R. W. Church's 2nd edition of book 1 of the *Ecclesiastical Polity* (1876). C. J. Sisson's *Judicious Marriage of Mr. Hooker* (1940) challenged and superseded all these lives but is not in itself a complete biography. Contemporary criticism included William Covell's *Just and Temperate Defence of the Five Books* (1603). A. P. d'Entreve, *Ricardo Hooker* (1932), and G. Michaelis, *Richard Hooker als politischer Denker* (1933), show that Hooker was studied under the Fascist and Nazi regimes. *See* also R. A. Houk's introduction to his edition of book 8 (1931); P. Munz, *The Place of Hooker in the History of Thought* (1952); F. J. Shirley, *Richard Hooker and Contemporary Political Ideas* (1949); W. S. Holdsworth, *History of English Law*, vol. iv (1924), which deals with Hooker's philosophy of the Tudor state.

(F. J. SH.)

HOOKER, THOMAS (1586–1647), American clergyman, through his piety, zeal and wisdom unquestionably one of the foremost of colonial pastors, was born, probably on July 7, 1586, at Marfield, Leicestershire, Eng. He took his M.A. in 1611 at Emmanuel college, Cambridge, the intellectual centre of Puritan-

ism; remained there as a fellow for a few years; and then preached in the parish of Esher in Surrey. About 1626 he became lecturer to the church of St. Mary at Chelmsford. Essex. delivering on market days and Sunday afternoons evangelical addresses which were notable for their moral fervour. In 1629 Archbishop William Laud took measures to suppress church lectureships, which were an innovation of Puritanism. Hooker was placed under bond and retired to Little Baddow, near Chelmsford. In 1630 he was cited to appear before the court of high commission, but he forfeited his bond and fled to Holland, whence in 1633 he emigrated to the colony of Massachusetts Bay in America. He became pastor at Newtowne (now Cambridge, Mass.) of a company of Puritans who had arrived from England in the previous year and, in expectation of his joining them, were called "Mr. Hooker's Company." Hooker publicly criticized the limitation of suffrage to church members, and, according to a contemporary historian, William Hubbard *(General History of New England).* "after Mr. Hooker's coming over it was observed that many of the freemen grew to be very jealous of their liberties." He was a leader of the emigrants who in 1636 founded Hartford. Conn. *(see* CONNECTICUT). He declared, before the Connecticut general court of 1635, that "the choice of public magistrates belongs unto the people by God's own allowance" and "they who have the power to appoint officers and magistrates, it is in their power, also, to set the bounds and limitations of the power and place unto which they call them." Though this theory was in advance of the age and caused many historians to call him "the father of American democracy," Hooker had no idea of the separation of church and state — "the privilege of election. which belongs to the people," he said, must be exercised "according to the blessed will and law of God." Hooker was pastor of the Hartford church until his death on July 7, 1647.

See G. L. Walker's *Thomas Hookrr* (1891), the best biography, which contains a bibliography of Hooker's published works.

HOOKER, SIR WILLIAM JACKSON (1785–1865), English botanist famous for his work as the first director of the Royal Botanic gardens at Kew, Surrey, was born at Norwich on July 6. 1785, and educated at the high school there. The natural history specimens of his first botanical expedition to Iceland in 1809 were lost on the homeward voyage through the burning of the ship, but Hooker was able to publish an account. mainly from memory, of the island and of its inhabitants and vegetation *(Tour in Iceland,* 1811). In 1814 he spent nine months botanizing in France; Switzerland and northern Italy; and in 1815 he married Maria Turner and settled at Halesmorth, Suffolk, devoting himself to systematic botany and the analysis of his herbarium, which became of world-\vide renown among botanists. In 1816 he published the *Britislz Jungermanniae,* succeeded by a new edition of William Curtis' *Flora Londinensis;* by the *Muscologia Britannica,* prepared in conjunction with T. Taylor (1818; 2nd ed., 1827); and by his *Musci Exotici* (2 vol., 1818–20), devoted to new foreign mosses and other cryptogams. In 1820, on the recommendation of Sir Joseph Banks, he was offered and accepted the regius professorship of botany in Glasgow. In 1821 he brought out the *Flora Scotica.* In 1841 he was appointed director of the Royal Botanic gardens at Kew; and under his direction the botanical collection expanded sixiold. By his energy and influence he greatly advanced knowledge of the higher plants and ferns, algae. lichens and fungi. He died on hug. 12. 1865. One of his sons. Sir Joseph Dalton Hooker (*q.v.*), followed his father's lead in botany.

Hooker's most important works besides those mentioned above include: *Exotic Flora* (1822–27); *Botanical Magazine* (1827–64); *Incones Filicum,* with *R.* K. Greville (1829–31); *British Flora,* with G. A. W. Arnott *et al.* (1830; 8th ed., 1860); *Flora Borealis Americana* (1829–40); *Journal of Botany* (1830–42); *Icones Plantarum* (1836–54); *The Botany of Captain Beechey's Voyage to the Pacific and Behring's Straits,* with *G. A.* W. Arnott (1830–41); *Genera Filicunz* (1838–42); *London Journal of Botany* (1842–48); *Species Filicum* (1846–64); *Journal of Botany and Kew Garden Miscellany* (1849–57); *Niger Flora* (1849); *Filices Exoticae* (1857–59); *British Ferns* (1861–62).

See J. D. Hooker, *Sir William Jackson Hooker* (1903).

HOOKWORM is a parasitic roundworm. When present in excessive numbers, two important parasites. *Ancylostoma duodenale* and *Necator americanus,* cause hookworm disease in the human being.

A malady resembling hookworm disease was described in Egypt as early as 1600 B.C. *A. duodenale* was discovered in Europe and associated with the disease in the middle of the 18th century. *N. americanus* was discovered in America in 1901–02 by Charles W. Stiles. It probably originated in Africa and was introduced into the new world by slaves.

The female worm deposits eggs in the intestine of the host. Each egg contains a two- to eight-segmented embryo, when passed in the feces. The embryo grows in the soil and hatches in 24 to 48 hours as an immature, noninfective larva. After two to three days it molts and develops into a mature, infective, nonfeeding larva. On contact with the human skin it molts again and penetrates the deeper skin layers, often causing "ground itch." It then invades lymph and blood vessels, is carried to the lungs. passes up the respiratory tree to the mouth and is swallowed. The larva undergoes a third molt, anchors itself to the intestinal mucosa, molts for a fourth time and becomes an adult worm. The worms live in the small intestine, and eggs are passed in the feces as early as five to six weeks after the larvae enter the skin.

The average sizes of adult worms are: *A. duodenale:* males 7-11 × 0.45 mm., females 9-14 × 0.6 mm.; N. *americanus:* males 6-9 × 0.2j mm., females 8-12 × 0.4 mm. The worms live in the intestine for many months. A few may persist for six to seven years or longer. Continual reinfection and acquired partial resistance result in a more or less constant number of worms harboured. Infective larvae when swallowed can develop in the intestine without preliminary lung passage, but this mode of transmission is not common in nature. There are two dog hookworms, *A. brasiliense* and *A. caninum,* which may infect man. Usually they cause an aberrant infection. "creeping eruption" or larva migrans. This disease is characterized by serpiginous tunnels in the skin caused by migrations of larvae that are unable to penetrate the innermost layers.

Hookworm infection occurs in a zone from approximately latitude 38° N. to 34° S. and may be encountered in cooler regions. particularly in mines and tunnels. The geographical distribution is determined by temperature and rainfall. which influence development of free-living larvae. Other important factors are drainage, type of soil, social habits and customs, poverty and bad sanitation. Optimum temperature ior larval development is between 70° and 85° F., *4. duodenale* being better adjusted to the lower range than *N. arnericanus,* which predominates in warmer regions.

Fully developed eggs and newly hatched larvae die in a few days ii kept below 43° to 46° F. Mature larvae can resist freezing temperatures as long as six days; developmental time is tripled at temperatures of jj° to 60° F. Under optimum conditions, iniective larvae may remain viable in the soil for several months or longer, but under natural conditions in the tropics the majority rarely survive longer than five or six weeks. A minimum rainfall of 40 in. per annum is required to maintain the infection in endemic proportions. The distribution of the rainfall throughout the year is also important; *e.g.,* a long dry season is detrimental to larvae in the soil. Drainage and subsoil water level are important in irrigated regions, or where canals are present. Coarse, sandy soil with humus is much more favourable for larval development than fine clay or silt loam, since larvae migrate vertically with changes in moisture and temperature. They cannot pass rapidly through fine-textured soils and thus become dry and die.

Hookworm disease is a scourge of tropical climates, resulting in a debilitated anemic population. Anemia in hookworm disease results from sucking of blood by the adult worms in the intestine and the attendant inflammation of the bowel. A single *A. duodenale* can remove, on the average, almost one cubic centimetre of blood a day. As a bloodsucker, *N. arnericanus* is about one-fifth as efficient. Infected individuals on adequate diet have been classified in iour groups, according to numbers of *N. americanus* harboured: (1j carriers, 2j or fewer worms — no symptoms; (2) light infections, 26 to 100 worms — few or no symptoms; (3) mod-

erate infections, 101 to 500 worms—moderate symptoms; (4) heavy infections, more than 500 worms—severe symptoms. In general. the symptoms in classical, heavy infections include pallor or' skin and mucous membranes, edema of the face and extremities, constipation alternating with diarrhea, abdominal tenderness, increased appetite for bulky foods or unusual substances (clay eaters j, sexual derangements (delayed puberty, impotence, irregular menstruation), endocrine insufficiency, stunted growth, cardiac weakness, palpitation, hypersensitiveness of the skin to cold. physical debility, fatigue. dullness. apathy and melancholia.

Microscopic laboratory diagnosis is made by searching for characteristic eggs in feces. In moderate or heavy infections, eggs are easily found. In light infections, so few eggs may be present that concentration by brine or zinc suliate flotation methods should be used. Egg-counting techniques are useful in estimation of the number of worms harboured by an individual. Parasitism with a very few eggs in feces is harmless. The laboratory report, therefore, should indicate the degree of infection, as determined by the egg count.

Treatment **and** Control.— Treatment involves removal of the worms and reduction of anemia. Worm removal in severe cases requires great skill. The vermifuge may be harmful if given before the patient is improved physically. Thus preliminary blood transfusion may be required with dietary and iron therapy before the vermiiuge is given. Many vermifuges have been used. Thymol, oil of chenopodium and carbon tetrachloride are effective but also toxic. They were supplanted by tetrachlorethylene and hexylresorcinol. The former is a safe drug and removes 90% or more of the worms on a single treatment. It may, however. cause migration of the roundworm *Ascaris lumbricoides*. Hexylresorcinol has no serious contraindications, is effective against 80% of the worms and removes 90% of *A. lumbricoides* on a single treatment. "Creeping eruption" caused by the larva of the dog hookworm is treated by freezing the migratory larvae in the skin with carbon dioxide snow or ethyl chloride spray. Mass treatment of large groups of heavily infected persons has been successful in reducing the incidence of hookworm, especially during the dry season when the soil contains few larvae and reinfection is minimal. Repetition of treatment every two to three years may be required.

Transmission of infection depends upon indiscriminate disposal of human infected excreta. Where all workers in the soil go barefoot. there is ample opportunity for intimacy of contact with polluted soil. The wearing of shoes would eliminate the disease. but in most hookworm regions the people cannot afford shoes and are ignorant of the dangers of bad sanitation. Without proper education and improvement in standard of living, little can be accomplished in securing satisfactory, permanent hookworm control. The International Health board of the Rockefeller foundation pioneered in hookworm control and pointed the way for adequate control programs. The essentials of this program are: (1) education in the principles of sanitation, emphasizing the importance of adequate disposal of feces, and aid in construction of simple sanitary toilets; (2) establishment of full-time local health services staffed by trained competent personnel; (3) examination and treatment of persons infected with hookworm disease; (4) continuous observation of the area to prevent the return of former unsanitary conditions. The success attained indicates the possibility of global control of this insidious tropical disease. *See* PARASITIC DISEASES; PARASITISM AND PARASITOLOGY; TROPICAL MEDICINE. (I. R.)

HOOLOCK: *see* GIBBON; PRIMATES.

HOOPER, FRANKLIN HENRY (1862–1940), editor of the *Encyclopedia Britannica* from 1932 to 1938, was born at Worcester, Mass.. Jan. 28, 1862. a brother of Horace Everett Hooper (*q.v.*). He graduated from Harvard in 1883. He was associated with the Century company from 1883 to 1896. being one of the editors of the *Century Dictionary*. He was literary adviser and manager for James Clarke and company. publishers. 1897–99. and became an editor of *Encyclopedia Britannica* in 1899. He was connected with five diiferent editions of the *Britannica:* associate editor of the 10th edition (1902); managing editor of the 11th edition (1910); and American editor of the 12th (1922). 13th (1926) and 14th (1929) editions. In 1932 Hooper became editor in chief. He edited and planned *These Eventful Years* (1924). and was also editor of *Britannica Junior* and the *1938 Britannica Book of the Year*. He retired in April 1938 and died near Saranac Lake, N.Y., on Aug. 14, 1940.

HOOPER, HORACE EVERETT (1859–1922), publisher of the *Encyclopædia Britannica*, was born in Worcester, Mass., on Dec. 8, 1859. He was of English descent; his father's ancestors included "King" Hooper. who had controlled much of the Massachusetts fishing interests in the 1700s, and his mother was a descendant of John Leverett. governor of Massachusetts, 1672–79. Hooper ended his formal education at the age of 16. after attending schools in Worcester and Washington, D.C. He clerked in bookstores. then went to Denver. Colo., where. with others, he organized the Western Book and Stationery company to sell books in western states. In 189; he shifted his headquarters to Chicago, Ill., where he organized. among other enterprises. a highly successful sale of the *Century Dictionary* through colourful and aggressive advertising. On a vacation trip to London in 1897, he became cognizant of an opportunity to market the ninth edition of the *Encyclopædia Britannica* by similar methods. With three others—Walter Montgomery Jackson and the Clarke brothers. James and George—he secured reprint rights from A. and C. Black. the work's publishers. then persuaded the *Times* (London) to lend its reputation and imprimatur to the reprint edition. He reduced the price and revolutionized the sale of the set by instituting an installment payment plan. *Times* officials anticipated meagre results! but the sale was astounding; in the first three months of 1898 some 10,000 sets were sold and in the subsequent five years another 50,000.

The success of this venture led Hooper to prepare, in 1902, a supplement of 11 volumes (under the joint editorship of Sir Donald Mackenzie Wallace, Arthur T. Hadley, president of Yale university. Hugh Chisholm and Hooper's brother Franklin) which, added to the ninth, formed the tenth edition. Again the sale, sparked by flamboyant advertising and promotional techniques. was large. Consequently. Hooper's influence at the *Times* expanded; he took an active part in its management as advertising director and was instrumental in organizing the *Times* Book club. a move that led him into rancorous controversy with various book publishers. Shortly after Lord Northcliffe became proprietor of the *Times* in 1908. Hoopcr's connection with that paper ended. He continued to live in England. but also maintained homes in the United States.

In 1903 Hooper had organized the preparation of an entirely new edition of the *Encyclopædia Britannica*, the 11th. Unlike previous editions, this one. edited by Hugh Chisholm, was to be issued as a single unit and not volume by volume. Despite difficulties occasioned by Hooper's separation from the *Times* and his subsequent legal wars with his erstwhile partner. Jackson, the edition was published, under an arrangement with Carnbridge university. in 1910–11. It was successful, its sale reaching some 75,000 in the next few years. In the years immediately preceding and during World War I. Hooper initiated other publishing projects, notably an edition of the *Encyclopædia Britannica* in smaller and cheaper form known as the Handy Volume issue. of which some 200,000 copies were sold. His final enterprise was the publication early in 1922 of the three war volumes of the *Encyclopcedia Britannica* which, with the 29 volumes of the 11th edition. constituted the 12th edition.

A master salesman and a daring innovator, Hooper was passionately devoted to the educational product he offered. He was convinced that the *Encyclopedia Britannica,* as a medium of popular education, was without a peer. When he died in Bedford Hills, N.Y., on June 13, 1922, the *New York Times* offered apt estimate: "In the view of the public, his success lay in the originality, boldness and brilliance of his operations. But that was merely the surface. The deeper source was his faith in the intelligence and the ambition of a great mass of citizens. Many professional educators of note have done less than he toward popular enlightenment:"

See Janet E. Courtney, *Recollected in Tranquillity (1928)* and *An Oxford Portrait Gallery* (1931); Herman Kogan, The *Great* EB *(1958)*. (HN. K.)

HOOPER, JOHN (d. 1555), bishop of Gloucester and Wortester and martyr. was born in Somerset about the end of the 15th century and graduated B.A. at Oxford in 1519. In 1538 a John Hooper appears among the names of the Black friars at Gloucester, another among the White friars at Bristol who surrendered their houses to the king, and another as canon of Wormesley priory in Herefordshire; but identification of any of these with the future bishop is doubtful, and in the sentence pronounced against him by Stephen Gardiner he is described as *"olim monachus* de *Cliva Ordinis Cisterciensis"; i.e.,* of the Cistercian house at Cleeve, Somerset. Before 1546 he was employed in the household of Sir Thomas Arundell, and Hooper speaks of himself at this period as being "a courtier and living too much of a court life in the palace of our king." But he chanced upon some of Huldreich Zwingli's works and Heinrich Bullinger's commentaries on St. Paul's epistles; and after some molestation in England and some correspondence with Bullinger he took refuge on the continent. reaching Strasbourg in the midst of the Schmalkaldic war. There he married Anne de Tserclaes, and later proceeded by way of Basle to Zürich, where his Zwinglian convictions were confirmed by constant intercourse with Bullinger, Zwingli's successar.

In May 1549 Hooper returned to England. He at once became the principal champion of Swiss Protestantism against the Lutherans as well as the Catholics and was appointed chaplain to the protector Somerset. After Somerset's fall he became Warwick's chaplain and after a course of Lent lectures before the king was offered the bishopric of Gloucester. This led to a prolonged controversy; Hooper had already denounced the "Aaronic vestments" and the oath by the saints prescribed in the new ordinal, and he refused to be consecrated according to its rites. Thomas Cranmer, Nicholas Ridley, Martin Bucer and others urged submission; but he spent some weeks in the Fleet prison before he submitted to consecration with the legal ceremonies (March 8, 1551).

Although he had opposed Northumberland's plot for the exclusion of Mary from the throne, he was sent to the Fleet on Sept. 1, 1553, on a doubtful charge of debt to the queen; the real cause was his staunchness to a religion which was still by law established. Edward VI's legislation was, however, repealed in the following month, and in March 1554 Hooper was deprived of his bishopric as a married man. There was still no statute by which he could be condemned to the stake, but Hooper was kept in prison, and in December the heresy acts were revived. On Jan. 29, 1555, Hooper, John Rogers, Rowland Taylor and others were condemned by Gardiner and degraded by Edmund Bonner. Hooper was sent to Gloucester, where he was burned on Feb. 9.

Hooper was the first of the bishops to suffer, because his Zwinglian views placed him further beyond the pale than Cranmer, Ridley and Hugh Latimer. He represented the extreme reforming party in England. While he expressed dissatisfaction with some of Calvin's earlier writings, he approved of the *Consensus Tigurinus* negotiated in 1549 between the Zwinglians and Calvinists of Switzerland; and it was this form of religion that he laboured to spread in England against the wishes of Cranmer, Ridley, Bucer, Peter Martyr and other conservative theologians. He would have reduced episcopacy to narrow limits, and his views had considerable influence on the Puritans of Elizabeth I's reign.

HOOPER, JOHNSON JONES (1815–1862), U.S. humorist and author of a series of tall tales describing "Some Adventures of Captain Simon Suggs," a shifty backwoods frontiersman He was born in Wilmington. N.C., and at the age of 20 moved to the frontier town of Lafayette, Ala., to read law under an elder brother. In 1842 he accepted the editorship of the East Alabamian, a weekly newspaper, for which he wrote "Taking the Census," a humorous essay, and the Simon Suggs series. Copied by the New York Spirit of the Times and widely quoted, these stories quickly brought Hooper national fame. In 1845 they were first published in book form. A second volume, *A* Ride With Old Kit Kuncker, was issued in 1849.

Meantime, Hooper had become known as a fearless journalist and. after editing several smaller papers, he became co-owner and editor of the Montgomery Mail. An ardent secessionist, in 1861 he was elected secretary of the provisional congress of the Confederate states and, when the capital was transferred from Montgomery, he moved to Richmond, where he died 13 months later.

See W. Stanley Hoole, *Alias* Simon Suggs: *the Life* and Times of Joknson Jones *Hooper* (1952). (W. S. HE.)

HOOPOE, any of about seven species of old world birds related to the rollers, having a slender decurved bill and constituting the families Upupidae (cinnamon-coloured hoopoes) and Phoeniculidae (glossy blue-black wood hoopoes) in the order Coraciiformes. The common hoopoe (*Upupa epops*), with nine races. ranges over Europe, Africa, Madagascar, Asia and Malaya to Sumatra. It is the size of a large thrush, with head and neck golden buff, its handsome semicircular crest opening and closing continually, bordered narrowly with white and tipped with black. It feeds on insects, grubs and worms and is filthy in food and habits. Its six to nine bluish or greenish-to-olive eggs are laid in a hole in bank, wall or tree, without nest. The other six species (*Phoeniculus* and *Rhinopomastus*) are called wood hoopoes or kakelaar; they have a long, wedge-shaped tail and no crest and inhabit savannahs and forests in Africa south of the Sahara. The different species are 9 to 18 in. long. They are shy, flitting among branches and climbing about trunks for insect food. Four whitish eggs are laid in a hole in a tree. The purple kakelaar (*P. purpureus*), with 12 races, extends well over Africa. (G. F. Ss.)

HOORN, a seaport in the province of North Holland, Netherlands, on a bay of the IJsselmeer called the Hoornerhop, 23½ mi north by east of Amsterdam. Pop. (1957 est.) 15,607 (mun.). In 1356 it received municipal privileges, and in 1426 it was surrounded with walls. There in 1416 the first great net was made for the herring fishery. In 1569 Spanish forces entered the town; but in 1572 it cast in its lot with the states of the Netherlands. Among the celebrities of Hoorn is William Schouten, who discovered in 1616 the passage round Cape Horn, or Hoorn, as he named it. Hoorn is distinguished for the beauty of its numerous gabled houses of the 16th and 17th centuries. Many of these are decorated with inscriptions and bas-reliefs, some of which commemorate the battle on the Zuider Zee in 1573. The Gothic bastion tower overlooking the harbour was built in 1532, the East gate not later than 1578. Among the public buildings are the St. John's hospital (1563); the old mint; the hospital for aged men and women (beginning of 17th century); the weighhouse (1609); the town hall; and the old courthouse, which dates from the beginning of the 17th century. though parts of it are older. There is a considerable trade with other parts of the Netherlands, especially in cheese and cattle. The small industries include gold and silver work, tobacco factories, sawmills and some boatbuilding yards.

HOOTON, EARNEST ALBERT (1887–1954), U.S. physical anthropologist, was a leading anthropometrist, known for both his scientific and his popular writings. Born Nov. 20, 1887, in Clemansville, Wis., he was educated in the classics at Lawrence college in Appleton, Wis. (A.B., 1907), and at the university of Wisconsin in Madison (M.A., 1908; Ph.D., 1911), where he also taught. He went to Oxford university as a Rhodes scholar in 1910. There his interest suddenly shifted from classical writers to the tribes they had described, and Hooton took up physical anthropology, largely independent of the continental traditions. He received his Ph.D. at Wisconsin in 1911, a diploma in anthropology at Oxford in 1912. and in 1913 a research degree from Oxford. He became an instructor at Harvard in the same year and was named professor in 1930, a position he held until his death in Cambridge, Mass., on May 3, 1954.

His originality in an undeveloped field, his avidity for the courses he taught, and a clear and witty delivery made him an outstanding teacher. The majority of professional workers in physical anthropology for a generation were his students, so that the influence of his formulations and methods was exceptional. His early research was on the craniology of Guanches and of American Indians. Out of his monumental study of the skeletons from the extinct Pecos (New Mexico) pueblo (1931), he developed a scheme of racial types that he believed to have composed the Indian stock as a whole, suggesting non-Indian components such as Mediterranean and Negroid. He was editor of the Harvard

"African Studies" series (1918–33) and organized and directed the Harvard Irish survey after 1932, from which stemmed a large number of publications in various fields of anthropology. His interest in types was carried further in his investigation of American criminals, but in the later part of his career he turned to the bodily constitution of the individual, being a major supporter of the method of body typing developed by W. H. Sheldon *(see* PERSONALITY: *Morphological* or *Physical Types)*. His criminal studies provoked considerable controversy, since he stressed the biological component of behaviour and the notion of the constitutional inferiority of criminals at a time when these ideas were in particular conflict with contemporary criminological opinion.

He was a writer of grace and precision, for which he credited his classical education. Beginning with *Up from the Ape* (1931; rev. ed., 1946), he published a series of popular books for laymen, including *Apes, Men and Morons* (1937), *Crime and the Man* (1939), *Why Men Behave Like Apes and Vice Versa* (1940) and *Man's Poor Relations* (1942), all notable for the presentation of information with humour and strength of personal view.

(W. W. H.)

HOOVER, HERBERT CLARK (1874–), 31st president of the United States, was born on Aug. 10, 1874, in the village of West Branch, Ia. He was the second of three children of Jesse Clark and Huldah Minthorn Hoover, both Quakers with a long American Quaker ancestry. Jesse Hoover, the village blacksmith, finally established a farm-implement business. He died when Herbert was six years old. Huldah, an unusually gifted woman, was a school teacher. She spoke frequently at Quaker meetings and took part in local "prohibition" campaigns. After Jesse's death she kept the family, taking in sewing, and carefully saving the life insurance left by her husband toward the education of the children. Herbert attended the public school at West Branch, but upon the death of his mother when he was eight, he was sent to the home of an uncle, Henry John Minthorn, a country doctor living in Newberg, Ore.

When he was 15, his uncle established a land settlement business in Salem, Ore., and for two years Herbert worked as office boy. He picked up the rudiments of typewriting, and in a business college in Salem developed a knowledge of mathematics. From a public library a friend brought him a copy of *Ivanhoe*, which opened to him the world of literature. A chance encounter with an engineer caused him to think of the importance of a college education and he determined to become a mining engineer. Declining scholarship aid at Earlham college (Quaker) because it had no engineering course, he turned his attention to Stanford university, which was about to open in California. Hoover entered Stanford as a member of its first freshman class on Oct. 1, 1891, and worked his way to graduation (A.B.) by typing and by operating a laundry agency and a newspaper route. During summer vacations he served as an assistant with a state geological survey in Arkansas, and with the U.S. geological survey in California and Nevada. Despite his working to earn his living, he participated in extracurricular activities, including a term as football team manager. He records in his *Memoirs* his contacts with Sen. Leland Stanford and, on one occasion, with former president of the United States, Benjamin Harrison, who was at Stanford delivering a special series of lectures on government.

After graduation from Stanford in 1895, Hoover worked for a brief time as a labourer in California mines. He then joined the staff of Louis Janin, a mining engineer in San Francisco, Calif., and in Oct. 1897, on his nomination to Bewick, Moreing & Co. of London. was placed in charge of their projects in Australia. Meanwhile, he had been reading books on economics in his spare time. While visiting England, he was deeply impressed by the historic landmarks in the long history of the British people. His work in Australia, filled with adventure and experience for himself, was profitable for his employers. They transferred him to China, where he became chief engineer in the newly organized bureau of mines of the Chinese government. Returning to London from Australia and then journeying to California in 1899, he married Miss Lou Henry (1874–1944), whom he had known as a fellow student at Stanford. He and his bride reached Peking in March 1899. Caught in the Boxer rebellion in June 1900, they were active in relief work until the arrival of international forces who rescued all foreigners in August.

In Nov. 1901 Hoover became a partner of Bewick, Moreing & Co., from which he withdrew after seven years to take up an independent career. He engaged in mining activities throughout the world, maintaining offices in New York city, San Francisco and London. Until 1914 he spent much of his time in England, but he also acquired a house at Stanford university, because he and Mrs. Hoover wished to spend more time in the U.S. as their two sons Herbert (1903–) and Allan Henry (1907–) grew up.

Hoover gave much thought during those years to engineering, which, in his lifetime thus far, had been transformed, as he put it, "from a trade into a profession." Lectures he gave at Columbia and Stanford universities were published in 1909 under the title *Principles of Mining*. He had also become interested in earlier writings on applied science, especially in Georgius Agricola's *De re Metallica*, printed in Latin in 1556. For five years Mr. and Mrs. Hoover spent their spare time in its translation which was published privately by them in 1912. A trade edition was published in 1950.

Always retaining a close interest in his native land, Hoover had thought of entering public service in some capacity, but his contacts in engineering and in government transcended national boundaries and his association with those active in politics were few, even in California, where he retained his residence. The factional political struggles that rocked the U.S. in the first decade of the 20th century apparently left little impression on him.

Prior to World War I he had for 18 years lived abroad, working as an administrative engineer on industrial projects in Russia, China, India, Australia, New Zealand, South Africa. Canada, Great Britain, Belgium and Mexico, as well as in the United States. Everywhere he went he participated in the daily life and work of the people.

As a U.S. citizen long resident in London, Hoover at the outbreak of World War I in Aug. 1914, organized and served as chairman of an "American Committee" in London which aided in securing passage home for more than 100,000 American tourists. The Commission for Relief in Belgium, a voluntary organization to which U.S. officials and residents in London gave full support, was started in Oct. 1914 with Hoover as chairman. Soon afterward he made the first of many visits to observe the problem of destitution in Belgium. Hoover concluded agreements with the British which permitted passage of food, clothing and medical supplies through the Allied blockade. The Germans, in turn, gave protection to the distribution of these supplies to the 10,000,000 people of Belgium and northern France. He ultimately secured subsidies for support of the commission from the governments of France, Great Britain and the United States. Under his direction, the commission expended nearly $1,000,000,000.

When the United States entered the war in April 1917, Hoover returned to the United States and in May Pres. Woodrow Wilson appointed him U.S. food administrator. In this work of stimulating production and conserving supplies, he called upon and obtained voluntary action from the American people. He organized the U.S. Grain corporation, Sugar Equalization board and Food Purchase board, agencies which, under his direction, handled over $8,000,000,000 in supplies for the U.S. public and military forces and for the Allies. During the critical year July 1, 1918–July 1, 1919, Hoover's Food administration furnished 18,500,000 tons of food, more than three times the normal export, to the Allies and famine areas of Europe. He served at this time as a member of President Wilson's War Trade council and as chairman of the Inter-allied Food council.

Hoover served also as alternate chairman of the Supreme Economic council and as a member of the advisory economic committee of the U.S. delegation to the peace conference. Establishing his headquarters in Paris, he co-ordinated the continuing work of the Food administration, the Belgian and Northern France Relief commission and the Relief and Reconstruction of Europe commission, of which he had been appointed director general by the Allied governments. These operations spread over 30 European

countries where, with the authorization of congress and an appropriation of $100,000,000, Hoover eventually established a special relief program for 10,000,000 undernourished and homeless children.

Altogether at this time he directed, on behalf of the Allies and the United States, the handling of $3,254,000,000 in relief funds and the distribution of more than 23,000,000 tons of food stuffs, medical supplies and clothing. In order to carry on this work effectively, Hoover obtained the mandate of the Allied powers to manage the railways and coal mines, waterways and ports in eastern Europe. With the termination of official activities at the signing of the peace, he set up a volunteer organization to continue relief work among European children and support for the people of Austria, Hungary, Armenia and Russia, raising over $250,000,000 for this purpose.

During the war Hoover had been gathering historical material, and had professional collectors in all belligerent countries engaged in gathering and holding material on the war. With the armistice he embarked upon an enterprise which he refers to in his *Memoirs* as a side issue, but which resulted in one of his great contributions to the writing of the history of the modern world. The large body of manuscript and particularly fugitive material dealing with the years of the war comprised the documentary story of both the established and revolutionary governments of western Europe. These materials were deposited for the use of scholars in a newly established war library at Stanford university. Later known as the Hoover Library on War, Revolution and Peace, it was enlarged to include materials on World War II and the history of governments and peoples throughout the world, finally becoming the Hoover institution.

His experiences during the war and reconstruction years (1914–21) had left deep impressions on Hoover's thinking and he gave expression to these in a little book. *American Individualism* (1922). He wrote that "Our individualism differs from all others because it embraces these great ideals: that while we build our society upon the attainment of the individual. we shall safeguard to every individual an equality of opportunity to take that position in the community to which his intelligence. character, ability, and ambition entitle him; that we keep the social solution free from frozen strata of classes; that we shall stimulate effort of each individual to achievement; that through an enlarging sense of responsibility and understanding we shall assist him to this attainment; while he in turn must stand up to the emery wheel of competition."

Later in the same book, Hoover reflected that "There is never danger from the radical himself until the structure and confidence of society has been undermined by the enthronement of destructive criticism. Destructive criticism can certainly lead to revolution unless there are those milling to withstand the malice that flows in return from refutation. It has been well said that revolution is no summer thunderstorm clearing the atmosphere. In modern society it is a tornado leaving in its path the destroyed homes of millions with their dead women and children."

These reflections help in explaining the later developments in Hoover's thought and action as he entered upon his long public career in 1921 as secretary of commerce, first in the cabinet of Pres. Warren G. Harding, and later, in the cabinet of Pres. Calvin Coolidge. Secretary Hoover undertook the reorganization of the department on the basis of voluntary co-operation among the commercial, agricultural and labour interests of the nation. He organized a multitude of committees representative of business and labour whose functions were to reduce wastes in manufacturing and distribution. He organized new divisions in the department to cover radio broadcasting and commercial aviation, and other divisions to answer the growing need of the country for better housing and greater highway safety. He also expanded the department's foreign trade activities.

During this period he served as a member of the advisory board of the Conference on Limitation of Naval Armaments (1921–22) and as a member of the World War Foreign Debt commission. He served also as chairman of the Colorado River commission and the St. Lawrence Waterway commission. The work of these commissions culminated in the erection of the Hoover dam (1930–36), and the construction of the St. Lawrence seaway.

In 1922 Hoover organized the American Child Health association and became its first president. Likewise, in 1923 he organized the Better Homes in America association. He served as chairman of a National Research fund established by the National Academy of Sciences for the support of research in pure science and raised over $5,000,000 for this purpose.

While secretary of commerce, he was placed in charge of relief at the time of the disastrous Mississippi flood of 1927. For this project he raised over $34,000,000 in charitable funds and directed the removal of 1,500,000 persons from danger areas to temporary camps and afterward restored them to their homes.

Prior to his cabinet service, under Presidents Harding and Coolidge, many indications appeared that Hoover's unusual services during World War I, especially his service as food administrator for President Wilson, had produced in the public mind a growing belief that he had unusual qualifications for the presidency of the United States in the post-war world. This was demonstrated by members of both political parties who discussed his availability during the preliminary canvass of 1920. But his appeal as a national figure was not regarded with favour by the leaders in control of either party. In the course of the discussion it was revealed that he had been and was a registered Republican. Despite activity for his nomination by many friends, his possible candidacy was scarcely considered at the Republican national convention of 1920. The well-known opposition of his fellow Californian, Sen. Hiram Johnson, which influenced many progressives, and the final nomination of Warren G. Harding, an old-line conservative, were indicative of the moderate position Hoover appeared to occupy. In the Republican national convention of 1924, he mas given 300 votes for the vice-presidency. All this provided significant background for his entrance upon an active canvass when President Coolidge chose not to be a candidate in 1928. Hoover was strong in the presidential primary contests. and in the convention of 1928, overcame the opposition candidates backed by senate leaders. as well as the candidacy of Gov. Frank Lowden of Illinois. Yet the nomination was not enthusiastically supported by experienced party leaders, for they were divided on the issues of prohibition and farm relief, on each of which the presidential nominee had his own program. With some marked defections, Hoover nevertheless held the Republican electoral vote of the previous two campaigns and added votes from southern states that would not support Alfred E. Smith (*q.v.*), the Democratic nominee. Although he polled 21,391,993 votes, 4,500,000 more than had his predecessor, Calvin Coolidge, it became clear that many progressive Republicans viewed Hoover with distrust, and the regular Republican organization still considered him an outsider.

Aware of these conflicting elements — for he had lived in the midst of them for eight years as a cabinet member and had seen the results of their existence in the trying days of President Wilson's war administration — Hoover bent every effort to make the transition from the Coolidge administration as painless as possible. At the same time, his cabinet appointments made it clear that his was to be a personal administration.

Beneath the surface of the highly emotional presidential campaign of 1928 were evidences of the impending crisis in party government that had threatened the disruption of the Republican party ever since the disappearance of the Progressive party in 1916. The choice of Hoover, who stood apart from factions in the party, had obscured the issues in this factionalism and the importance of the personalities involved. But these were at once revealed in the new congress that met to deal with farm relief and with limited revision of the tariff. The centre of the fight was in the senate.

President Hoover presented his program for what he had termed in his campaign "The New Day," a realization of the great economic and social potentialities of the American people in an age of developing science. He pushed toward the enactment of this program throughout his four years in office.

Three developments forced him repeatedly into activities in other fields: (1) the overwhelming need of new federal action on

prohibition; (2) the growing importance of an energetic U.S. program overseas to meet rising tides of economic and political uncertainty; and (3) the long train of demands upon the president caused by the stock market crash in the autumn of 1929 and the ensuing widespread depression. On each of these, the President's program as it developed was the object of attack by his Democratic opponents. by a large body of U.S public opinion, and particularly by members of his own party in the senate.

Despite continuous strife among Republican congressmen Hoover succeeded in establishing the Federal Farm board to serve agriculture, and in increasing the powers of the Tariff commission, thus protecting the principle of a flexible tariff. He also obtained senate approval of the London Naval treaty on July 22, 1930.

The defeat of the Republicans in the congressional elections of 1930 signalized not only the downfall of effective party government in congress, but also the rise to first place in public estimation of a great need for partisan leadership in the presidency. In the ensuing two years of his term in office, Hoover offered that leadership, and in the campaign for re-election more vigorously defended and explained his program for the termination of depression at home and abroad.

The U.S. had been making a slow but certain recovery from the recession when, in 1931, inflation in Europe, unbalanced budgets, unlimited currency issues and excessive borrowing by European nations from U.S. banks resulted in the gigantic European financial collapse of that year. The president, proposed to the European governments a moratorium upon all debt payments for one year, obtaining in record time support for his proposals not only from U.S. financial leaders but from senate and house members of both political parties.

Frequently at odds with independent members of his own party and opposed vigorously throughout his administration by Democratic congressmen and the Democratic national committee, Hoover nevertheless obtained a considerable amount of constructive legislation during his administration. The Reconstruction Finance corporation was created (1932), to save building and loan organizations and savings banks, and to prevent the collapse of weaker banks, trust companies, railways and industries. Home loan banks were set up to aid homeowners in meeting their mortgages and Agricultural aid banks, to help farmers.

The Republican national convention of 1932 renominated Hoover on a platform of his own choosing, and he was supported by the party organization in the ensuing campaign. Despite his extensive and constructive program for dealing with the problems of the depression, and his defense of that program in the campaign, the electorate failed to return him to office: and the Republican party returned to congress a smaller number of representatives than at any time since 1897. Hoover was defeated by Franklin D. Roosevelt by 22,821,857 to 1j.761.841popular votes—in effect a reversal of the vote of 1928. For further details of the Hoover administration, *see* UNITED STATES (OF AMERICA), THE: *History*.

None of Hoover's predecessors had had such extensive experience as he in handling both domestic and foreign problems. Likewise, none of his predecessors had been confronted with so many difficult problems at home and abroad. Despite the record he had made as president and his defense of it in the campaign, the voters had decided that they wished a political change in order to deal with the problems of the depression as they saw it. Furthermore, repeated crises in "party politics" had again brought the United States to the verge of abrupt political change, as in the elections of 1828 and 1860.

Having served his nation continuously since April 1917, Hoover retired on March 4. 1933, taking an apartment in New York city and reopening his home on the Stanford campus near Palo Alto, Calif. There, a trustee of the university since 1912, he had established not only the Hoover institution, but also had led in establishing a graduate school of business and a food research institute.

At no time during the 12 years of Franklin D. Roosevelt's administration was former President Hoover called into service by his successor. Hoover opposed most of the measures, domestic and foreign, of the Roosevelt administration, voicing more than any other individual the "loyal opposition" of the U.S. system of government. He opposed the involvement of the United States in World War II and on June 29, 1941, in discussing a tacit alliance with Soviet Russia, he said in a radio broadcast: "If we go further and join the war and we win, then we have won for Stalin the grip of communism on Russia. . . . Again I say, if we join the war and Stalin wins, we have aided him to impose more communism on Europe and the world. At least me could not with such a bedfellow say to our sons that by making the supreme sacrifice, they are restoring freedom to the world. War alongside Stalin to impose freedom is more than a travesty. It is a tragedy."

Hoover continued to be sharply critical of the foreign policies of the Roosevelt administration, yet continued to address his countrymen in discussions of the ends of peace to be achieved in the course of the war. In particular did he attack radical influences in the U.S. government, distinguishing, however, between socialist attack by ballot and communist attack by secrecy and violence.

In view of Hoover's record as relief administrator during World War I, it mas not surprising that the former president organized relief for Poland, Finland and other European states after World War II. Pres. Harry S. Truman summoned him to aid in the organization of relief during the great famine of 1946. In order to co-ordinate the work, Hoover visited 39 countries. In 1947 he undertook a mission to Germany and Austria for President Truman, to advise upon U.S. policies in the administration of those occupied countries. In response to requests from both Pres. Dwight D. Eisenhower and Chancellor Konrad Adenauer, Hoover repeated his visit to Germany in 1954.

For more than 35 years Hoover had called attention to the inefficiency, waste and rising costs of government services. During his administration, he had made marked contribution to improvement under the difficult conditions of depression. In 1947, congress by unanimous action created a bipartisan Commission on Organization of the Executive Branch of the Government, and Hoover was selected its chairman. Known popularly as the Hoover commission, this group, after extensive hearings and research, made 270 specific recommendations, of which, with President Truman's aid, 70% were adopted in the interest of reducing expenditures by eliminating overlapping and waste in the swollen number of bureaus, sections, services and units.

In 1953 a second Hoover commission was created with wider power. Hoover was again chosen chairman and aiter two years reported on his exhaustive inquiry. The commission brought in 375 recommendations, many of which were adopted.

In the course of his long public career, Hoover gathered about him a host of admirers and supporters. He twice received the unique distinction of joint resolutions of appreciation from congress. He was honoured by more than 80 universities and received medals, awards and testimonials from all parts of the world. His birthday became the occasion for an outpouring of appreciation and regard on the part of his fellow citizens.

In 1958 he published *The Ordeal of Woodrow Wilson*, based upon his own observations of the struggle over the treaty of peace ending World War I and the establishment of the League of Nations. This book was widely acclaimed as a major contribution to the literature of international relations. Hoover had dealt with some of the details of this theme first in a small volume, *America's First Crusade* (1941), and again at greater length in the first volume of his *Memoirs*, published in 1951. In this and the following year, he published three volumes of his *Memoirs*. His other works include *The Challenge to Liberty* (1934); with Hugh Gibson, *The Problems of Lasting Peace* (1942); and seven volumes of his *Addresses Upon the American Road* (1938–55).

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HOOVER, HERBERT WILLIAM (1877–1954), U.S. industrialist, was for 26 years president of the Hoover company of North Canton, Ohio, pioneer manufacturer of electric vacuum cleaners. Born near Canton, Oct. 29, 1877, Hoover joined his

father in the leather goods business in 1898 after attending Hiram college. He saw the potentialities in the electric suction sweeper and with his father developed the product which later became the Hoover vacuum cleaner. From maker of 400 cleaners in 1908 the Hoover company grew to be a major producer of vacuum cleaners with plants in several countries. Hoover died in North Canton, Sept. 16. 1954. (J. S. BL.)

HOOVER, THEODORE JESSE, (1871–1933), U.S. mining engineer, naturalist and educator. elder brother of Herbert Clark Hoover, was born in West Branch, Ia., Jan. 28, 1871, the son of Jesse Clark Hoover, village blacksmith, dealer in agricultural machinery, and Huldah Minthorn Hoover. Quaker minister. He was educated in the public schools and at Penn college in Iowa and received his A.B. degree in mining engineering from Stanford university in 1901. From 1903 to 1919 he was manager or consulting engineer in the gold mines of California. west Australia. Mexico and Alaska: was an engineer or administrator of lead and silver mines in Burma, copper mines in Finland and Russia, and had offices in London and San Francisco.

In 1919 he returned to Stanford university as professor of mining and metallurgy, becoming dean of the school of engineering in 1925 until his retirement in 1936. Thereafter he lived at his ranch in Santa Cruz county, Calif. As a writer, conservationist and naturalist. he directed a definitive study of the life cycle of the Pacific coast steelhead trout! assisted by the California fish and game commission. He was the author of *Concentrating Ores* by *Flotation* (1912), *Economics of Mining* (1933), *The Engineering Profession* (1941) and of numerous articles in technical publications. He was a member of the American Society of Mining and Metallurgical Engineers, a life member of the Cooper Ornithological society and colonel in the C.S. army reserve. He died near Santa Cruz on Feb. 4, 1955. (HT. H.)

HOOVER DAM, a solid masonry dam 726 It. high. on the Colorado river near the Arizona-Nevada boundary. The dam is 31 mi. S.E. of Las Vegas, Nev., and 8 mi. N.E. of Boulder city. Nev. First called Boulder dam. C.S. congress in 1947 officially changed the name to Hoover dam. The dam has an installed capacity of 1,249,800 kw. and a reservoir capacity of 29,827,000 ac.ft. See COLORADO RIVER; ARIZONA: *Physical Geography; History.* For engineering and construction details *see* AQUEDUCT: *Nigh-Pressure Hydroelectric Pipes; DAM: Solid Masonry Gravity Dams.*

HOP is a twining perennial plant commonly placed in the Cannabinaceae or hemp family. It is of common occurrence in temperate North America, in the southern counties of England, in Europe extending into Asia and to a limited extent in temperate South America. Besides the common hop (*Humulus lupulus*), which includes all commercial varieties, there is a related annual species called the Japanese hop (*H. japonicus*). Two types native to North America have been called *H. americanus* and *H. neomexicanus,* respectively, but botanists are not in universal agreement with respect to this classification.

Description of the Plant. — The hop is a long-lived herbaceous perennial with rough twining stems often 25 ft. long which always wind in a clockwise direction. New vines (*i.e.,* stems; called "bines" in England) are produced each season and die following maturity. An extensive root system penetrates the soil to a depth of 15 it. or more. Young vines have been observed. under favourable conditions. to grow six inches or more in 24 hours. Strong hooked hairs help the stem cling to its support. The leaves. dark green, hairy, heart-shaped, and deeply three- to five-lobed with serrated margins. are borne oppositely on long petioles.

The plant is dioecious; *i.e.,* the male and female flowers are produced on separate plants. The male flowers form panicles two to six inches long and consist of a small, greenish live-parted perianth enclosing five stamens. The female flowers are in short axillary spikes or catkins. During the development of the inflorescence the stem elongates and the bracts enlarge greatly to form the scales or petals of the mature cones (strobiles). The mature cones. two to four inches long. are yellowish-green. oblong or ovoid and loose and papery to the touch. Mature, dried strobiles constitute the hops of commerce.

The pollen is carried by the wind to the female flower. Following fertilization a single ovule develops. The fruit is an achene which contains a spirally coiled embryo.

The fruits and the bases of the bracts forming the mature cone are covered with sticky, yellowish granules consisting of glandular hairs or glands called lupulin. These glands contain an oleoresin consisting of essential oils and resins which possess the characteristic aroma and bitter taste to which the brewing and medicinal properties of hops are attributable.

Geographical Distribution and Production. — Hops are grown commercially over a wide range of climatic and soil conditions. In general, rich alluvial soils or deep sandy or gravelly, well-drained loams are preferred. Soils that are heavy and wet, unduly shallow, or stiff and clayey should be avoided. Hops are produced successfully in milder regions which have abundant rainfall or where adequate moisture can be supplied through irrigation. They are not adapted to regions which are subject to long and severe winters. Prolonged cold, damp and foggy weather in the spring. excessive winds during the growing season and excessive rainfall during the harvest months usually cause damage to the crop.

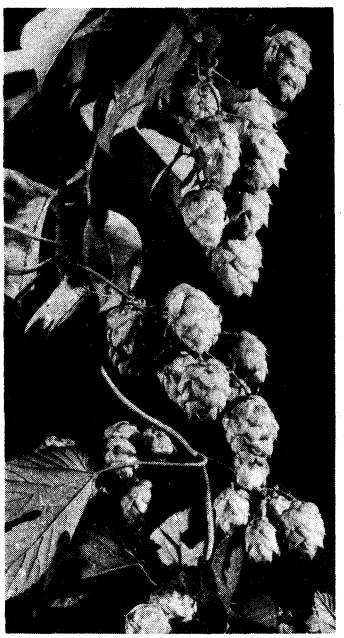

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FIG. 1.—HOP VINE AND CONES (HUMULUS LUPULUS)

In North America the hop is cultivated extensively in Washington, Oregon. California and Idaho and to a lesser extent in New York and British Columbia. It is grown commercially in England. Germany. Czechoslovakia, the U.S.S.R.. France. Australia, Yugoslavia. Belgium and Poland and to a limited extent in Japan, New Zealand. South America and South Africa. The United States leads all countries in production, followed closely by England and then by Germany; the combined annual production of these three countries ordinarily account for about three-quarters of the world's total production.

Culture. — The production of hops is a complex and highly specialized industry. The time at which the various cultural and management operations are performed and the care with which they are done can have great influence on the yield and market acceptability of the crop. In all regions the growing areas tend to become localized. As a result, certain practices have tended to become traditional within areas but to vary from one area to another.

Commercial hop fields are propagated from "root cuttings" (actually sections of underground stems): not from seeds, to ensure uniformity of characteristics. Planting is done during the winter or early spring months when weather conditions permit. A common practice in the United States is to plant the cuttings in rows 7 to 8 ft. apart with the hills in the rows spaced 6½ to 8 ft. apart (680–1,000 or more hills per acre). In England one-year-old plants are commonly set in rows 6 to 9 ft. apart and spaced 3 to 7½ ft. apart in the rows according to the system of training to be used (774–2,420 hills per acre).

Each spring the young vines are commonly trained to climb strings suspended from wire trellises and attached to stakes at the hills, or, in some countries, they are allowed to climb poles located at the hills. The heights of the trellises vary from 8 to 25 ft. from one country to another. Practically all of the crop in the United States is grown on trellises 16 to 18 ft. in height. which facilitates harvesting by machinery. In the United States two strings are commonly attached at each hill and two vines are trained up each string. In England two or four strings are attached at each hill, according to the system of training used, and two vines are usually trained up each string. As a result, two to three times as many vines are grown per acre in England as are grown in the

United States.

Hops are heavy users of calcium, nitrogen, phosphorus and potassium. In most regions the natural fertility of the soil is supplemented by additions of these and other elements in organic or inorganic form. In the U.S. much needed organic matter is commonly supplied by applications of farmyard manure and harvesting residues. or by the growing of a cover crop of cereal grain or legume which is planted in the fall and plowed under in the spring. English growers apply relatively large amounts of organic matter in farmyard manure, hoof-and-horn meal. fishmeal and other materials which are plowed under in the spring.

Hops are commonly produced under irrigation in the United States where summertime precipitation is low. Irrigation is not practised in England where rainfall during the growing season is usually sufficient.

Hops may be produced either with or without seeds. Their dioecious or unisexual character enables the grower to produce either type by exclusion of male plants from the hop fields or by planting one male plant to about every 100 or 200 female plants. Seeded cones are larger than those of the seedless type and, for this reason, seeded hops produce higher yields. Their lupulin content. however. does not differ materially from that of seedless hops. Seedless hops are considered to be superior to the seeded type for brewing purposes. Male plants are excluded in most of continental Europe. and seeded hops are not produced there. The production of seeded hops is a common practice in England and in some areas of the United States.

Diseases and Insect Pests.—Two fungus diseases (downy mildew and progressive *verticillium* wilt) and virus diseases are perhaps the most destructive diseases of hops. All commercial varieties are susceptible in some degree to downy mildew, which attacks the plants in all stages of growth, reduces yields, causes discoloration of the cones and affects their quality. By repeated removal and destruction of the diseased portions of the vines and frequent applications of liquid sprays or dusts containing copper sulfate (Bordeaux mixture) or zinc, the disease usually can he held in check.

Verticillium wilt, an important disease in England, invades the soil and infects all parts of the plants, plugging the water-conducting tissue and subsequently causing death. There are no control measures once the fungus has been introduced into the field, although some commercial varieties are more tolerant to the disease than others.

The various types of virus diseases cause various symptoms in the plants. A diseased plant cannot be cured. Virus diseases can, however, be kept in check by prompt removal of infected hills, which are replaced with cuttings from healthy plants. Control of insect vectors retards spread of virus diseases.

Sooty mold can cause serious damage if hop aphids (plant lice) are not controlled. The aphids secrete a sticky substance called honeydew on which the mold will grow and produce discoloration and undesirable flavour in the cones. Red mold will attack the leaves and later infect the inflorescences of the hops which will reduce yield and lower quality. Both of these fungus diseases can be controlled.

Many different species of insect pests have been known to infest hops, but only a few of them present a persistent problem. The most important of these are the aphids and the spider mites. The hop aphid is a sucking insect which will devitalize the plant by extracting the sap from the leaves. It will also excrete honeydew on which sooty mold will develop. Excessively moist and damp weather encourages the attack of hop aphids.

The spider mite is prevalent in all growing regions, especially during seasons of high temperature and drought. It injures the plant by puncturing the leaves and withdrawing the sap. Each puncture usually results in the appearance of a small light-coloured spot on the leaf surface. As the spots become more numerous the infested leaf will gradually shrivel and die. The spider mite will also attack the cones; causing them to turn reddish-brown, adversely affecting their marketability.

Both spider mites and hop aphids can be controlled by spray applications of contact-type insecticides containing organic phosphate or chlorinated hydrocarbon formulations. Systemic insecticides, *i.e.*, those which are absorbed by the plant and transported in the sap, have been used to provide effective protection over a considerable length of time.

Harvesting, Drying and Baling.—Hops should be harvested when fully mature. Full ripeness is indicated by bright, yellowish-green. sticky, resilient cones that are crisp and papery to the touch, and by hard purple-red seeds. In this condition they possess a maximum of lupulin, which contains the resins and essential oils so important in the brewing of beer and ale. Unripe cones are smaller and contain more moisture and less lupulin. Overripe cones become darker yellow or reddish and shatter easily. resulting in some loss of lupulin. The date of maturity depends upon the variety and environmental conditions, but is fairly constant from year to year within a region for any particular variety.

Hops are picked either by hand or by machine. In the United States they are picked almost entirely by machine. in England by machine to a large extent, but a considerable portion is picked by hand. Hand picking predominates in the remaining hop growing countries of the world. Picking begins shortly before the middle of August in some regions and continues until late September in others.

The machines used for picking consist of various designs, but most of the machines in large scale use have wire picking fingers or loops mounted on bars which travel against the vines, plucking the cones as they pass. Picking machines are either stationary, being housed in large sheds, or are portable. The former have a larger capacity and require a larger labour force.

Freshly picked hops contain 65% to 80% moisture. depending on the variety and climatic conditions. Drying to approximately 10% moisture is accomplished in kilns, usually referred to in England as oasts. The size and construction of the kilns and the methods of conducting the heated air through the hops differ. American kilns are usually of frame construction, although some are built of concrete and brick. Individual kiln floors are usually square or rectangular, 32 by 32 ft. being a common size. The freshly picked hops are loosely and evenly scattered on the slatted floor of the kiln, which is covered with burlap to prevent the hops

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FIG. 2.—HOP KILNS. OR OASTHOUSES, AT EAST FARLEIGH. ENG.

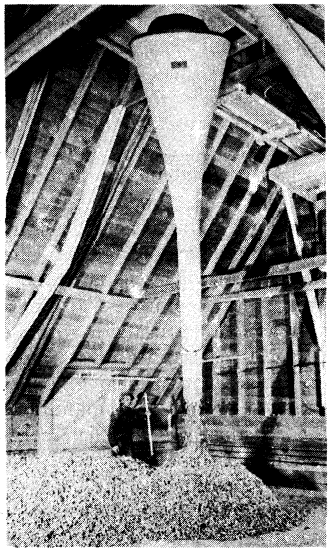
from falling through. Air which has been heated by a stove or furnace passes through the hops from below. Air passage is accomplished by natural draft (convection) or by forced draft. In the forced-draft kilns a current of heated air from the outside is forced through the hops by means of bottom blower fans or by suction fans placed in the cupolas of the kilns. The forced draft kilns are by far the more common because of greater capacity, since a bed of hops up to 40 in, in depth may be dried at one time. Heating is accomplished by burning wood, oil or gas.

The typical kiln in England is either a square (16–20 ft.) or a circle of 16–20 ft. diameter. Most oasthouses are built of brick and have a tapering roof which is surmounted by a pivoted nooden cowl. The cowl assists in preventing a back draft in windy weather,

particularly in natural-draft kilns. All modern kilns are equipped with fans, and fans have been installed in many old natural-draft kilns. Many kilns are heated by open anthracite fires; the products of combustion pass through the hops. Other systems of heating in England employ oil flame or steam radiators.

Low drying temperatures are recommended for production of hops of best quality. Temperatures exceeding 150° F. are discouraged because the hops are likely to darken in colour, with destruction of their resinous and aromatic constituents. The time required for drying a particular lot of hops depends upon humidity, temperature, air velocity and moisture content of the hops, and will vary from 6 to 20 hours.

After hops have been dried sufficiently in the kiln they are removed to a cooling house where they are stored in large heaps for a period of 1 to 12 days, depending upon the capacity of the coolers. During this time they undergo a curing process which equalizes the moisture content, modifies the pleasant aroma and causes them to become tougher and more pliable for baling.



BY COURTESY OF JOHN I. HAAS, INC.

FIG. 3.— FRESHLY PICKED HOPS ENTERING A KILN; THEY ARE DRIED BY HEATING FROM BELOW

Baling is the last step preparatory to marketing. After drying and curing, the common procedure in the United States is to compress the hops into rectangular bales of approximately 18 cu.ft. weighing about 200 lb. and finally to wrap them in heavy burlap for marketing. In England they are compressed into "pockets"—large bags made of jute sacking about six feet in length and two feet in diameter—containing slightly more than 1½ cwt. of hops.

Properties and Uses.—Hops have been used almost exclusively for brewing purposes for 1,200 years or more. They are also reputed to have certain medicinal properties and are of value as a bitter stomachic for stimulating appetite and aiding digestion.

Their brewing value is based on their content of bitter (soft) resins, their essential oils and perhaps their tannins. These constituents, which are extracted from hops by boiling in wort (an aqueous infusion of malt), impart the desired mellow bitterness and delicate hop aroma to brewed beverages and aid in their preservation. There is a wide range in brewing value among the many commercial varieties of hops. The content of total soft resins ranges from 15% to 22% in American and British hops and from 11% to 16% in the inherently milder continental European hops. The percentage of essential oil which contributes to aroma varies from 0.2% to 2.5% or more in commercially dried hops.

(S. N. B.)

HOPE, ANTHONY, the pen name of SIR ANTHONY HOPE HAWKINS (1863–1933), British novelist, who was born on Feb. 9, 1863. He was educated at Marlborough and Balliol college, Oxford, and was called to the bar at the Middle Temple in 1877. He won a great popular success with the publication (May 1894) of *The Prisoner of Zenda.* This was followed a few weeks later by *The Dolly Dialogues.*

The Prisoner of Zenda established a fashion for what was christened, after its fictitious locality, "Ruritanian romance"; *The Dolly Dialogues* was the forerunner of a whole school of epigrammatic drawing-room comedy. In 1894 also appeared *The God in the Car,* a novel suggested by the influence on English society of Cecil Rhodes's career; and *Half a Hero,* a complementary study of Australian politics.

In a series of novels Anthony Hope advanced from his light comedy and gallant romantic inventions to the graver kind of fiction of which *The God in the Car* had been an earlier essay. Other notable novels were: *Quisante* (1900), a study of English society face to face with a political genius of an alien type: *Tristram of Blent* (1901), a study of family pride; and the witty *The Intrusions of Peggy* (1902). He was knighted in 1918.

HOPE, THOMAS (1769–1831), English writer, designer and connoisseur, born in London in 1769, eldest son of John Hope, one of a wealthy family of Scottish merchants and bankers settled in London and in Amsterdam. nhere Thomas gren up. About the age of 18 Hope traveled widely in Europe. Asia Minor and Egypt, studying and sketching architecture. About 1795 he settled in England, and in the following years he designed the furniture and decoration of his London house in Duchess street and his country house at Deepdene, Surrey. to provide a suitable background for his fine collection of ancient and modern sculpture. In 1807 he published his furniture designs in a folio entitled *Household Furniture and Interior Decoration.* This work. though much criticized by his contemporaries. exercised considerable influence on Regency furniture. It provided a wide range of furniture based on "correct" classical and Egyptian models. In 1819 Hope anonymously published a novel: *Anastasius, or Memoirs of a Modern Greek, written at the close of the 18th century.* It mas at first generally attributed to Lord Byron. but Hope later revealed his authorship. Hope died in London on Feb. 3, 1831.

See M. Jourdain, *Regency Furniture,* rev. ed. (1948). (J. E. LE.)

HOPEH (HO-PEI SHENG), the most northeasterly of the historic 18 provinces of China proper, situated between the lower Yellow river and the Great Wall. The name Hopeh, meaning "north of the (Yellow) river," was given to the province in 1028. Previously, the province was known as Chihli. meaning "directly controlled," for it contained the city of Peking (Peiping) which was, before 1928 and again from 1949. the capital of China.

Before 1949 Hopeh had an area of 54,000 sq.mi. Under the Communist regime. after 1949. the province increased its area to about 75,000 sq.mi. as a result of annexations from the iormer provinces of Chahar (1952) and Jehol (1956). The population of Hopeh within its expanded borders was about 39,000,000, based on the census of 1953. Another administrative change took place in 1958, when the seat of the provincial government was transferred from Pao-ting. the historic provincial capital. to Tientsin.

The greater part of the province lies in the north China plain, which shelves almost imperceptibly toward the shallow gulf of Po-Hai, an arm of the Yellow sea. The surface of the plain consists of alluvium, river sands and loess, which form a fertile though thin veneer over a subsurface made up of infertile marine gravels. Hopeh is one of China's leading producers of winter wheat and cotton. Other crops are soybeans. peanuts and other oilseeds. In the newly annexed territory north of the Great Wall, extending to the windswept Mongolian plateau, livestock herding becomes more important. In that area of low rainfall and cold winters, hardier crops such as spring wheat, millet and potatoes are grown.

Coal is Hopeh's leading mineral resource. The Kailan basin, centred on T'ang-shan, is one of China's main coal producers. Kailan coal is suitable for power-station fuel and other steam-generating uses. The Men-t'ou-kou mine. west of Peking. yields anthracite. Fengfeng. near the city of Han-tan, is a coking-coal centre that was expanded by the Communist regime after 1949. Iron ore is mined in the Lung-yen district near Hsiian-hua in former Chahar province, and at Wu-an, west of Han-tan. Other mineral industries are based on gold and copper deposits in the P'ing-ku-Tsun-hua area near the Great Wall, and on coastal salines, centred on the town of Han-ku on the gulf of Po-Hai.

The coal and iron-ore resources furnished the basis for an integrated iron and steel industry at Shih-ching-shan, a western suburb of Peking. Blast furnaces at Shih-ching-shan produced 430,000 tons of pig iron in 1957. The pig iron was converted into steel at Shih-ching-shan itself, as well as at smaller steel plants in Tientsin and T'ang-shan. Before Communist rule. Tientsin was the province's only metal-fabricating and manufacturing city. After 1949 industrial expansion was promoted in Peking. the national capital, which built new plants and iactories in industrial suburbs. Peking's metal industries produce automobiles, tractors, locomotives and bridge girders. As a leading cotton-growing province, Hopeh has been developed also as a textile producer. Large

cotton mills operate at Peking, Shih-chia-chuang and Han-tan.

Hopeh's population is made up almost entirely of Chinese speaking the northern Mandarin dialect, China's national language The only national autonomous areas reserved for ethnic minorities are tno autonomous *hsien* (counties) of the Hui (Chinese Moslems) at Ta-ch'ang east of Peking, and at Meng-ts'un, near the Shantung border in the southeast. Both autonomous *hsien* mere established in June 19j6.

The province's largest cities, with 1953 populations, are Peking (2,768,149), Tientsin (2,693,831), T'ang-shan (693,000), Shih-chia-chuang (373,400), Kalgan (299,300), Pao-ting (197 000), Ch'in-huang-tao (186,800) and Hsuan-hua (114,100). (T. Sd.)

HOPEWELL. This name is given to a spectacular cultural development shared by prehistoric American Indians from about 100 BC to AD. 500 in what is now the southern part of Ohio. Typical monuments—groups of burial mounds nith extensive enclosures of banked earth—are the M. C. Hopewell. Mound City, Harness and Seip groups, all in Ross county; Turner in Hamilton county; Tremper in Scioto; the Ft Ancient hilltop enclosure in Warren; and the works at Marietta and Newark. Archaeological excavations have been carried out since 1846 by various institutions, notably the Ohio State museum and the Ohio State Archaeological and Historical society. Across the northern United States from western New York to Kansas City are concentrations of other prehistoric sites called Hopewellian but representing coordinate cultural developments not necessarily tributary to Ohio. Southward to the Gulf of Mexico a number of cultural groups were variously affected by the spread of Hopewellian ideas.

Some Hopewellian sites yielded considerable evidence of domestic occupation and data concerning the economic systems upon which contemporary societies were based. The major sites, especially in Ohio, have the character of mortuary precincts, however, and since excavators have not been unmindful of the occurrence of fine museum specimens deposited as offerings in mounds and graves, there is even more information about burial customs.

Some details of architectural and building practices are known from the remains of charnel houses and log tombs found under the burial mounds as well as from the occasional remains of domestic dwellings. The relics of costumes and objects deposited with the dead reveal something about technology and kinds of raw materials. Differential placement of burials contrasting in regalia and wealth of offerings suggests distinctions of social status and permits some inferences about the kind of society in which such differences could occur. It is also possible that Hopewellian communities included specialist artisans. The wealth of objects buried with the dead required constant replacement, While virtually nothing is known concerning religion, it appears from grave offerings that the status granted in life was expected to be maintained in the hereafter. The elaborations of mortuary and probably other ceremonies may have required a specialized priesthood to look after such matters.

Reconstruction of the lifeways of the various Hopewellian peoples is an engrossing task. The economy—to judge from preserved food remains—was based on hunting, fishing and gathering wild plant foods. That cultivation was known is attested by occasional finds of carbonized maize, and of maize and beans at a site near Kansas City. Yet the basic orientation may have been toward hunting and gathering rather than toward agriculture. There is better information concerning technology. Tools and weapons were of chipped and ground stone, bone, wood and cold-hammered copper. The art of smelting was unknown. Ground stone axes were used to fell the timbers for domestic and mortuary buildings. Chipped flint drills, knives, scrapers and projectile points had many uses at home as well as in hunting. Woven textiles have been iound with burials, preserved by the salts of copper objects placed with them, and small painted pottery figurines also show details of dress and hair style.

The Hopewellians excelled in crafts and so skillful was the workmanship on many of the objects deposited with the dead that these are often sought by museums and collectors of art objects. These include copper "Panpipes," breastplates, headdresses, bracelets and many other items, but especially noteworthy are stone pipes carved in the forms of birds and animals.

Other information—stylistic changes in artifact forms—permits tentative conclusions concerning the origin, spread and eventual disappearance of the cultural efflorescence achieved by the Hopewellian societies. Most features of Hopewellian life had a gradual historical development in the northern United States east of the Mississippi and the people themselves were a longheaded physical type indigenous to the region. The basic mortuary practices also had a long history in the area, but many specific details in Ohio Hopewell were borrowed from a related culture—Adena—that lay immediately southward in Kentucky, began earlier and ended sooner. The various northern Hope~vellian groups possessed their own cultural traditions, but at about the time of the great Ohio development they are found to share similar burial habits. some kinds of artifacts, and their economies were probably based upon similar adjustments to natural resources. All these societies were historically related, and there was much interaction and trade among them that would have promoted the spread of ideas, furthering the likenesses among the various groups. This trade extended far beyond the borders of the northern Hopewellian societies, however, and was at least in part the instrument through which cultural linkages were established with the south. From the Lake Superior region came native copper which was cold-hammered into ornaments; from the Carolinas, mica which was carefully cut in abstract and naturalistic forms and attached to costume; from the Atlantic coast and Florida came seashells for other ornaments and the large *Cassis* shells for cups; evidently it was the west which supplied obsidian for manufacture of fine black spearheads. Although most Hopewellian ceramics were of local origin, simple wide-mouth pots decorated with impressions of cord, fabric or a cord-wrapped stick, there was widespread in the north at this time a finely made and tastefully decorated pottery that may have been manufactured in only one or a few places.

The offerings in the Ohio mounds were the most varied and elaborate, but there is no evidence that Ohio exercised political domination over the other northern areas although it must have been a major hub of Hopewellian trade. After about A.D. 500 the more spectacular features of Hopewellian burial practices gradually disappeared and were replaced by simpler rites. It is uncertain whether this represented some kind of total cultural decline or simply an unwillingness to continue to devote so much wealth and effort to the care of the dead in the hereafter. Whatever the case, there was a corresponding decline in the quantity and quality of the fine articles immolated with the dead and a virtual disappearance of the trade in the materials from which these had been made. Important social changes may have taken place at this time; some of the later sites are smaller and show much less in the way of material equipment, suggesting a simpler kind of social organization and a more unsettled way of life.

See also INDIAN, NORTH AMERICAN: *Culture Provinces: Eastern North America;* NORTH AMERICA: *Archaeology: Mississippi Valley.*

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HOPI. A division of Shoshonean Indians in northern Arizona, inhabiting seven small towns and forming part of the Pueblo group.

They are also known as Moki or Moqui and their district as Tusayan. They were discovered by Tobar of Coronado's expedition in 1540, annexed in 1598 by Oñate, missionized in 1629. After the Pueblo rebellion of 1680 most of the Hopi moved their towns onto mesas for defense; only Oraibi perhaps still occupies the same site as in 1540. Soon after the rebellion, groups of Tewa from the Rio Grande established themselves among the Hopi; one of these remained and still preserves its old speech in the town of Hano. A single mission was re-established, at Awatobi, but per-

manently abandoned on the destruction of this pueblo by the other Hopi. Awatobi and Oraibi were the largest towns in this period; Shongopovi, Mishongnovi and Walpi already existed; Sichomovi and Shipaulovi were founded in the 18th century. The population, perhaps 4,000 at discovery, has long been nearly stationary at about 2,000, nearly half of it in Oraibi until factionalism bet een the conservative and progressive elements in that town led to a secession and the founding of Hotavila.

Since their discovery, the Hopi have been the westernmost of the Pueblos. Spanish influence therefore rested lightly on them and native culture has been maintained more purely than at Zuñi, Acoma and especially the Rio Grande towns. The Hopi snake dance, perhaps the most famous native ceremony still practised in the United States, owes its interest and repute to the purity of its aboriginal flavour; except in details, it was like other Pueblo rites before these were modified or abandoned. The Hopi are also the last of the Pueblos to grow, spin and weave a native cotton.

See the series of monographs by Fewkes **and** Mindeleff in *Reports of the Bureau of American Ethnology.* **(A. L. K.)**

HÖPKEN, ANDERS JOHAN, COUNT VON (1712–1789), Swedish statesman, was the son of Daniel Niklas Höpken, one of Arvid Horn's most determined opponents and a founder of the Hat party. When in 1738 the Hats came into power the younger Höpken obtained a seat in the secret committee of the diet, and during the Finnish war of 1741–42 was one of the two commissioners appointed to negotiate with Russia. During the diet of 1746–47 Höpken's influence was of the greatest importance. It was chiefly through his efforts that the estates issued a "national declaration" protesting against the arrogant attitude of the Russian ambassador, who attempted to dominate the crown prince Adolphus Frederick and the government. This spirited policy restored the waning prestige of the Hat party and firmly established their anti-Muscovite system. In 1746 Höpken was created a senator. In 1751 he succeeded Gustaf Tessin as prime minister, and controlled the foreign policy of Sweden for the next nine years. On the outbreak of the Seven Years' War, he contracted an armed neutrality treaty with Denmark (1756), but in the following year acceded to the league against Frederick II of Prussia. During the crisis of 1 76—62, when the Hats were at last compelled to give an account of their stewardship, Höpken retired from the senate and from the premiership. After the revolution of 1772 he re-entered the senate, finally retiring in 1780.

See Carl Silfverstolpe, *Grefve Höpkens Skrifter* (Stockholm, 1890–93). (R. N. B.)

HOPKINS, EDWARD WASHBURN (1857–1932), U.S. philologist, and outstanding Sanskrit scholar, was born at Northampton, Mass., Sept. 8, 1857. Receiving his training in classics at Columbia university and in Sanskrit at the University of Leipzig (Ph.D. 1881), Hopkins later taught at Columbia (1881–85), Bryn Mawr (1885–95) and at Yale (1895–1926), where he became Edward E. Salisbury Professor of Sanskrit and Comparative Philology. Hopkins' monograph on "The Social and Military Position of the Ruling Caste in Ancient India," in the *Journal of the American Oriental Society* (1889), is still the best account of its subject. In *The Great Epic of India* (1901) he furnished the first statistical and scientific evidence for distinguishing the chronological layers of the *Mahabharata.* More widely read were his books: *The Religions of India* (189j), *Epic Mythology* (1915), *The History of Religions* (1918), *Origin and Evolution of Religion* (1923) and *Ethics of* India (1924). Hopkins died on July 16, 1932.

See *Journal of the American Oriental Society,* 52:314–315 (1932), for a bibliography of Hopkins' work. (D. H. H. I.)

HOPKINS, ESEK (1718–1802), first commodore of the American navy, was born in Scituate, R.I., April 26, 1718, and went to sea at the age of 20. Ability as a seaman and trader and a wealthy marriage placed him at the head of a large merchant fleet prior to the French and Indian War. Successful privateering during that war added to his opulence and gave him a naval reputation. Rhode Island named him a brigadier general of its land forces at the outbreak of the American Revolution, but a call from the Continental Congress, where his brother was chairman of the naval committee, induced him to forsake the army and, on Dec. 4, 1775, accept the command of the first Continental fleet then outfitting at Philadelphia. Instructed to attack Lord Dunmore's British fleet in the Chesapeake, Hopkins considered his orders discretionary, and the enemy too strong. He sailed his fleet of eight armed vessels, therefore, to the Bahamas, captured considerable war material at New Providence, and, upon his return, fought an inconclusive action with the British ship "Glasgow," April 6, 1776. Dissatisfaction with the achievements of the fleet and its subsequent inactivity in Rhode Island, brought an investigation in congress where Hopkins, in Aug. 1776, was ably defended by John Adams, who sensed an anti-New England spirit behind the attack upon the commodore. Censured for disobedience of orders, but saved from dismissal, Hopkins returned to Rhode Island, his command restricted to only "the fleet formerly put under his care." At loggerheads with most of his officers, and unable to man his ships and dispatch them as a fleet, he soon lost the confidence of congress. When a group of officers preferred formal charges against him, congress, on March 26, 1777, suspended him from his command. Hopkins managed to have several of his principal accusers court-martialed and "broken," but he never regained his command. Dismissal from the navy came on Jan. 2, 1778. Thereafter, until his death at Providence, Feb. 26, 1802, he played a prominent part in Rhode Island politics.

See *Journals of Continental Congress, 1775–1778* (1905–1908); *Esek Hopkins Letter Book* and *Correspondence of Esek Hopkins* (1932, 1933); Edward Field, *Life of Esek Hopkins* (1898). (W. B. CK.)

HOPKINS, SIR FREDERICK GOWLAND (1861–1947), English biochemist and Nobel laureate, was born on June 30, 1861, at Eastbourne, East Sussex. In 1888 he began his medical studies at Guy's hospital. He combined activities in research with clinical work and after taking his degree at the University of London in 1894 became a member of the staff of the medical school of Guy's. In 1899 he was called by Sir Michael Foster to Cambridge, where he joined the illustrious school of physiology which Foster was founding. Trinity college created the post of prelector in physiological chemistry specially for him.

Hopkins showed that the wing pigments of certain butterflies were derivatives of uric acid, and gave a new turn to thought concerning animal pigmentation by demonstrating that excretory substances may function in ornament. He early realized that one of the urgent needs of biochemistry, then entering its modern phase under Felix Hoppe-Seyler and Franz Hofmeister, was accurate knowledge of the proteins. He succeeded (with S. W. Cole) in isolating from proteins the amino-acid tryptophan. In 1906, in collaboration with W. Fletcher, he laid the foundation of modern knowledge of the chemistry of muscular contraction by his researches into lactic acid production in muscle. In the same year he published preliminary reports of experiments involving "pure diets" which proved the existence of essential amino acids and of those accessory factors in foods which were afterward to be known by the name of vitamins; full results of the vitamin experiments were published in 1912. Another important research was that of 1910 (with G. Savory) on Bence-Jones protein. In 1921 Hopkins made his most fundamental contribution by isolating from living tissues the sulfur-containing dipeptide glutathione and by showing its great importance for oxidation in living cells.

Among the many honours Hopkins received were the Royal medal (1918) and the Copley medal (1926) of the Royal society; the Nobel prize (jointly with Christiaan Eijkman; *q.v.*) for physiology (1929); and the Order of Merit (1935). He was knighted in 1925. Hopkins died on May 16, 1947, at Cambridge, Eng. (J. NE.; X.)

HOPKINS, GERARD MANLEY (1844–1889), English poet, was born at Stratford, Essex, on July 28, 1844. He wrote his first'poetry while a pupil at the Cholmondley grammar school, Highgate, London, but at this time was more concerned with painting than with poetry. In April 1863 he went up to Balliol college, Oxford, where Matthew Arnold was professor of poetry in the university. Under the waning influence of the Oxford movement, Hopkins abandoned his Anglican upbringing to enter the Roman Catholic Church in 1866, and two years later joined

the Society of Jesus. In 1877 he was ordained priest and, after working among Irish immigrants in the Liverpool slums and teaching Latin and Greek at Stonyhurst college in Lancashire, he became professor of Greek at University college. Dublin, in 1884. On June 8, 1889, he died of typhoid fever in Dublin and was buried in the Jesuit cemetery at Glasnevin.

It was while studying theology at St. Asaph in Wales, during his novitiate, that Hopkins entered his most productive period as a poet. culminating in his long poem, "The Wreck of the Deutschland" (1875).

Hopkins' collected poems were first published in 1918, by Robert Bridges, then poet laureate, to whom he had entrusted his works. His innovations in metre and rhythm, his abnormally sensitive use of language and the depth and passion of his religious convictions made an immediate impact on the young poets of the 1920s and '30s.

The main features of Hopkins' poetry are the complex pattern of rhyme, alliteration and assonance that he wove around his generous use of sprung rhythm. Sprung rhythm is a method of manipulating stressed and slack syllables in a line of poetry to achieve desired effects, that had not been used in English verse since the time of Robert Greene and the early Elizabethans. He used the term "inscape" to express the vital quality behind all his creative activity — the quality of discerning the distinctive character of the person or object observed. Hopkins derived philosophical justification for this conception from the works of John Duns Scotus (*q.v.*).

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See also G. F. Lahey, *Gerard Manley Hopkins* (1930); John Pick, *Grrard Manley Hopkins, Priest and Poet* (1942); *W.* H. Gardner, *Gerard Manley Hopkins, 1844–1889,* and ed., rev. (1948–49).

(B. E. O.)

HOPKINS, HARRY LLOYD (1890–1946), administrator of federal relief during the New Deal and Pres. Franklin D. Roosevelt's close adviser and personal emissary during World War II, was born at Sioux City, Ia., on Aug. 17, 1890. He entered social work in New York city immediately after his graduation from Grinnell (Ia.) college in 1912. In 1931 when the acuteness of the depression forced large-scale state aid to the unemployed, he became executive director, then chairman, of the New York state temporary emergency relief administration under Gov. Franklin D. Roosevelt. In the spring of 1933 when Roosevelt became president, he appointed Hopkins administrator of the new Federal Emergency Relief administration. Hopkins immediately began distributing an initial $500,000,000 in federal grants-in-aid to establish state relief programs. He tried to resist political pressures and laboured vigorously to estahlish relief agencies of high professional standards. He combined crusading moral fervour with hardheaded executive ability. Worrying about the moral erosion and loss of skills of those who had not worked for years, he persuaded President Roosevelt to estahlish a work relief program, the Civil Works administration (CWA), in the fall of 1933. Criticism of the makeshift nature of many of the projects led to the abolishment of the CWA in the spring of 1934. Heavy Democratic victories in the fall elections of that year encouraged Hopkins to pressure the president to recommend extensive reforms in 1935. These included the establishment through an act of congress of a more substantial work relief program, the Works Progress administration (WPA). Some parasitism, and by 1938 much politics, entered into the WPA. Republicans charged that the enormous relief funds were being spent to influence elections and claimed Hopkins had remarked. "Spend and spend, tax and tax, elect and elect." Yet Hopkins altogether spent a total of $8,500,000,000 for unemployment relief with the record marred by a few relatively insignificant scandals compared with many substantial public works achievements, and the aiding at one time or another of about 15,000,000 people. By the time of the election of 1936 Hopkins had become deeply interested in politics and increasingly an adviser to President Roosevelt. In the late 1930s he developed presidential ambitions. Roosevelt appointed him secretary of commerce in 1938. A serious stomach operation leaving him in permanently precarious health put an end to his political ambitions but, if anything, made him more valuable to Roosevelt as a trusted confidant. He acted as personal manager for Roosevelt at the Democratic convention in July 1940. In Aug. 1940 he resigned as secretary of commerce to devote himself fully to working on the problems of the defense crisis and aiding Great Britain. He made several trips to London, and after, the U.S.S.R. entered the war, to Moscow, to discuss assistance, and after the United States entered the war, strategy. Hopkins was head of the lend-lease program in 1941 but until the end of the war functioned for the most part informally as the president's adviser, so close to Roosevelt that he even lived in the White House. His final service after Roosevelt's death was to visit Moscow in the spring of 1945 to help arrange the Potsdam conference for Pres. Harry S. Truman. Hopkins had long been thin and wracked by pain; he died in New York city on Jan. 29. 1946.

See Robert Sherwood, *Rooscvelt and Hopkins* (1948). (FK. F.)

HOPKINS, MARK (1802–1887), U.S. educator and moral philosopher, of whom it was said that "The ideal college is Mark Hopkins on one end of a log and a student on the other." was born in Stockbridge. Mass., on Feb. 4. 1802. He became identified with a philosophical outlook that combined 18th-century puritanism and 19th-century progress. His teachings at Williams college, Williamstown, Mass., where he was in charge of instruction of the senior class from 1830 to 1887 and president from 1836 to 1872, and his four series of lectures before the Lowell institute, Lowell, Mass., gave him an opportunity to preach the "gospel of wealth," which emphasized the importance of striving to possess property and of treating wealth with the responsibility of Christian stewardship.

Hopkins was firmly established in the folklore of U.S. education by the above-quoted aphorism, attributed to Pres. James A. Garfield, his former student. This aphorism may be considered to define the purposes of the liberal arts college in the United States, suggesting an emphasis on self-education, close student-faculty relations and moral as well as intellectual training. Hopkins' retirement from the Williams presidency in 1872 meant an acceleration of those tendencies toward secularism, intellectualism and professionalism that he deplored. He died at Williamstown on June 17, 1887.

Hopkins is sometimes confused with a contemporary Mark Hopkins, who was associated with Theodore Judah. Collis P. Huntington and Leland Stanford in California railroad development.

BIBLIOGRAPHY.—Franklin Carter, *Mark Hopkins* (1892); John H. Denison, *Mark Hopkins* (1935); Frederick Rudolph, *Mark Hopkins and the Log* (1956).

(F. RII.)

HOPKINS, SAMUEL (1; 21–1803), American Congregational theologian, a disciple of Jonathan Edwards (*q.v.*), was born in Waterbury, Conn., on Sept. 17, 1721. He was graduated from Yale college in 1741; studied divinity at Northampton, Mass., under Edwards; and in Dec. 1743 was ordained minister of the Congregational church in frontier Housatonick (later named Great Barrington, Mass.), where he continued his contacts with Edwards and served until 1769. From April 1770 to his death on Dec. 20, 1803, he was minister of the First church in Newport, R.I. He and Joseph Bellamy were Edwards' most important and creative disciples, Hopkins being the more arresting, controversial and influential of the two. His uningratiating manner and severe views on unregeneracy, church membership and baptism led to his dismissal at Great Barrington and to much dissatisfaction at Newport; hut "Hopkinsianism" flourished despite the ravages of imperial wars and the Revolution. *A System* of *Doctrines Contained in Divine Revelation* (1793) is Hopkins' masterpiece, a closely reasoned dogmatics developing the great Edwardscan themes yet adjusting them to the growing humanitarian temper of the times. His most widely discussed contentions were these: that God's permission of sin stemmed from his concern for the happiness of the whole and hence is "advantageous"; that human virtue con-

sists in a similar concern for the whole, with disinterested benevolence or complete submission to God's will being the supreme motive, even unto willingness to be damned; that sin consists essentially in self-love; and that there is no promise of salvation but in the exercises of holiness of regenerate men. His work had great effect in expanding missionary activity in America and abroad (particularly Africa) and in developing philanthropic social attitudes. Beginning in the early 1770s he began to speak and write actively for Negro emancipation and against the slave trade, being one of the first New England Congregationalists to do so.

BIBLIOGRAPHY.—Hopkins' *Works*, 3 vol. (1852) contains a good biography by E. A. Park; Stephen West's *Sketches of . . . Hopkins* (1805) is largely Hopkins' autobiography. *See* also Williston Walker, *Ten New England Leaders* (1901): F. H. Foster. *Genetic History of the New England Theology* (1907); Joseph Haroutunian, *Piety Versus Moralism* (1932). (S. E. A.)

HOPKINSON, the name of two English engineers and physicists, father and son.

JOHN HOPKINSON (1849–1898), chiefly known for his work in the electrical field and in particular for his analysis of the magnetic circuit, was born in Manchester on July 27, 1849. After a brilliant career at Cambridge and London universities he entered, as a pupil, the engineering works in which his father was a partner. In 1872 he became engineering manager in the glass manufactories of Chance Brothers and Co. at Birmingham, where he studied the problems of lighthouse illumination and advocated the group-flashing method of differentiating lights. He also undertook researches on electrostatic capacity, the phenomena of residual charge and other problems arising out of Clerk hfaxwell's electromagnetic theory.

In 1878 Hopkinson established in London a successful practice as a consultant engineer. His work was mainly electrical: he acted, for instance, as consultant to the English Edison Co., to the Metropolitan Electric Supply Co. and to Mather and Platt on the City and South London railway. He was also in great demand as an expert witness in patent cases. In the early 1880s Hopkinson was almost alone in his grasp of the correct principles underlying the new application of electricity to "the electric light." In conjunction with his brother Edward he worked out the general theory of the magnetic circuit in the dynamo, making great improvements in its design and efficiency; he analyzed the process of commutation; and he took a leading part in the development of the three-wire system of distribution. He also elucidated the theory of alternating current, and the parallel operation of alternators.

In 1890 Hopkinson took charge, with the title of professor, of the newly founded Siemens laboratory at King's college, London. He received, among other distinctions, a Royal society medal, and was twice president of the Institution of Electrical Engineers. His death occurred on Aug. 27, 1898, when, together with one son and two daughters, he was killed in an accident while climbing the Petite Dent de Veisivi, Switz. (M. K. W.)

BERTRAM HOPKINSON (1874–1918), distinguished for his work in aeronautics and for his researches on the process of explosions, was born at Birmingham, Eng., on Jan. 11, 1874, the eldest child of John Hopkinson (*see* above). When his father was killed, Bertram took up his unfinished work. designing electric tramways at Crewe, Newcastle and Leeds. In 1903 he succeeded Sir J. Alfred Ewing (*q.v.*) as professor and head of the engineering department, Cambridge, and under his leadership the department grew in numbers and reputation. He was an effective teacher with a passion for research, covering such diverse subjects as the properties of steel, the dynamics of explosions and the hunting of alternators. He was elected a fellow of the Royal society in 1910 and a fellow of King's college, Cambridge, in 1914. In 1915 he was appointed to the department of military aeronautics of the royal flying corps, taking charge of the design of bombs and establishing an armament experiment station at Orfordness. In 1916 the testing of airplanes was put under his charge and his influence on the general development of aeronautics steadily increased. On Aug. 26, 1918, he was killed while piloting a Bristol fighter. (J. F. BR.)

HOPKINSON, FRANCIS (1737–1791), U.S. author, musician and statesman, one of the signers of the Declaration of Independence, was born in Philadelphia, Pa., Sept. 21, 1737. His father, Thomas Hopkinson, a lawyer, was first president of the American Philosophical society and trustee of the College of Philadelphia, predecessor of the University of Pennsylvania. Francis Hopkinson was enrolled as the first student in the college, from which he received his bachelor's degree in 1757, his master's in 1760 and the degree of LL.D. in 1790. He aided the revolutionary movement and the later struggle for the adoption of the constitution by a series of prose and poetic satires, which were widely reprinted and most effective. Among them are *A Pretty Story* (1774) and *Tize Battle of the Kegs* (1778). He published *A Collection of Psalm Tunes* (1762) and composed *Seven Songs for the Harpsichord or Forte-Piano* (1788). He died May 9, 1791. His *Miscellaneous Essays and Occasional Writings* was published in 1792.

HOPPE-SEYLER, FELIX (1825–1895), German physiologist, became in 1856 assistant to Virchow in Berlin, in 1864 professor of applied chemistry at Tübingen and in 1872 professor of physiological chemistry at Strasbourg. He pursued important researches on blood and metabolism, and was the first to obtain lecithin in the pure state. His most important studies concern milk, bile, urine and chlorophyll.

Hoppe-Seyler wrote a handbook of chemical analysis applied to physiology and pathology (1858) and a treatise on physiological chemistry (1877).

HOPPNER, JOHN (1758–1810), English portrait painter, who emulated the style of Sir Joshua Reynolds, probably was born on April 4, 1758, at Whitechapel. His father was of German extraction, and his mother was one of the German attendants at the royal palace. Hoppner received the patronage of George III, whose regard for him gave rise to the report that he was the king's natural son. As a boy he was a chorister at the royal chapel, and in 1775 entered as a student at the Royal Academy. In 1778 he took a silver medal for drawing from life, and in 1782 the Academy's highest award, the gold medal for historical painting, his subject being King Lear. He first exhibited at the Royal Academy in 1780. His earliest love was for landscape, but necessity obliged him to turn to the more lucrative business of portrait painting. At once successful, he had throughout life the most fashionable and wealthy sitters, and was the greatest rival of the king's painter, Thomas Lawrence. The prince of Wales especially patronized him, and many of his finest portraits are in the state apartments at St. James's palace, the best perhaps being those of the prince, the duke and duchess of Tork, of Lord Rodney and of Lord Nelson. Among his other sitters were Sir Walter Scott, Wellington, Frere and Sir George Beaumont. A *Series of Portraits of Ladies* was published by him in 1803, and a volume of translations of eastern tales into English verse in 1805. Ideal subjects were very rarely attempted by Hoppner. though a "Sleeping Venus," "Belisarius," "Jupiter and Io," a "Bacchante" and "Cupid and Psyche" are mentioned among his works. Hoppner died on Jan. 23, 1810.

He was confessedly an imitator of Reynolds. When first painted, his works were much admired for the brilliancy and harmony of their colouring, but the injury due to destructive mediums and lapse of time which many of them suffered caused a great depreciation in his reputation. The appearance, however, of some of his pictures in good condition has shown that his fame as a brilliant colourist was well founded.

HOPSCOTCH, a children's game played on a diagram drawn on the ground or other flat surface, having named or numbered spaces. The game is world-wide and has many variations. In a common form, each player tosses or kicks some small flat object into each division. in sequence, and then hops on one foot through the spaces to get the object and return. When he misses (by stepping on a line, putting both feet down, etc.), he forfeits his turn until the other players have played. The winner is the player who moves through all the spaces first. (N. F. J.)

HOPTON, RALPH HOPTON, BARON (1598–1652), Royalist commander in the English Civil War, appears to have served in the army of the elector palatine in the early campaigns of the Thirty Years' War, and in 1624 he was lieutenant-colonel of a regiment raised in England to serve in Mansfeld's army.

Charles I. at his coronation. made Hopton a Knight of the Bath. Hopton, as member of parliament successively for Bath, Somerset and Wells, at first opposed the royal policy, but after Strafford's attainder (for ahich he voted) he gradually became an ardent supporter of Charles, and at the beginning of the Civil War he was made lieutenant-general under the marquess of Hertford in the west. His first achievement was the rallying of Cornwall to the royal cause, his next to carry the war from that county into Devon. In May 1643 he won the brilliant victory of Stratton, in June he overran Devon, and on July j he inflicted a severe defeat on Sir William Waller at Lansdown. In the last action he was severely wounded by the explosion of a powder wagon and he was soon after shut up in Devizes by Waller, where he defended himself until relieved by the victory of Roundway Down on July 13. He was created Baron Hopton of Stratton. But his successes in the west mere cut short by the defeat of Cheriton or Alresford in March 1644. After this he served in the western campaign under Charles's own command, and toward the end of the war he succeeded to the command of the royal army. It was no longer possible to stem the tide of the parliament's victory, and Hopton, defeated in his last stand at Torrington (Feb. 16. 1646), surrendered to Fairfax. Subsequently he accompanied the prince of Wales in his attempts to prolong the mar in the Scilly and Channel islands. He died in exile, at Bruges in Sept. 1652.

HOR, MOUNT, the scene of Aaron's death, according to the Bible. and since the time of Josephus. generally identified with Jabal Hārōn, about 4,500 ft., near Petra. A shrine on the summit is said to cover the grave of Aaron, and is an object of pilgrimage to the surrounding tribes, but it is obviously of comparatively modern construction. This identification is challenged by many, and other localities have been suggested, *e.g.,* J. Madāra, Hermon, etc.

See **Numbers, xxxiii, 37, and** xxxiv, **7, 8.**

HORACE (QUINTUS HORATIUS FLACCUS) (65–8 B.C.), the celebrated Roman poet, mas born on Dec. 8, 6 j B.C., at Venusia, a small town of southeast Italy. He was a contemporary and friend of Virgil. His work comprises short meditative personal poems. in which irony of observation and reflection are combined with the more lyrical qualities of poetry in a way more common in modern literature than in antiquity, and longer, more discursive hexameter verse essays dealing in a sophisticated and personal fashion nith everyday ethics and manners and with literary criticism. There are extant 121 lyric poems (Odes, Epodes and Carmen *saeculare*) and 41 verse essays (Satires, sometimes called *Sermones;* Epistles and Ars *poetica*). It is not likely that Horace published more. The verse essays have always been popular, though few place them in the front rank of literature. The reputation of the lyric poems has fluctuated. Horace's ability to embody conspicuously sane pronouncements on the problems and follies of his fellow men, or succinctly evocative vignettes of city life and scenes of natural beauty, in memorable phrases that have the impact of epigrams while retaining an unmistakable note of serene high seriousness has established his position among the general lettered public of all ages as the best-loved Roman poet. A reputation so founded, on the striking turn of phrase (Quintilian's *felicissime audax*) and evident quality of craftsmanship (Petronius' *curiosa* felicitas) rather than on the merit of complete poems (their development of thought is often elliptical and elusive), has often led to some disparagement by those whose poetic standards are exacting. This has been true particularly at times when imagination and spontaneity have been the prized qualities of poetry, at the expense of structural strength and subtlety of technique. Moreover, the charm of Horace's personality that pervades his work and his evident warm humanity have hindered recognition of his claims as a serious and original artist. In the mid-20th century, nhen technical accomplishment and the more intellectual qualities of poetry again came to the fore. and, as a result of sympathetic revaluations by scholars, the reputation of Horace's lyric poetry seemed more secure than it had for 150 years.

Horace lived in one of the best-documented periods of Roman history. Moreover, several of his poems are directly autobiographical and more about him can be gathered from remarks scattered through his work. However, this material needs critical handling. The information provided by the Satires is incidental and scattered, but contemporary and probably reliable. Certain of the Epistles are more consciously autobiographical, but what Horace says about his poetic formation should be accepted with caution. since he is looking back over a period of 20 years. In the lyric poems there is a good deal of attitudinizing and probably a certain amount of poetic fiction. Further information, about the later part of his life especially, can be derived from a condensed version of a biography by Suetonius, an undiscriminating mixture of gossip and fact which, however, preserves valuable quotations from contemporary documents.

Horace's father, a freed slave, held a minor official post as collector of market dues (coactor *argentarius*) in Venusia, which was the seat of a Roman garrison and colony. Culturally the influence of Greece was perhaps as strong as that of Rome, for Venusia was on the periphery of the centuries-old Greek civilization of south and southwest Italy. His southern upbringing may have contributed to that easy familiarity with Greek culture with which his work is penetrated, in contrast to the more flamboyant Hellenism of Catullus or Propertius, though the ambition of his father contrived soon to provide him with the expensive standardized education that his betters enjoyed, first at Rome and later at Athens. Horace's first sojourn in Rome was short and fell in the unquiet years following Julius Caesar's crossing of the Rubicon in 49 B.C. By the time of the assassination of the dictator in 44 B C. Horace was already in Athens. He was acquiring, he later tells us, that moralistic approach to literature which constantly recurs in his poetry, when he was engulfed by the'march of events. Out of idealism, or through personal friendships, he joined the armies of Brutus. For perhaps two years he moved about in Greece and the near and middle east until the inevitable trial of strength came with Antony and the future emperor Augustus. Brutus' defeat at Philippi (autumn, 42 B.C.), in which Horace states he took part as a *tribunus militum,* ended this episode in his career. To his intellectual development it contributed a personal acquaintance with the greater Roman world and that sense of personal involvement in the fortunes of the state which adds occasionally deeper and more passionate overtones to his lyric poetry, leaving him midway between the frivolous antimilitarism of Propertius or Tibullus and the intellectual idealism of Virgil.

Horace returned to Rome after Philippi, as those who wished were permitted to do by a liberal amnesty. He was now about 25 years old, reasonably rich in experience, but destitute in a city he had known only as a schoolboy. He resisted despondency and bitterness with a resilience and determination worth bearing in mind as correctives to the humorously self-depreciatory autobiographical sketches which he affects. He obtained a moderately important administrative post (scriba *quaestorius*) and began writing verse. His early work shows talent rather than genius. But the new regime supported literature generously, and within about five years Horace was able to claim publicly (*e.g.,* Satires i, 5, and i, 10, 81 ff.) that the greatest political figures in Rome, above all Maecenas, were his friends, as well as the leading personalities of literature, especially Virgil.

Horace's devotion to literature continued for nearly a quarter of a century more. He became perhaps the first example in Roman society of a professional man of letters, claiming freedom to write as he chose. He accepted patronage (his small farm in the Sabine hills northeast of Tibur given him by Maecenas some time before 31 B.C. is the most famous example), but resisted vocally all that seemed to him an attempt to restore the old relationship between patron and poet (familiar in Roman society from the 2nd century B.C. onward, and still existing in Horace's day) which imposed on the artist the task of his master's glorification. It is likely that Horace's refusal to attempt epic poetry (the commonest genre in his day) sprang less from the diffidence in his ability that he professes than from the suspect integrity of a form uhich at Rome had become too exclusively devoted to the eulogy of statesmen. Horace's stand was new and his position delicate: Maecenas (to judge from the surviving scraps of his verse) possessed enthusiasm for literature rather than taste and, in applying

pressure to the poets of the Augustan age to serve the regime, he was probably unaware of the artistic problems involved for the writer scrupulous about his integrity.

The decade which followed the battle of Actium (31 B.C.) and the final overthrow of the opponents of the new regime undoubtedly appeared to those like Virgil and Horace who had lived through the horror of almost constant civil war lasting from their early childhood as a new era of peace and hope. The term "Augustan poets," often applied to Horace and Virgil (and their contemporaries), is historically misleading. Both were grown men already writing before the civil wars ended and their intellectual formation was largely complete before the Augustan age began. Virgil (d. 19 B.C.) did not live to see the more ruthlessly totalitarian character of the emperor fully emerge, and the *Aeneid* reflects the genuine enthusiasm aroused by the beginnings of Augustan rule. Horace's poetry of that period occasionally expresses similar feelings (particularly *Odes* iii. 1–6), but his position during the decade by uhich he survived Virgil is less clear. He became rhe emperor's friend. and in his later works references to Augustus become more frequent and tinged with flattery and those to Maecenas rare. It is perhaps not coincidental that at this time Augustus and Maecenas were estranged, though we are told that all his life Maecenas regarded Horace as a loyal friend. In Horace's latest norks *(Epistles* ii, *Odes* iv) open adulation of the emperor and his family appears. How far the need for this decided Horace to give up writing is not clear. At all events, he appears to have written no lyric poetry during the last 5 years of his life and little during the last 15, while, in the three long verse essays which he wrote after Virgil's death, though they deal with literature, his attitude to poetry at times seems curiously sour. As an artist of the highest literary standards, Horace may have felt he had exhausted his genius, though in a poet whose genius was for detailed craftsmanship rather than spontaneity this is not an immediately convincing explanation. He died in Rome on Nov. 27, 8 B.C., after a sudden illness, a few days before the completion of his 57th year.

WORKS

The 30 years of Horace's writing life fall into three periods: a period of rapid development from his return to Rome after Philippi to about the battle of Actium (roughly 40–30 B.C.); the period of his finest work in both styles, covering the next decade; a period, covering probably another decade, of decline in his creative and imaginative powers.

First period.—Satires and Epodes.—The *Satires:* Book i contains work down to about 35 B.C.; Book ii to about 30 B.C. The writing of the *Epodes* seems to have extended over the whole decade.

Horace's initial ambitions as a writer were limited. He began with experiments in two distinct styles. One was a loose form of hexameter verse which he made the vehicle of something very like the modern prose essay. In the space of about 100 lines he argued ethical and literary questions, usually from a very individual viewpoint forcibly maintained, the whole varied by moralizing anecdotes and marked by abrupt transitions intended to create the appearance of spontaneity, though scrutiny shows the essays were in fact carefully composed. The Romans called this *satura.* Horace says *(Satires* i, 10. 46 ff.) that he chose the form in order to have no serious contemporary rival. He expected little difficulty in doing better than the originator of the genre. Lucilius (whose talent he freely admits), by avoiding Lucilius' slipshod methods of composition and the roughnesses of expression which the evolution of the Latin language and technical improvements in the hexameter had eliminated in the 60 years since Lucilius' death. His honesty is disarming and no doubt sincere.

It is clear from *Satires* i, 4, 41 ff. that he originally regarded his essays as something more like prose than poetry. At this stage poetry meant for Horace the high style and impassioned diction of epic and tragedy. His view of the nature of poetry quickly became more subtle and his recipe for satire more exacting. In a fine appraisal of the genre in *Satires* i, 10, 7–14 he claims it can rise, at least occasionally, to the status of real poetry. Of the ten satires of Book i, two deal with literary criticism, four are sermons delivered from a practical unintellectual standpoint in general adherence to the current Epicurean philosophy, while the remaining four have a loose narrative form displaying that interest in character and situation which is also a feature of Horace's lyric poetry. The eight satires of Book ii include a number of experiments in dramatic form and a good deal of that argument about rival ethical theories which (as the treatises of Cicero on popular philosophy show) fanned among the Romans of this period something akin to the heat of religious controversy. The sixth satire of Book ii and the fifth, ninth and perhaps sixth of Book i are those which can be read today with the greatest pleasure. After about ten years of experiment. Horace seems to have felt his poetic intentions and abilities had outgronn this form and he gave himself over exclusively to the kind of lyric poetry which had also begun to take shape during this first period.

The collection called *Epodes* contains 17 poems from 16 to 102 lines in length. The form and, to some extent, the style are based on the iambic poems of Archilochus, a Greek poet of the 8th or 7th century B.C. Horace probably took him as his model mainly to break away from contemporary trends. The influence of Catullus (who died when Horace was about ten) is clear, though unacknowledged. Horace avoids the actual iambic metres used by Catullus, wishing perhaps to disassociate himself from Catullus' successors in his own day. Most of the poems show a pleasant talent and technical competence with some flair for the grotesque and gruesome, spoiled occasionally by a precarious sense of humour. The *Epodes* also contain the first examples of Horace's use of poetry for impassioned commentary on political issues. He admits difficulty in completing the collection; presumably, as with the *Satires,* he outgrew the limitations of the form. Four poems (11, 13–1j), uhich differ sharply from the rest, are better regarded as early odes, included to bring the book up to the minimum dimensions for publication. These four also contain the best nriting.

Second period.—Odes i–iii and Epistles i.—To the seven or eight years after the battle of Actium belongs Horace's most ambitious and permanent contribution to literature. Three books of *Odes* were probably published together in 23 B.C. It was a period of national resurgence after 30 years of civil strife. During most of it, Virgil was working on his national epic, the *Aeneid.* Both factors are likely to have added stimulus to Horace's poetic concentration. *Odes* i–iii comprise *88* poems mostly from 16 to 50 lines long, with a few shorter and a few longer pieces.

The predominating formal theme of rather more than a third is friendship (a friend is normally addressed), with which are mixed in varying proportions counsel, encouragement or philosophical reflection. The hortatory tone adopted by the adherents of Epicureanism in their letters to one another may have contributed to the formal layout, but often the poetic intent obviously transcends the philosophical. For example ii, 10 (*Rectius uiues, Licini, neqzte altum, . .*) is primarily hortatory though with serious poetic qualities as well; whereas in i. 4 (*Solvitur acris hiems . . .*) the philosophical commonplace formally provides a thread to link the rich imagery of the first part of the poem with that of the second part, tuning the simple sensuousness of the imagery with pervading attitudes of irony and melancholy. The famous ode ii, 14 (*Eheu fugaces, Postume, Postume, labuntur anni . . .*) on the other hand, while dealing with a similar commonplace. is one of a group of odes (compare, for example, i, 27; ii, 3; iii, 13) in which a dramatic context is discreetly suggested.

Nearly another third of the odes deal with love. Horace treats this theme differently from either Catullus or Propertius and contemporary poets. Where they are concerned more nith the analysis of emotions arising out of a single affair and the effect on the poet of his involvement in it, Horace chooses typical situations. The emphasis is not on the facts of the situation, but on the possibilities of irony, pathos or charm they offer to the poet as observer. These love poems are characterized therefore by a high level of detachment, in contrast to the open and forceful personal comment of his earlier period. Judgment of the situation does not go beyond a slightly ironical or melancholy implication. As a result of this humanist and realist standpoint, the

themes chosen for study are more often trivial than heroic. In solving the problems raised by the need in such short poems for maximum concentration of complex data, Horace drew upon the formal conventions of Greek epigram: the technique, for example, of writing a poem as a fragment of a story with only enough of the facts given to form a sketched-in background to the real point —a humorous remark, a pathetic situation, etc. To the conventions of epigram Horace makes two notable contributions. He writes a rather longer poem which can study fairly complex emotional patterns instead of a single point. Secondly, he exploits a technique of oblique description of scene. The poems become a kind of puzzle, setting the task of fitting together the relevant data, which are suggested rather than overtly presented. As in the philosophical odes, some poems are dramatic monologues rather than poems actually directed to their addressee—studies, as it were, in the process of the unwinding of the speaker's thoughts (*e.g.,* especially i, 5; iv. 13).

The remaining odes deal with the practice of poetry and miscellaneous topics, including short formal hymns to gods and goddesses. The six great Roman odes that begin Book iii form a group on their own. On the whole Horace's attempt to adapt his intimate personal style to the grander themes of patriotic poetry is successful. He stresses the moral seriousness of the new regime with a severe sobriety that scrupulously avoids adulation. Some of Horace's best imaginative writing (the picture of traditional rustic life in iii, 6; the superb episode of Regulus in iii, 5) is found here.

About three-quarters of the collection are written in one or other of two types of four-line stanza associated with the Greek lyric poets of the 7th century B.C. (His Sapphics and Alcaics are written to stricter rules than obtained in Greek. Long syllables are regularized where shorts had been permitted, an effect more congenial to Latin and to the serious tone of Horace's poetry. He made similar modifications in his Asclepiads and other metres and in general regularized the use of caesurae.) It is in this technical metrical sense that the ancients called the poems lyrics. They are, of course, no more songs than modern meditative lyric poems are. In an epilogue poem (iii, 30) Horace claims that he re-created Aeolic poetry (*i.e.,* Sappho and Alcaeus) in Italian verse:

> dicar, . . .
> princeps Aeolium carmen ad Italos
> deduxisse modos.

Elsewhere (Epistles i, 19, 32 ff.) he indicates that his main indebtedness was to Alcaeus. In both places Horace seems to suggest affinity in style and spirit as much as in metrical form. His words are allusive rather than specific and, as Alcaeus' poetry survives only in fragments, the nature and validity of Horace's claim are hard to fix. Modern critics differ sharply. According to a view popular among German critics, Horace, after beginning as a Hellenistic poet in spirit (Epodes and early Odes), became increasingly "classical." Others follow Giorgio Pasquali's theory of a tension in Horace between the essentially Roman-Hellenistic background and subject matter of the Odes, and their consciously pre-Hellenistic, classical form. The predominating 19th-century view that the content of the Odes is trivial perhaps stems from an often-quoted remark attributed to Goethe allowing the technical perfection of the Odes, but denying them any status as real poetry. The harshness of this criticism is probably due to their lack, in Goethe's view. of worthwhile personal experience (*Eriebnis*).

A book containing 20 hexameter epistles was published about 20 B.C. Horace, who was 44, describes himself as "a little baldish man, easy-going though quick-tempered, fond of the sun." The Epistles in many ways resemble the Satires, but show, too, the influence of the literary development of the short personal letter as shaped by Catullus in verse and Cicero in prose: compare, for example, i, 5 (an elegant discursive invitation to dinner) with Catullus, 13. About six more of the epistles are of this kind, the best perhaps being 9—a delightfully tactful letter of introduction. The tone is not unlike that of the lighter odes.

In a second group the jerky allusive style of the Satires persists with little progress stylistically beyond the point Horace reached a decade earlier. The quality varies: i, 18 is a piece of advice, opportunist in tone, on how to win influential friends; 7 an altogether delightful letter to Maecenas (and, incidentally, an eloquent testimony to the ease of their relationship). The epistolary form is sometimes an obvious fiction: in 16 the charming opening paragraph describing Horace's farm is obviously sewn on to the dullish sermon which follows it.

A third group attempts the exposition of an essentially practical philosophical attitude toward life: uirtus est *uitium* fugere, et *sapientia* prima stultitia caruisse, "Virtue consists in avoiding vice. To be free of folly is the first step to wisdom" (Epistles i, 1, 41 f.); and, *mihi res* non me rebus subiungere *conor,* "To be the master of circumstance, not its slave, that is my aim" (Epistles i, 1, 19). The quality of the style in this third group is high. The sentences. though often free of any ornament, possess a dry, terse quality and a serenity of tone that makes them admirable writing. The book, however. has few essentially poetic qualities.

Third period.—Odes *iv,* Carmen saeculare, Epistles ii and Ars poetics.-Horace implies that the odes won him recognition as Rome's leading poet (after Virgil's death) rather than popularity. The poetry was perhaps too uncompromisingly hard. In 17 B.C. Horace was commissioned to compose a choral hymn for the secular games, which heralded the start of a new century. The Carmen saeculare, in sapphics, is diligent rather than inspired work, an elaborate invocation of the appropriate deities. It is more a hymn for an official occasion than a poem. Also at the emperor's suggestion a fourth short book of odes appeared about 13 B.C., comprising partly poems attempting but not achieving, the old style (the best are the Spring ode, 7, and the fine dramatic monologue, 13), and partly very competent laureate writing (4, 5, 14, 15), more openly laudatory than hitherto. Some odes look like work written earlier (*e.g.,* 12; perhaps 7); others (*e.g.,* 8; g) have a straight expository style devoid almost of imagery and verbal poetry that makes them read like epistles done into lyric metres. A weakness of Horace's lyric writing is that little springs from his o n fancy, experience or intellectual strength. The core is the delicate handling. with just the right mixture of approbative and satirical attitudes, of external everyday incidents. This gives a context too limited for extensive repetition.

About this time. Horace published three more long epistles dealing more or less loosely with literary criticism, though his personal attitude to poetry became progressively less sympathetic. A public letter to Augustus on the state of poetry in Rome vigorously defending contemporary writers and a sermon on avaritia introduced by a diffuse discussion of his abandonment of lyric make up Epistles ii. The date of composition is uncertain. The third, usually called Ars poetica, is Horace's longest single composition. Its date (whether early or late in the last decade of Horace's life) is debated. The work has acquired in the history of criticism a fame and at times an authority it hardly deserves. It lacks the intellectual calibre of Aristotle's Poetics and was aimed presumably at a more modest target, though the circumstances of its writing are unknown. It is a kind of practical survey of the history and theory of dramatic poetry. glancing occasionally at lyric and epic, and drawing heavily on Greek theory as propounded by Neoptolemus of Parium and Philodemus, though the issues were contemporary and Roman. The essay, though obviously laid out with care, makes difficult reading. It suffers seriously from Horace's habit of expressing himself in vigorous precepts (many have become famous) and aphoristic illustration, rather than connected argument. There is much good sense, but little fresh criticism, not enough evidence he had fully thought out his critical standpoint, or himself appreciated the complexity of his own poetic achievement.

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HORAE, in Greek and Latin mythology the Seasons. In the Iliad they are the custodians of the gates of Olympus. In the Odyssey they are represented as bringing round the seasons in regular order. The brief notice in Hesiod's Theogony, where they are called the children of Zeus and Themis who superintend the operations of agriculture, indicates by the names assigned to them (Eunomia, Dike, Eirene; *i.e.,* Good Order, Justice, Peace) the extension of their functions from nature to the events of human life, and at the same time invests them with moral attributes.

At Athens they were apparently two in number: Thallo and Carpo, the goddesses of the flowers of spring and of the fruits of summer. In honour of the Horae a yearly festival (Horaea) was celebrated.

In later mythology, under Alexandrian influence, the Horae became the four seasons, daughters of Helios and Selene, each represented with the conventional attributes. Subsequently, when the day was divided into 12 equal parts, each of them took the name of hora. (See also GRACES.)

HORAPOLLON, of Phaenebythis in the nome of Panopolis in Egypt, Greek grammarian, flourished in the 4th century A.D. According to Suidas, he wrote commentaries on Sophocles, Alcaeus and Homer, and a work, Temenica, on consecrated places. Photius calls him a dramatist as well, and credits him with a history of Alexandria.

Under the name of Horapollon two books on Hieroglyphics are extant, which profess to be a translation from an Egyptian original into Greek by a certain Philippus. The translation is evidently late and has been ascribed to the 15th century. All that can be said is that there is evidence of the hieroglyphic tradition being still alive in the days of the author.

HORATII AND CURIATII, in Roman legend, two sets of three brothers born at one birth on the same day—the former Roman, the latter Alban—the mothers being twin sisters. During the war between Rome and Alba Longa it was agreed that the issue should depend on a combat between the two families. Two of the Horatii were soon slain; the third brother feigned flight, and when the Curiatii, who were all wounded, pursued him separately he slew them one by one.

When he entered Rome in triumph, his sister recognized a cloak which he was wearing as a trophy as one she had herself made for her lover, one of the Curiatii. She thereupon invoked a curse upon her brother, who slew her on the spot. Horatius was condemned to be scourged to death, but on his appealing to the people his life was spared.

The origin of the story is obscure and disputed. It obviously contains a traditional origin for the right of appeal to the people. The root of the legend is probably in the sororium *tigillum,* the purificatory yoke under which Horatius had to pass.

HORATIUS COCLES, a legendary hero of ancient Rome. With two companions he defended the Sublician bridge against Lars Porsena and the whole army of the Etruscans, while the Romans cut down the bridge behind. Then Horatius threw himself into the Tiber and swam in safety to the shore. A statue was erected in his honour in the temple of Vulcan, and he received as much land as he could plow round in a single day. According to another version, Horatius alone defended the bridge, and was drowned in the Tiber. E. Pais finds the origin of the story in the worship of Vulcan, and identifies Cocles (the "one-eyed") with one of the Cyclopes.

HORDEUM, a genus of perhaps 20 species of annual or perennial grasses, widely distributed in temperate regions. The two important species are barley (H. vulgare) and squirreltail grass (H. *jubatum*). See BARLEY; SQUIRREL-TAIL GRASS.

HOREA, NICOLAS URSU, Rumanian patriot (1735?–1785), was born in Zlatna, Transylvania. In 1783 the peasants of Transylvania were in turmoil about the proposed transfer of part of their territory from noble rule to the military frontier system. Horea declared that unless the serfs were liberated they would rise and wipe out their oppressors. Joseph II of Austria is said to have answered: "Thut Ihr das" ("Do so"), and to have given him a paper of secret instructions. Horea organized an army out of the peasants who were being conscribed and armed for the frontier regiments. This alarmed the authorities, who suspended the recruiting; whereupon, in Nov. 1784, hostilities broke out. At first the peasants genuinely believed themselves to be fighting for the emperor; but Horea proclaimed himself "emperor" and "king of Dacia." He was at last defeated and captured (Dec. 27, 1784). Convicted of high treason, Horea was broken on the wheel (Feb. 28, 1785). (C. A. M.; X.)

HOREB, the ancient seat of Yahweh, the tribal god of the Kenites, adopted by His covenant by Israel. This is the name preferred by the Elohistic writer (E) whose work is interwoven into the Old Testament narrative, and he is followed by the Deuteronomist school (D).

The Yahwistic writer (J), on the other hand, prefers to call the mountain Sinai (*q.v.*), and so do the priestly writers (P). This latter form became the more usual.

HORE-BELISHA, LESLIE HORE-BELISHA, 1ST BARON (1893–1957), British politician, who as minister of transport, 1934–37, initiated measures against road accidents which included the erection of "Belisha beacons" to make pedestrian crossings safer, was born in London on Sept. 7, 1893. After serving in World War I, he went to St. John's college, Oxford, and in 1923 was called to the bar and entered parliament as a Liberal. He joined the national government as secretary to the board of trade in 1931, was financial secretary to the treasury, 1932–34, entered the cabinet in 1936 and became secretary of state for war in 1937.

His energy achieved considerable reforms, but also led to friction with Prime Minister Neville Chamberlain, which resulted in his resignation in 1940. From 1942 to 1945 he sat in parliament as an Independent, and in 1945 became minister of national insurance in Winston Churchill's caretaker government, but lost his seat at the general election.

Hore-Belisha was raised to the peerage in 1954. He died at Rheims, France, on Feb. 16, 1957.

HOREHOUND (HOARHOUND). Common or white horehound (*Marrubium* vulgare) is a white-woolly, perennial herb of the mint family (Labiatae). Native to Europe, north Africa and central Asia it has become widely naturalized in North America—from Maine southward to North Carolina and westward to northern Mexico and British Columbia. It is cultivated in Britain and is occasionally found as an escape on drier soils. The plants are coarse, strongly aromatic, from one to three feet tall with roundish-oval, bluntly toothed leaves which are white and woolly below and pale green and downy above. The flowers are small, whitish, densely clustered in axillary whorls; the calyx has ten short teeth, each terminating in a hooked spine. The leaves and flowering tops of white horehound are in some demand as a crude drug. Infusions or extracts of horehound in the form of syrup, beverage or candy are favourite domestic remedies for coughs, colds and pulmonary affections. Black horehound (Ballota nigra) is a hairy perennial herb with a fetid odour, belonging to the same family. It does not have the white-woolly appearance of white horehound and has rose-purplish flowers with five broad calyx teeth. It is occasionally found as an adulterant of white horehound in the crude drug form. It is native to the same regions as white horehound and has become naturalized in North America from southern New England to Maryland and Pennsylvania. (Q. J.)

HORGAN, STEPHEN HENRY (1854–1941), G.S. inventor and pioneer in the development of the halftone engraving process, was born Feb. 2, 1854, near Norfolk, Va. He studied photography in his youth and in 1874 went to New York to join the old Daily Graphic as a photographer.

While on the Graphic, he developed a process for making halftone pictures, using a glass screen made up of fine parallel lines. Using this method, the Graphic in March 1880 printed the first halftone to appear in a newspaper, from an original plate run on a slow-speed press. In 1893 Horgan became art director of the New York Herald and studied ways to apply the halftone to high-speed presses.

He sold the idea to the *New* Pork *Tribune,* which became the first paper to print a halftone on a high-speed press. Horgan also contributed to the technique of transmitting colour pictures by wire. He died in Orange, N.J., Aug. 30, 1941.

See also PHOTO-ENGRAVING.

HORIZON, the apparent circle around which the sky and earth seem to meet. At sea this circle is well defined, the line being called the sea horizon, which divides the visible surface of the ocean from the sky. In astronomy the horizon is that great circle of the sphere the plane of which is at right angles to the direction of the plumb line.

Sometimes a distinction is made between the rational and the apparent horizon, the former being the horizon as determined by a plane through the centre of the earth, parallel to that through the station of an observer. But on the celestial sphere the great circles of these two planes are coincident, so that this distinction disappears.

The dip of the horizon at sea is the angular depression of the apparent sea horizon, or circle bounding the visible ocean, below the apparent celestial horizon as above defined. It is due to the rotundity of the earth and the height of the observer's eye above the water.

The dip of the horizon and its distance when the height of the observer's eye above sea level is h feet, are approximately given by the formulas: dip = $0.97\sqrt{h}$; distance = $1.17\sqrt{h}$ sea miles. The difference between the coefficients 0.9; and 1.17 arises from the refraction of the ray.

HORMISDAS, pope from July 514 to his death in Aug. 523, was a native of Campania. He obtained the reunion of the eastern and western churches, which had been separated since the excommunication of Acacius in 484. After two unsuccessful attempts under the emperor Anastasius I, Hormisdas nas able to come to an understanding in 518 with his successor Justin and with the patriarch John of Cappadocia. In 519 legates were dispatched to Constantinople; the names of the schismatic patriarchs were erased from the diptychs, and union was resumed with the Holy See. Hormisdas secured Dionysius Exiguus to edit the synodal decrees of the Greek church. His memorials and briefs were printed by J. P Migne, *Patrologin latina,* volume 63.

HORMIZD or HORMIZDAS, the name of five kings of the Sassanid dynasty (see PERSIA. *History).*

1. HORMIZD I (reigned 272–273), son of Shapur I, appears in Shapur's wars against Rome: but scarcely anything is known of his short reign. In the Persian tradition of the history of Ardashir I, preserved in a Pahlavi text, he was the son of a daughter of Mithrak, a Persian dynast, whose family Ardashir had extirpated because the magians had predicted that from his blood would come the restorer of the empire of Iran. Only this daughter was preserved by a peasant; Shapur married her, and her son Hormizd was afterward acknowledged by Ardashir. In this legend the great conquests of Shapur are transferred to Hormizd.

2. HORMIZD II, son of Karseh, reigned from 302 to 309. Of his reign little is known save that he persecuted the Manichees. After his death his son Adarnases (Adhur-Narseh) took the crown but was killed by the grandees; another son, Hormizd, was kept a prisoner, and the throne reserved for the infant of a concubine of Hormizd II. Hormizd escaped from prison and found refuge at the court of Constantine the Great.

3. HORMIZD III, son of Yazdegerd I, succeeded his father in 457. He continually had to fight with his brothers and with the Ephthalites in Bactria, and was killed in 459 by Peroz, who was preferred by the Zoroastrian clergy.

4 HORMIZD IV, son of Chosroes I, reigned 579–590. Some characteristic stories are told of him by Tabari. Hormizd protected the common people and introduced a severe discipline in his army and court. When the priests demanded a persecution of the Christians, he declined on the ground that the throne and the government could only be safe if it gained the good will of both concurring religions. Consequently he raised a strong opposition in the ruling classes. From his father he had inherited a war against the Byzantine empire and against the Turks in the east, and negotiations of peace had just begun with the emperor Tiberius, but Hormizd haughtily declined to cede anything of the conquests of his father. Therefore the accounts given of him by the Byzantine authors, Theophylact, Simocatta (iii, 16 ff.), Menander Protector and John of Ephesus (vi, 22), are far from favourable. In 588 his general, Bahram Chobin, defeated the Turks, but in the next year was beaten by the Romans; and when the king superseded him he rebelled. This was the signal for a general insurrection. The magnates deposed Hormizd and proclaimed his son Chosroes II king. In the war which followed between Bahram Chobin and Chosroes II, Hormizd was killed (590).

5. HORMIZD V was one of the many pretenders who rose after the murder of Chosroes II (628). He maintained himself about two years (631, 632) in the district of Sisibis.

(ED. M.; T. C. Y.)

HORMONES. The realization that blood is a carrier of many principles that affect mental and physical health dates back at least as far as the Hippocratic humoural theories. Also, the appearance of generalized effects after castration of men and domestic animals was well known in biblical times and through the middle apes. The documentary woodcut (fig. 1) from Gesner's *Historia Animalum* (1551) expresses correctly the consequences of orchectomy (removal of testes) for growth of feathers, combs and wattles, and for certain behaviour patterns (fighting, crowing). However, the birth of a true science of internal secretions usually is dated only with the year 1849. At that time. the German physiologist Arnold Adolph Berthold reported on the restitution of cock characteristics by the implantation of testes into capons. He inierred that the testes produce a substance which is released into the blood stream. Generally distributed throughout the body. these substances induce reactions in specially responsive "target organs." often histologically complex systems such as combs. feather germs or the hrain. In spite of much experimentation, virtually no progress on testicular secretion was accomplished until 192; when L. C. McGee extracted from hull testes an alcohol and ether soluble material which. after injection into capons, fully restored the male characteristics. Following this discovery. various laboratories pursued work toward the chemical identification of the substance. By 1934. A. Butenandt had found the chemical structural formulas for the two most important androgens. which were named androsterone and testosterone.

The progress from observations on normal and deficient. often sick organisms. to experiments of extirpation, reimplantation and injection of organ extracts is typical for investigative work on endocrine organs. The next step—chemical identification of the

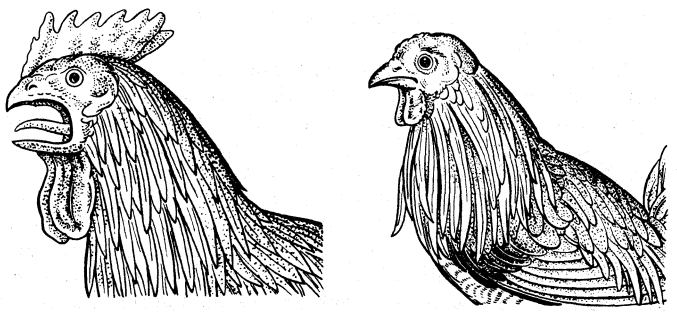


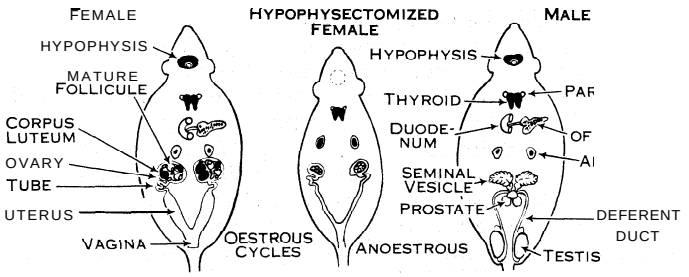
FIG. 1.—COCK (LEFT) AND CAPON, SHOWING DIFFERENCES IN COMB AND WATTLES. REDRAWN FROM WOODCUTS IN KONRAD GESNER'S "HISTORIA ANIMALUM." ZURICH. SWITZ.. 1555

active principles—has been successful mostly if the chemicals involved nere not of proteinic composition.

In the meanwhile (1904), the term hormone had been introduced by W. M. Bayliss and E. H. Starling to denote in general the products of internal secretion. It soon found widespread acceptance, and its meaning was extended beyond the original limitation to blood-borne substances. Thus one speaks also of neurohormones, insect and plant hormones. There is a tendency to apply the name to any substance which carries inductive excitation from one part of the body to another. In this wider formulation the hormones appear in the role of chemical messengers. They may remain confined within the membrane of a single cell, carrying their "message"

from one district of a protozoan to another. or from the peripheral dendrites of a nerve cell to its central ganglionic body and nucleus. Also, the original restriction to substances produced within the organism fell when the chemists were able to synthesize not only the naturally occurring hormones but also structurally different mimetic hormones n-hich, in some instances, act as almost ideal. substitutes (*e.g.*, stilbestrol for the natural female sex hormones).

With such liberal acceptance of new connotations, the term hormone risked danger of becoming vague or ill-defined. However, the following survey includes only the typical and most important endocrine systems and hormones.



BODY WEIGHT	260 g	BODY WEIGHT	180 g	BODY WEIGHT	300g
HYPOPHYSIS	12 mg	THYROID	13 mg	HYPOPHYSIS	8mg
THYROID	24 mg	ADRENALS	16 mg	THYROID	24 mg
ADRENALS	65 mg	ACCESSORY SEX ORGANS	150 mg	ADRENALS	45mg
ACCESSORY SEX ORGANS	1,000 mg	OVARIES	16 mg	ACCESSORY SEY ORGANS	2,000 mg
OVARIES	80 mg			TESTES	3,000 mg

E. WITSCHI

FIG. 2 — THE VERTEBRATE ENDOCRINE SYSTEM SHOWN IN A NORMAL FEMALE A HYPOPHYSECTOMIZED FEMALE AND A NORMAL MALE RAT, ALL LITTER MATES

The hormone producing glands are scattered throughout the body; but among them the hypophysis plays a dominant role, being functionally related to nearly all others. Often it controls the degree of their secretory activity. In many cases reciprocal influences result in delicately balanced equilibria.

The general principles of hormonic action were clearly worked out by mid-20th century; but this brief sketch can merely refer to the participation by hormones in the highly complex sequences of reactions which sustain menstrual cycles, pregnancy or the phenomena of stress. Hormones. always in astoundingly small quantities usually weighed in millionths of grams, often start reaction chains that influence the entire future course of the life process. They serve not as building stones but rather as executive officers, organizing and directing growth, differentiation and maintensnce of organisms by control over enzymatic chemical transformations. Their importance becomes most evident in their failures. under pathologic conditions, and in senescence. Hence their growing usefulness as therapeutic agents in medical practice.

Thyroid. — Through release of a thyrotrophic hormone, the hypophysis stimulates production and release of thyroxin by the thyroid gland. Thyroxin produces spectacular effects in some amphibians. particularly the frog, inducing metamorphosis of the long-tailed aquatic larva into the four-legged terrestrial adult form. In the higher vertebrates, including man. it mainly intensifies the respiratory metabolism, drawing on the carbohydrate. fat and protein reserves of the body. Hyperactivity of the thyroid increases the rate of basal metabolism, a condition typical of exophthalmic goitre. Failure of the thyroid to secrete adequate amounts of hormone leads to low metabolic rates and cretinism (*q.v.*). While the cause for either too high or too low thyroxin production often lies with abnormal thyrotrophic functioning of the hypophysis. the resulting conditions are usually treated by partial destruction of the thyroid through surgery and irradiation or by the administration of sdditional dosages of thyroxin. Since the thyroxin molecule contains four atoms of iodine. a deficiency of this relatively scarce element in water and food intake is probably the most common primary cause of disturbances in thyroid function. Therapeutically thyroxin is administered for the stimulation of metabolism, and also as a reducing agent. Thiourea and thiouracil inhibit the secretion of thyroxin, but their continued use leads to a goitrous enlargement of the thyroid.

Thyroxin disappears relatively quickly from the blood stream. J. Gross and C. P. Leblond, using thyroxin tagged with radioactive iodine, show that the liver is nearly eight' times as active in the elimination process as the kidneys. (See also GOITRE; THYROID).

Parathyroids. — Laterally attached to the thyroids are from two to four small parathyroid bodies. Their hormone regulates the blood calcium and phosphorus levels. Extirpation of the glands often leads to tetany and death. Parathormone production seems not to be controlled by the hypophysis.

Duodenal Gland. — The duodenum is not anatomically a typical endocrine gland; but upon the entrance of acid stomach contents. certain cells of its inner lining release a polypeptide called secretin into the blood stream, which induces active flow of pancreatic juice and bile. It was during the study of these relationships that Bayliss and Starling (1904) introduced the term horn one for blood-borne chemical messengers.

Islet Glands. — Special cell islets (of Langerhans) of the pancreas which do not connect with the pancreatic duct system, release into the blood stream the polypeptide hormone insulin. the most important regulator of carbohydrate metabolism. Under its influence blood sugar (glucose) is built up to glycogen and stored in liver and muscle cells. Deficient insulin production leads to a rise in the blood-sugar level. Sugar is incompletely removed after meals, and the mobilization of liver glycogen by intervention of two antagonists or' insulin remains uninhibited. Of the latter, the diabetogenic principle of the hypophysis counteracts the production of insulin as well as its glycogen storing activity in the liver (B. Houssay). The second antagonist, glucagon. is a companion hormone which is also produced in the pancreatic islets. Normally it assists in balancing and adjusting insulin activity. Glucagon and insulin are produced by separate islet cells, which are designated as α and β cells respectively. As a whole, the α cells are more resistant to damage. Particularly under alloxan treatment they still persist. after all β cells have been destroyed. This explains why in many diabetic animals blood-sugar levels are lowered after removal of either the hypophysis or the pancreas.

If the blood-sugar concentration rises above the so-called renal threshold, it passes into the urine and establishes the morbid condition known as diabetes mellitus (*q.v.*). This formerly dreaded and inevitably fatal sickness is now easily controlled by the injection of extracted insulin after methods developed by F. G. Kanting and C. H. Best. Work by C. F. and G. T. Cori and others opened a path toward an understanding of the chemistry of glycogen formation in the liver under the influence of insulin and its hypophyseal antagonist.

Adrenal Medulla. — The adrenals are composites of two glands of different embryologic origin and secretory functions. The adrenal medulla derives from ectodermal sympathoblasts which separate late from sister cells that differentiate into sympathic ganglia. It is therefore not surprising that its hormones. epinephrine (adrenaline; *q.v.*) and norepinephrine (noradrenaline), produce similar effects as the activated sympathic nervous system. In fact, the latter itself releases a "neurohormone" which may be identical with noradrenaline. These medullary hormones, whose chemical constitution was cleared up as early as 1904, are, however. of uncertain physiologic importance. They constrict the capillaries in resting muscles and thus may play a role in directing the blood flow toward working muscles. They also can mobilize glycogen stores of the liver and thereby act as antagonists of insulin. Since fright and other forms of emotional stress cause an increased outpour of adrenaline, they effect a rise in the blood-sugar level. which in turn enables muscles to do increased work ("emergency function" of adrenaline, after W. B. Cannon). While apparently adrenal medullary function is not controlled by the hypophysis. it seems that adrenaline is able to influence at least one phase of hypophyseal activity. namely. the release of corticotrophic hormone under conditions of stress. (See ADRENAL GLANDS.)

Steroid Glands. — The adrenal cortex, testis and ovary are a complex of endocrine glands that produce about 30 known hor-

mones, all belonging to the chemical order of steroids. One may summarily speak of the steroid glands. Embryologically they are closely related to each other and to the middle kidney (mesonephros). All are derived from the intermediate mesoderm. The proportion of kidney and endocrine gland formation from the embryonic blastema can be shifted. Some such experimental changes may even lead to partial or complete sex reversal.

While the testis and ovary are foremost germ cell producing organs. the adrenal cortex functions exclusively as a hormone gland. Histologically it is the least differentiated of the three; but in respect to hormone production it is the most versatile. In fact. it can produce not only the characteristic corticoids but under special conditions also sex hormones which are usually elaborated by the follicular and interstitial cells of the sex glands.

With regard to prevailing physiologic actions the go-odd hormones fall into five groups: androgens, estrogens, gestagens. glucocorticoids and mineralocorticoids.

Androgens (*e.g.*, androsterone, testosterone) are characteristic products of the testis and maintain the male secondary sex characters.

Estrogens (*e.g.*, estradiol) are primarily produced by the ovarian follicles and support the female secondary sex characters. According to the higher or lower amounts released into the blood, the animal is in the oestrous or the anoestrous condition (cf. fig. 2). the oestrous or "heat" phase being characterized by a high development of the uteri and other parts of the female genital tract, and by a receptive behaviour toward the male.

Gestagens (*e.g.*, progesterone) typically are released by the yellow bodies (corpora lutea) of the ovaries; they direct the preparations for and maintenance of pregnancy, in the uterus.

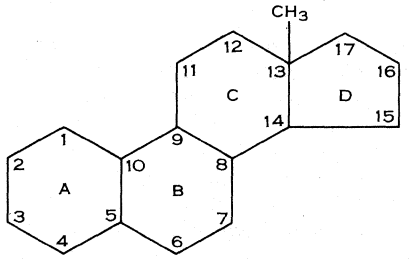
Glucocorticoids (*e.g.*, cortisone, hydrocortisone) of the adrenal cortex cause the transformation of proteins into glucose and liver glycogen. Under extreme dosages the rise in blood sugar may even lead to diabetes; but at the same time glycogen stores of the body are replenished at the expense of proteins. These hormones produce euphoric effects and give symptomatic relief in many inflammatory afflictions such as iritis and arthritis.

Mineralocorticoids (*e.g.*, desoxycorticosterone, aldosterone) are of vital importance in the maintenance of electrolyte and water balance. After pathologic shrinking of the cortex (Addison's disease, *q.v.*) or following surgical removal. the kidney thresholds for sodium, chloride and water fall very low; the excretion of urine and salt are highly increased. Patients and animals may be partly maintained with high water and salt rations. Addison's disease, once unavoidably fatal. came to be controlled by administrations of desoxycorticosterone and hydrocortisone. The important aldosterone was discovered in 1954. The production of the glucocorticoids is stimulated by the hypophyseal ACTH (adrenocorticotrophic hormone). Quite to the contrary, mineralocorticoids are released in response to the concentration of sodium. potassium chloride and water in the blood serum. Thus, hypophysectomy does not markedly upset the electrolyte and water balance; however, the effect of low salt diets is largely obviated through an immediately increased output of aldosterone.

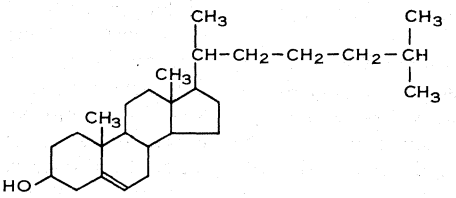
Probably the three steroid glands prepare their hormones from the universally distributed cholesterol. By the use of cholesterol and acetate which were both labelled with radioactive carbon, O. M. Hechter could show that perfused isolated adrenals use these materials for the biosynthesis of corticoids. Cholesterol and the steroid hormones have a common nucleus of a cyclopentane and three benzene rings. They differ in the array of attached hydrogen and oxygen atoms. short side chains and the occurrence of double bonds. In writing the constitutional formulas it is customary to omit hydrogen atoms which are attached to the basic skeleton. In the selection of formulas of six representative substances given below, estrane and cholesterol are not hormones, but the first is of interest as the chemically simplest parent hydrocarbon of the entire order of steroids. and the second as the probable starting base of biosynthesis of the natural hormones.

The distribution of the sites of manufacture of the steroid hormones shows many surprising features. The ovaries of most and possibly all vertebrates produce not only female but also male sex hormones, often in sufficient quantity to induce recognizable heterosexual effects. The reverse situation seems rather exceptional, but at least the testes of the human male and the stallion produce considerable amounts of estrogens. The adrenal cortex elaborates small amounts of male sex hormones almost regularly, and in both sexes. If the output becomes excessive it leads to various degrees of masculinization in young girls as well as in adult women. Prevailing symptoms are the change of voice and growth of beards (hirsutism). These variations and abnormalities become in a sense comprehensible through the established close embryologic relationships between the endocrine components of the three types of glands. However, the further fact that estrogens and progesterone are also fabricated by the chorionic (*i.e.*, embryonic) placentae of human male and female foetuses remains entirely unexplained.

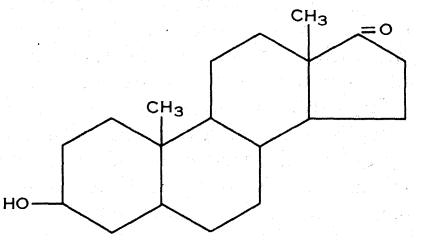
Hypophysis (Pituitary). — The hypophysis, master gland of the endocrine system, consists of two loosely connected parts which usually are distinguished as the anterior and posterior lobes (fig. 3). The latter, being an outgrowth of the floor of the forebrain and consisting mainly of large bundles of nerve fibres, is also called the



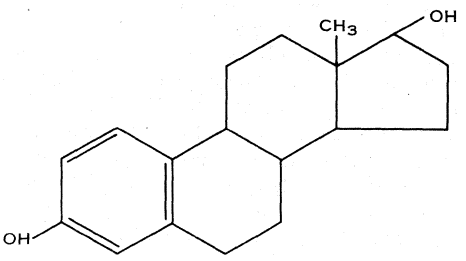
ESTRANE

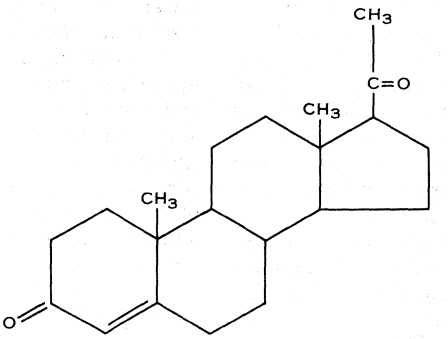


CHOLESTEROL

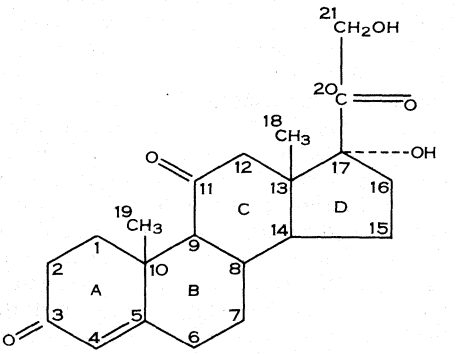


ANDROSTERONE



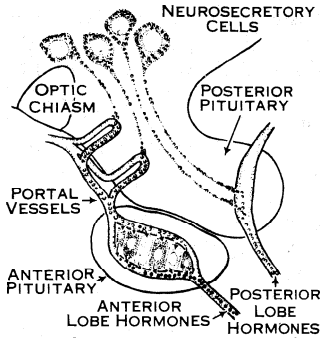


PROGESTERONE



CORTISONE

nervous part. The former, much like the lens of the eye. starts from an embryonic epiderm plate (placode). Invaginating first as a pouch, it grows toward the nervous part, to which it becomes broadly attached. Sometimes one distinguishes between an anterior lobe proper and an intermediate lobe, the latter developing from that part of the epidermal pouch which applies itself directly to the posterior lobe.



FROM E. SCHARRER, "EXPERIENTIA," VOL. X, FASC. 6, P. 266 (1954); BY COURTESY OF VERLAG BIRKHAUSER

FIG. 2.—HYPOTHALAMUS AND HYPOPHYSIS

All hypophyseal hormones are proteins or polypeptides. Consequently their separation presents great difficulties and even their total number is not knonn. Usually they are designated on the basis of a characteristic action or relationship. often with a suffix "trophin" or "tropin" attached which. however. is without deeper meanina. Increasingly popular are abbreviations as given in the following partial list of hormones oi the anterior lobe. Those of the posterior lobe and the hypothalamus are described below.

- Thyroid stimulating hormone (TSH) or thyrotrophin
- Adrenocorticotrophic hormone (corticotrophin, or ACTH)
- Follicle stimulating hormone (FSH)
- Interstitial cell stimulating hormone (ICSH)
- Luteinizing hormone (LH)

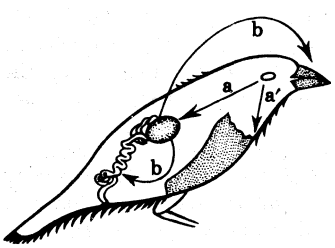
} gonad stimulating hormones

- Growth hormone (GH) or somatotrophic hormone (STH)
- Melanophore expanding hormone (MEH) or intermedin

The separate existence of ICSH and LH is contested; distinction rests entirely on differences in biologic reactions. On the other hand it seems possible that further work may lead to the identification oi even larger numbers. Already mentioned were indications that the parathyroids and the pancreatic islets may be hormonally linked with the hypophysis.

Chemically these hormones fall in two groups: simple proteins and glucoproteins. Their molecular weights range between about 2,000 and 100,000. Only the two last ones of the above list act directly and exclusively on peripheral targets. The melanophore expanding hormone controls adaptational colour changes in many amphibians and fishes. It is just as prevalent in the hypophysis oi warm blooded animals, but neither in birds nor mammals has it any known influence on pigmentation or on other characteristics. It is sometimes called intermedin because in frogs it was particularly found in the intermediate lobe While the anterior lobe as a whole is the most likely place oi origin, it has also been extracted from the hypothalamic region of the brain.

The growth hormone is important mainly through its protein-sparing influence on the general metabolism. Nitrogen excretion being reduced, it favours a compensator)- increase of fat oxidation. It has a marked influence on epiphyseal bone growth. The deficiency or absence of this hormone, as after hypophysectomy, leads to dwarfism (*cf.* fig. 2); on the other hand hypersecretion or injection of additional hormone causes gigantism in young animals and acromegalism in individuals that had already stopped growing.



E. WITSCHI

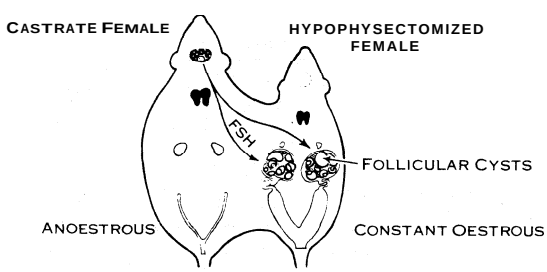
FIG. 4.—DIRECT AND INDIRECT GONADOTROPHIN REACTIONS IN THE AFRICAN WEAVER FINCH EUPLECTES

The other hormones of the list have in common their effect upon endocrine glands and are recognized mainly irom the induced secondary effects. Thus, administered thyrotrophin is usually not evaluated from immediate effects in the thyroid but by observed changes in metabolic rates or in amphibian metamorphosis, which really are responses to thyroxin. Probably most hormones of this group exert also some peripheral influences. In the case of the African weaver finch the gonadotrophic hormones (a, fig. 4) induce the testes to release androgen (h, fig. 4), which in turn elicits two independent secondary reactions, namely the enlargement of the seminal ducts and melanin production in the bill; but LH stimulates also directly melanin production in certain feather germs of the nuptial plumage oi the cock (a', fig. 4). Similarly the luteotrophic hormone stimulates another endocrine gland, the corpus luteum of the ovary, and also a peripheral endorgan, the mammaries, where it initiates and sustains milk secretion.

The two-step system of hormonal control seems to facilitate the correlation and equilibration of hormonic systems, particularly within the large steroid complex. As concentration of a steroid hormone in blood rises, it slows and checks the further increase in output of the corresponding hypophyseal "trophin." These reiationships are not always immediately obvious but can be demonstrated in specially arranged experiments. Fig. 2 illustrates the consequences oi hypophysectomy periormed at the age of eight weeks. The animal barely gained further weight. The cortices of the adrenals are shrunk and the ovaries are in an immature condition. The secondary sex characters are as underdeveloped as those oi a total castrate. If united in parabiosis with a normal sister rat, the deficiencies remain unrelieved. This must be so, because all hormones disappear relatively iast from the blood stream and the exchange of blood through the parabiotic bridge is too slow (1 ml. per 10 min.) to carry effective amounts from the normal to the hypophysectomized member. But if now the normal iemale is castrated, its uninhibited hypophysis at once pours out FSH at an estimated fivefold rate. This is enough to spill over also into the other member and to stimulate an excessive follicular growth. The subsequent release of estrogen is sufficient to stimulate also the animal's own sex ducts, though not those of the castrate partner (fig. 5).

The described experiment serves also in the elucidation of the nature of the so-called antihormones. Purified FSH from sheep or beef hypophyses injected into rats for periods of ten days or more seems to lose first slowly, then almost suddenly its effectiveness. This observation led to the notion of antihormones, *i.e.*, a class of substances u-hich were assumed to play a role in the deiense against overstimulation. However, in parabiosis experiments, with an arrangement as shown in fig. 5, oestrous and large ovaries are maintained ior indefinite times; several experiments were kept running for more than one year. This proves that the "antihormones" actually are antibodies oi an immunity reaction; *i.e.*, of the rat's defense against injected beef or sheep proteins.

The posterior lobe or neurohypophysis stores and releases at least two hormones. V. du Vigneaud succeeded in identiiying and synthe-



E. WITSCHI

FIG. 5.—PARABIOSIS OF A CASTRATE FEMALE AND A HYPOPHYSECTOMIZED FEMALE RAT

sizing vasopressin, which increases blood pressure and causes water retention (antidiuretic effect), and oxytocin, which causes contraction of smooth muscles. The latter is used clinically to induce labour in childbirth.

Hypothalamus and Neurosecretion.—The research of E. Scharrcr, R. Collin and others seems to establish that the posterior lobe only stores vasopressin and oxytocin, which actually are the products of neurosecretion by specialized cells of the hypothalamus, a part of the iorebrain (fig. 3). This discovery also opened the door to the understanding of many long known iacts which indicate that the neural and the hormonal control systems are not absolutely separate. Obviously, the latter is in many instances governed by the iormer. It is well known that light, particularly increased day length, oiten causes an increased output of gonadotrophic hormones by the anterior hypophysis. Jacques Benoit collected suggestive evidence for the existence of a pathway from the region of the optic nucleus in the hypothalamus to the anterior lobe oi the hypophysis. Apparently, some substance that is prepared by neurosecretory cells is secreted first into a small system of portal veins that drains irom the hypothalamus into the anterior lobe. Here apparently the neurosecretion, acting as a hormone, induces the release of the gonadotrophins which bring about the seasonal recrudescence of the sex glands of many wild birds and mammals, thus bringing on the chain of events characteristic of the breeding season. See also HYPOTHALAMUS.

The Placenta.— As mentioned beiore, the implantation of the iertilized egg, or rather of the young germ issued from this fertilization, is aided by maternal ovarian hormones. First the follicular estrogens and later progesterone, the hormone of the corpus luteum, prepare the endometrium or inner lining oi the uterus ior the arrival of the germ (R. Courrier). On the seventh day aiter fertilization the human

blastocyst attaches itself to the uterine wall and immediately begins to draw nutrition from the maternal circulation. The following week being the last of the normal menstrual cycle, it obviously becomes necessary to prevent shedding of the endometrium; *i.e.*, menstrual flow. This the embryo accomplishes by production and release of the chorionic gonadotrophin, CGH, into the maternal bloodstream. This hormone, substituting for the falling and soon discontinued LTH supply, stimulates the continued production of progesterone by the corpus luteum of the maternal ovary. Without it the activity of the corpus would subside by about the 25th day of the cycle. By the time of the first "missed period," only two weeks after fertilization, the CGH has reached a sufficiently high level in blood and urine of the mother. to become detectable by means of several pregnancy tests (Aschheim-Zondek, Allen-Doisy. Friedman, etc.). The chorionic gonadotrophin. like the hypophyseal gonadotrophins. is a glucoprotein; but it is chemically and physiologically distinctly different. Later a specialized area of the chorion. the disc placenta, produces not only gonadotrophin but also estrogen and progesterone. The hormonal control over the maintenance of pregnancy thus passes entirely from the mother to the foetal placenta. The latter also exercises control over its termination ; *i.e.*, over the events that lead to the birth of the child.

Tumours and Cancers.— Some endocrine glands, particularly the thyroid, may metastasize and spread hormonally active tissues over the body, lungs, bone marrow and so on. By the use of radioactive iodine such foci can be detected and partly also destroyed.

Ovarian embryomas, usually in the form of cysts containing more or less distinct parts of an embryonic body, may produce large quantities of chorionic gonadotrophin, the same as in normal pregnancies. Most probably, such tumours start from parthenogenetic ovarian eggs.

Similar embryomas may develop also in testes oi young men. Rut they start early upon a definitely malignant course. Metastases of this testicular chorionepithrlioma locate particularly in the lungs and the brain but also in other parts of the body. CGH is oiten produced and poured into the blood stream of these patients in much larger quantities than observed in typical pregnancies. (*See* also ENDOCRINOLOGY.)

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HORMONES, INVERTEBRATE. Certain invertebrate animals, just as vertebrates, possess specialized glandular elements which produce and liberate into the body fluids, special chemical substances called hormones. These hormones, through their specific influences upon other cells and tissues, co-operate with the nervous system in the integration of various bodily functions. Although evidence exists suggesting widespread occurrence of hormonally regulated phenomena among invertebrates, extensive investigations have been carried out chiefly for crustaceans and insects.

Hormones and Colour Change. — The walking-stick insect *Dixippus* shows striking colour changes which result from dispersion (dark phase) and condensation (light phase) of brown and red pigments contained within the general hypodermal cells. The dispersal of the pigments occurs in response to a blood-borne hormone produced chiefly in the brain of the insect but found also, in smaller amounts, in the ventral and subesophageal ganglia and in the corpora allata *(see* below). The same character of hormonal control seems also to prevail for colour changes in *Corethra* (Diptera) larvae.

Some of the most striking instances of colour changeability among animals are found among higher crustaceans, particularly certain shrimp and crabs. These changes are brought about largely by differential movement of several types of pigments within highly branched integumentary pigment cells (chromatophores) controlled almost exclusively by means of hormones.

One of the most important places of liberation of colour-change hormones into the blood in crustaceans is the sinus gland. usually located in the eyestalks when these are present. In other forms it is located in the head close to the brain. This gland consists of clusters of secretion-filled terminations of the fibres of neurosecretory cells; these clusters, termed X-organs, occur in nervous ganglia within the eyestalks. Other sinus-gland fibres originate in neurosecretory cells in the brain and possibly in still other central nervous organs. The most studied X-organ is the medulla terminalis ganglionaris X-organ (MTGX), though others have been described. The colour-change hormones are formed in the nerve cells and move along inside the fibres to the nerve terminations in the sinus gland from which they are released.

A second important place of liberation of colour-change hormones into the blood is the postcommissural organ lying just posterior to the esophagus and closely associated with the tritocerebral commissure. Like the sinus gland, this organ, too, comprises the terminations of fibres of neurosecretory cells located some distance away, in this instance. chiefly in the brain. Again, the hormones formed in the cell bodies are transported within the nerve fibres to their point of eventual discharge into the blood. In view of the attenuated character of the neurosecretory complexes and their location in the nervous system. it has generally not been possible to employ the common endocrinological technique of observing the effects upon the animal of gland removal. An exception is the case of the important MTGX sinus-gland complex; this is easily removed by eyestalk amputation, after which the endocrine basis of consequent disturbances can be established by tissue implantations or extract injections.

Such studies reveal differences among the crustaceans with respect to their responses to eyestalk removal and MTGX sinus-gland replacement. The common prawn, *Palaemonetes,* behaves like numerous other macrural decapods (lobsters, shrimp, etc.). It possesses red. yellow, blue and white pigments in its chromatophores Eyestalk removal results in integumentary darkening by dispersion of the coloured pigments. Injection of extract of the eyestalk-gland complex results in rapid blanching by pigment concentration The fiddler crab. *Uca,* and most brachyuran decapods (true crabs) behave differently Eyestalk removal gives a response opposite to that seen in *Palaemonetes;* namely, a lightening by concentration of their predominating black and red pigments; eyestalk-gland implantation or extract injection produces rapid darkening The sand shrimp. *Crago,* behaves still differently; after eyestalk removal it assumes a mottled coloration. In certain integumentary areas its dominant black and red pigments are concentrated. in others dispersed, and elsewhere in an intermediate state. Eyestalk-gland extracts produce over-all paling of these eyestalkless animals.

The observed differences among crustaceans in response to eyestalk removal and MTGX sinus-gland complex replacement reflect, in part, differences in specific responses of chromatophores. In general, the gross response of the eyestalkless animals to injection of eyestalk extract is independent of whether the extract is made from their own eyestalks, or from those of species which themselves react differently. However, comparative study of various chromatophore types in single species, and among various species— together with separation of active fractions by differential solubilities, electrophoresis and paper chromatography — has revealed the eyestalk glandular complex to contain several different chromatophore activating hormones. Studies of extracts of the postcommissural organs have indicated that these organs, also, contain two or more powerful chromatophore activators. The majority of the chromatophore activators seem widely distributed among the decapod crustaceans, though some differences between species are found.

The long-known ability of certain prawns, shrimp and crabs to simulate the colour of their background appears to be approaching explanation in terms of a delicately regulated neurosecretion of a complex of hormones actively effecting both dispersion and concentration of pigments.

Hormones and Retinal Pigment Migration. — Movements of certain pigments in cells of the crustacean compound eye have been shown to be hormonally regulated. A distal, or iris, black pigment is located nearest the eye surface; a deeper, proximal black pigment lies close to the light-sensitive retinal elements, as does also a reflecting white pigment. Controlled movements of these three pigments give the eye optimal visual efficiency for each illumination level.

A hormone from the eyestalk MTGX sinus-gland complex is known to move the distal pigment to the light-adapted state in crustaceans. Prawns or crayfish in total darkness may be caused to assume the light-adapted position of the pigment, even while still

retained in darkness, by injection of extract of eyestalk-gland complex.

Much variability appears to occur among crustaceans as to a light-adapting influence of an eyestalk hormone upon eye pigments other than the distal. In some (*e.g.*, *Palaemonetes*) the reflecting pigment also responds; in others (*e.g.*, crayfish) the proximal pigment may respond. As with integumentary pigment cells the distal pigment has a double hormonal control; a second hormone is responsible for moving this pigment into its dark-adapted position. The state of eye adaptation is thus brought about by changing ratios of tno hormones.

Hormones and Growth, Molting and Metamorphosis.— Invertebrates such as crustaceans and insects which possess a hard or tough continuous exoskeleton typically grow by a series of abrupt steps involving the periodic casting off, molting or ecdysis, of the old skeleton and the production of a new one. Molting and the associated phenomena of growth and differentiation are regulated by hormones in arthropods.

In crustaceans the frequency of molting, high in the young. rapidly growing individual, diminishes as the animal ages. Some species (*e.g.*, crayfish and lobsters) continue to molt and grow throughout life. Other species (*e.g.*, certain crabs) cease molting and growth once the animal is fully mature. The molt cycle. which includes many morphological and chemical changes. is initiated by the cessation of secretion by the MTGX sinus-gland complex of a molt-inhibiting hormone and the production by it of a molt-accelerating factor. The complex appears also to liberate another hormone which regulates the amount of water absorbed just prior to the hardening of the new skeleton. Molting depends also on a gland. termed the Y-organ, located in the antennary or maxillary segment of the head. There is some reason to believe that the molt-inhibiting and accelerating hormones of the eyestalks exert their action through controlling the release of the Y-organ molting hormone.

The postembryonic development of insects, including both the larval and metamorphic periods, is governed by hormones. One of the complicating factors is that the hormones act upon cells, tissues and organs which themselves become altered in time with respect to their competence to respond to the hormones. The larval period is predominantly one of growth. At each larval molt a growing insect reconstitutes its larval characteristics, including its larval skin. The fully grown insect then undergoes a metamorphic molt in which adult structures become differentiated. The stimulus which initiates the succession of events terminating in a larval molt is known in only a few cases. For example, in the bloodsucking bug *Rhodnius,* which undergoes incomplete metamorphosis (hemimetabolous), the stretching of the body by a feeding of blood is followed by a molt in a definitely predictable manner. The stretching stimulates, through nerves, certain neurosecretory cells in the dorsal region of the brain (pars intercerebralis). These cells release a hormone which activates the prothoracic gland (located in the prothorax) which in turn releases a hormone, setting into motion the processes of molt. The prothoracic-gland hormone has been called the gromth and differentiation hormone; it has recently been obtained in pure chemical form and named ecdysone. Permitted to act alone, the hormone induces a metamorphic molt; but during normal larval growth, another gland begins to secrete soon after the prothoracic gland becomes active. This additional gland, the corpus allatum, liberates a factor termed the juvenile hormone, whose action is to cause the reconstructive processes during the molt to be directed to producing another larval generation.

In *Rhodnius,* in which there are typically five nymphal stages preceding the metamorphic molt, the juvenile hormone is secreted by the corpus allatum at each molt except that of the last-stage nymph. In the absence of the juvenile hormone, the insect metamorphoses into the adult. Diminutive adults have been obtained by the removal of the corpus allatum from nymphs earlier than those in the fifth-stage. On the other hand. sixth-stage nymphs which develop into giant adults have been obtained by transplanting juvenile corpora allata into otherwise normal last-stage nymphs.

This general manner of regulation of development appears to hold for all insects, with slight differences from group to group. In a completely metamorphosing (holometabolous) insect, *e.g.*, the giant silkworm Platysamia, the last larval, or caterpillar. stage is followed by a pupation molt under the influence of the prothoracic-gland hormone in the absence of the juvenile one. The pupa then enters a period of inactivity known as diapause under the influence of a diapause hormone produced by the subesophageal ganglion. Diapause may be terminated, and the metamorphic molt initiated, by subjecting pupas to a period of chilling followed by return to higher temperature. Such chilling activates the neurosecretory cells in the brain to produce the hormone which stimulates the prothoracic glands.

The glands involved in the regulation of gromth and differentiation in insects vary greatly in structure and in location in the body. The corpus allatum. in the head, may be paired or single. Prothoracic glands may differ greatly in size and cellular form. In the fly larva these two glands are united with a third gland of less well-knonn function, the corpus cardiacum, forming an organ termed the ring gland.

Hormones and Reproduction.— In many crustaceans a male reproductive hormone arises in a small organ, the androgenic gland, located on the sperm duct near its external opening. This male hormone is necessary for the development of the testes, male accessory sex organs and secondary sex characters. Removal of the gland results in gradual alteration of body form and functions, the castrate tending to resemble the female.

Activity of the crustacean ovary is regulated by an inhibitory hormone arising in the MTGX sinus-gland complex. In the breeding cycle, decrease in this hormone permits the maturing of the eggs and subsequent ovulation. In certain crustaceans which show in their life history a protandric hermaphroditism (first a functional male, later a female), the sexual transition is correlated with the disappearance of the ovary-inhibiting factor and the degeneration of the androgenic gland Evidence also suggests that the activated ovary liberates a hormone upon nhich depends differentiation of such breeding accessories as brood pouches and ovigerous hairs.

The maturation of the ovaries and the activation of certain accessory reproductive glands have been shown to depend upon a corpus allatum hormone in insects as diverse as cockroaches, grasshoppers, beetles. *Rhodnius* and flies. In these insects there appears, furthermore, to be a reciprocal relationship between the corpus allatum and the ovary. Removal of ovaries results in hypertrophy of the corpus allatum. Restoration of this gland to normal size is effected by implanting mature ovaries.

That some differences may occur among insects is evident; certain moths, nith corpora allata removed during the larval stage, are still able to develop fully functional ovaries and produce viable eggs. There is also evidence suggesting that a brain hormone, possibly liberated by way of the corpus cardiacum, exerts a regulatory action on the corpus allatum.

Another hormone, the prothoracic-gland hormone, is also essential to the development of functional ovaries and testes. in part in its general role in growth and differentiation of larval organs, and also through a more specific influence upon gonad maturation.

At least in the blowfly, a third hormone. found in neurosecretory cells of the brain, and also in the corpora cardiaca, contributes directly to the normal regulation of ovarian function.

Other Hormonal Activities.— Hormones have been implicated as regulators of many other specific processes in arthropods, probably essential metabolic correlates of the foregoing phenomena. However, another hormonal mechanism in crustaceans justifies separate mention. In the wall of the pericardial cavity (enclosing the heart) lies a cluster of fibre terminations of neurosecretory cells of the ventral nerve cord. These terminations, the pericardial gland. release a heart-accelerator hormone.

In a sipunculid worm. *Physcosoma,* certain glandular structures, the internephridial organs. found in association nith the large nephridial (excretory) tubules, have been reported to secrete a hormone essential for normal metabolism and viability. Removal of the glands leads to characteristic changes terminating with death; these changes are prevented by gland implantations.

Colour changes in the cephalopods are effected by an unusual kind of integumentary chromatophore, small elastic sacs of pigment having radially arranged muscle fibres. Although the chromatophore changes are controlled chiefly by nerves, two blood-borne hormones, tyramine from the salivary glands, and betain influence the chromatophore state.

Many invertebrates exhibit sexual dimorphism including differentiation of accessory organs or secondary sexual characteristics. Studies of animals castrated by parasitic infection, irradiation or surgical removal, and studies showing correlations of time of certain morphological changes nith states of gonadal activity have suggested that sex hormones, probably produced by the gonads, are essential for the development of these characteristics. Such studies have included animals as diverse as planarian worms, snails, earthworms, cephalopods and crustaceans.

General.— There appears to be no fundamental similarity of origin of endocrine glands between invertebrates and vertebrates, yet the parallel role of the endocrine systems of these two major divisions of the animal kingdom is striking. Furthermore, there is no established identity of any functional vertebrate and invertebrate hormone, though substances with actions resembling adrenin, estrogens, juvenile hormone and melanophore-stimulating hormone occur in both groups. Hormone secretion by nervous elements appears widespread throughout the animal kingdom

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HORMUZ, an island in approximately 27° 4′ N., 56° 28′ E.. in the Strait of Ormuz, $1\frac{3}{4}$ mi. from the coast of Iran, and 11 mi. E.S.E. of Bandar Abbas. Pop. (1954 est.) 2,514. It has a perimeter of about 16 mi. with a greatest length of $4\frac{1}{2}$ mi. and is composed of jagged hills of variegated hues of reddish purple and white of an average of 300 ft. in height, with one peak rising to 600 ft. The principal geological formations are rock-salt, red ochre and a greenish clay; a white encrustation of salt covers large areas. The barrenness of Hormuz is relieved only by a few *Kunar* trees and some small patches of barley or melons. Gazelles are the only wild fauna. The only permanently inhabited place on the island is the village of Hormuz, close southward of the site of the older city and comprising some 300 mat huts.

Hormuz has a population which may rise to 1.000 males when the salt and oxide mines are being worked, but which falls to less than half in the summer when numbers migrate to the mainland. especially to Minab. for the date harvest or to escape the excessive heat. Iranians predominate, but there are also Baluchis and Arabs. The water supply is from rain collected in pools or cisterns and is brackish and often very scanty even for so small a population.

Hormuz Island is under the jurisdiction of the governor of the gulf ports—but until recent years the revenues were farmed from the Iranian government for a fixed sum.

The resources of the island are red oxide for export. and salt for local use; copper and iron ore are also present but are not worked. Red oxide (Hormuz red) has been an important article of export from Hormuz for centuries, and, since 1922. has been mined and exported under a concession granted to an Iranian merchant. Shipments of this commodity, during the period 1921–27, averaged annually: 2.666 tons to the United Kingdom, 583 tons to the United States. 448 tons to India, and 5,000 tons were sent to Germany during 1926–27. For the better handling of the mineral a truck line has been constructed for some hundreds of yards along the shore.

Of the old and famous city which stood upon the promontory on the northern shore, scarcely anything of definite shape stands at the present day, except the old Portuguese fort, and much even of that has been undermined and washed away by the action of the sea; but traces of buildings of massive foundations, constructed of stone quarried in the island, and a great number of ruined water cisterns remain.

The name Hormuz referred originally to a town on the mainland situated probably on Khor Minab, near the present day Minab in 27° 9′ N., 57° 5′ E. The earliest mention of this name occurs, it seems, in the voyage of Nearchus (325 B.C.) when that admiral anchored Alexander's fleet on the shore of Harmozia at the mouth of the Anamis (R. Minab) in Kirman, "in a country pleasant and agreeable and abounding in everything except olives." The foundation of the city which eventually arose here is ascribed to Ardashir Papakan, founder of the Sassanian dynasty, but it was only after the Arab conquest that it attained great prominence. It was situated one parasang (about four miles) from the sea on a river which ships ascended to the town. Idrisi, Istakhri and Muqaddasi describe the place as the chief market of Kirman. Indigo is mentioned as the most important product, and Yaqût states that this Hormuz had attracted all the trade of India. After about the year A.D. 1100 Hormuz was under a dynasty of Arab rulers, and subsequent to 1262 it came under the rule of the Ilkhani of Persia. Marco Polo twice visited the place, in 1272 and 1293, and describes the business of the port, particularly noting the export of horses. It can not be certainly ascertained what brought about the transference of the mart from the mainland to the island. Abul Fida says the town was destroyed by the "Tartars," but the Mongol invasion hardly touched the coast of Kirman.

Be that as it may, the new settlement was established by Qutb ud Din, on the island then known as Jerun or Zerun, and in spite of the unfavourable natural conditions, there arose a thriving centre of the world's commerce, from the 14th to the 16th centuries. The new Hormuz gradually superseded Qais (q *v.*) as the most important emporium trade of the Persian gulf. Friar Odoric gives the earliest notice of the city which he describes as strongly fortified and abounding in costly wares. It was visited in the lapse of time by a number of other travellers from all of whom we infer that it was a fine city rising out of the sea and serving as a mart for all the products of India, which were distributed hence over all Persia. The princes of Hormuz at one time or another appear to have held sway over other islands of the gulf and even over the shores of Oman. Nikitin, the Russian (c. 1470) conveys a similar impression of its importance and calls it "a vast emporium of all the World."

The appearance of the Portuguese in the Indian seas decided the fate of Hormuz. In 1507 the city was attacked by a Portuguese fleet under Alphonso d'Albuquerque and partially subdued but it was not until 1 j14 that, having captured Goa and Malacca, Albuquerque returned and completed his conquest, and built a castle. For about a century, Hormuz remained practically in the dominion of Portugal, though the hereditary ruler, paying from his revenues a yearly tribute to Portugal (in lieu of which the latter eventually took the whole of the customs revenues) continued to be the instrument of government.

The rise of the English trade and factories, in the Indian seas, in the early part of the 17th century, led to constant broils and friction with the Portuguese; while the success of the East India company in establishing trade relations with Persia only served to embitter the situation. Moreover Shah Abbas I resented the Portuguese occupation of such a position as Hormuz within his dominions and was strongly desirous of obtaining the aid of English ships in attacking it. During 1620–21 the fleets of Portugal and of the East India company more than once came into action in Indian waters, and in the latter year, the council of the company at Surat resolved on what was practically maritime war with the Portuguese flag, agreeing, though reluctantly, to lend the aid of their ships to the land forces of Persia, in an attack on the Portuguese. The combined forces first assaulted and destroyed the Portuguese fort on Qishm Island and then turned their attention to Hormuz itself. The siege was opened on Feb 18, 1622, and continued until May 1, when the Portuguese, after a gallant defense, surrendered. Hormuz never recovered from the blow.

The Persians transferred their establishments and material to Gombrun on the mainland, where Shah Abbas founded a port under the name of Bandar Abbas (*q.v.*), and in a few years Hormuz city was little more than a ruin.

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HORN, ARVID BERNHARD, COUNT (1664–1742), Swedish statesman, was born at Vuorentaka in Finland on April 6, 1664, of a noble but indigent family. He served for several years in the Netherlands, in Hungary under Prince Eugene, and in Flanders under Waldeck (1690–1695). He was one of the generals of Charles XII. in the earlier part of the great Northern War. In 1704 he was entrusted with his first diplomatic mission, the deposition of Augustus II. of Poland and the election of Stanislaus I. Shortly after the accomplishment of this mission he was besieged by Augustus in Warsaw and compelled to surrender. In 1705 he was made a senator, in 1706 a count and in 1707 governor of Charles XII.'s nephew, the young duke Charles Frederick of Holstein-Gottorp. In 1710 he succeeded Nils Gyldenstolpe as prime minister. Both in 1710 and 1713 Horn was in favour of summoning the estates, but when in 1714 the diet adopted an anti-monarchical attitude, he gravely warned and ultimately dissolved it. After the death of Charles XII. (1718) it was Horn who persuaded the princess Ulrica Leonora to relinquish her hereditary claims and submit to be *elected* queen of Sweden. He protested against the queen's autocratic behaviour, and resigned both the premiership and his senatorship. He was elected *landtmarskalk* at the diet of 1720, and contributed, on the resignation of Ulrica Leonora, to the election of Frederick of Hesse as king of Sweden, whose first act was to restore to him the office of prime minister. For the next eighteen years he controlled both the foreign and the domestic affairs of Sweden, and it was owing to his care that Sweden so rapidly recovered from the condition in which the wars of Charles XII. had plunged her. Horn increased the influence of the diet and its secret committees in the solution of purely diplomatic questions, thus weakening the central government. In 1734, however, the opposition in the diet denounced his neutrality on the occasion of the war of the Polish Succession, when Stanislaus I. again appeared upon the scene as a candidate for the Polish throne; but Horn was still strong enough to prevent a rupture with Russia. Henceforth he was bitterly but unjustly accused of want of patriotism, and in 1738 was compelled at last to retire before the impetuous onslaught of the triumphant young Hat party. The rest of his life was spent at his estate at Ekebyholm, where he died on April 17, 1742. Horn in many respects resembled his contemporary Walpole. The situation of Sweden made his policy necessarily opportunist, but it was an opportunism based on excellent common-sense.

See V. E. Svedelius, *Arvid Bernhard Horn* (Stockholm, 1879); R. N. Bain, *Gustavus III.,* vol. i. (London, 1894), and *Charles* XII. (1895); C. F. Horn, *A. B. Horn: hans lefnad* (Stockholm, 1852).

HORN, PHILIP DE MONTMORENCY, COUNT OF (1518–1568), a man of illustrious descent and great possessions in the Netherlands, became in succession under Charles V. and Philip II. stadtholder of Gelderland, admiral of Flanders and knight of the Golden Fleece. In 1559 he commanded the fleet which conveyed Philip II. from the Netherlands to Spain, and he remained at the Spanish court till 1563. On his return he placed himself with the prince of Orange and Count Egmond at the head of the party which opposed the policy of Cardinal Granvella. When Granvella retired the three great nobles continued to resist the introduction of the Spanish Inquisition and of Spanish despotic rule into the Netherlands. But though Philip appeared for a time to give way, he had made up his mind to visit the opponents of his policy with ruthless punishment. The regent, Margaret, duchess of Parma, was replaced by the duke of Alva, who entered the Netherlands at the head of a veteran army and at once began to crush all opposition with a merciless hand. Orange fled from the country, but Egrnond and Horn, despite his warning, decided to remain and face the storm. They were both seized, tried and condemned as traitors, and were executed on June 5, 1568, in the great square before the town hall at Brussels. (*See* also EGMOND, LAMORAL.)

See biographical notices in A. J. van der Aa, *Biographisch Woordenboek der Nederlanden* (Haarlem, 1851–79); J. Kok, *Vaderlandsch Woordenboek* (Amsterdam, 1785–99); also bibliography to chaps. vi. vii. and xix. in *Cambridge Modern History,* vol. iii., pp. 798–809 (1904).

HORN, English hero of romance. *King Horn* is a heroic poem or gest of 1,546 lines dating from the 13th century. Murry (or Allof), king of Sudenne (Surrey and Sussex?), is slain by Saracen pirates who turn his son Horn adrift with 12 other children. The boat drifts to Westernesse (Cornwall?), where the children are received by King Aylmer (Aethelmaer). Presently Horn is denounced by one of his companions as the lover of the king's daughter, Rymenhild (Rimel), and is banished, taking with him a ring, the gift of his bride and a talisman against danger. In Ireland he serves for seven years, and slays in battle the Saracens who had killed his father. Learning that Rymenhild is to be married against her will to King Mody, he returns to Westernesse disguised as a palmer, and makes himself known to the bride by dropping the ring into the cup she offers him, with the words "Drink to Horn of Horn." He then reconquers his father's kingdom and marries Rymenhild. The story of Horn resembles the legend of Havelok the Dane, and Richard of Ely followed the Horn tradition in the 12th century *De gestis Herewardi Saxonis.*

King Horn was rc-edited for the Early English Text Soc. by G. H. McKnight in 1901.

HORN, CAPE, a steep rocky headland on Horn Island, at the southernmost extremity of South America, lies 55° 59′ S., 67° 12′ W. in Tierra del Fuego (*q.v.*) archipelago, Magallanes province, Chile. It was named Hoorn by the Dutch navigator Willem Cornelius Schouten who rounded it in 1616 and who was born at Hoorn, Netherlands. False Cape Horn, the southernmost point of Hoste Island, 35 mi. N.W., is sometimes mistaken for Cape Horn. Navigating the rough waters around the Cape is hazardous.

See Felix Riesenberg, *Cape Horn* (1941).

HORN, a class of wind instruments primarily derived from natural animal horns, and having the common characteristics of a conical bore and the absence of lateral holes.

Modern horns may be divided into three classes: (1) the short horns with wide bore, such as the bugles (*q.v.*), and the post-horn. (2) The saxhorns (*q.v.*), a family of hybrid instruments designed by Adolphe Sax, and resulting from the adaptation of valves and of a cup-shaped mouthpiece to instruments of the calibre of the bugle. (3) The French horn, one of the most valuable and difficult wind instruments of the orchestra, having a very slender conical tube wound round in coils upon itself.

The French horn consists of four principal parts — the body, the crooks, the mouthpiece, and the slides.

(a) The *body* is the main tube, having a bore of the form known as trunco-conical measuring approximately 7 ft. 4 in. in length. The body is coiled spirally, and has at one end a wide-mouthed bell from 11 to 12 in. in diameter, with a parabolic curve, and at the other a conical ferrule into which fit the crooks.

(b) The *crooks* are interchangeable spiral tubes of varying lengths, by attaching which to the mouthpiece the total length of the tube can be varied at will, and the pitch and key of the instrument thereby altered. The principle of the crook was known early in the 17th century, and it had been applied to the trumpet, trombone, and Jagertrummet before being adapted to the horn. From the crook, in turn, was developed the system of valves, which is but an instantaneous application of the same general principle to the individual notes of the harmonic series, each of which is thereby lowered a semitone, a tone, or a tone and a half as long as the valve remains in operation. The body of the horn without crooks is of the length to produce 8 ft. C, and forms

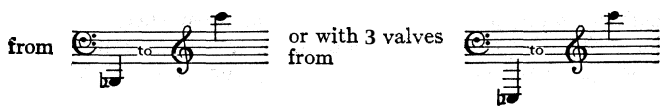
the standard, being known as the alto horn in C, which is the highest key in which the horn is pitched.

(c) The *mouthpiece* of the horn differs substantially from that of the trumpet. There is, strictly speaking, no cup, the inside of the mouthpiece being, like the bore of the instrument itself, in the form of a truncated cone or funnel.

(d) The *tuning slides* consist of a pair of sliding U-shaped tubes fitting tightly into each other, by means of which the instrument can be brought strictly into tune, and which also act as compensators with the crooks.

Pitch.—The pitch of the horn, as of other wind instruments, depends almost exclusively on the length of the air-column set in vibration, but varies in accordance with the amount of blowing force employed. As regards the fundamental tone, to set in vibration a column of air some 16 or 17 ft. long, is extremely difficult; hence it is quite exceptional to find a player who can sound the fundamental on the low C or Bb *basso* horns.

The practical aggregate compass of the natural horns from Bb basso at the service of composers therefore ranges (actual sounds)



Scale.—By means of hand-stopping, *i.e.,* the practice of thrusting the hand into the bell in order to lower the sound by a tone or a semitone, or by the employment of valves, this compass may be rendered chromatic almost throughout the range. The valve system consists of valves or pistons attached to additional lengths of tubing, the effect of which is almost invariably to lower the pitch. Horns are made with either two or three valves by means of which the pitch can be lowered at will a semitone, a tone or a tone and a half. The three devices—crooks, valves, and slides—are, it will be seen, all based upon the same principle, that of providing additional length of tubing in order to deepen the pitch of the whole instrument at will, and to transpose it into a different key. But valves and slides, being instantaneous in operation, give to the instrument a chromatic compass, whereas crooks merely enable the performer to play in many keys upon one instrument instead of requiring a different instrument for each key.

Timbre.—The *timbre* of the natural horn is mellow, rich and sonorous, and distinguished at the same time by a certain human quality which differentiates it from that of all the other members of the brass wind. But it may be noted that the timbre of the piston notes is more resonant and less pleasing than that of the open notes, probably owing to the fact that the strictly conical bore of the natural horn has in this case been replaced by a mixed cylindrical-conical one, as in the trumpet and trombone.

History.—The origin of the horn must be sought in prehistoric times, when, by breaking off the tip of a short animal horn, one or at best two notes, powerful, rough, unsteady, only barely approximating to definite musical sounds, were obtained. This was undoubtedly the archetype of the modern families of brass wind instruments, and from it evolved the trumpet, the bugle, and the tuba no less than the horn. Before civilization had dawned in classic Greece, the Egyptian, Assyrian and Semitic races were using wind instruments of wood and metal which had left the primitive ram or bugle horn far behind Among the Romans there were four instruments known by the name of *cornu:* (1) the short animal horn used by shepherds; (2) the longer, semicircular horn, used for signals; (3) the still longer *cornu,* bent and carried like the buccina, uhich had the wide bore of the modern tuba; and (4) a small instrument like the mediaeval hunting-horn, or post-horn, with a single spiral turn A terra-cotta model of one of the last named, slightly broken, but with the spiral intact, was excavated at Ventoux, in France, and is preserved in the department of Greek and Roman antiquities at the British Museum.

All these wind instruments, to which may be added the lituus or cavalry trumpet, and the long straight tuba, seem to have been used during the classic Greek and Roman periods merely to sound fanfares, and therefore, in spite of the high degree of perfection to which they attained as instruments, they scarcely possess any claim to be considered within the domain of music.

After the fall of the Roman empire, when instrumental music had fallen into disrepute, and had been placed under a ban by the Church, the art of playing upon such highly-developed instruments gradually died out in Western Europe. With the disappearance of the civilization and culture of the Romans the skilled crafts also gradually vanished, and the art of making metal pipes of delicate calibre and of bending them was completely lost, and had to be re-acquired step by step during the middle ages from the more enlightened East.

During the middle ages the bugle-horn or bull's horn was extensively used as a signal instrument on land and sea *(see* BUGLE), by the night-watchmen in cities, in the watch tower of the feudal castle, and by foresters and huntsmen. The hunting-horn is generally represented as small and crescent-shaped in the hunting scenes which abound in illuminated mss. and early printed books, and when played it was held with the wide end curving upwards in front of the huntsman's head.

Music.—The earliest orchestral music for the horn goes back beyond the middle of the 17th century. Already, in 1639, Cavalli, in his opera *Le Nozze de Tito* e *Pelei* (act. i. sc. 1) introduced a short scena, "Chiamata alla Caccia" in C major for four horns on a basso continuo.

Cesti's operas of the same period likewise contain many passages evidently intended for the horn, although the instruments are not specified in the score, which was nothing unusual at the time. Later Lulli, in the incidental music for a ballet, *La Princesse d'Elide,* which formed part of Molière's divertissement, "Les plaisirs de l'île enchantée," written for a great festival at Versailles, on May 7, 1665, introduced a piece entitled "Les violons et les cors de chasse," written in much the same style as Cavalli's scena, by which, indeed, it is believed to have been inspired. The introduction of the natural horn into the orchestra of the French opera did not occur, however, until much later, viz., in 1734, in André Campra's *Achille et Deidamie,* and then only in a fanfare. In the meantime the horn had already won a place in most of the rising opera houses and ducal orchestras of Germany, and had been introduced by Handel into the orchestra in London in his *Water-music,* composed in honour of George I.

Horns were also employed by Bach, while it scarcely needs saying how largely they have been used since by modern composers from the time of Beethoven (who had an especial fondness for the instrument) onwards.

HORN. The weapons which project from the heads of various species of animals, constituting what are known as horns, embrace substances which are, in their anatomical structure and chemical composition, quite distinct from each other; and although in commerce also they are known indiscriminately as horn, their uses are altogether dissimilar. These differences in structure and properties were thus indicated by Sir R. Owen:—"The weapons to which the term horn is properly or technically applied consist of very different substances, and belong to two organic systems, as distinct from each other as both are from the teeth. Thus the horns of deer consist of bone, and are processes of the frontal bone; those of the giraffe are independent bones or 'epiphyses' covered by hairy skin; those of oxen, sheep, and antelopes are 'apophyses' of the frontal bone, covered by the corium and by a sheath of true horny material; those of the prong-horned antelope consist at their basis of bony processes covered by hairy skin, and are covered by horny sheaths in the rest of their extent. They thus combine the character of those of the giraffe and ordinary antelope, together with the expanded and branched form of the antlers of deer. Only the horns of the rhinoceros are composed wholly of horny matter, and this is disposed in longitudinal fibres so that the horns seem rather to consist of coarse bristles compactly matted together in the form of a more or less elongated sub-compressed cone." True horny matter is really a modified form of epidermic tissue, and consists of the albuminoid "keratin." It forms, not only the horns of the ox tribe, but also the hoofs, claws, or nails of animals generally, the carapace of the tortoises and the armadilloes, the scales of the pangolin, porcupine quills, and birds' feathers, etc.

Horn is employed in the manufacture of combs, buttons, the handles of walking sticks, umbrellas, and knives, drinking cups, spoons of various kinds, snuffboxes, ktc. In former times it mas applied to several uses for which it is no longer required, although such applications have left their traces in the language. Thus the musical instruments and fog signals known as horns indicate their descent from earlier and simpler forms of apparatus made from horn.

In the same way powder horns were spoken of long after they ceased to be made of that substance; to a small extent lanterns continue to be "glazed" with thin transparent plates of horn.

HORNBEAM, any tree of the genus *Carpinus* of the birch family (Betulaceae). The American hornbeam, blue- or water-beech, is *Carpinus caroliniana,* a medium-sized tree, ranging from Nova Scotia to Florida and westward to Minnesota and Texas. Its extremely tough hard wood is used for the making of charcoal. The common hophornbeam, a native of the south of Europe, is Ostrya *vulgaris;* the allied American species, *O.* virginiana, is also known as ironwood from its hard! tight, close-grained wood. The genus Ostrya likewise belongs to the Betulaceae; its members may be distinguished from those of *Carpinus* by their papery saclike fruits.

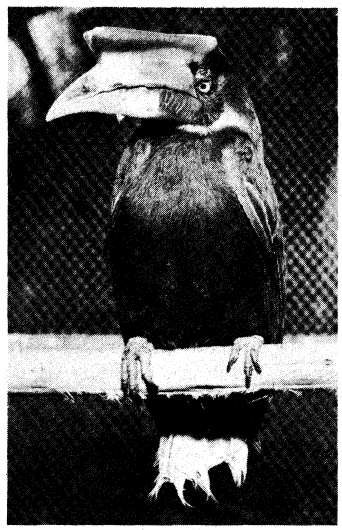
The European common hornbeam, or yoke elm, C. *betulus,* is indigenous to the temperate parts of western Asia and of Asia Minor and in Europe, where it ranges as high as 55° and 56" N. latitude. It is common in woods and hedges in parts of Wales and of the south of England. The trunk is usually fluted and twisted as though composed of several united stems. The bark is smooth and light gray. The leaves are short-stalked, in two rows, two to three inches long, elliptic-ovate, doubly toothed, pointed, numerously ribbed, hairy below and opaque, not glossy as in the beech. The stipules act as protecting scale leaves to the winter buds and fall when the buds open in spring. The flowers appear with the leaves in April and May. The male catkins are about one and one-half inches long, and have pale yellow anthers, bearing tufts of hairs at the apex; the female catkins attain a length in the fruiting stage of two to four inches, with bracts one to one and one-half inches long. The fruit is a small, green, angular nut, about one-fourth inch in length, borne at the base of a three-lobed, leafy bract.

The hornbeam thrives well on stiff, moist clay soils. into which the roots penetrate deeply; it does not flourish on chalk or gravel. It is, however, occasionally grown as a timber tree. its chief employment being for hedges. The wood of the hornbeam is white, close-grained, of considerable tenacity and little flexibility and is extremely tough and hard to work. But because of its toughness. it was once used to make cogwheels and spindles. A a fuel it is excellent and in France the leaves serve as fodder. The tree is a favourite with hares and rabbits, and the seedlings are liable to be destroyed by mice. The American Ostrya *virginiana* is of little commercial importance. (E. S. Hr.; N. Tr.)

HORNBILL, any bird of the family Bucerotidae classed with the hoopoes, rollers, kinghshers and motmots (*qq.v.*) in the order Coraciiformes. They are usually two to four feet long from tip to tail and are remarkable for the enormous bill, often surmounted by a colourful hornlike casque, solid in the helmeted hornbill (*Rhinoplax vigil*) of the East Indies, honeycombed with air spaces in the others. They are grotesque birds with loud croaking voices and noisy flapping flight. Although these tree-divellers are omnivorous feeders! most of them search out fruits.

The ground hornbills (*Bucorvus*) are more terrestrial. The larger species will devour snakes: the smaller also eat insects. The plumage is usually black or brown and white, the bill and casque yellowish, with black and orange or red, or largely red. The homrai or great Indian two-horned hornbill (*Buceros bicornis*), the largest, is nearly five feet long, ranging from Bombay to Sumatra.

The female—as in a wedge-tailed hornbill (Tockus *albotermina-tus*), of eastern and south Africa. the Papuan hornbill (Aceros *plicatus*) and perhaps most other species—is walled into a hollow tree by the male: imprisoned while she incubates two to four white eggs and cares for the naked helpless young until they can fly; the male regurgitates food in a gizzard lining and feeds the female through a small slit in the mud wall. Most remarkable is the huge rhinoceros hornbill (Buceros rhinoceros), nearly four feet long, black and white. with the huge casque turned up in front like another bill turned upside down; it inhabits forests of the Malay peninsula, Sumatra, Java and Borneo. One of the noisiest forest creatures is the rufous hornbill (B. hydrocorax) of the Philippines, known for its hissing, whistling flight and its raucous cry.



R. VAN NOSTRAND FROM THE NATIONAL AUDUBON SOCIETY

RUFOUS HORNBILL OR CALAO (BUCEROS HYDROCORAX), A HABITANT OF PHILIPPINE FORESTS

A dozen smaller species of *Tockus*—including the common gray (T. *nasutus*), red-beaked (T. *erythrorhynchus*) and yellow-beaked (T. *flavirostris*) hornbills—range over Africa, with a few species in India. They are scarcely two feet long. Other genera occur in central African forests, and in southeastern Asia. (G. F. Ss.; X.)

HORNBLENDE: see Amphibole.

HORNBOOK, a name originally applied to a sheet containing the letters of the alphabet, which formed a primer for the use of children. It was mounted on wood, and protected with transparent horn. The wooden frame had a handle, and it was usually hung at the child's girdle.

The sheet, which in ancient times was of vellum and later of paper, contained first a large cross—the crisscross—from which the hornbook was called the Christ Cross row, or crisscross row. The alphabet in large and small, letters followed. The vowels then formed a line. and their combinations with the consonants were given in a tabular form. The usual exorcism—"in the name of the Father and of the Sonne and of the Holy Ghost, Amen"—followed, then the Lord's Prayer, the whole concluding with the Roman numerals.

HORNBY, SIR PHIPPS (1785–1867), British admiral, was born on April 27, 1785, the son of Geoffrey Hornby, rector of Winwick (Lancs.). He entered the navy in May 1797, and served with Capt. William Bligh until 1804, when he was promoted lieutenant of the "Excellent." He took part in various naval engagements in the Napoleonic Wars, distinguishing himself in particular in the frigate action off Lissa (1811) under Adm. Sir William Hoste (*q.v.*).

From 1816 to 1832 Hornby lived in retirement and was then appointed superintendent of the Royal Naval hospital at Plymouth. He again went to sea in 1847, when he was made commander in chief in the Pacific. In 1851–52 he was a lord of the admiralty and became vice-admiral in 1854 and admiral in 1858. He died on March 19, 1867.

HORNCASTLE, a market town and urban district in the Horncastle parliamentary division of the Parts of Lindsey, Lincoinshire, Eng., at the foot of the western slopes of the Lincolnshire wolds, at the confluence of the Bain and Waring streams, 21 mi. E. of Lincoln by road. Pop. (1951) 3,809. Area 2.2 sq.mi.

The name, Hornecastre in Domesday Book, signified the horna or tongue of land by a Roman camp. There was a small Roman administrative centre, part of the walls of which remain. It is probably the *Banovallum* mentioned in the *Ravenna* Itinerary. The manor of Horncastle belonged to Queen Edith in Saxon times and was royal demesne in 1086. Under Stephen it belonged to Alice de Cundi, a partisan of the empress Maud, and passing to the crown on her death it was granted by Henry III to Gerbald de Escald. from whom it descended to Ralph de Rhodes. who sold it to the bishop of Carlisle in 1230. Horncastle was never a municipal or parliamentary borough, but during the middle ages

it was frequently the residence of the bishops of Carlisle. The see of Carlisle retained it until the reign of Edward VI when it was granted to Edward, Lord Clinton. but was recovered in the following reign. Horncastle was a centre of the Lincolnshire rebellion of 1536. Royalist troops occupied the town in 1643 and were pursued through its streets after the battle fought at Winceby, 4 mi. E.S.E. of the town. Its prosperity once depended largely on its fairs, the great horsefair described by George Borrow in *The Romany Rye* (1857) being granted to the bishop in 1230 for the octave of St. Lawrence. together with the fair on the feast of St. Barnabas. The church of St. Mary is mainly Decorated and Perpendicular, with some Early English remains and an emhattled western tower. Queen Elizabeth's grammar school was founded in 1562.

The prosperity of the town is chiefly dependent on agriculture with malting, tanning, canning and a large plant nursery. There is also a clothing factory. At Somersby, seven mi. E.N.E., Alfred Lord Tennyson was born. The red brick castle of Tattershall, 9 mi. S.S.W., dates from 1440.

HORNCHURCH, an urban district and parliamentary division of Essex, Eng.. 14 mi. E.N.E. of London by road and on the Inprebourne where it joins the Thames, with more than 3 mi. of Thames frontage. Pop. (1961) 128,127. Area 30.9 sq.mi. It is a "dormitory" area with industries such as light engineering and the making of office equipment, chemicals and clothing. Henry II founded there a hospice for the St. Bernard monks of Savoy. granting them the church and some land, and in 1245 the Savoy palace in the Strand. London. was attached to it. A stone, copper-horned bull's-head over the gabled east window of the parish church (the hull's-head is also on the seal of the French monastery) is probably the'origin of the name *Hornedecherche* in 1311. Royal flying corps. later royal air force, fighters stationed at Hornchurch distinguished themselves in the defense of Britain during World Wars I and II. A civic theatre was opened in 1953. Rainham. Upminster and North Ockendon have historic churches.

HORN DANCE, a dance performed at Abbots Bromley, Staffordshire. on Wakes Monday in September. Four men impersonate a fool, Maid Marian, a hobby horse and a boy with bow and arrows. Six more bear sets of antlers on their shoulders. A single file procession is followed by a mock battle between the three nith black antlers and three with white. Accordion and triangle provide accompaniment. The dance shows some similarities to a local custom observed prior to the English Civil War and may derive from a primitive fertility ritual.

See R. Crompton Rhodes, "The Truth About the Abbots Bromley Horn Dance," *Dancing Times,* N.S. no. *288* (Sept. 1934); Cecil J. Sharp, *The Sword Dances of Northern England Together With the Horn Dance of Abbots Bromley,* 2nd ed., rev. by Maud Karpeles (1951). (S. J. Cn.)

HORNE, HENRY SINCLAIR HORNE, 1ST BARON, cr. 1919 (1861–1929), British general. was born on Feb. 1, 1861. He joined the royal artillery in 1880 and served on the staff throughout the South African War (1899-1902). In 1912 he became inspector of artillery and in Aug. 1914 went to France in command of the artillery of the 1st army corps. At the end of 1915 he was given charge of the 15th army corps in Egypt and he took this to France in April 1916, commanding it during the opening phases of the battle of the Somme. His method of employing his guns during these operations attracted much attention and was signally successful, as was recognized by his being chosen in September to succeed Sir C. Monro as leader of the 1st army. His troops took a prominent part in the battle of Arras, 1917, and when the enemy. in March and April 1918, made its great effort they repulsed all attacks that were made upon their front. Then, when the Allies' counteroffensive developed in the late summer, their part in the final victories was conspicuous. For his services he was raised to the peerage as Baron Horne of Stirkoke and received a grant of £30,000. He held the Eastern command from 1919 to 1923 and retired in 1926. He received many honours, including the G.C.B. (1919). Lord Horne died on Aug. 14, 1929.

HORNE, ROBERT STEVENSON HORNE, 1ST VISCOUNT (1871–1940), British lawyer, politician and businessman, achieved success in whatever he attempted by steady ambition, a talent for organization and genial good humour. Born at Slamannan, Stirlingshire, he studied philosophy at Glasgow university, became interested in student politics and decided to read law. meanwhile taking a post as lecturer in philosophy at the University College of North \Vales. Bangor. Called to the Scottish bar in 1896, he took silk in 1910, and in the same year tried at both general elections to enter parliament as a Unionist. During World War I he worked first with Eric (later Sir Eric) Geddes in organizing railway transport at the front and then went to the admiralty, becoming director of materials and priority in 1917, and director of labour and third civil lord in 1918. Elected to parliament in 1918, he became minister of labour. dealing successfully with trouble on Clydeside, in the coalfields and on the railways. In 1920 he was made president of the board of trade and in 1921 chancellor of the exchequer. but after the dissolution of the coalition in 1922, loyalty to Lloyd George led him to refuse office under Bonar Law. He turned his energies to the management of such large undertakings as the Suez Canal company. Lloyds bank. and the Burma corporation. In 1934 he became chairman of the Great Western Railway company. He was created a viscount in 1937 and died on Sept. 3, 1940, at Farnham, Surrey.

HORNE, THOMAS HARTWELL (1780–1862), English theologian and bibliographer. was born in London on Oct. 20, 1780, and educated at Christ's Hospital, with Samuel Taylor Coleridge as an elder contemporary. On leaving school he became clerk to a barrister but showed a keen taste for authorship. As early as 1800 he published *A Brief View of the Necessity and Truth* of *the Christian Revelation,* which was followed by many works on varied subjects. He was appointed (1524) senior assistant librarian in the department of printed books in the British museum. After the project of making a classified catalogue had been abandoned. he took part in the preparation of the alphabetical one, and his connection with the museum continued until within a few months of his death on Jan. 27, 1562.

HORNED OWL, an owl with hornlike tufts of feathers, especially the large eagle owl (*q.v.; Bubo bubo*) of Europe, Asia and north Africa. The great horned owl (*B. virginianus*) of America, from arctic tree limits to the Straits of Magellan, is a powerful mottled brown predator often reaching two feet in length. Although its usual fare is small rodents and birds it has been known to carry off larger game, hens, turkeys, etc. Being adapted to desert and forest, the great horned owl migrates only during time of food shortage.

Related species of *Bubo* occur over Africa, India and Burma to the Malay archipelago. (*G.* F. Ss.; X.)

HORNED TOAD, the common name of North American lizards of the genus *Phrynosoma.* There are 17 species. of which 10 occur in the arid regions of the western United States and the remainder in similar situations in Mexico. They are short-legged. flat-bodied, harmless creatures of grotesque appearance. The hinder border of the head is armed with long or short sharp hornlike spines; the sides of the body and tail bear soft spinelike scales. The horned toads inhabit arid plains, deserts and dry forests and feed upon insects and chiefly upon ants. The eggs are retained within the body of the female until ready to hatch in some species, while in others the eggs are laid in the ground in sandy places. The common horned toad (P. *cornutum),* one of the largest species, is about 6 in. long, with a body width of 2½ in. It is abundant in high arid plains from western Nebraska southward to Texas and Mexico. Other species, some of which are less than 4 in. long. are found from Wyoming to Washington and southward to Mexico.

HORNEMANN, FREDERICK (1772–1801), German traveler in Africa and the first European in modern times to traverse the Sahara, was born at Hildesheim in Lower Saxony in Sept, 1772. Early in 1796 he offered his services as an explorer to the African association in London. In Sept. 1797 he arrived in Egypt and, after receiving assistance from Napoleon, on Sept. 5, 1798, joined a caravan returning from Mecca to the Maghreb. He was attached to a group of Fezzan merchants traveling with the pilgrims and assumed the character of a mameluke trading with the Fezzan. He was accompanied by Joseph Freudenburg,

a German convert to Islam who had made the pilgrimage to Mecca three times, who acted as his servant and interpreter. They traveled by way of the oases of Siwa and Aujila and reached Murzuk on Nov. 17, 1798. Hornemann remained there until June 1799 and then made a journey to Tripoli, dispatching his journals to London in August. He returned to Murzuk intending then to travel southward to Hausa country, and was the first European to establish its definite location. Nothing more was heard of him until a report reached Murzuk in 1819 that he had reached "Noofy" (Nupe) and died there in Feb. 1801.

Hornemann's journal was printed at Weimar in 1802; an English translation, Frederick Horneman's Travels from Cairo to *Mourzouck* with maps and commentary by Maj. James Rennell, was published in 1802.

See Heinrich Schiffers-Davringhausen, *The* ***Quest*** for *Africa,* **pp.** 285–86 (1957). (R. M. P.)

HORNET, a name given to several species of large wasps (*q.v.*), especially the European *Vespula* (Vespa) crabro and North American V. *maculata*. *See* SOCIAL INSECTS.

HORNEY, KAREN (née DANIELSEN) (1885–1952), U.S. psychoanalyst, author and teacher, whose importance stems from her dissatisfaction with the traditional Freudian approach to psychoanalysis, was born at Hamburg, Ger., on Sept. 16, 1885, the daughter of a Norwegian father and a Dutch mother. After study at the medical school at Berlin, she began the practice of medicine in 1913, studying meanwhile with Karl Abraham.

She became prominent in the psychotherapeutic field about 1930, moving to Chicago in 1932 to be assistant director of the Institute for Psychoanalysis there, and in 1934 to New York, where she lectured at the New School for Social Research and New York Medical college, trained other psychoanalysts and worked as a practising analyst. She was one of the co-founders of the American Institute for Psychoanalysis. Her death occurred in New Tork on Dec. 4, 1952.

Dr. Horney stressed the significance of social and environmental factors in determining the personality pattern of the individual and his conilicts. Her best-known books are The *Neurotic* Personality of *Our Time* (1937). *Our Inner Conflicts* (1945) and *Neurosis and Human* Growth (1950). Emphasis was placed on childhood training in such aspects of behaviour as weaning, cleanliness, sex taboos and aggression.

In later life, she maintained, experiences that are perplexing and threatening may contribute to behaviour anomalies. Dr. Horney. among others, questioned the "death instinct" theory advanced by Freud for explaining aggressive behaviour.

(R. M. D.)

HORNFELS, in petrology, a series of rocks that have been partially or wholly recrystallized by the heat of intrusive igneous masses. Most hornfelses are fine textured and massive, recrystallization having effaced the structures and textures of the original rocks and replaced original minerals by new assemblages. They are the characteristic rocks forming the inner zone of the thermal aureole of alteration surrounding bosses or laccoliths of plutonic rocks. The commonest types of hornfelses are derived from shales, impure limestones and basic igneous rocks. Shales give rise to brown or black hornfelses rich in biotite mica, andalusite and cordierite; while impure limestones give the "calc-silicate hornfelses" rich in pyroxene, garnet, idocrase or wollastonite. The hornfelses derived from basic igneous rocks are dark-green types rich in feldspar and pyroxene or monoclinic amphibole. These are the basalt or dolerite hornfelses. See also METAMORPHISM: *Types of Metamorphism.* (C. E. T.)

HORNIMAN, ANNIE ELIZABETH FREDERICKA (1860–1937), English theatrical manager, who was a pioneer in the repertory theatre movement, was born at Forest Hill, London, on Oct. 3, 1860. Educated privately, she studied art for a period at the Slade school, University college, London, under Alphonse Legros. Later she was secretary to W. B. Yeats.

Miss Horniman's first theatrical enterprise, at the Avenue theatre, London, in 1893, was a failure. In 1904 she became associated with the Abbey theatre, Dublin, and subsidized the Irish National Theatre society, which presented a series of plays by Irish dramatists dealing with various phases of Irish life. She is chiefly remembered, however, for her institution in 1907 of the repertory theatre movement in Manchester. She opened at the Gaiety theatre, Manchester, in 1908, and converted it into a repertory house, the first in Great Britain, in which some of the best-known plays of modern times were originally produced. In 1917 she was forced to disband her company, but retained control of the theatre until 1920. She died at Shere, Surrey, on Aug. 6, 1937.

See R. Pogson, *Miss Horniman and the Gaiety Theatre, Manchester* (1952).

HORNING, LETTERS OF: see PRACTICE AND PROCEDURE.

HORNPIPE. A term denoting (1) a musical instrument; (2) a dance; and (3) an item in the musical suite in 3/2 time.

The dance was supposedly performed to the instrument, and at times is synonymous with the jig, country dance (*qq.v.*) and reel. Commonly, "hornpipe" signifies a "round" or country dance (15th–16th centuries), a "longways" country dance in 3/2 time (17th–18th centuries) and particularly a solo dance (usually male) in 2/4 or 4/4 time. Known in all parts of Great Britain, it is characterized by intricate steps and sometimes by mimetic action (as in the "sailor's hornpipe," originally a stage dance in the 18th century). Particularly in northern counties, itinerant dancing masters taught new steps which were jealously regarded as personal to each individual and were performed solo to the fiddle at country balls.

See *Die Musik in Geschichte und Gegenwart,* ed. by F. Blume (1949). (M. J. D-S)

HORNSEY, a municipal (1903) and parliamentary borough in Middlesex, Eng , 6 mi. N of St. Paul's cathedral, on the "northern heights" adjoining the administrative county of London. Pop. (1961) 97,885. Area 4.5 sq.mi. The manor, called in the 13th century *Haringeie* (surviving as Harringay), early belonged to the see of London, the bishops having a seat there. In 1387 the duke of Gloucester, uncle of Richard II, assembled in Hornsey park the forces by which he compelled the king to dismiss his minister Michael de la Pole, earl of Suffolk. Finsbury park (115 ac.), administered by the London County council, Alexandra and Priory parks are nithin the borough. Highgate (q v) is largely in Hornsey borough as are Crouch End and Muswell Hill.

HORNWORT, a common name for the species of the genus *Ceratophyllum* of the Ceratophyllaceae family, a monogeneric family containing three or four species of cosmopolitan distribution. All grow under water and possess whorled, finely dissected leaves. Two species (C. *demersum* and *C. echinatum*) are widely distributed in quiet nater in temperate North America and are frequently used in the unheated aquarium. (J. M. BL.)

HOROLOGY, the science of measuring intervals of time; also, the principles and techniques of constructing instruments used for indicating time. It is treated in the folloning articles: CHRONOGRAPH ; CHRONOMETER; CLEPSYDRA ; CLOCK ; HOURGLASS; SUNDIAL; TIME MEASUREMENT; WATCH. The measurement and designation of long periods of time falls under the domain of chronology, and is dealt with in CALENDAR; CHRONOLOGY; DAY; MONTH; TIME; TIME, STANDARD.

HOROSCOPE: see ASTROLOGY.

HOROWITZ, ISAIAH (c. 1555–*c.* 1630). Jewish rabbi and mystic, nas born at Prague, and died at Safed (now in Israel). He held various rabbinates, notably at Frankfurt am Main (c. 1606) and at Prague (1614). From 1621 onward he lived in Palestine. In 1625 he was imprisoned by the pasha but, on being ransomed, settled in Safed, at that time the home of Jewish Cabala Horowitz' largest work, *Shelah* (abbreviated from the initials of the full title *Shene luhoth ha-berit,* "Two Tables of the Covenant"), is a compilation of ritual, ethics and mysticism. It has been often reprinted, especially in abbreviated form. His prayer book is also marked by cabalistic doctrines.

For an account of the Jewish mystics at Safed, *see* S. Schecter, *Studies in Judaism,* series ii (1908).

HORROCKS, JEREMIAH (c. 1617–1641), English astronomer and clergyman whose successful observations of the transit of Venus of 1639 are the first recorded of that phenomenon, mas born at Toxteth Park, near Liverpool. He was a student at Em-

manuel college, Cambridge, from 1632 to 1635; then he became a tutor at Toxteth and studied astronomy in his spare time. He was ordained to the curacy of Hoole, Cheshire, in 1639. He calculated that a transit of Venus, overlooked in Kepler's Rudolphine tables, would occur on Sunday, Nov. 24 (O.S.), 1639; when the transit took place, he fitted his observations in between church services. Horrocks was a brilliant young man, and before his death at Toxteth on Jan. 3, 1641, he had considerably advanced the lunar theory, reduced the solar parallax to 14″, suggested perturbations of the moon's orbit as due to the disturbing action of the sun, made observations of the tides, and investigated the irregularities of motion of Jupiter and Saturn.

HORS D'OEUVRE. Hors d'oeuvre in cookery is the name given to small appetizing morsels of food generally served cold, such as caviar, creamed meat or fish masked with aspic, etc. These dishes are served at the beginning of a meal and may be either handed round or placed ready in front of the diner.

Many different kinds of food are used for making hors d'oeuvre dishes; *e.g.*, meat, fish, vegetable or fruit. While some are "made-up" dishes, other foods are served in a raw state; *e.g.*, oysters. As far as possible, where "made-up" hors d'oeuvres are given, these should be prepared as complete portions so that they need no carving or cutting. Diminutive rolls, thin strips of pastry. toast or special small savoury biscuits are frequently used as canapés (foundations) for hors d'oeuvre mixtures. Sieved yolk of a hard-boiled egg, truffles, diced vegetables, aspic jelly. mustard and cress, parsley. etc., are among the many decorations used for these dishes. Where vegetable salads are used as hors d'oeuvres a mayonnaise sauce mixed with aspic jelly is often employed as a coating. Stuffed hard-boiled eggs, jellied molds of vegetables, fish, meat, etc., are other forms of hors d'oeuvre, also dainty sandwiches with a well-flavoured savoury paste.

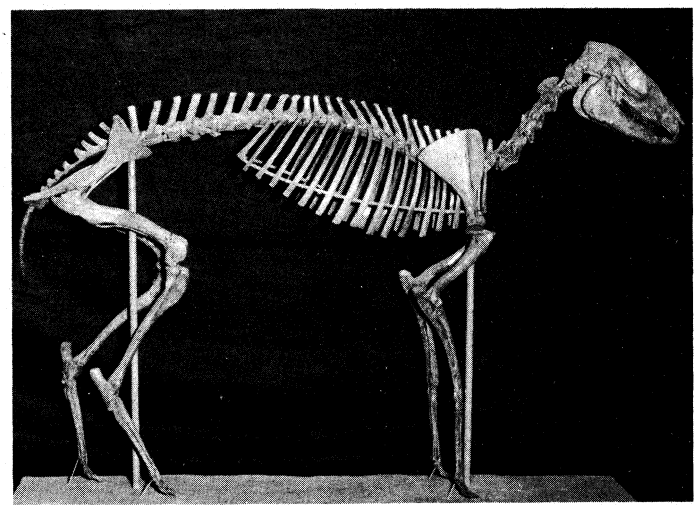
Smoked and cured fish are popular forms of hors d'oeuvre; *e.g.*, smoked salmon and anchovies. Strips of smoked salmon are occasionally spread with a sawoury mixture and rolled. Anchovies may be boned and coiled round olives, etc. Prawns may be served au *naturel* by sticking them into a whole lemon. Crab and lobster meat form the basis of many creams, while bivalves, such as oysters or mussels, may be served with vinegar or lemon, a relish sauce, etc., and handed with brown bread and butter.

Hors d'oeuvre *varié* is a mixed dish of different kinds of foods; *e.g.*, sardines, anchovies, olives, some form of galantine, slices of tomato, beetroot, etc.

HORSE (*Equus* caballus). The horse is an important and valuable member of the Mammalia. For its zoological history the article EQUIDAE should be consulted; that on HORSE RACING AND BREEDING describes its speed development, this gift being the horse's age-old special attribute *(see* also HORSEMANSHIP AND RIDING). The present study is historical in the broad sense.

Origin and History. — The prehistory of the horse is largely speculative. the few clues being chiefly of a geological. archaeological or zoological nature. The horse preceded man on earth by many ages but little is known of its history previous to about 2000 to 3000 B.C. The zoological reconstruction of the horse from stage to stage has been made possible by the series of fossil skeletons unearthed in the trans-Mississippi region of the U.S., these antedating all others discovered by the second half of the 20th century; but the original habitat of the species remains controversial. One school of speculation contends for Central Xsia, whence migrants to North America crossed (hypothetically) to Alaska and thence made their way south and eastward, where for ages they increased and multiplied, changed vastly in form and then disappeared in some mysterious manner. Their presence there remained unknown until discovery of the remains of the dawn horse arid his successors. Be this as it may, it appears that the modern species descended from an Asiatic rather than an American ancestor! the preferred theory pointing to the north central portion of Asia as the region where its rise took place, followed by its distribution throughout the world.

This great equine migration divided into three main streams. One, moving eastward, resulted in the Chinese and other Mongoloid types. Another, moving westward, crossed into Europe and



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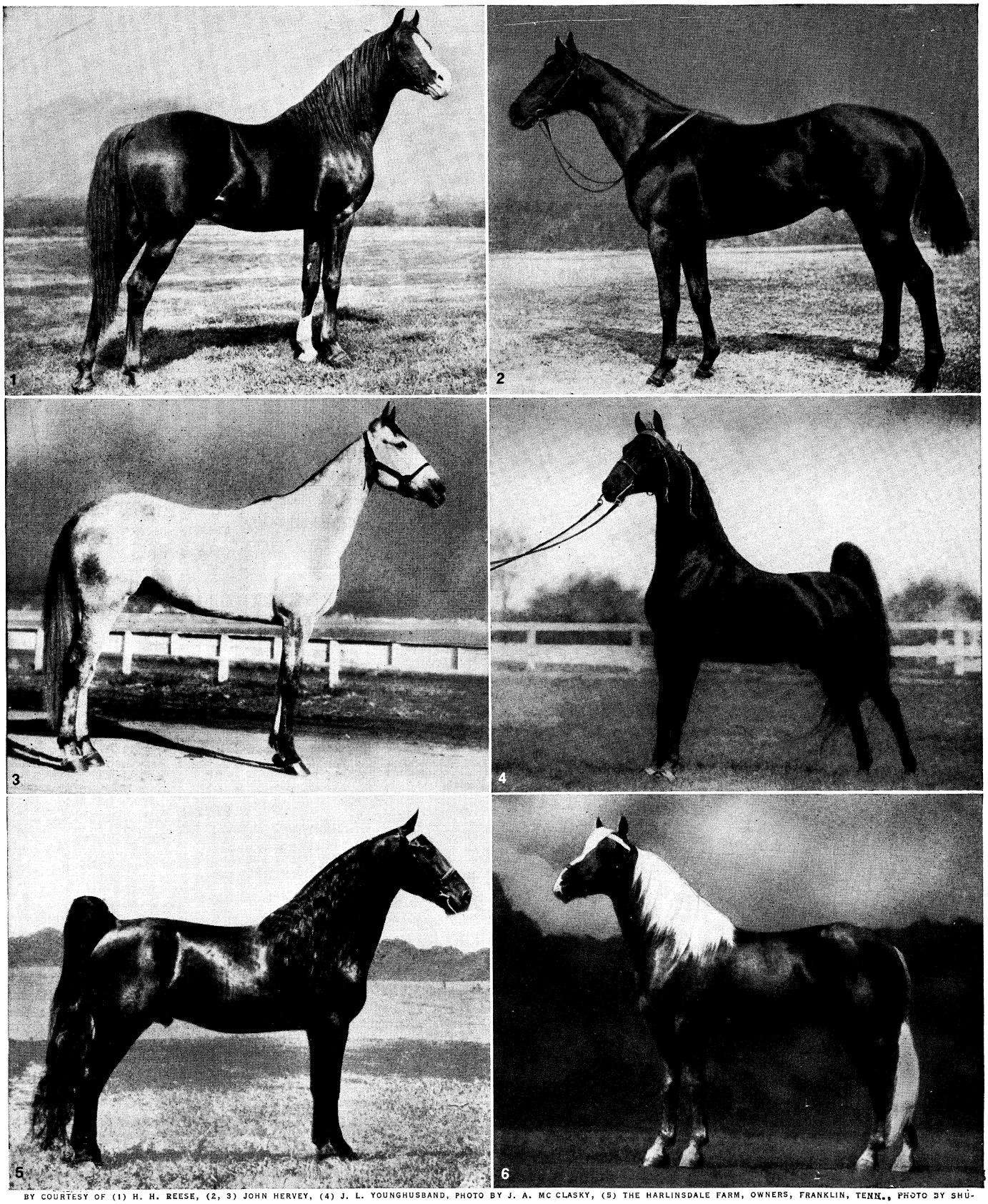
SKELETON OF MESOHIPPUS, A SMALL. THREE-TOED HORSE FROM THE OLIGOCENE PERIOD

there originated the vast hordes of primeval animals that eventually roamed almost the entire continent. The third and all-important one flowed to the southwest and found its way into Xsia Minor and the neighbouring lands of Iran (Persia). India and Arabia. Ultimately it crossed into Egypt, then spread from that country along all of north Africa. At the same time it crossed from Asia Minor into Greece and spread along the northern shores of the Mediterranean. It was from the horses of this final migratory stream that the ancestors of almost all modern improved breeds came. The Chinese and other Mongoloid horses remained too remote to be of any influence outside their own habitats: the same was true of the north European hordes. The destinies of the genus were bound up with that of the Mediterranean civilization, of which the modern horse is the descendant.

John Trotwood Moore. in a tribute to the horse, wrote: "Wherever man has left his footprint in the long ascent from barbarism to civilization we will find the hoofprint of the horse beside it." According to western European mythology and folklore, all the great early civilizations arose among horse-owning, horse-breeding and horse-using nations; those in which the horse was either unknown or in the feral: or untamed, state were backward and no great forward movement of mankind was made without the assistance of the horse. So consistently was this the case that the glorified figure of "the man on horseback" became the symbol of power. The image of the horse was stamped upon man's coinage, sculptured on his temples and even elevated to his pantheon and worshiped as divine.

There were two channels through which the oriental horse. the Arabian and the Barb (Barbary). were distributed in northern Europe. The first led them northward through Greece, Macedonia and the Gothic countries into the land of the Vandals. At the same time they were finding their way eastward to the region of the Huns and Scythians of Asia. The second channel was through the conquest of the Romans across the Alps into the countries now known as France and the Low Countries near the North sea corresponding to the present nations of the Netherlands, Belgium, and parts of Germany. Previously, shaggy descendants of the horse of Central Asia had constituted the equine population of this region. When the barbarians invaded the Roman empire, the vast number of horses which they possessed helped them to overthrow the Romans. The ages that followed witnessed the diffusion of oriental horses throughout. the countries of northern Europe and the breeding of improved types. The most important of these was the "great horse." which originated in the Low Countries; its size and strength were required to carry the heavy load of the medieval knight in heavy armour. These horses. the ancestors of modern draft breeds, were bred from the largest and most powerful of the northern European horses, but there was apparently an admixture of the oriental blood which the Romans

HORSE



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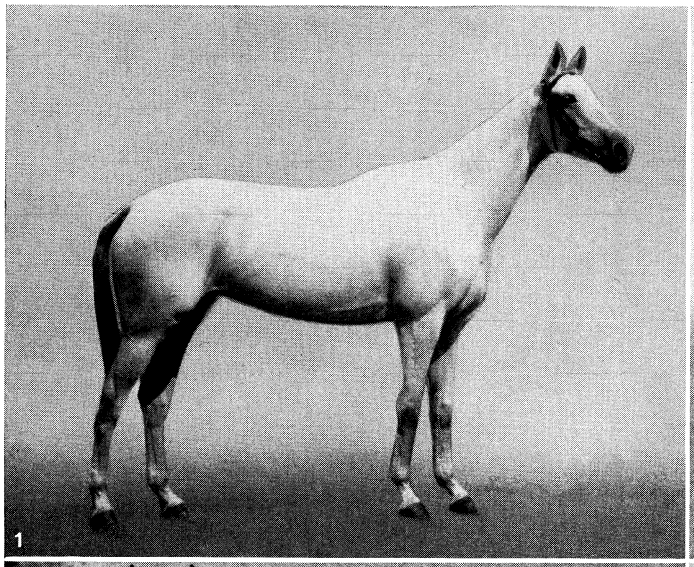
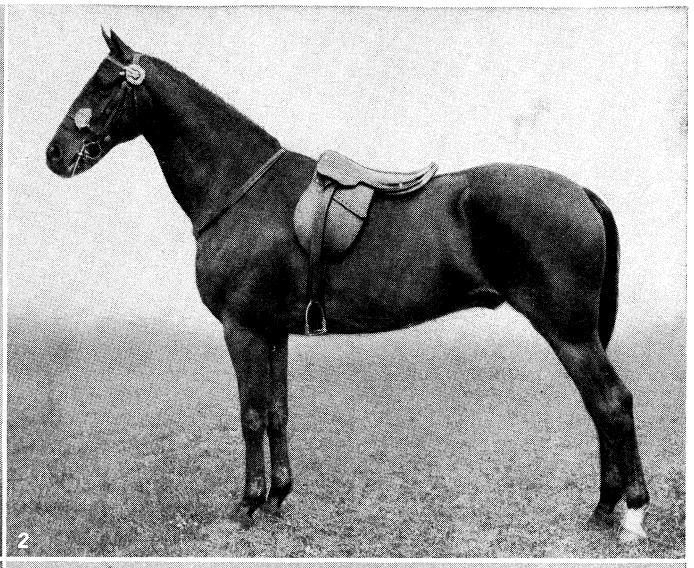
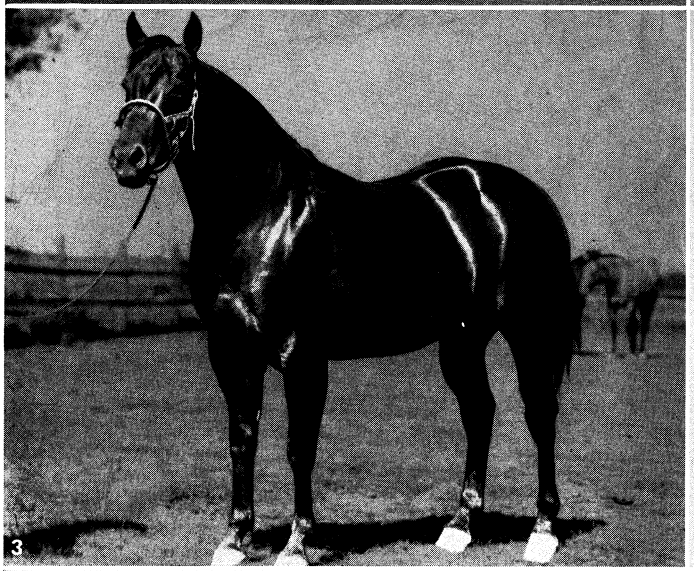
SADDLE AND HARNESS HORSES

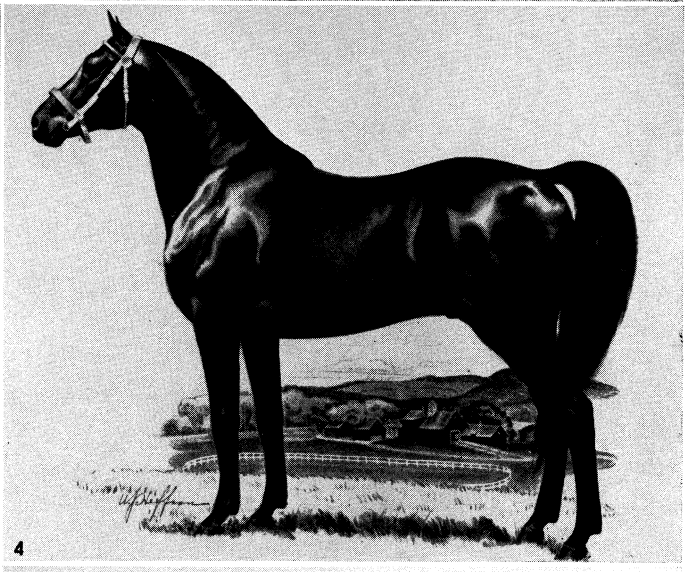
1. Arabian stallion, Abu Farwa
2. Thoroughbred stallion, Equipoise
3. Standard-bred trotting gelding, Greyhound
4. American saddle horse, Genius Bourbon King
5. Tennessee walking horse, Midnight Sun
6. Palomino stallion, Oro Intringo

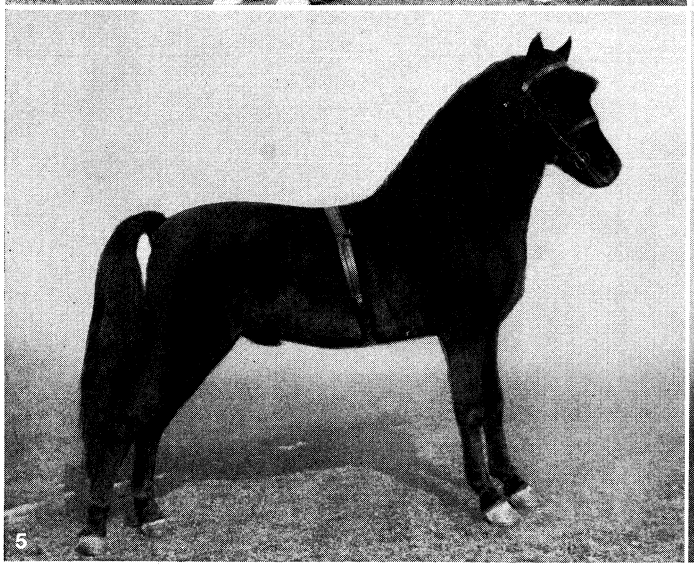
HORSE

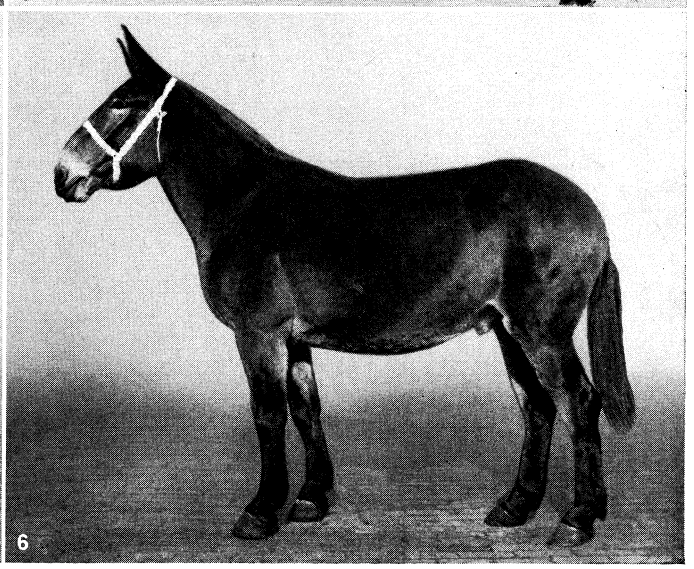












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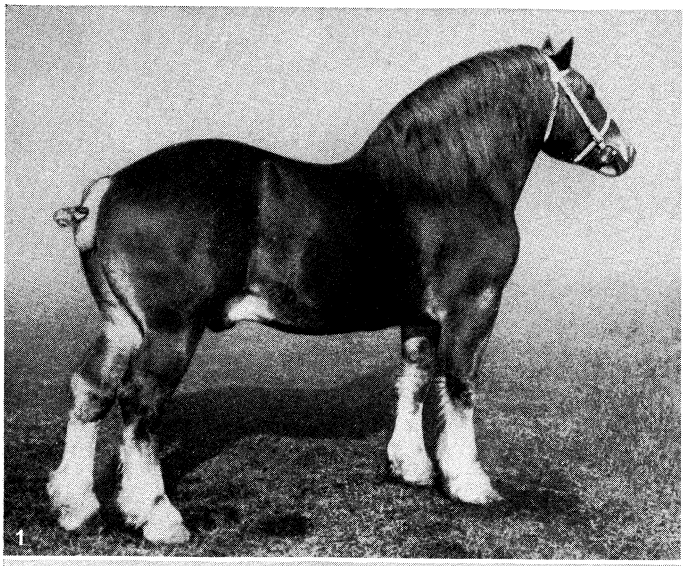
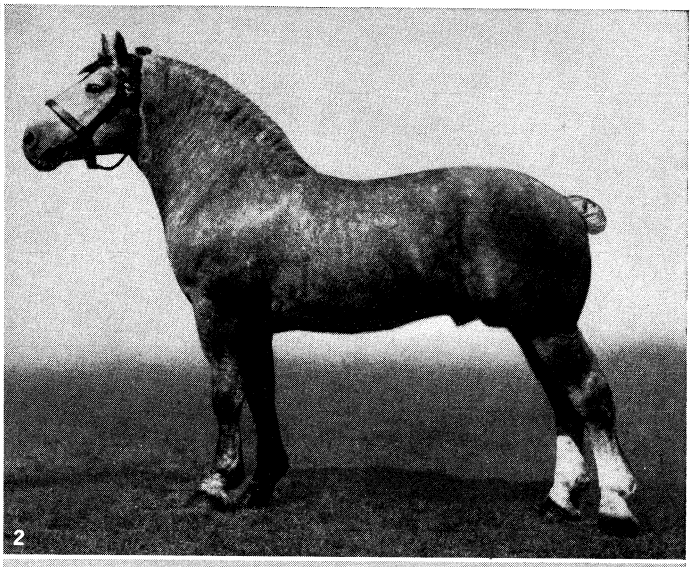
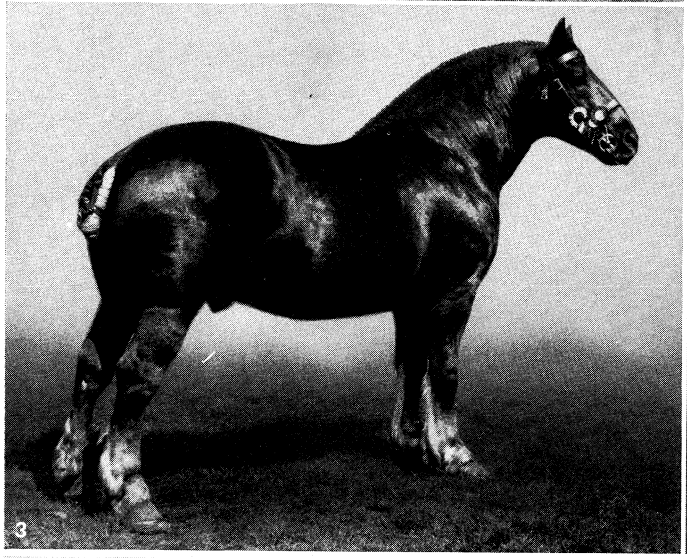
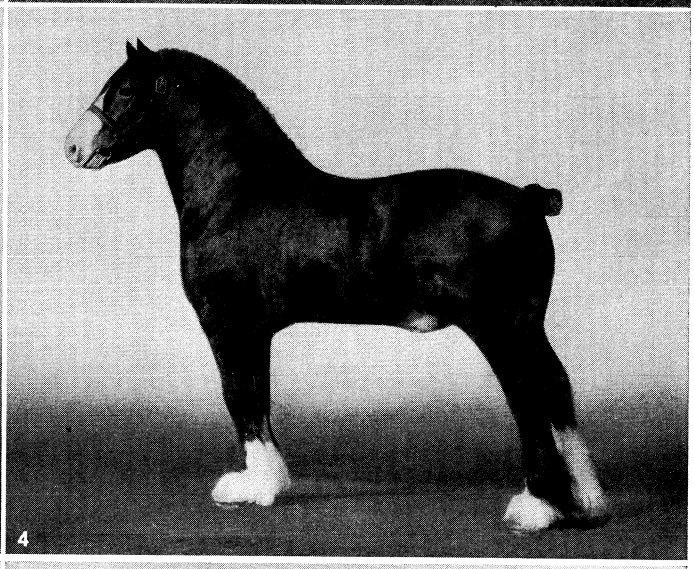
VARIOUS MEMBERS OF THE HORSE FAMILY

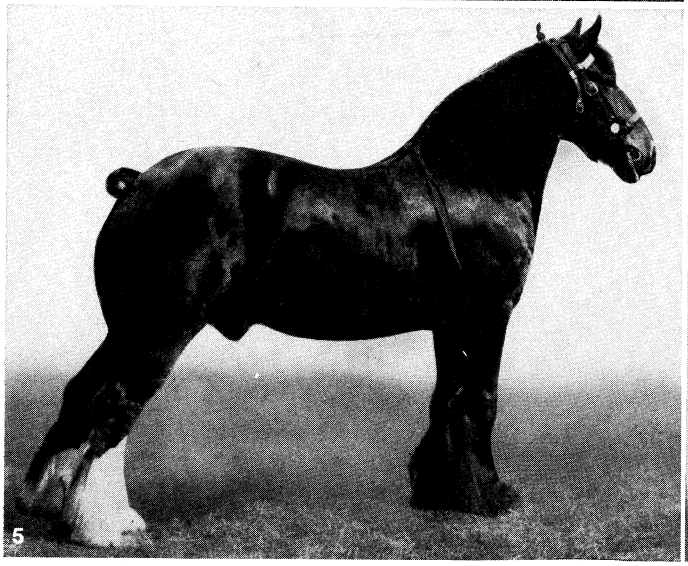
1. Polo pony, White Mark
2. Hunter, Always There
3. Quarter horse stallion, Poco Bueno
4. Morgan stallion, Upwey Ben Don
5. Shetland stallion, King Larigo
6. Large mule used by cotton growers

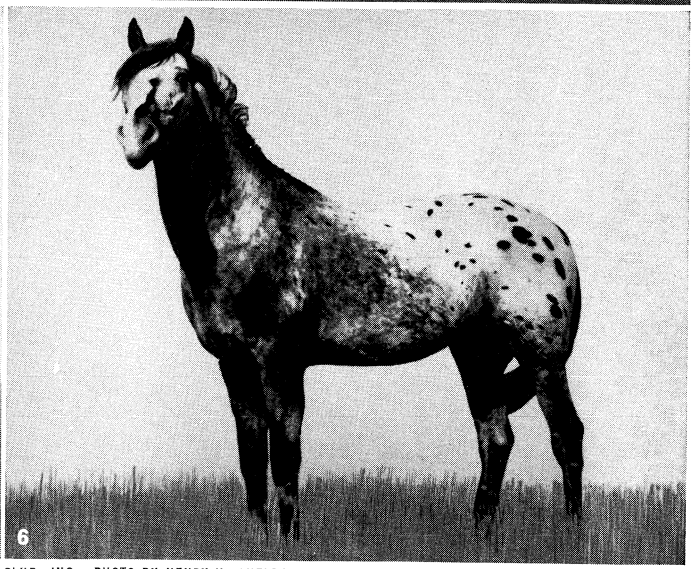












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WORKING HORSES

1. Belgian stallion, Siehl's Kenny Farceur
2. Percheron stallion, Carburateur
3. Suffolk Punch stallion, Hintlesham Agility
4. Clydesdale stallion, Mainring
5. Shire gelding, Albion Duncan
6. Appaloosa stallion. Toby II. The breed was developed by U.S. Indians of the northwest to perform a variety of tasks

had brought in.

The crusades of the 12th and 13th centuries took the kings and nobility of northern Europe into the native land of the oriental horse. The speed and agility of these light horses so impressed the crusaders that large numbers were imported into England and France. The Moors took Arabian and Barb horses into Spain over a long period of time. They were crossed with the native stock and produced the superior horses of Spain that were sought after by other nations. The Spanish horses were taken to the Americas by the Spanish conquerors and settlers. Of oriental antecedents. they were the principal ancestors of the western equine population of both North and South America. They thrived in their new homes and multiplied into the numerous herds of the prairies and pampas.

The new world, unlike the old. was never populated by hordes of wholly wild horses. The wild bands, known as mustangs, cayuses or broncos. that became numerous on the American prairies mere the descendants of the domestic horses imported from Spain. So they were never of the same primitive character as the truly wild horse of Europe and Asia. Not only did the conquistadors take horses from Spain, the English colonists also imported and bred good horses.

The only truly wild horse remaining in the 20th century was the *Equus przewalski*, discovered in western Mongolia in 1879—a small (12 hands or 48 in.), rough, dun-coloured pony that was of wholly feral (wild) ancestry and habits. Specimens were acquired for many zoos. A few of these still exist in a wild state.

The modern horse spread throughout the habitable world because of its capacity to withstand the extremes of climatic conditions and its adaptability to the uses of man. In these respects the horse has no equal.

Classification.—No attempt has ever been made to classify all the breeds and types of horses of the world. There are several ways by which horses can be classified—by size, type, place of origin and use. The most common classification is division into draft horses, light horses and ponies. Light horses may be further divided into riding and driving types. However, there is a great overlapping of use as all light horses can be ridden, driven and used as light work horses. The coach horse is a blend between the two types with emphasis on style and height of action.

Riding horses may be classified by type and training regardless of their breeding. So any of the light breeds may qualify as riding horses. Hunters are trained to jump under field conditions. While usually predominantly of Thoroughbred breeding, they may be American Saddle horses, Standardbreds, part Arabian and even of unknown breeding.

Polo ponies are usually grade Thoroughbreds, that is, have one Thoroughbred parent. It is the nature of training that determines their classification (see also POLO). Stock horses are horses of suitable type and training to be efficient in working livestock under range conditions. Cutting horses are similar to stock horses but are more specifically trained to separate cattle. Roping horses are likewise stock horses but are trained for roping in rodeos, where winning is based upon catching and tying a calf or steer in the shortest possible time. In South America the Criollo (native, Spanish type) and grade Thoroughbreds with a Criollo foundation are used as stock horses. Most countries of the United Kingdom use grade or pure Thoroughbred horses for both polo and stock horses. Canada uses some grade Thoroughbreds, but the Appaloosa and Quarter horse and Arabians have gained recognition as stock horses.

The early horses were probably around 12 hands (48 inches) at the withers, and 14 hands was exceptional. Some modern horses reach 17 hands and occasionally 20 hands (80 inches). The Low Countries specialized in breeding for size, first for armoured knights and later for draft horses. The Belgian is the main survival. Other draft breeds of France and England were likewise bred up from the old "great horse." Large scale use of heavy horses for farm and draft labour was specifically a United States development, although in England the draft breeds were extensively used on the farm and for dray horses in large cities.

The primitive horse was of a prevailing dun-coloured coat. Bay is the standard horse colour among the older registered breeds with brown, black, chestnut, gray and roan completing the list. Extensive efforts have been made to associate coat colour with useful qualities such as speed, gameness and endurance, but the age-old folk proverb that "a good horse is always of a good colour" retains its validity.

All light breeds of horses are related to the Arabian, mostly through the Thoroughbred. The Arabian is regarded as the oldest breed. The Barb horse, of north Africa, is similar to the Arabian in many characteristics and is probably related to the latter. The Barb, along with other oriental horses, contributed to the origin of the Thoroughbred when they were crossed in various ways among themselves and with the light horses that were native to England.

The Thoroughbreds in turn were used to improve the Hackney, Cleveland Bay and Yorkshire Coach horses of England. Arabians contributed to the quality and the beauty of the head of the Welsh pony. All Standardbred horses trace back to a gray Thoroughbred stallion Messenger. imported to the Cnited States in 1788.

The Thoroughbred sire, Denmark, is recorded as the foundation stallion of the American Saddle horse, though most of the horses trace to him through his outstanding son, Gaines' Denmark, the son of a pacing mare. The Xrabian, and the Barb to a lesser extent, contributed more directly to the American breeds. The American Quarter horse and the Tennessee Walking horse have some Thoroughbred breeding.

Horse Terms.—The term horse is used to designate a male, either stallion or gelding, as well as the whole species. A normally sexed male horse is a stallion. and an unsexed male a gelding. A female is a mare and her young is a foal. A male foal is a colt; a female foal is a filly. They are often called colt or filly until mature. A stud is a place where horses are kept for breeding purposes. A stallion kept for breeding purposes is called a stud-horse. A small horse under 14.2 hands is a pony. A mule is a cross between an ass (*q.v.*) and a horse (see MULE).

Character of the Horse.—The intelligence of the horse has been appraised in widely different terms. Ordinarily it is ranked fourth among the "lower animals." following the elephant, the ape and the dog but it is sometimes dropped to tenth or even lower in the scale. Its psychology is difficult to construe with any pretense of exactitude. It is at once timid and courageous, affectionate and unfriendly, docile and ungovernable, hot-headed and phlegmatic, teachable and obtuse. As among human beings, brothers and sisters may be poles apart in temperament, though in certain families and tribes some traits are distinctly hereditary. The horse's sensitiveness is extreme, its memory is long; it has a tendency to form habits difficult to eradicate. Authorities testify that few horses are naturally vicious, and that those which become so have been, with few exceptions, the victims of bad handling, especially as colts. Certain of their instincts are highly developed. such as their ability to find their way home when their masters cannot; to become aware of unknown and unseen dangers; to detect the presence of water in deserts and barren wastes; to discriminate between enemies and friends at long range or close quarters. From time immemorial they have been exploited by man for his own benefit and often with wanton abuse; the Society for the Prevention of Cruelty to Animals was first inspired by their gross ill treatment. Being herbivores, they seldom attack either man or animal. An exception is the stallion protecting mares and foals from the Carnivora. The maternal instinct in the genus is likewise strong, and mares will fight desperately to defend their nursing foals.

Horses are customarily broken, either to saddle or to harness, when two years old—race horses usually as yearlings, the heavy breeds sometimes not until three. When males are gelded it is usually at an early age. Until the five-year-old season, the sexes classify as colts and fillies, subsequently as stallions and mares. Full maturity is attained with the sixth year. It has become the custom to date the ages of all horses from Jan. 1 of the year in which foaling takes place. While cases have been known in which yearling colts have begotten offspring, and yearling fillies been gotten with foal, successful breeders never use animals of either

sex until they are at least two or preferably three. The period of gestation for mares is 11 months. While a single foal is the usual result of a mating, mares frequently produce twins and, rarely, triplets; in such cases only one is likely to survive. When both live they are usually weaklings. Normally mares continue fertile until past the age of 20, but instances of maternity beyond 30 are of record. When used solely for breeding. 20 or more foals each have been produced by many brood mares. It is a popular belief that a horse at 20 years is physiologically equivalent in age to a man at 70, though there are authenticated cases of horses living to the age of 50.

The fertility of stallions corresponds with that of mares, but they may retain their potency a few years longer. Some of the highly refined and closely inbred strains, notably the Arabian and the Thoroughbred, are often scanty foal getters. Breeders of race horses ordinarily restrict a sire to from 25 to 40 mares per season, believing that this improves the quality of the offspring, but a normally vigorous sire in his prime may be allowed from 50 to 60, and part-bred and common stock horses often cover 100 or more. Hambletonian, the patriarch of the breed of standard trotters, was badly overbred; at 15 years he covered 217 mares and got 148 foals. From 13 to 17, inclusive, he covered 823 mares and got 524 foals, an average of 105 per season through five consecutive years. The drain on his vitality, however, was so great that. he had to be retired from service one season and thereafter to be limited to not more than 30 mares. Some famous progenitors have been remarkable controllers of both colour and form; others have had progeny of all hues and shades, without family resemblances.

When allowed to run wild and breed as nature prompts, horses will degenerate in size and type. Extremes of climate have similar effects. To an extent, stunting produced by environment becomes an attribute of heredity, like the size of the larger breeds. However, after the size and type are established, they must be kept in check by selection, especially when the animals are moved to a more favourable environment, including sufficient feed. There is a tendency for Shetlands to grow larger and they possibly would if it were not for rules limiting the size for registration.

Under ordinary conditions the horse remains healthy, hardy and sound until old age. It is susceptible to many diseases. however, especially those of the respiratory, circulatory and digestive systems. Unless starved, it is particular about food and often dainty; it is strongly affected by quality and sudden changes in food or water. The more highly bred, the more easily its physical organization becomes affected, but this is offset by the manner in which a hot-blooded horse will fight for its life and survive? when a cold-blooded horse, that is, one predominantly of draft-horse breeding, will succumb. Rangemen of the far western U.S. and Canada report that, in hard winters during which range horses obtain all their feed from natural sources, losses of the pure and part-bred light strains are much lower than those of heavy (cold) blood.

FEEDING AND CARING FOR HORSES

The natural feed of horses is grass. Idle horses that graze nutritious grasses in large pastures have fewer respiratory and digestive disturbances than more closely confined animals. However. some grain is essential to produce firm muscles and enduring qualities. Grain supplements the grass or hay and provides a more complete diet for working horses.

Hay usually provides sufficient calcium but may lack phosphorus. Calcium and phosphorus are essential for bone growth, protein for muscle growth. By-products of milling such as wheat bran, linseed meal, and soybean meal provide an abundance of phosphorus. Therefore a little of these feeds will offset the lack of phosphorus and protein that may occur in winter range feeds.

Horses are fed for long-time efficiency. For safety some bulk and a variety of feeds and. to insure sufficient consumption. palatable feeds should be provided. Horses do best when fed small amounts frequently according to age, type and amount of work. For efficiency grain is fed punctually three times a day. The bulk of the hay may be fed at night.

Oats, the most satisfactory grain feed, are palatable, bulky and nutritious. Barley. widely used, should be ground or preferably rolled. Corn (maize) is extensively fed but lacks protein and mineral. Grain sorghums may be used, but it is better to feed legume hay, to balance corn and grain sorghums.

Hays may be legume (alfalfa. clover, soybean) or grass. Timothy, the standard grass hay, is palatable and safe but may lack protein and caicium. Legume hay has more protein, vitamin A, and calcium. It usually is included in the ration of young horses. Hay cut early has more protein, minerals and vitamins than late cut hay. Hay and grain should be free from mold and dust. Moldy feeds cause digestive trouble; musty, dusty hay is associated with heaves. Horses will eat too much palatable hay; hence it may be necessary to limit hay for economy and health reasons.

Horses doing heavy work should receive from 1.2 j to 1.4 lb. of concentrates and 1.0 lb. of hay per 100 lb. of weight. As the work lessens, the grain is decreased and the hay increased. Idle horses or horses doing light work may be fed only hay.

Salt needs vary, but if salt is available. horses will adjust their requirements. Horses receiving a variety of good feed will seldom need a complicated and expensive mineral mixture. (See also FEEDS. ANIMAL.)

Grooming helps the appearance of a horse. Use of comb and brush eliminates the dead hair and dust and distributes the natural oil. resulting in a sleek appearance. The mane is brushed and trained to fall to the right side for most show horses. the left for stock horses. Some horses are shown with a roached (cropped) mane. The customs of the breed or show classes vary in this respect.

The most vulnerable portion of the equine anatomy is the underpinning. For more than 6,000 years, until the advent of the railroad. the horse was the sole agency of rapid transit on land, yet its legs and feet remain its weakest parts. A broken leg, unless the fracture is slight and not above the ankle, usually necessitates destruction; if saved, the animal is thereafter a cripple. The use of the horseshoe to protect the hoof from breaking, splitting and shelling away dates back to antiquity. and its importance is attested by its having become a symbol of good luck; the axiom "no foot. no horse" is world-wide. The texture of the hoof is strongly affected by climatic conditions and the nature of the habitat. The Arabian. reared in the desert where the ground is rough and stony and the climate dry. has a remarkably tough and sound hoof. while breeds common to moist latitudes are much more susceptible to foot ailments. Under natural conditions, horses keep their feet worn down, and trimming is unnecessary. Confined horses should have their feet trimmed level so the frog makes contact with the ground and the hoof and pastern are on the same straight axis. When horses are used. shoeing is necessary to protect their feet. Trimming may correct a faulty foot, especially of a young horse. After maturity, shoeing may alter the way of traveling but seldom corrects a natural fault. See also HORSESHOES. (J. A. GN.)

Diseases of **the** Horse.—Skeletal and Muscular Defects.—To allow proper utilization of the horse, it is essential that it remain sound of foot and limb. In part. this is dependent upon inherited characteristics. hence the emphasis placed upon conformation—the proper placement and development of the legs and body anatomical structures. Hard usage, especially when the horse is young. mineral imbalances in the feed, injuries and infection may also be responsible for defects. Some changes in the bones and tendon sheaths may be obvious without exciting lameness; others are definitely associated with lameness; sometimes it is difficult to detect the cause.

Parasites, External.—In certain areas. horses may be bothered by ticks. Depending upon the species of tick, stages in the life cycle may be completed on rodents or other animals with the horse as host for the adult. In others, as the spinose ear tick, only the horse is necessary as a host. Infection is picked up from vegetation carrying the proper stage of tick.

Mange in horses is caused by semimicroscopic mites. Infection may be spread by direct contact with infected animals and indirectly by blankets, harness. etc. Aside from the irritation and local changes in the skin, advanced cases may develop generalized symptoms of weakness. With neglect or where large numbers of

horses are held together this may develop into a serious scourge.

Lice on horses may be sucking or biting lice, the former being more injurious. Favourite locations are the mane and tailhead. Resultant irritation leads to rubbing, loss of hair and inflammation of the skin.

Adult botflies (*Gastrophilus* spp.) are of considerable importance due to the annoyance they cause horses. These flies deposit their eggs primarily on the hairs about the head, forelegs and chest wall, certain species having a predilection for a definite area. After a variable period. depending upon conditions. larvae develop. These are passively taken into the digestive tract by the horse's lips coming in contact with the hairs on which the eggs have been laid. or. with some species. this is an active process on the part oi the larvae. On reaching the stomach the larvae attach to the wall and undergo developmental stages. After some ten months they pass out with the feces. although some species may for a time attach themselves to the wall of the rectum with resultant irritation leading to tail rubbing. After evacuation irom the body the larvae enter a pupal stage in the ground and reappear as adult flies within a few weeks. Considerable numbers of larvae may be maintained on the stomach n-all in apparently normal individuals, but their presence is not harmless.

Parasites, Internal.—Ascarids or roundworms may become a serious problem in young horses; occasionally older horses also are seriously affected. Eggs irom adult worms in the intestine are passed out with the ieces. After a relatively short period of time they develop to the point where they are infectious. Ingestion of contaminated feed or water introduces the parasite; in its further development migration through the lungs occurs before the adult form appears in the intestine. Damage results irom migration in the developmental stage as well as from the adult forms. They are easily recognized by their large size. 6 to 12 in. in length.

Practically all horses harbour numerous small worms that conveniently may be grouped together as strongyles. a suborder of "thread worms," or Nematoda (*q.v.*). Their cycle is similar to that of the ascarids except that from the intestine the ingested larvae enter the circulation. Numbers are deposited in the mesenteric artery in the abdomen and its branches with resultant damage. but many finally reach the intestinal wall which they penetrate to emerge as mature parasites. This migrant journey may produce verminous colic. or. if the arteries of the hind legs are involved. transient weakness or paralysis of these parts. In addition. because of their large numbers and blood-sucking habits a constant drain is placed upon the host. Poor condition. weakness and death may result from heavy infestations.

The oxyurids or pinworms are also common in the colon and rectum of horses. These moderate-sized worms, up to several inches in length. may be seen passed in the feces or attached to the wall of the rectum. They are relatively harmless except for the irritation produced which frequently results in tail rubbing.

Parasites, Blood.—Several blood parasites knon-n as trypanosomes appear in horses. Transfer is primarily by blood-sucking insects: in some this is merely a mechanical transier but in others biological development in the vector occurs. Nagana affects mammals. especially horses, in Africa producing fever. subcutaneous edema, anemia and emaciation. It is spread through the tsetse fly. *Glossina* spp. Surra, another of the trypanosomiases. occurs in southeast Asia and is transmitted by flies. *Mal* de *caderas* is caused by *Trypanosoma equinum* and occurs in South America. Dourine. caused by T. *equiperdum,* is the exception to insect transmission as this disease is transmitted by coitus. Dourine is characterized by local inflammation of the external genital organs, urtical eruptions of the skin and symptoms of paralysis. This disease has. at various times. become widespread. (See also PARASITIC DISEASES; PARASITISM AND PARASITOLOGY.)

Infectious Diseases.—The respiratory group includes strangles, influenza and pleuropneumonia. Strangles is an acute, contagious disease marked by pronounced nasal discharge. irequently followed by swelling of the lymph nodes of the throat and to some extent other parts of the body, and in some instances by pneumonia. *Streptococcus* equi is usually considered to be the cause. The organism is resistant to drying and other agents so that a stable infected with pus containing the organism may remain infective for several months. Apparently healthy horses may harbour the organism. and young animals. by close contact with such individuals, may develop the disease. The active case of strangles especially serves as a source of infection by direct contact and dissemination of the causative organism hy contamination of water pails, etc. Recovery from an attack usually confers a lifetime immunity against strangles. Young animals in the six months to three years age group. being especially susceptible. should be protected against exposure if at all possible. Inclement weather, shipment and improper feeding and watering lower the animal's resistance.

Equine influenza or shipping fever is an extremely contagious disease marked by high fever and depression. Inflammation of the eyes is usually associated with the disease so that sometimes it is reierred to as pink eye. Nasal catarrh and swollen lymph nodes may simulate the appearance of strangles. Edema of the pendant parts of the body may develop. Occasionally panzootics comparable with pandemics of human influenza occur, but usually the infection is not widespread and is apt to be maintained in barns or other centres where there is a continual turnover in the susceptible horse population. Spread is probably air borne in most cases but the viral agent is also present in the saliva. urine. and semen. Transfer by coitus has been reported.

Equine contagious pleuropneumonia is typically an acute. iebrile disease marked by pneumonia and pleurisy. Many cases do not progress to this point but resemble influenza. However. the disease does not appear to be as iniectious as influenza and also has a longer incubation period. It is frequently complicated by *Streptococcus* equi infection. although probably viral in nature. Transmission is by droplet infection. Recovery confers immunity of an unknown duration.

Equine iniectious anemia is an infectious disease of chronic nature. sometimes termed swamp fever because of its association with low-lying lands. Acute attacks characterized by fever. weakness. anemia and edema of the chest and belly are apt to occur during the summer months. Many such cases appear to recover only to relapse again at some later time. The causative agent is a virus which experimentally has been found in the blood ior long periods: it is also present in the body discharges. Spread appears to be chiefly by blood-sucking insects going from an infected to a noninfected animal. The symptoms. while suggestive, cannot always be relied upon ior diagnosis, so that for an absolute diagnosis blood from a suspected case must be injected into a normal animal to reproduce the disease.

Infectious equine encephalomyelitis as the name indicates is an inflammation of the brain and spinal cord. Because of the disturbance in mental equilibrium it is popularly known as sleeping sickness. Early in the course of the disease the horse is inclined to walk aimlessly and to push against obstacles. Depression follows and. with paralysis of muscles. the animal may go down and be unable to rise. Animals that recover may retain permanent damage to the brain and fail to have complete control over muscular co-ordination. The cause is a virus. In the U.S., the eastern type of virus appears east of the Appalachian mountains: west of the chain. the western type appears. In South America, the Venezuelan virus is present. A similar disease. Borna disease. is seen in Germany. The American viruses are known also to affect humans. (See also ENCEPHALITIS.) Originally importance was attached to the horse as a reservoir for human iniection. Work with the eastern and western strains indicates mosquitoes to be the prime vectors. Viremia is present for a short period only in the horse. and it is only during this time that the horse is capable of iniecting mosquitoes. However, a number of birds, both wild and domestic, have been found to be inapparent carriers of the disease. Ordinarily the disease, transmitted by mosquitoes, smoulders in these reservoirs and flares up in extensive epizootics in the horse only when conditions are suitable. See also VETERINARY SCIENCE.

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(J. F. RF.)

By-Products of the Horse.—The use of horseflesh for human food (hippophagy) was common among early mankind and still prevails in various countries, especially in time of scarcity or famine. From horsehide, tanned and untanned, a wide diversity of articles are fabricated. In cruder civilizations these include tents, coverings for all sorts of receptacles, articles of clothing. harnesses, etc. In the middle ages shields and bucklers, the leather coats worn under chain armour, and other portions of the knight's equipment were fashioned from it. Among numerous fine leathers derived from it was the elegant cordovan. In Greece and Rome the mane was used to ornament the helmets of warriors. In medieval and modern times the tail served as a battle standard among the Turks. Horsehair has been woven into fabrics for innumerable uses, among them the shirts worn by religious penitents. The strings of fine violin bows are made of white horsehair of the highest grade. Glue is made from the tissues, bones and blood of the horse, and serum is obtained as a by-product. Gelatins used in photography and in foods are other derivatives. Mares' milk is drunk by various primitive peoples and serves as the basis of koumiss, a fermented beverage of Mongolia and sometimes prescribed by physicians.

BREEDS OF HORSES

The following breeds are grouped by types.

Light Breeds.—Arabian.—The Arabian is a beautiful horse easily distinguished by his type and style. The head is broad and tapers to a fine muzzle capable of great dilation. The jaws are wide, eyes prominent and expressive. The neck is of moderate length and gracefully arched. The tail is light and gaily carried. The Arabian is small, seldom exceeding 1 j hands and 1,050 lb. in weight. The colours are chestnut, gray and bay, a few being brown but rarely black. They are never spotted or pure white. The gray fades to white in old age, but the skin remains dark throughout life. Their best gait is the gallop, which has been perfected by long use at the gallop in their native land. The Arabians are recorded in the stud books of different nations. Horses imported from Arabia are usually accepted for registration and are designated by the suffix D.B., an abbreviation for desert bred.

Thoroughbred.—The Thoroughbred, oldest of the improved breeds, is the running race horse of England. The term is often applied to any purebred horse. Such usage is incorrect. The other breeds may be called purebred or registered, but not Thoroughbred. The Thoroughbred represents the speed types. They are tall. narrow and light of leg and are characterized by refinement, long muscle, long. slender necks, short backs, prominent withers and long legs. The height averages 16 hands but varies from 1 j to 17 hands. In breeding condition the animals vary from 1,000 to over 1,400 lb. The prevailing colour is bay with a few chestnuts, browns, blacks and grays. The Thoroughbred has a long. low, straight stride. The trot lacks the height and flexibility of the other light breeds. Their most perfect gait is the gallop. As the Thoroughbred was used in establishing other breeds, so they are still used in improving grade horses throughout the world. Their breeding usually prevails in cavalry horses. The Thoroughbred is an international horse, found wherever racing is a sport. For a more detailed history of the Thoroughbred. see HORSE RACING AND BREEDING.

Standardbred.—The Standardbred is a harness race horse that originated in the eastern part of the United States. The Thoroughbred was fused with other breeds and types to produce a light breed with remarkable speed at the trot or pace. They are called Standardbreds because. when the breed was developing, they were required to trot or pace a mile in a standard of time. The Standardbred resembles the Thoroughbred in that it is light and narrow. However, they are usually longer in body, flatter of rib, lower to the ground and heavier of bone. Their weight and height varies a great deal. but they usually weigh 1,000 to 1,200 lb. and vary from 15 to 16½ hands. Bay is the dominant colour with brown. chestnut, black and gray. In earlier races, heat racing prevailed. a heat being a dash or part of a race. It took three and sometimes five heats to determine the winner. The type of racing and training developed stamina and enduring qualities. So they are a useful all-purpose horse.

American *Saddle* Horse.—This is a breed of riding horse possessing several easy riding gaits, great vigour and style. They are the prevailing riding horse of horse sho s in the United States. The Thoroughbred, Morgan, Standardbred, Arabian, pacers and easy riding horses of a mixed background contributed various qualities to this American breed. Selection for an easy riding gait. style and beauty, accompanied by line breeding (see ANIMAL BREEDING). helped shape them into a breed. This breed has a short, strong back and the barrel is more rounding than in most light breeds. The neck is long, slender and well arched; it blends smoothly into a well-shaped shoulder. The croup is long and almost level. They have most of the solid colours with limited white markings. They are shown under flat saddles as either three- or five-gaited horses. The three gaits are the walk, trot and canter. The five-gaited horse has these same three gaits plus the rack and one slow gait. The slow gait is usually the stepping pace but may be the running walk or foxtrot. The gaits are characterized by extreme animation and collection. Three-gaited horses are shown with a roached (clipped, standing) mane and a clipped tail. Five-gaited horses are shown with a full mane and tail. They may be used as pleasure horses. driving horses and quite often as hunters and jumpers.

Morgan.—Once the most famous and widely disseminated breed in the United States, the Morgan receded into the background and for a while their breeding was supervised by the government. The breed was founded by a horse known as Justin Morgan, after his owner. He was born about 1789 and died in 1821. He was one of those equine progenitors of such rare prepotency that his individual stamp still persists. He stood about 14 hands high and was a compact, active, virile and stylish little horse whose pedigree was probably a blend of Thoroughbred and Arabian with some other elements. The modern Morgan averages about 15 hands in height and from 1,000 to 1,200 lb. in weight. They are a stylish attractive horse with smooth lines, small ears, expressive eyes and a nicely crested neck. ,They are an all-purpose horse though they lean toward the riding-horse type more than formerly. The number of registered horses is increasing.

Tennessee Walking Horse.—This breed derives its name from the state of Tennessee and from its distinctive gait—the running walk. It is an older type, organized and recognized as a breed in 1935. In a broad sense: it originated from all the ancestors that could do a running walk. Allan F-I (b. 1886). a Standardbred stallion with several crosses of Morgan breeding. had the greatest influence on the breed. The Walking horse is heavier and stouter, and lacks the refinement and style of the American saddle horse. The head is usually carried low. Some are more sloping in the croup and more curved in the hocks than other riding horses. They average 15.2 hands in height and weigh from 1,000 to 1,400 lb. Some ponies derived from crossing with other breeds also will perform a running-walk gait. The Walking horse has a quiet. even temperament. and perhaps because of this they are a long-lived breed. In colour they are flashy. The colours are black. chestnut, bay, brown, roan, gray, yellow and pure white. They are satisfactory as a general-purpose horse. The running walk is a natural gait that may be improved but not acquired by a horse without the natural ability. The gait is faster than a flat-footed walk. with a speed of six to eight miles an hour. The front foot strikes the ground an instant before the diagonal hind foot. The horse has a low, gliding, reaching action, the hind foot overstepping the print of the fore foot by several inches. The foot movement is accompanied by a nodding head. The gait is pleasant to ride and easy on both the horse and the rider. The horse should also do a good walk and a slow, easy canter.

American Quarter *Horse*.—Although the breed association was organized in 1940. the breed itself represents an old type. The name was derived from its speed in quarter-mile races. The British North American colonies had short-distance running horses called quarter horses. The most prominent sire was Janus. an English stallion imported in 1756. With the advent of longer-distance racing. the type retreated into the background and finally found a home in the southwestern U.S. There it was kept alive by frontiersmen and cowboys in a desultory way until it became the sub-

ject of organized promotion and publicity. It is commonly used by cowboys for cutting cattle from herds. Its ancestral elements are chiefly Thoroughbred with an admixture oi the Spanish horse and other breeds of the range states. In type, the Quarter horse is a thick, short-muscled horse, varying in height from 14.1 to 1j.2 hands and in weight irom goo to 1.250 lb. In addition to the usual colours. buckskin, Palomino and grullo (smoky) colours exist. reflecting the Spanish ancestry. Holders of most short-distance records are Thoroughbreds or Quarter horses with considerable Thoroughbred breeding. However, the fastest horses are not always the best for use under range conditions.

Colour Breeds.--Following the organization of the Palomino Horse association in 1935, other groups began registering horses by colour, additional associations being formed to record the following breeds: Albino. Pinto and Appaloosa.

Palomino.—The Palomino is some shade of yellow or gold with a white or silver mane and tail. The colour does not breed true. Horses of proper colour, saddle-horse type and from at least one registered parent of several light breeds can be registered. Two associations register Palominos; their requirements are slightly different. This colour is popular for pleasure and parade classes. Their type and use depends upon their breeding and training. They may conform to the breed types of several light breeds.

Albino.—Foals are born pure white with a pink skin and remain white throughout life. They conform to riding-horse type.

Pinto.—This is Spanish for painted. Horses are registered on the basis of their colour pattern and light-horse conformation.

Appaloosa.—The most popular of the colour breeds, with several colour patterns. The name derives from the Palouse river of Idaho and Washington state. Some have a solid colour except for a white patch over the hips, interspersed with small. round spots of the same colour as the body. Others may have a basic solid colour with white dots over the entire body. or may be white with coloured dots. They sprang from Spanish stock. The Nez Percé Indians of Idaho selected them for colour and using ability. After the breed association was formed. the quality was improved by crossing with other breeds. especially the Arabian. They are of stock-horse conformation and useiul for many purposes. The breeders take great pride in the useful and enduring qualities of these horses.

Ponies.—Shetland.—The smallest, most numerous: and most popular of the pony breeds, Shetlands originated in the Shetland islands. 100 miles north of Scotland. where the feed is scanty and the climate severe. They are adapted to this environment. In the Shetland islands, they average about 10 hands and resemble miniature draft horses; in America lighter, more refined types are desired. They are of many colours, solid colours being preferred for show ponies, but spotted ponies being often preierred by children. Shetlands are lively, courageous, hardy and long-lived. They can be quite stubborn. but this may be avoided by proper training.

Welsh.—The Welsh descended from the native ponies of \Vales. being improved by a dash of Arabian and Thoroughbred breeding. About 12 hands tall, they may be used by man or child. They possess considerable spirit and ability for their size. Gray and dark colours are preferred in \Vales: cream and buckskin colours are popular in the United States.

Others.—Other ponies of England are the New Forest. Dartmoor and Exmoor. These breeds were improved by use of a few Arabian and Thoroughbred sires. They lack the quality of the Welsh but are larger and taller. The United States has no true breed of ponies. but small nondescript range horses are of pony size.

Coach Breeds.—These three breeds originated in England.

The Cleveland Bay is a breed which is always bay in colour. Only minute white markings are permitted for registration.

The Yorkshire Coach is related to the Cleveland Bay with more Thoroughbred breeding which is reflected in more quality and style. They are usually bay or brown in colour. Both the Cleveland Bay and Yorkshire Coach stand over 16 hands tall. They are of limited importance outside of their native regions.

The Hackney is the most popular coach horse because of its style and high action. Their height is from $14\frac{1}{2}$ to $15\frac{1}{2}$ hands tall. Their appearance is one of compactness and strength. The back is strong. the croup level with a high carriage oi tail. The colours are usually dark. but roan may be found. They are shown in most of the larger shows of the United States.

Lipizzan Horse (Lipizzaner).—This breed derived its name from the Austrian imperial stud at Lipizza. near Trieste. formerly a part of the Xustro-Hungarian empire. The foundation dates to 1580; detailed breeding records are available since 1700. The ancestry was Spanish. Arabian and Berber. The six strains {Pluto. Conversano. Neapolitano. Favory. Maestoso and Siglavy) are named irom their foundation sires. They are of comparatively small stature with a long back, a short, thick neck and ,powerful conformation. The head with a Roman nose, in contrast to the concave profile of the Arabian, and an attractive. expressive eye lacks the refinement of most light breeds. The colour is largely gray. hay and brown being but rarely found. The powerful. flexible and high action qualifies them for the intricate and difficult movements of haute *école* (high school) horses. the purpose for which they have been bred. They are found to a limited extent in countries that were originally a part of the Austro-Hungarian empire. A few have been exported to the United States.

Heavy **Breeds.**—*Belgian.*—As the name suggests, this type was produced in Belgium and is the modern direct descendant of the "great horse" of the middle ages developed in the Low Countries. Average height is 16 to 17 hands; weight 1.800 to 2.200 lb. Several colours exist, but in the U.S. light chestnuts or sorrels (with flaxen manes and tails) and roans are preferred to other colours. It is a breed of remarkable uniformity of build. style and other traits. Extremely docile. patient and willing. the Belgian excels in straight draft and farm work.

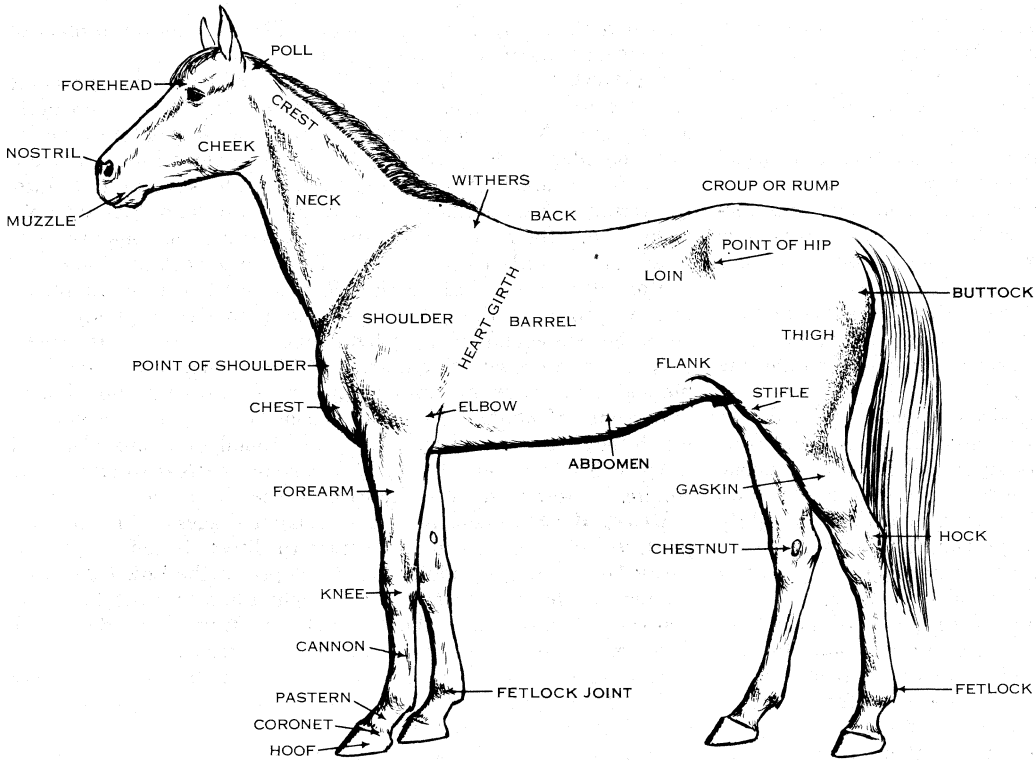
Clydesdale.—A breed native to Lanarkshire, Scotland, a county watered by the river Clyde. The iounder was a Dutch stallion brought in from England about 171j. It is slightly smaller than the Belgian or Percheron, though there are occasional immense specimens. Average size is 16 to $16\frac{1}{2}$ hands; weight 1.700 lb. The usual colour is very dark brown or bay, frequently black. which was that of the founder. There are prominent white markings. The Clydesdale is noted for its long and heavy fetlocks and its high action. both walking and trotting. It is esteemed for farm work.

Percheron.—Most famous of all modern draft breeds, also is known as Percheron-Norman or Norman Percheron. from having originated in the district of La Perche, Normandy. In blood it is a composité of the medieval "great horse." the latter French diligence or coach horse, and other strains with a leaven of oriental ancestry which is indicated by the head. often of small size, and Arabian contours. Average size is 16 to 17 hands; weight 1,900 to 2,100 lb. Despite its bulk. it is very active and nimble. The Percheron excels for draft and agricultural purposes.

Shire.--This breed is native to the middle section of England. It is equal to the Belgian in weight but taller. In colour they resemble the Clydesdale but are less extensively marked with white. They are characterized by a greater abundance of hair, called feather. around the pastern than the Clydesdale. They are heavier. coarser, steeper of pastern and lack the quality of the Clydesdale. They are farm and dray horses in England. This breed is not as popular in the United States as those breeds with less feather.

Suffolk or Suffolk Punch.--The typically English heavy breed, originating in Suffolk and existing as far back as 1586. Another descendant of the medieval "great horse." its vast bulk combined with singularly compact form led to the surname. Average height is 16 to $16\frac{1}{2}$ hands, but there is a range of from $15\frac{1}{2}$ upward; weight from 1.600 to 2,000 Ib. Colour is uniformly a dusty chestnut with flaxen mane and tail; few white markings. Like the Percheron. it often has a small, handsome head. testifying to oriental ancestry. It is a farm and not a dray type. The Suffolk, Clydesdale and Shire are used almost exclusively in Great Britain in preference to the Percheron and Belgian.

Wild Horses.—The European tarpan was the true wild species of horses found over much of Europe. In the middle ages they existed in the wilder and more inaccessible regions of Europe. A few survived until after 1900; they became extinct but a similar type has been produced by selective breeding. The "wild" horses of North and South America are feral horses or descendants of



PARTS OF THE HORSE

domestic horses that reverted to the wild state.

The only true wild horse is the *Equus przewalskii,* found in central Asia (see *Origin and History,* above). They are yellowish or light red in colour with a whitish muzzle. They usually have a dorsal stripe. The short, erect mane is without a foretop. The mane and tail are dark or black in colour. They are from 12 to 14 hands tall and resemble a large-headed, coarse, domestic pony. The low withers blend into a narrow back almost level with the withers. The croup is short and steep.

Breed Associations.— Breed associations register horses that meet all the qualifications for registration and promote the re.. spective breeds. A new association may admit horses that meet certain qualifications without the parents being registered. These qualifications may be type, colour, or speed. Standardbred horses, for example. were admitted to the registry if they could trot a mile in 2:30 or pace a mile in 2:25. The new associations may be known as open associations. The older associations require that each horse have a registered sire and dam to qualify for registration. These are known as closed associations.

Perhaps the oldest association for registering horses is the *General Stud Book* of England. An *Introduction to a General Stud Book* was published in 1791, and volume i in 1793. The publishers used various records that had been accumulated in connection with horse racing in England in establishing the registry. The *General Stud Book* is recognized as the official registry for the English Thoroughbred. Other leading nations have their own stud books for registering Thoroughbred horses. Registration certificates of Thoroughbred horses in one nation are usually recognized by all the other Thoroughbred registering organizations.

Other associations have been organized as new breeds developed. The names and addresses of some important ones are:

General Stud Book (Thoroughbred), London; Shire Horse Society, Middlcsex; Clydesdale Horse Society of Great Britain and Ireland, Glasgow.
Australian Jockey Club, Sydney, Australia.
Société Hippique Percheronne, Nogent-le-Rotron, France. Chevaux de Pur Sang, Paris.
L'Association des Eleveurs Italiens, Rome.
Gesellschaft für Ziichtungskunde, Bonn, Germany.
Sociednd Rural Argentina, Buenos Aires.
Canadian Thoroughbred Horse Society, Canadian Pony Society, Toronto, Ont., Clydesdale Horse Association of Canada, Winnipeg.
The Jockey Club (Thoroughbreds), New York; American Quarter Horse Association, Amarillo, Texas; The United States Trotting Association, Columbus, Ohio; American Shetland Pony Club, Laiayette, Indiana; Arabian Horse Club Registry of America, Chicago, Illinois; Palomino Horse Breeders of America, Mineral Wells, Texas; Appaloosa Horse Club, Moscow, Idaho.

HORSE POPULATION

The number of horses of the world has been decreasing as a result of the competition of mechanized equipment. In much of Europe and Asia, the horse has given way to food-producing animals. In the eastern half of the world, it is difficult to obtain accurate estimates of the horse population, but it is believed that the numbers remain about the same. The United States showed a pronounced decline from over 25,000,000 horses and mules in 1920 to fewer than 4,000,000 by 1950. Other American countries have shown less decline.

Some of the leading horse-producing countries are Bulgaria with about 500.000; France, 2,000,000; Japan, 1,000,000; and Argentina and Brazil 7,000,000 each.

New Zealand reached a peak of 400,000 horses in 1911 and declined to fewer than 150,000 in the 1950s. Great Britain had about 200,000 horses and ponies, with the numbers still falling and horse numbers in Australia and Canada have likewise declined.

Horse numbers appear to be increasing in Turkey, Yugoslavia and Brazil. The U.S.S.R., with an estimated 13,000,000 horses, and Poland, with 2,500,000, have had a great interest in horse breeding and since 1917, the Soviet Union has developed a few new breeds.

Draft horses have declined more than light horses which are used for pleasure and sports.

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(J. L. HE.; J. A. GN.)

HORSE CHESTNUT. The name of a tree, *Aesculus hippocastanum* (family Sapindaceae or listed by some authors as Hippocastanaceae), thought to be indigenous in Greece, but now scattered throughout the temperate regions of the world. There are 20 or more named species and varieties of the genus *Aesculus. A. hippocastanum* in particular is called the common horse chestnut, but all are popularly known as buckeye or horse chestnut. Several species are shrubby, as A. *parviflora, A. discolor, A. neglecta* and *A, splendens,* but the majority are rapid-growing, pyramidal trees attaining a height of 60 ft. or more, They thrive well in moist sandy loam. The buds, conspicuous for their size, are, in some species, protected by a coat of viscous substance impervious to water. The buckeyes are deciduous with large palmately compound leaves, and white, red or yellow flowers in terminal panicles. They blossom in May or June and the fruit, superficially resembling the sweet chestnut, ripens about the middle of October. There is some disagreement as to uses to which the

JOHN H GERARD

HORSE CHESTNUTS (AESCULUS HIPPOCASTANUM)

fruit can be put, some authorities even maintaining that it is poisonous. *A* glabra, the American buckeye, in particular, is thought to have poisonous seeds and leaves. Most of the species have bitter flavoured seeds and bark, the bark being used for tanning. *A. californica, A. turbinata, A. octandra* are known to hear edible seeds which are used as sweet chestnuts. The wood of the horse chestnut is not particularly useful, but as ornamentals both trees an3 shrubs are very valuable. (P. W. Z.; E. S. HR)

HORSEFLY, the common name of the members of the family Tabanidae of the order Diptera (*q.v.*), but more specifically any member of the genus *Tabanus.* They suck blood and their bite is most painful. Other common names are gadfly, cleg and breezes. (C. H. CN.)

HORSE GENTIAN or FEVERWORT, common names for species of Triosteum, a small genus of weedy perennial herbs of the honeysuckle family, with three species common in the woods of North America and others in southeastern Asia. They are coarse, upright plants, growing to about four feet, having pointed leaves tapering to the base at the stem.

Inconspicuous flowers, borne in the axils of the leaves, are followed by orange-red fruits. They are of some use in wildflower gardens.

HORSE GUARDS, ROYAL: *see* GUARDS AND HOUSEHOLD TROOPS.

HORSEHAIR: see **HAIR.**

HORSE LATITUDES, the regions of light variable winds or calms, and nearly cloudless weather, under the central areas of the oceanic permanent or semipermanent subtropical anticyclones (see ANTICYCLONE). Their average latitude is about 30° N. and 30° S., but they move some degrees north and south with the sun. The origin of the name is obscure; some British meteorologists accept the tradition that it arose from the practice of throwing overboard horses which were being transported to America or the West Indies on sailing ships becalmed in these latitudes. (See WINDS, GENERAL CIRCULATION OF.) (R. G. SE.)

HORSE-MACKEREL or **SCAD,** a genus of fishes (*Trachurus*) found almost everywhere in the temperate and tropical zones of both hemispheres. Some go kinds of this fish and its close allies, the crevallys (*Caranx,* etc.), are known, mostly active, free-swimming fishes of warm seas, the majority being wholesome food; some species have a length of over 3 ft. Together with the American horsehead or ocean old-wife (*Argyreiosus* vomer), the pilot-fish (*q.v.*), and the true mackerel (*q.v.*) and its allies, they belong to the division Scombriformes.

HORSEMANSHIP AND RIDING, the art of managing the horse from his back; controlling his paces and the direction and speed of his movements. In the 16th century Pignatelli at Naples founded his famous academy of horsemanship, and the Italian school was so generally recognized that Henry VIII and other monarchs had Italian masters of the horse. The continental haute e'cole developed from the teachings of these early masters. The duke of Newcastle's Me'thode *nouvelle* de dresser les chevaux (1648) was the standard work of the day, and in 1761 the earl of Pembroke published his *Manual* of Cavalry Horsemanship. The Austrians at the imperial stables at Vienna and later the French at Saumur continued the haute e'cole system up to recent years. It, however, did not find favour in England for some time. In a modified degree it is seen today at shows and at the Olympic games as an example of extreme obedience and control of the horse. Haute *école* produced handiness and dexterity; the somewhat lofty head carriage while executing the haute e'cole manoeuvres should never be cramped; must flex and be free to extend at the wish of the rider without losing perfect balance—which always means control.

Haute *école* is simply a school for the proper understanding of the uses of the aids so that horse and rider better understand each other. When properly applied it puts the horse in such a position that he has little choice but to obey the rider's commands. The necessity of handiness, but not at the expense of speed, was recognized by horsemen in Great Britain. Consequently certain "aids" were adopted from the haute *école* to obtain this desideratum. These "aids" exist in the British Manual of *Cavalry* Training, vol. I. "A horse is said to be balanced when his own weight (and that of his rider) is distributed over each leg in such proportion as to allow him to use his powers with the maximum ease and efficiency at all paces." The head and neck form the governing factors in weight distribution, and it is by their position that the horse carries his weight forward or backward as his paces are extended or collected. Modern horsemanship includes: (a) learning to ride, (b) making an animal handy as a hack or charger or for polo, (c) schooling over fences, (d) show jumping, (e) riding to hounds, (f) racing over fences or on the flat.

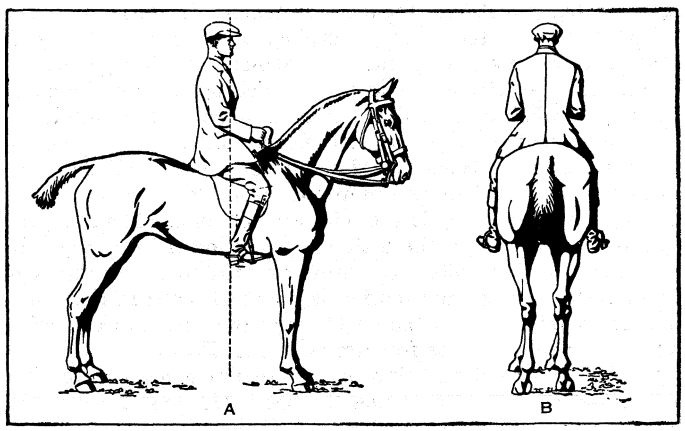


FIG. 1.—(A) SIDE VIEW OF RIDER IN CORRECT POSITION. (B) REAR VIEW OF RIDER IN CORRECT POSITION

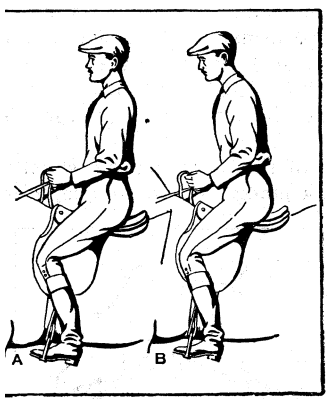


FIG. 2.—(A) CORRECT LEG POSITION, (B) CORRECT LEG POSITION IN ACTION

Riding for Beginners.—From Norman times through the Tudor, Stuart and Georgian reigns up to the early part of last century, riding was considered an essential part of a gentleman's education. The introducti'on of railways and later of motor cars has resulted in the retention of the riding horse merely for pleasure and sport. In spite of this there has been a large increase during recent years in the number of riders. All riding classes in horse shows are largely filled, including those for children, and in the hunting field the numbers have in no way diminished.

When mounting, the rider should take up the reins in his left

hand, at the same time holding a lock of the mane or the horse's neck above the withers with the same hand. Standing by the horse's near (left) shoulder facing the tail, he should hold the stirrup with the right hand for the reception of the left foot. Then place the right hand on the back arch of the saddle, spring off the right toe and drop lightly into the saddle. The rider's seat depends upon balance and contact. It is essential for the beginner to get a good natural seat, comfortable and strong without being stiff. After gaining confidence, first at the walk, then at the trot and canter without depending on the stirrups, the rider should dispense with the latter for short periods and develop both his balance and seat. First of all, sit square to the front with the muscles relaxed, with the flat of the thigh and the knee kept in contact with the horse or saddle flaps, the lower part of the leg parallel to the girth and the toes up. If the stirrups are now adjusted to support the foot in this position they will be at the required length. The body must be supple from the hips, swinging easily backwards and forwards as required or leaning over in the direction that the horse is turning. Ride as far as possible with a long rein; a strong and well balanced seat independent of the reins is essential for good hands. The upper arm should be normally parallel to the body. The reins when held in both hands should be round the third or little finger. In the case of double reins the bit (curb) reins should be outside round the little finger, unless it is intended to ride more on the bridoon, in which case the position is reversed. If the reins are held in one hand they are divided on one side by the little finger and on the other side by the forefinger. By pulling the arms towards the body the reins are shortened. A springy tension is obtained between the rider's hand and the bit, by (1) the fingers; (2) the flexion of the wrist; (3) the movement of the forearm from the elbow.

The beginner will find difficulty in retaining his stirrups, but must avoid the habit of raising the heels He must learn to use the stirrup only as a rest for the foot. If the stirrup is the proper length the heel will be lower than the toe because the stirrup holds the toe up, if the rider does not contract the muscles in the leg by pressing on the stirrup, which should be at a natural angle as when walking. Pressure should be firmer on the inside of the stirrup next to the horse so that the soles of the feet are turned slightly outward. In this position, a light pressure on the stirrup strengthens the contact and the rider will not lose his stirrups.

At the trot. rise with the action of the horse, leaning slightly forward; at the canter, sit upright. keeping the loins supple, with

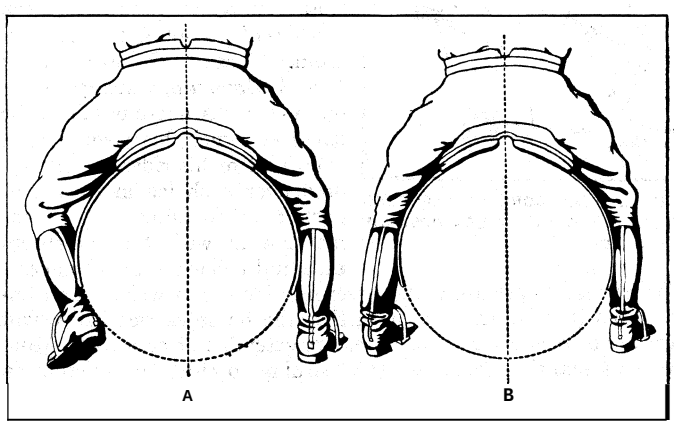


FIG. 3.— USE OF LEGS. A.—GRIPPING WHILE RIDING LEFT LEG. INCORRECT: RIGHT LEG. CORRECT. B.—AT REST: LEFT LEG, INCORRECT: RIGHT LEG. CORRECT

sufficient contact with the knee and thigh, and the leg below the knee vertical; at the gallop, shorten the reins, sit down in the saddle, lean slightly forward and increase the contact with the knees. At all times keep as light a contact with the horse's mouth as is compatible with adequate control.

Handiness.—Handiness is the result of perfect balance in a horse whose movements are readily controlled by the rider. First obtain direct impulsion and free forward movement. To make a horse walk out, close the legs to his flanks and lightly feel the snaffle in his mouth. Occasionally teach him to diverge from the straight line by leaning the rein against his neck on the opposite side to the change of direction. Preferably work on undulating ground. Increased impulsion from leg pressure in conjunction with the voice and possibly the whip. if your horse is slow or dull, will induce the horse to trot. When free forward movement at these paces has been obtained, the horse can gradually be taught to move collectively by a change of balance. The head is raised by means of the snaffle, a pressure of the rider's legs keeping the hind limbs well under the horse to support the weight thus brought back. Later he must be taught to bend from the poll and relax his jaw by a springy feeling of the fingers on the curb bit rein. the head being kept raised by the bridoon. The reins control the horse's forehand and the rider's legs the hindquarters; the combination of both controls the whole mass. The next stage is lateral impulsion, when the horse is taught to move diagonally forward (half passage) to one hand. To move to the half-right, apply a strong pressure of the left leg, pressing the left rein against the horse's neck, the right rein bending and leading him in the required direction, the right leg applied as required to hold the horse up to his bit. He must be keat collected and the head flexed in the direction he is moving. Reverse the aids to move diagonally to the left. To obtain lateral movement to either flank, accentuate the above aids. These lessons should be taught first at a walk, then at a collected trot and later at a canter The next lesson is the canter, which is a collected pace. For example, to canter with the off-fore leading, there are two methods. Firstly, trot collectedly on a large right-handed circle. increase the tension of the reins and the pressure of both legs, the left leg the stronger, at the same time flex the horse's head slightly to the left. He will then canter with the off-fore leading. Later, or if the horse is inclined to disobey this aid, make him half passage to the right at the trot, accentuate the aids to increase impulsion, when he will break into a canter aith the off-fore leading. then move forward on a straight line. Rexerse the aids to canter with the near-fore leading. To change the leading leg at the canter check to a trot, half passage in the required direction as above and break into a canter. By degrees reduce the number of paces at the half passage until the horse changes direct at the canter from one leading leg to the other. He must now be taught to canter on a loose rein, occasionally increasing the pace and stretching his neck and forelegs, again coming back to a collected canter, readily and smoothly adjusting his paces and balance and learning to control his momentum. The canter is the result of urging and restraining equally, so that in order to go the horse must give a little leap, which is the first step in a canter. He can now be taught to rein back one step at a time, being pressed forward at a walk, trot or canter in accordance with

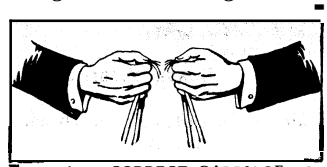


FIG. 4.— CORRECT CARRIAGE OF HANDS AND HANDLING OF REINS

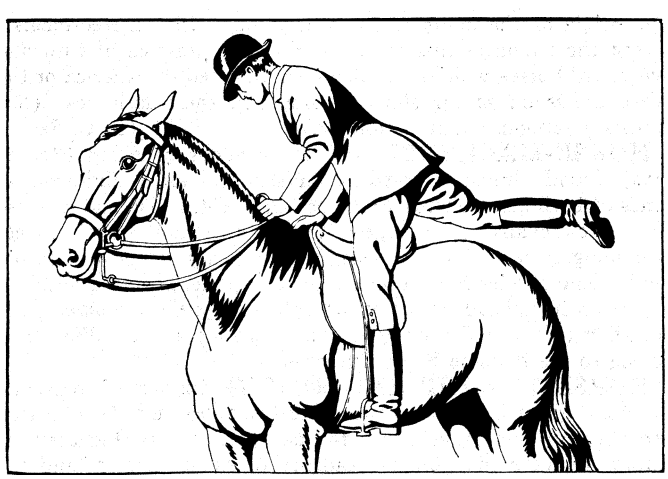


FIG 5.— RIDER MOUNTING CORRECTLY WITH RIGHT LEG FULLY EXTENDED

the aids applied. He must next be taught to turn on the haunches, the only correct way of turning sharply at fast. paces. To turn to the right or rightabout, lead the forehand round with the right rein, holding the horse up to the bit with the legs, lean the left rein against his neck, apply a strong pressure of the left leg to check a tendency of the hindquarters to move to the left, and thus keeping them under control, the horse consequently pivots the forehand round the hindquarters. Gradually accentuate the aids to sharpen the turn, reversing them to turn left-handed. The horse must now be taught to pull up on the haunches, by fceiing the reins, the rider at the same time closing his legs and leaning his body back. This must be practised first at a walk and trot and later at a canter. When the horse has learned to extend himself at the gallop and then come back to a collected canter, the halt from the gallop may be taught and finally the turn on the haunches from the gallop. Progress must be slow but progressive, and if the horse is not performing smoothly it is due to his training being hurried. Riding on a loose rein with short periods of collected work will teach him to relax his jaw to the curb bit. But the above syllabus must be executed first on a snaffle, then in a curb bit, again commencing at the first stage. The entire training may extend from 6 to 18 months according to the temperament, condition and previous training of the horse. Patience and sympathetic handling are essential.

Schooling over Fences.—First lessons may be confined to jumping free in a lane, using a trained horse as a leader, or the youngster may be led in hand over small obstacles. Training must be progressive over small but solid fences and ditches. Later, when mounted, the rider should approach the fence at a collected canter with the reins in both hands. Three lengths from the fence lower the hands, still maintaining contact with the horse's mouth. Unless the horse is a naturally free jumper, close the legs to retain impulsion and to keep the horse's hocks under him. The rider should be sitting upright ready to lean forward as the horse takes off, his own weight being borne on the knees and thighs, the leg below the knee being free to drive on the horse. As the latter raises his forehand, the rider inclines his body forward, his weight being approximately over the horse's centre of gravity. He must be prepared in mid-air to give the horse more rein which the latter will require while jumping. If the rider is leaning back at this period, he will upset the horse's balance and when jumping slowly he is liable to give the horse a chuck in the mouth as he is thrown back himself. This is known

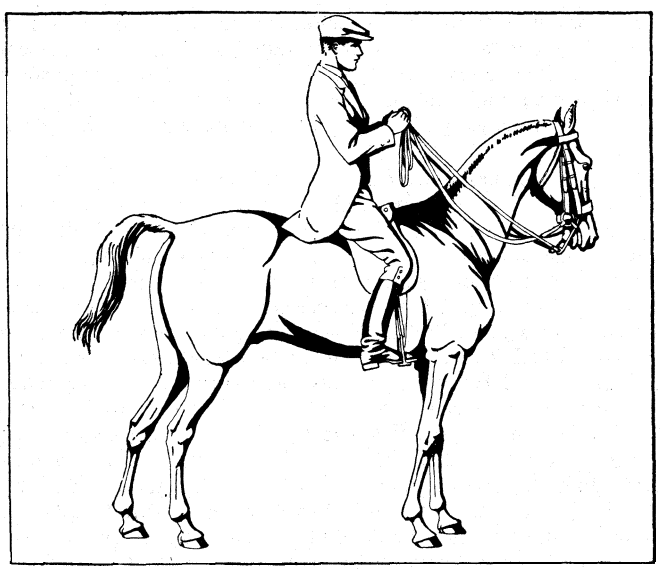


FIG. 6.—RIDER SHOWN COMING TO A CORRECT STOP

as the horse "jumping away" from his rider as opposed to the rider "going with" his horse. Schooling a youngster over simple fences the rider need not attempt to lean back. He can best assist the horse by keeping his weight constant over the latter's centre of gravity (approximately the dees of the stirrup leathers). The lighter the horse's mouth the lighter the contact between hand and mouth. To strengthen the seat and ensure correct balance over fences it is advisable to ride without stirrups. This is recommended to beginners, and on no account must the knee be kept stiff. This, of course, must be done only on a suitable horse.

Horses refuse from: (1) pain of the jar on landing, (2) heavy hands injuring the mouth, (3) too severe a bit. (4) fear of falling and lack of confidence. The cause once diagnosed, the remedy is obvious, rest and attention in the case of injury. Regain the horse's confidence, schooling over small fences if necessary in a snaffle. Concentrate on getting the horse to like jumping. Reward him, humour him, keep him quiet and unflurried. Only resort to punishment in extreme cases, after which it is essential to persevere and defeat a recalcitrant horse. If he runs out left-handed turn him sharply to the right and vice versa. If he takes off too close to his fences make use of a ditch or guard rail nine inches high and two to three feet from the fence. Normally he should take off not nearer than the height of the fence and not more than eight feet from it.

Show Jumping.—Practically the same procedure should be adopted, but the rider should exaggerate the leaning forward, thus minimizing the risk of touching the fence with the hind legs. The horse must lower his head to give free play to his loins when jumping, the more easily to tuck up his hind legs. It further assists him to judge his take-off and adjust his stride. Never steady a horse too late so that he cannot lower his head. The exaggerated forward seat is permissible as normally there is no question of jumping at speed over a drop on to sticky landing, hence there is no risk of the rider being thrown forward of the horse's centre of gravity and both coming to grief. A good horseman on a well balanced handy horse can lengthen or shorten his mount's stride as required to take off correctly. This necessitates a high standard of training and horsemanship. Show jumpers improve with years and experience. Horses like Broncho and Combined Training, who jumped for England and won the King George's cup and the championship at Olympia, were probably at their best when over 20 years old.

Riding to Hounds.—The seat is the same as for schooling over fences. Good horsemanship is essential for riding a young horse in a hunt. Never jump unnecessary fences, as it is unfair on the farmers and tiring to the horse. Hold your horse together over heavy ground, picking out the best going. Hold a gate open for the huntsman, shut it if you are the last to go through. Stand still when hounds check or are being cast, and if your horse has been galloping turn his back to the wind as wind on a horse's chest will almost always founder him. Then he is nine times out of ten worthless. Don't ride on the tail of hounds, but to a flank level with the tail hounds and preferably on the downwind side. Watch the leading hounds and the older ones in the body of the pack, who will generally put their more impetuous juniors right when scent is catchy. With regard to all fences, preferably select a sound take-off. Sail on at a low fence with a ditch beyond. With a ditch and possibly a blind one on the take-off, keep the horse collected up to the last few strides. Over trappy blind places it may even be advisable to jump from a walk or trot. Ride slowly over walls, timber and gates; *i.e.*, pull back to a collected canter unless there is a wide ditch beyond. Over a drop, though the rider leans forward as the horse takes off, his body on landing should not exceed the perpendicular to the horse's back. An experienced rider can feel whether the horse's balance is such that he may possibly pitch on landing, in which case he can lean back, or he may find it expedient to lean forward should he anticipate his horse dropping his hind legs in the ditch. If in mid-air the rider is too far forward or too far back, he cannot adjust his position and balance as described above. If he lands with his body too far forward and the horse overjumps and pecks badly, the rider's weight is thrown forward of the horse's centre of gravity and both will come to grief. The horse must have freedom of his head to stretch his forelegs over a wide place or to save himself if he has blundered on landing. Certainly the rider cannot keep him on his legs by holding him up with the reins. A horse that

stumbles can be held together to prevent this, but when he has actually stumbled badly, freedom of his head admits a reasonable chance of recovery. Banks are encountered in many countries. They may have a ditch on one or both sides and may be crowned with a hedge. Invariably they should be ridden at slowly to prevent the horse attempting to fly them, and at the same time giving him time to change his legs at the top. He requires a free head to alternate his change of balance when negotiating banks. A line of pollards indicates the presence of a brook. If the hounds attempt to jump it, it is safe to assume that the horse can clear it. The rider must be determined or he will fail to inspire his horse for the effort. Pull the horse together about 20 lengths from the brook, preparing him to adjust his stride for the take-off, then send him on with increased pace the last few strides, holding him straight at the obstacle. Impetus must be maintained, and this will ensure clearing a good 15 feet of water. Over dykes and big bottoms it may be necessary to crawl down one side, pop over the bottom and clamber up the far side. Obedience to the-rider's leg is necessary for opening gates. Once unlatched, the horse can be trained to push open the gate, the rider giving the final push with the hook of his" whip. When pulling back a gate with the latch on the left use the whip in the right hand, and vice versa.

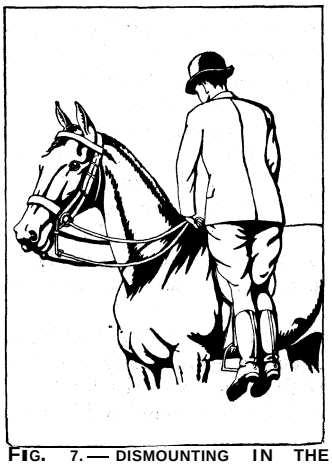


FIG. 7.— DISMOUNTING IN THE USUAL MANNER

Racing **Over** Fences.--Over hurdles the jockey keeps his weight constant over the horse's centre of gravity; viz., he adopts the modern seat of the flat race jockey, the weight being well forward over the pivot of the leading foreleg. This position gives the maximum assistance to the horse. In steeplechasing over park courses, the same principles are adhered to, but to a lesser degree, as the rider must be prepared to lean back if a horse blunders. The impetus of a bold fencer to some extent counterbalances the leaning back of the rider's body, but to enable the horse to get away from his fence with the utmost speed after landing, the rider must be forward in the recognized position for galloping. Over Liverpool, horses often fall from hitting the fences, but even more frequently from over-jumping. Under these circumstances the so-called forward seat increases the chances of grief. Here the first essential is to keep the horse on his legs and the rider in the saddle. This applies especially to a fence like Becher's brook, where the horse descends over the big drop at such an angle that he may pitch forward on landing. It does not follow that a horse will fall over a drop if the rider is not sitting back. Over timber, for instance, the horse can see a drop on the far side and he can adjust his balance accordingly. But in this case he cannot, added to which there is the momentum derived from the speed of his gallop and the fact that he has stood well back from the fence. Much depends upon the horse and his particular style of jumping and the speed at which the fence is taken. Under the following conditions it is advisable to sit back:— (1) when a horse is inclined to over-jump himself especially when going at great speed. (2) When the landing is heavy. (3) When the drop comes as a surprise and the horse is not prepared to adjust his balance accordingly. Coming at his fences a chaser should extend his paces, stand well back and gain ground at each obstacle.

Racing an the Flat.— This is confined to light-weights. Good jockeyship entails early apprenticeship to get the necessary experience. At first a lad should ride on easy horses, attention being paid to the length of his stirrups and reins. The American jockey, Tod Sloan, was the first exponent of the modern racing seat in Great Britain. The advantages are as follows: (1) Wind resistance is reduced to a minimum. (2) The racehorse must advance his centre of gravity with the free extension of his head and neck to get full extension of his fore-limbs. Therefore the rider's weight must be proportionately advanced. (3) The leading foreleg at the gallop exerts the greatest effort, consequently a tired horse keeps changing his legs; the rider's weight being over the pivot of the leading foreleg reduces this effort. (4) At the same time the rider relieves the horse's loins of as much weight as he can to enable it to bring its hind legs as far forward as possible. By adopting this method he obtains the maximum of propulsion.

The lad first learns to sit still and obey orders. He next learns to keep his place on different types of horses, driving a sluggard, soothing and restraining an impetuous youngster, remaining quiet on a free but temperate horse. During this home training he develops a judgment of pace and learns to appreciate the peculiarities of different horses. If he is to become a successful jockey he must have brains be keen, determined and in sympathy with horses. The latter quality is essential for good hands which alone can deal with a wayward animal. With these qualities he will develop confidence, and once endowed with this asset he is well on the road to success: smartly off at the start, with his horse instantly balanced in its gallop, seizing the opportunity of coming through his field, getting on the inside at the turns, keeping still when well placed and holding his horse together to make his final effort with a strong finish when required.

See Baucher, *Passe-temps Équestres* **(1840)**; Hundersdorf, *Équitation allemande* **(1843)**; d'Aure, *Traité d'kquitation* **(1847)**; Raabe, *Mkthode de haute école d'dquitation* (1863); *Méthode d'dquitation* **(1867)**; Barroil, *Art dquestre;* Fillis, *Principles de dressage;* Hayes, *Riding on the Flat,* etc. **(1882)**; Goldsmidt, *Bridlewise* **(1926);** Brooke, *Horse-sense and Horsemanship* **(1926)**; H. **R.** Hershberger, *A Work on Horsemanship* **(1844);** Henry William Herbert, *Horse and Horsemanship of the United States and of the British Provinces of North America* (1857) and *Hints to Horsekeepers; A Complete Manual for Horsemen* **(1859);** *T.* **C.** Patteson, *Observations on Riding* (1901) and *Saumur Notes,* (1909); H. **L.** de Bussigny, *Equitation* **(1922)**; Baretto de Souza, *Elementary Equitation* **(1922);** *L. L.* Fleitmann, *Comments on Hacks and Hunters* **(1922);** *I.* Maddison, *Riding Astride for Girls* (1923). **(*G.* Br.; X.)**

THE UNITED STATES

Riding, once the medium of transportation of men from place to place, became in the 20th century in the United States solely a medium of recreation. As such it increased rapidly, particularly in metropolitan and suburban areas The first essential for riding is adequate facilities—that is, good bridle paths in city parks; riding trails near cities; and in suburban districts, where wealthy men have large estates, arrangements whereby riders from one estate may use trails on neighbouring estates. For such purpose swinging gates or panels are installed to permit easy passage of riders. This adds variety to the route—which is important, for when men and women must ride over the same path every day they sometimes grow tired of the sameness of scenery and terrain.

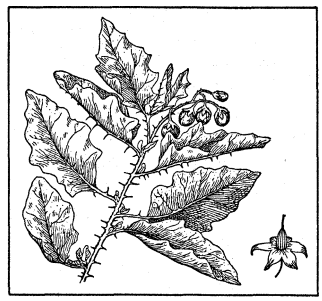
Chicago outranks other cities, except London, in excellency of bridle paths, its paths being broader, better constructed and better maintained than any others. Boston and New York have good paths through the public parks, and Washington's paths are good though somewhat narrow. One of the most beautiful stretches of bridle path anywhere extends through the Wissahickon natural park area In Philadelphia. Automobiles are forbidden in this area, which is an added attraction, for where riders are forced out upon paved highways in close proximity to speeding motor cars there is great danger of accident. St. Louis, San Francisco, Los Angeles and other cities also have built good paths and are steadily improving them. There is likewise amazing development throughout the country in riding trails—which are distinguished from bridle paths through the fact that they are natural trails leading over rights-of-way. Outstanding among these are trails on private estates about Piping Rock, L I., Greenwich, Conn., Aiken, S.C., Oconomowoc, Wis. and public trails in forest preserves of Westchester county, New York, and Union and Essex counties, New Jersey.

The second essential to riding is good mounts, and in these there is wide variety of choice. Some prefer three-gaited saddle horses, some five-gaited, while those who play polo want mounts

of the polo type. Still others, brought up in sections where hunting is popular, select their horses from hunter stock. The important thing is to get a horse that is sure-footed, light-mouthed and that will give the rider a pleasurable and safe ride.

(W. DI.)

HORSE NETTLE (*Solanum* carolinense), a North American plant of the nightshade family (Solanaceae), called also sandbrier, native to dry fields and waste places in the southern and southwestern United States and introduced northward to New England and southern Canada. It is an erect perennial, 1 to 4 ft. high, armed with sharp yellow prickles, and bearing large, more or less deeply-lobed leaves, light blue or white flowers: strongly resembling those of the potato, and orange-yellow berries, about ¾ in. in diameter. In sandy or gravelly soils the horse nettle sometimes becomes a troublesome and very persistent weed, spreading not only by its seeds, but also by its long underground rootstocks. (See SOLANUM.)



FROM MUENSCHER, "WEEDS" (THE MACMILLAN COMPANY)

THE HORSE NETTLE (SOLANUM CAROLINENSE) OR SANDBRIER

HORSENS, town of Denmark, at the head of Horsens fjord, on the east side of Jutland, 32 mi. by rail S.W. of Aarhus. Pop. (1955) 36,567. It is the junction of railways to Bryrup and to Törring inland, and to Juelsminde on the coast. There is also a good harbour. The monastery and church were built in 1270 and there is a museum with a famous collection of Stone Age material.

There is much pleasure boating on the fjord. The principal manufactures are textiles! tobacco, soap, engines, electrical apparatus, dairy produce and condensed milk. Organs are also manufactured.

HORSEPOWER is the common unit of power measurement, the rate at which work is done by an engine, turbine or motor, or absorbed by a driven machine. In the English system one horsepower equals 33,000 ft.-lb. of work per minute. This value was adopted by James Watt after experiments with strong dray horses and is about 50% more than the rate which an average horse can sustain for a working day. The electrical equivalent of 1 h.p. is 746 w., and the heat equivalent is 2,545 B.T.U. (British thermal units) per hour. In the metric system one metric horsepower (*cheval-vapeur* in France) equals 4,500 kg.-m. per minute (32,549 ft.-lb. per minute) or 0.9863 h.p.

Horsepower at the output shaft of an engine, turbine or motor is termed brake horsepower or shaft horsepower depending on whether it is usualiy measured with an absorption dynamometer such as a brake, or by a transmission dynamometer such as a shaft torsion meter (see DYNAMOMETER). Horsepower of reciprocating engines, especially in the larger sizes, is often expressed as indicated horsepower, which is determined from the pressure in the cylinders (see INTERNAL-COMBUSTION ENGINE; STEAM: *Steam Engine*). Brake or shaft horsepower is less than indicated horsepower by the friction horsepower of the engine itself. which may amount to 10% or more of the indicated horsepower. Electric motor horsepower can be determined from the electrical input in watts, allowing for heat and friction losses in the motor itself. Thrust horsepower of aircraft jet engines and rocket motors is equal to the thrust (pounds) times the speed of the aircraft (miles per hour) divided by 375 (which is one horsepower measured in mile-pounds per hour). (See JET PROPULSION; ROCKETS.)

Taxable or nominal horsepower of steam and internal-combustion engines is an arbitrary figure calculated from certain physical dimensions of the engine and bearing no exact relationship to actual power capacity. For motor vehicles in Great Britain and in some of the U.S. states the usual formula for taxable horsepower is $d^2n/2.5$, where d is cylinder bore of the engine (inches) and n is the number of cylinders. Maximum horsepower of modern automobile engines may be three to five times the taxable horsepower.

Rated horsepower or horsepower capacity of any machine is the potential output, and will be actually developed only when both speed and load circumstances permit. For instance, maximum horsepower rating of an automobile engine in a passenger car can be developed only if the speed is high enough (on the order of 75 to 100 m p.h. in driving gear) and the car accelerating or climbing so as to load the engine fully. Gear transmissions and torque converters permit engines to run fast enough to develop their maximum power at lower car speeds. They do not increase the horsepower, but make the power available at lower car speeds, thus increasing the propelling force at the wheels.

Rated horsepower of electric motors usually represents the shaft horsepower which can be sustained continuously without overheating to the point of causing damage to the internal insulation of the motor. Such motors usually are capable of momentary overloads well in excess of rated horsepower. (See MOTOR, ELECTRIC.)

(Co. C.)

HORSE RACING AND BREEDING. This article is divided into seven main sections dealing with the principal aspects of horse racing and breeding. For collateral information see also ANIMAL BREEDING; HORSE; HORSEMANSHIP AND RIDING.

Following are the main divisions of this article:

I. EARLY HISTORY

Contests of speed between horses are among the oldest diversions of man, having arisen, in all probability, soon after the domestication of the horse. The earliest dates for such contests have not even been approximated, but archaeologisis have turned up at ancient Hattusas, about a hundred miles east of Ankara in Asia hlinor, a lengthy treatise on the breeding and training of horses, written about 1500 B.C. (the dating of such texts is still far from exact) by "Kikkuli of the land of Mitanni," an expert apparently in the employ of a Hittite king. The Hittites became a powerful nation through their use of the light, spoke-wheeled war chariot; but their knowledge of horsemanship apparently came to them from older cultures which had already developed the equestrian arts as well as clumsy carts with four wheels of solid wood. The earliest full-length account'of a chariot race appears in book xxiii of the Iliad. Though it is of uncertain date, it attests a long antecedent history of conventions which had attached themselves to the sport. First prize was "a woman skilled in women's work, and a tripod of two-and-twenty measures with handles to it." Post positions were determined by lot, a patrol judge was sent out, and Antilochus received instructions from Nestor before the race and subsequently was disqualified from second place because of having followed them too well.

The first historical record of races for mounted horses is given in connection with the XXXIIIrd Olympiad, about 624 B.c., but the horse had been used for riding more than a thousand years

earlier. The Greeks made less use of horses, and were perhaps less skilled in handling them, than the earlier peoples of Asia or the later Romans. In Rome each of the various racing factions had its own colours and spent enormous sums in anticipation of competitive honours. Successful drivers were as popular and as well known as leading athletes of modern times.

Whether it was entirely fortuitous or largely the result of prehistoric selective breeding, the horses in the Mediterranean areas (whose river deltas became the centres of the first Western civilizations) were the ones best fitted to become ancestors of a breed specialized for speed, the modem thoroughbred. Wherever the Romans went in conquest, they took with them the fleet runners derived from the stock of Arabia, Asia Minor and North Africa; and wherever the Roman civilization persisted, the hippodrome was established. When Caesar invaded Britain in 5j B.C., he was opposed by skilled charioteers, and it was in the British Isles that modern organized racing had its beginning, together with the sovereign breed that came to be known as the thoroughbred.

II. GREAT BRITAIN

The aristocratic status of racing, established centuries earlier, was maintained in England, where it crystallized eventually into the familiar designation of "the sport of kings." The earliest English racing of which a description has been left took place about A.D. 1174, in the reign of Henry II, outside the gates of London at Smithfield, where horse fairs, usually attended by "earls, barons and knights," were held every Friday, the lords coming to inspect and buy "well-bred horses," while "multitudes of citizens" flocked thither to look on. The contenders were ridden by professional jockeys, who urged them forward by their cries and the use of whip and spur. The course was over the open field, cleared for the purpose.

The first mention of a formal event for a money prize, contested by a field of horses, occurred in the reign of Richard I (1189–99) when "at Whitsuntide" a purse of £40 in "ready gold" was run for by divers knights over a 3-mi. course. John, who followed Richard upon the throne (1199–1216), had "running horses" in his stables, this being the first mention of royalty in connection with them. The earliest mention of an established annual race meeting is of that held at Chester; in describing the race (there was only one) for the year 1512 (early in the reign or' Henry VIII), the chronicler stated that this event had been given "time out of mind." It is possible, therefore, to date its origin as previous to the year 1500. It was contested over the Roodee, just outside the city, the site of the later Chester course. This has been the scene of racing for five centuries.

The rise of the turf in England must, however, be dated from the advent of the Stuart dynasty, beginning with James I (1603–25). This monarch had previously patronized the sport in Scotland. Subsequently he sponsored meetings at Croydon and Enfield, in the suburbs of London, and associated himself with the infancy of racing at both Epsom and Newmarket. While Henry VIII had acquired numerous "coursers" from Italy and Spain as early as 1520 and had established studs at Hampton Court, at Malmesbury in Wiltshire, at Tutbury in Staffordshire, at Ripon in Yorkshire and elsewhere, it was not until the accession of James that their importance became notable. For this, the influence of his favourite, George Villiers, duke of Buckingham, was largely responsible, he being passionately addicted to racing and breeding and the importer of numerous oriental animals. As master of the horse (according to tradition the king first encountered him in a stable), he had charge of all the royal horses until his death in 1628, after the accession of Charles I (1625–49). Charles himself had little interest in the turf, but concentrated his breeding stock at Tutbury where, according to the inventory taken after his deposition and death in 1649, there was a stud of 139 horses, with 37 brood mares. They were dispersed in a series of sales, but six of them were taken over by Oliver Cromwell, who was obliged to suppress his sporting instincts in deference to his Roundheads, but privately indulged them.

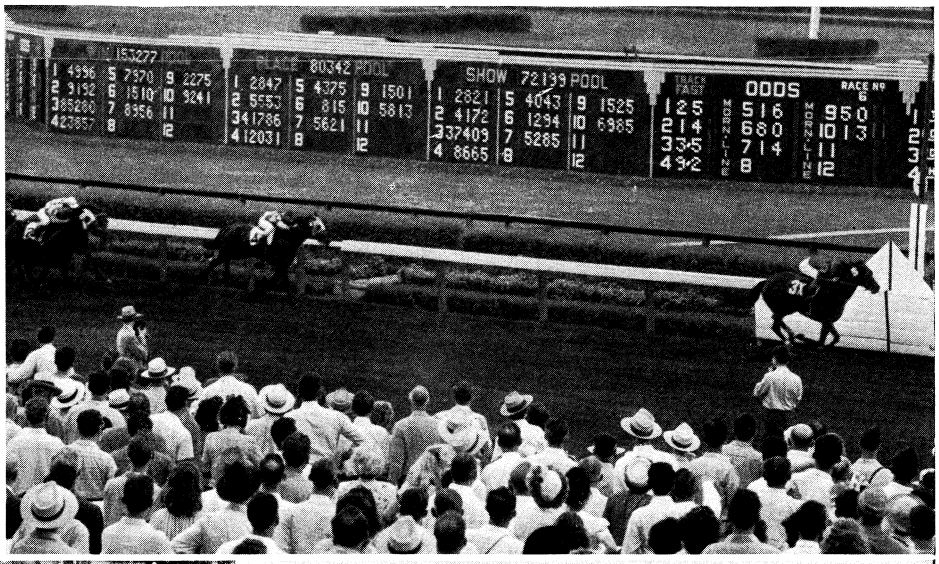
1. Genealogy of the Thoroughbred.—When Charles II inaugurated the Restoration in 1660, he speedily demonstrated the propensities which won for him the title of "father of the British turf." It was his patronage which raised Newmarket to the position it thereafter occupied, as the headquarters of both racing and breeding in the kingdom. There, on various occasions, he rode and won both match and plate races; *i.e.*, races for money and races for trophies. The statement that he also bred on a large scale and "sent abroad the master of the horse, to procure a number of foreign horses and mares for breeding, and the mares brought over by him (as also many of their produce) have since been called royal mares," nhich first appeared in volume i of the General *Stud Book* in 1791, is incorrect. The English state papers disclose that throughout his reign Charles II formally contracted with various breeders to supply him with a stated number of animals annually, and upon his death but a single brood mare was found among his horses. The so-called royal mares are of historic importance, as they appear at the foundations of practically all the pedigrees in the *Stud Book*, either as "taproots" (earliest known mares in direct female lines) or collaterally. Analysis of these pedigrees has shown that the entire body of English thoroughbred horses, from the earliest times to the present day, descend in their female lineage from fewer than 50 "taproots," while the vast majority of them descend from fewer than 20. The former supposition that these foundation mares were of purely oriental blood is not tenable in the light of recent research. Only a few of them were imported, the remainder being native (English) bred and of mixed native and oriental blood. The majority of the foundation sires were oriental or quasi-oriental, but the antecedents of the majority are unknown. Few were ever certified as to blood or place of origin. By the old authorities they were termed "Arabians," "Turks," "Barbs." etc., in a loose and careless way.

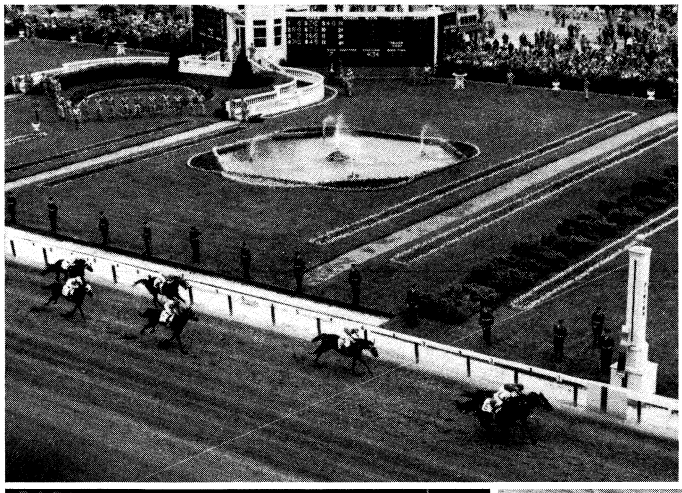
But one thing emerges with certainty: the percentage of authentic Arabians was meagre, while that of Barbs was proportionately large. The Barb, indeed, may be designated as the preponderant influence of the foundation period. This arises from the much greater facility with which both stallions and mares of that strain could be imported, either direct from North Africa or from Spain or Italy. A long-sustained argument, pro and con, has raged between thoroughbred genealogists regarding the precise origin of the Arabian and the Barb. The theory that both descend from a remote ancestry which flourished in prehistoric Asia Minor, and that the Barb is an offshoot of the Arabian, was generally held by mid-20th century.

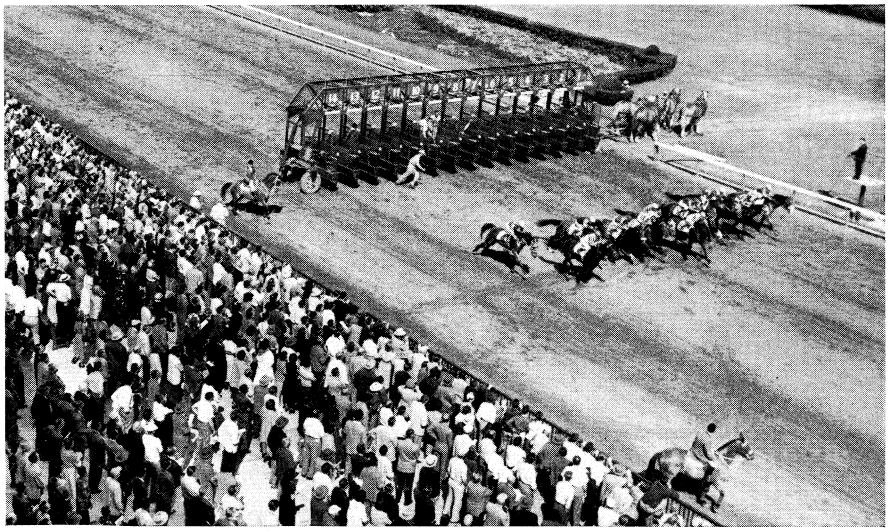
The most interesting fact. genealogically, regarding the modern thoroughbred is this: Of the vast number distributed over the entire world, all, without exception, can be traced in their male lineage from but three early 18th-century oriental progenitors: the Byerly Turk, the Darley Arabian and the Godolphin Barb or Godolphin Arabian. Furthermore, in turn, the lines of descent from them trace back through but a single descendant of each. Matchem (1748), grandson of the Godolphin; Herod (1758), great-great-grandson of the Byerly; and Eclipse (1764), great-great-grandson of the Darley horse.

The Byerly Turk was the first of these founding fathers to appear. It is known only that he was the charger of the English Captain Byerly at the battle of the Boyne in 1690, that he was supposititously a Turkish stallion brought in from Europe shortly before, and that he afterward became a service horse at Byerly's seat, Goldsborough hall, in Yorkshire. The Darley Arabian, in every way a most exceptional animal, came direct from Aleppo in 1704, certified as an Arabian of the best Mu'niqua (Maneghi) blood; he was sent from Syria by Thomas to his father, Richard Darley, of Aldby Park, Yorkshire, where he was kept throughout his career. The Godolphin Barb or Arabian was brought into England from France about 1730 by Edward Coke. As the "mysterious Frenchman," he has been the subject of much picturesque romance, myth and fable. Coke died in 1733 bequeathing the horse to his friend Roger Williams, who either gave or sold him to the earl of Godolphin, the horse dying his property in 1753 at his stud in Cambridgeshire.

In tracing lineage through the male, the prepotency of the Darley Arabian through Eclipse far outstripped that of the Byerly and Godolphin horses; but collaterally, the Byerly strain through







PHOTOGRAPHS. (TOP LEFT, TOP RIGHT, CENTRE LEFT, BOTTOM RIGHT) UNITED PRESS. (CENTRE RIGHT, BOTTOM LEFT) WIDE WORLD

HORSE RACING IN THE UNITED STATES

Top left: A field of horses breaking from the starting gate at Churchill Downs, Louisville, Ky.

Top right: Totalizator board at Washington Park, Chicago, Ill. The board records electrically the odds on horses, the amount of money bet and the prices for winning tickets

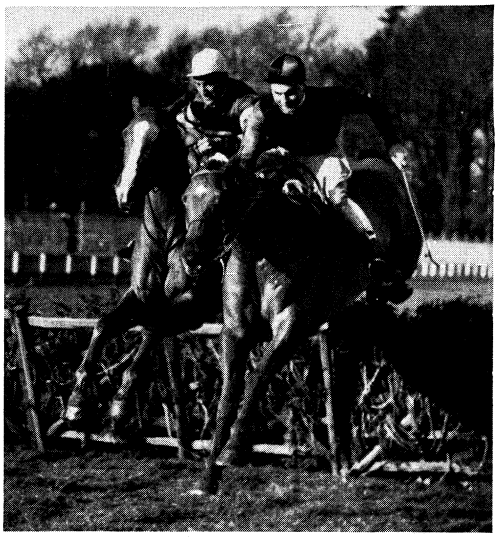
Centre left: Churchill Downs, scene of the annual Kentucky Derby, the most famous horse race in the United States

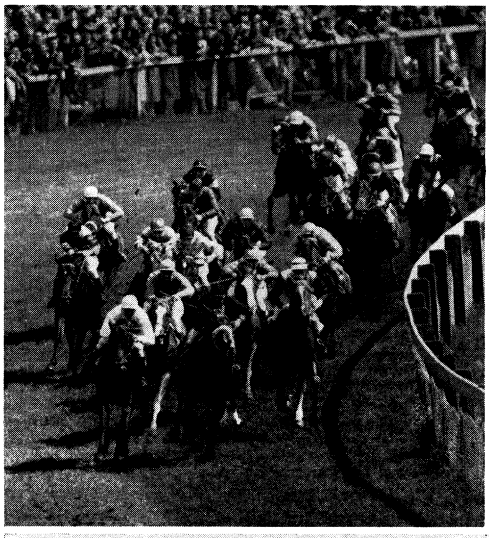
Centre right: Crossing the finish line on the Widener course at Belmont Park, N.Y., the only straight course in the United States

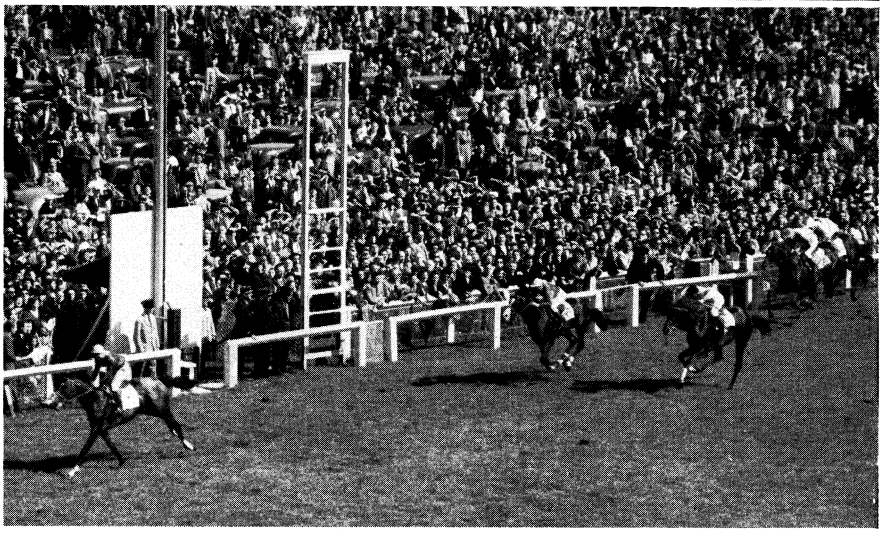
Bottom left: Photo finish showing a triple dead heat at Hollywood Park, Inglewood, Calif.

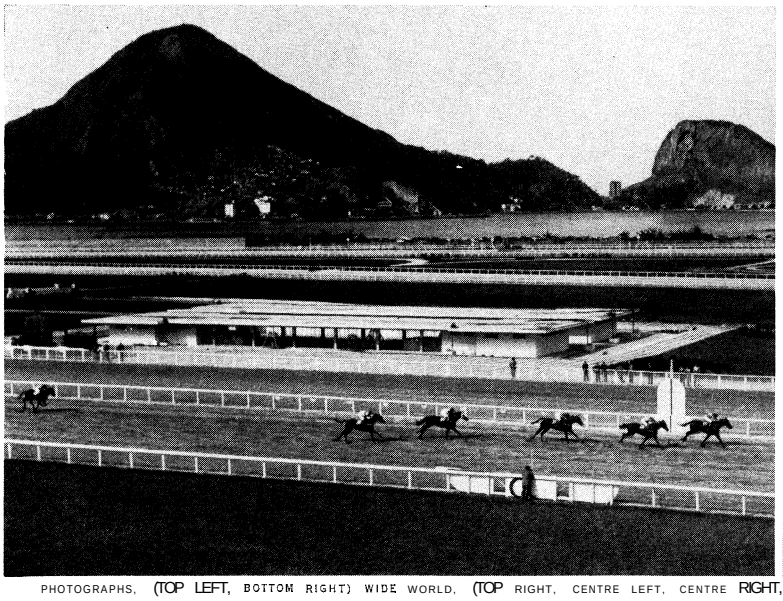
Bottom right: Start of a race at Hialeah Park, Miami, Fla.

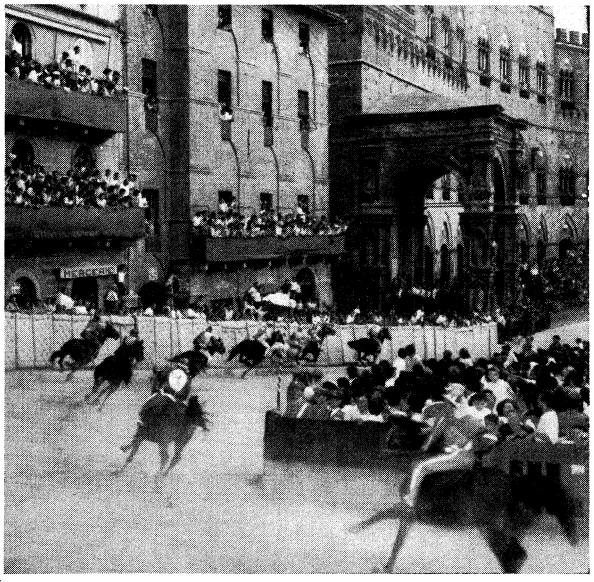
HORSE RACING AND BREEDING











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HORSE RACING IN GREAT BRITAIN AND OTHER COUNTRIES

Top left: Clearing Becher's Brook, the most difficult jump in the 4½-mile Grand National Steeplechase at Aintree, Liverpool, Eng.

Top right: Horses going over the last hurdle at Leopardstown, Dublin, Ireland. Hurdle racing is a miniature form of the steeplechase

Centre left: A field of horses rounding Tattenham Corner in the Derby at Epsom Downs, Surrey, Eng.

Centre right: Winning the Grand Prix de Paris at Longchamp race course

Bottom left: The Gavea course at Rio de Janeiro, Brazil

Bottom right: The "Palio delle Contrade" race, held annually since the 17th century in the public square at Siena, Italy. Jockeys ride bareback and carry clubs

Herod is present through the greater number of crosses. Other oriental strains may be found, some of them in great frequency, in pedigrees at the developmental stage of the breed; these are not necessarily less important, but are less well kno n than the three ancestors which for many generations have monopolized the male lines.

2. The Classics.—It was the patronage of Charles II which brought Newmarket to the front as the English racing capital. That of Queen Anne (1702–14) gave Ascot its high distinction. Still earlier, Epsom Downs had found favour with James I, as noted, but it was not until late in the 18th century, with the foundation of the Derby (1780) and Oaks (1779), that its fame began. The St. Leger at Doncaster, in Yorkshire, founded in 1776, was the first-established of what are now known as the classics, which are five in number, the other two being the much younger 2,000 Guineas (1809) and 1,000 Guineas (1814), both run at Newmarket. These great stakes (races in which the money prizes are mainly the total of fees paid by owners of the horses) have been contested annually since their foundation, except the St. Leger which had to be abandoned because of war in 1939; all are exclusively for three-year-olds; and the Oaks and 1,000 Guineas are for fillies only. The premier all-ages English fixed event is the Ascot Gold Cup race, established in 1807. For military reasons the Derby, Oaks and St. Leger were transferred to Newmarket during World Wars I and II; the Gold Cup, not run in 1915–16 or in 1940, otherwise was shifted to Newmarket. These races vary in distance from 1 mi. (the Guineas), to $1\frac{1}{2}$ mi. (Derby and Oaks), $1\frac{3}{4}$ mi. (St. Leger) and 29 mi. (Gold Cup). All but the St. Leger are May and June events. it being run in September. Through long and eventful histories, crowded with picturesque and sensational incidents, they became the backbone of the British turf and acquired world-aide celebrity and imitation. The Derby is universally regarded as the greatest horse race of all. The winner of any classic or of the Gold Cup immediately assumes a place apart and an exalted value.

It may be said that the history of the turf, as an authentic chronicle, begins with that of the classics. However, the steady growth of racing and breeding from the time of Charles II had made an annual record of races run the previous year a necessity as early as 1727, when volume i was published of the work still extant as official, the *Racing Calendar*. Its founder, John Cheny, was succeeded by other publishers, most notably James Weatherby in 1772–73, whose descendants continued its issue until 1902 when it was purchased by the Jockey club, though Weatherby's have continued to produce it. James Weatherby is also notable as the originator of the *General Stud Book*, of which he issued a preliminary volume in 1791; not until 1808, after several revisions, did the edition ahich has become standard appear. This, the basic collection of pedigrees of race horses upon which all subsequent compilations of the kind ultimately rest, has been followed by many volumes. It is still compiled and published by Weatherby's. but it is the Jockey club which, in effect, lays down the rules that govern admission. Until 1913, thoroughbreds of other countries, duly registered in their stud books, had been accepted. Then, by the passage of the so-called Jersey act (sponsored by the earl of Jersey, one of the stewards of the Jockey club), it uas declared that only horses whose ancestors, in all removes, were registered in previous volumes would thereafter be admitted. This disqualified a vast number of animals bred outside England and Ireland, including most of the race horses in the United States and stock in other countries derived from North American strains. Since the modern American thoroughbred was descended from numerous ancestors imported before there was a stud book, it was impossible to document connections with a nonexistent registry. Thirty-five years of research, remonstrance, ridicule and logic failed to remove the exclusion clause. But immediately after World War II French owners achieved a spectacular series of victories in England, many of them with horses descended from "American" strains imported before France set up its own exclusion policy in 1913. In 1948 the stud book authority in France removed its ban on American horses, and shortly thereafter the British authority followed suit. The thoroughbred in North America now qualifies as a thoroughbred in any other country.

3. The Jockey Club.—The Jockey club, exercising control over racing and breeding in England, and indirectly in many other countries, was formed about 1750; precise records are lacking. In the beginning it comprised a small group of leading turfmen, mainly noblemen, who banded themselves together for the purpose of promoting the sport. Powerful from the first, it grew more and more so until it became not only a court of last resort but an autocratic one whose decrees are final. During a lengthy period it was the custom to delegate its authority to some ste ard who commanded general deference and who was popularly known as the "dictator of the turf." The first of them, Sir Charles Bunbury (1740–1821), was succeeded upon his death by Lord George Bentinck (1802–48), and he in turn by Adm. John Henry Rous (1795–1877), the last and most famous one, who had no successor. A board of three stewards administers Jockey club policy. The most important function of the Jockey club in regard to racing itself, is its law- and rule-making powers. Originally confined to Newmarket only, its authority later became supreme. Its code took the place of the many and diverse local ones promiscuously in vogue formerly, a centralization of authority sometimes irksome but on the whole beneficent. Thereafter, by acquiring first the *Racing Calendar* and then control of the *Stud Book*, it became arbiter of both the turf and the breeding industry, amenable only to the law of the land in its supervision of them. Its immense prestige is attested by world-wide imitation.

4. Matches and Handicaps.—The mechanism of organized racing as it now exists began to evolve in the 16th century. While, as has been seen, contests by fields of horses for money and other prizes are very ancient, when the sport began to assume definite status it tended most often to be a matter of matches, usually between two, but often three or more, owners. The early racing calendars were indeed officially known as "Match books, ana swarm with summaries of these events, often for large amounts, with tremendous sums wagered in side bets. The condition "owners to ride" was common, though professional jockeys were an institution dating far back into Roman days. Feeling ran high, and rough and foul riding were frequent until the strong hand of the Jockey club curbed it by drastic legislation. "Man-to-man" betting was the rule for centuries, either by direct personal wager or by means of go-betweens, and it is impossible to date the advent of the professional better who evolved into the bookmaker, along with "the ring," the milieu in which he operated. As in all things else, Newmarket was betting headquarters, under the aegis of the Jockey club at its famous rooms. In 1752 that body took a long lease of what were then known as the "coffee rooms," later acquired title to the property, converted it into a sort of combination clubhouse and gaming place and still occupies the premises, which have several times been rebuilt.

Meanwhile, off-course betting grew gigantic, with professional layers of odds established in London and elsewhere, patronized alike by the leviathans of the ring and the general public. "Betting on the races" developed into one of Britain's great national preoccupations, permanently to remain so. This situation naturally attracted the attention of the lawmakers and the censors of morals, and finally in 1926 was changed into a revenue-producing medium by the imposition of a tax of 2% on all wagers made at, and $3\frac{1}{2}$% on those made off, the course. This proving unsatisfactory, in 1928 a new Betting act was passed which legalized the use of the totalizator (pari-mutuel), a machine of French origination familiarly known as the tote (see *Totalizator*, below). The bookmaker was not, however, abolished and still handles a major portion of the betting. The tax (or take) deducted from the daily turnover of the tote varies from 10% to 15%, a meagre portion of which is allocated to a maintenance fund and grants of various kinds for the promotion of racing and breeding.

As the 18th century progressed, matchmaking steadily declined and racing programs were devoted chiefly to stakes, plates and the like for fields of horses ridden by professional jockeys, though the "gentleman jock" continued prominent well into the 19th century. These events usually closed their entries months, sometimes a year

or more, in advance of decision, and were eventually to include what are termed produce stakes. to which mares with foal are nominated, their produce racing as two-year-olds. The rise of races for two-year-olds — which were for long unknown, while events for three-year-olds were vastly in the minority, most performers being four-year-olds or older — dates from about 1779, when the first calendared event of that kind occurred. but it required several decades for them to become staple. The oldest fixture for that age still in existence, the Woodcote Plate (or Stakes), was founded in 1807, the Champagne in 1823 and the Criterion in 1829; but the Middle Park, familiarly "the two-year-old Derby,!' was first run only in 1866.

The original absence of all two- and most three-year-olds from the course inhered in the severity of the contests. Four-mile heats were the standard with weights seldom less than 10 stone (140 lb.) and frequently as high as 12 stone (168 lb.)—Eclipse carried 12 stone repeatedly — while in many match races, owners to ride, they were higher still, in some cases more than zoo lb. Immature animals could not meet such tests, and change inevitably took its course, introducing shorter distances and lighter weights, together with the elimination of heats and substitution of dashes exclusively. For a long time. weights were assigned according to the heights of the horses, a system that was bound to be abused and unsatisfactory and that gave way to systematic apportionments based upon three different factors: age, distance and season of the year.

The Jockey club provides a basic set of weight allowances whose theoretical purpose is to equalize the opportunities of horses of different ages. In practice it is used more as a point of departure, in races with penalties and allowances based on previous performances, than as a rigid standard.

To further complicate the already complex weight problem, the handicap injected into it still another ambiguous element. This concerns a type of race which came into vogue with the founding in 1539 of the two most famous ones, the Cambridgeshire and the Cesarewitch. Open to horses of all ages and sexes (including geldings. nhich are barred from the classics), but with occasional races for two- or three-year-olds exclusively, a handicap field is assigned weights upon the hypothesis of "bringing together" the best and the worst horses that start, and giving each an equal chance to win. The uncertainties of handicaps have proved so great that the principal ones are among the biggest betting races of the season.

The difficulty of winning a great handicap in England became so formidable that it became the established custom never to expose classic winners to the ordeal, though they are proclaimed to possess a class far loftier than any handicap horse may aspire to. This "confession and avoidance" is in contrast with former practice. when classic winners proved themselves in handicaps as well as against each other, thereby establishing an incontestable certificate of merit. It is a significant fact that the three dominant male lines in England (and also in most other parts of the world), namely, those of Bend Or, Isonomy and Hampton, were founded by horses that ran and won great handicaps, while, of the trio, Bend Or alone was a classic winner.

For some years after handicaps were first introduced, the weights were assigned by the various club managements. Later on there came a demand for centralization because of the widely different and often very eccentric assignments by the many local officials that apportioned them. It was felt that this should be remedied and that something more thoroughly rationalized should take its place. The difficulty lay in finding a man whose judgment of "public form" was so widely accepted that there would be general confidence in his work; his position and character should place him above suspicion.

Admiral Rous, last of the three "dictators of the turf" previously referred to, was chosen. His administration of his duties, which, roughly speaking, covered the last 25 years of his life (which closed in 1877), marked a new era in racing. While the imposts he meted out often aroused severe criticism. his work on the whole was such as to vindicate the trust reposed in him. Eventually, as the Jocliey club became more and more absolute in the control of the sport, the post of official handicapper was formally created and is now occupied by a man of its selection. The system has proved satisfactory. but has never been adopted in the U.S.

5. Race Courses. — Racing in England is exclusively over turf, the courses varying widely in shape and gradients. Ascot is roughly triangular. Doncaster kite-shaped, Epsom a tremendous U. Newmarket's great main course is shaped something like a boomerang, about $2\frac{1}{4}$ mi. in length, the last half quite straight. In the majority of the longer races the start is effected so far from the finish, where the grandstands are located, as to be out of sight of them; in many instances little can be seen of the contest until it is nearly over. A marked exception is the ancient Chester course, which is an oval of almost precisely one mile, lying on level ground, the horses being in plain view at all times.

The great differences in the various courses, differences in themselves as well as between each other, make it extremely difficult to establish any parity of judgment between performances over them. They have ascents and descents, waves and dips, sharp corners and difficult turns, and inequalities of turf and the earth beneath it, all impossible to co-ordinate; this has given rise to the saying "horses for courses," individual animals showing distinct preferences for certain ones and dislikes for others, the skill of jockeys being similarly affected. Because of these things, the time test was discredited by English turfmen until the 1940s, when Phil Bull, using sound statistical procedure, began to appraise the speed of individual runners in relation to fixed standards which made allowance for permanent and temporary differences in courses.

Race courses in England may otherwise be subdivided into two classes, namely, enclosed and unenclosed. Up to about 1873 all fell in the latter category. The general public were at liberty to make themselves at home anywhere about the course except in the small enclosure surrounding the stands at the finish line, to which admission was free for club members and their guests, a fee being charged to all others.

This practice continued at the old established meetings, but more recent parks are, almost without exception, fenced or walled throughout their entire extent, with a gate fee invariably charged. There was at first a loud outcry against enclosed courses, but they are now popular and, on "big" days, are crowded to capacity, having increased rather than diminished the hold of racing on the public. This hold is immense. Naturally no enclosed course can house the vast throngs that attend such meetings as Epsom, Newmarket, Doncaster, Liverpool, etc., which are genuine "outpourings of the masses." Derby day at Epsom, as a national holiday, has long been the theme of the artist, the minstrel and the novelist. It is estimated that as many as 250,000 people often assemble there to witness the decision of that event — the fact that many of them never catch sight of the horses in no way dampens their enjoyment. Grand National day at Liverpool is only second in its drawing power.

Proprietorship of courses varies. Newmarket is owned and administered by the Jockey club. Ascot is a crown demesne, and the Goodwood meetings are sponsored by the duke of Richmond. At Doncaster and other places the town corporation controls. There are clubs and holding companies which own the courses they operate or have long-term leases of the grounds. The Jockey club is, in the last analysis, always the ruling power. No regular meeting can be held unless licensed by it, on dates which it specifies. The powers with which it is clothed are such that it prohibits associations with enclosed courses from declaring dividends of more than 10%, prescribes the patterns of courses that must be constructed, etc.

6. The Rise of Commercialism. — By mid-20th century, horse racing itself offered little resemblance to that which launched the turf upon the tide of prosperity. Despite its aristocratic ensemble, with the royal family foremost in its support, it had become commercialized in many respects; and the epigram coined at the turn of the century. that "In England racing is a sport, in France it is an entertainment and in America it is a business," lost much of its pertinence insofar as England mas concerned. Commercialism retrenched distance racing to the danger point, substituting "quick action for your money." It placed precocious speed and two-year-old success at a premium, consequently inflated yearling

values, and made the market breeder, as distinguished from the sporting breeder, the producer of a large percentage of the animals that perform. The animals themselves were modified to meet conditions very different from those that formerly existed. The modern race horse may be said to have been remolded to fit the system into which he is dovetailed rather than, as was the case with his ancestors, having that system shaped to fit his own highest capacities. While speed is always the hallmark of the thoroughbred, his gameness, soundness and campaigning ability were, until the end of the 19th century, among the attributes for which he was most highly valued. In the 20th century this no longer ruled. He became much of a hothouse product and could with justice often be compared to the beautiful but short-lived triumphs of the florist, which fade untimely under stress of the stimulation that forced them to such premature efflorescence.

The decline of the British horse was attested by the unprecedented success of raiding French stables in the years following the close of World War II; the French turf, which breeds about one-half as many foals as are produced in England and Ireland, accounted for winners of the Derby, Oaks, St. Leger and Ascot Gold Cup. Most of the important weight-for-age races at the longer distances went to invaders from Europe. In 1956, for example, the richest of them, the 1½-mi. King George VI and Queen Elizabeth stakes. fell to an Italian champion, Ribot. unbeaten in a career of 16 races and generally acknowledged the best horse in Europe (see also Continental Europe, below). English breeders were aware of the declining stamina of their horses and of the reasons for it. but they could find no remedy. Caught between the millstones of high taxes and low purses, the more important private studs were dispersed or decimated; and the principal goal of breeders became sales to the "dollar areas," where demand for speed and precocity had weakened the native product to a still greater extent. It was because of economic pressure that exportation of top-class horses became the rule, rather than the exception, as it had been.

Before World War II prices at private treaty ranged as high as £60,000 (about $298,000), the sum paid in 1938 by M. H. Benson of London for the unbeaten Italian horse Nearco (1935), whose ancestry combined English, French, American and Italian strains. In 1942 Nearco was syndicated at a valuation of £62,000. In 1953 the Aga Khan sold Tulyar, unbeaten as a three-year-old the previous season, to the Irish National stud for £250,000 ($700,000), the highest price in thoroughbred history until the American colt Nashua was sold for $1,251,200 late in 1955. Tulyar changed hands again in 1955, going to an American syndicate for £240,000 ($672,000). In sales by auction the record price of 47,000 guineas (about $240,000) mas paid by an English syndicate in 1932 for the ten-year-old stallion Solario.

The highest price for a yearling was the 28,000 guineas (about $141,000) paid in 1945 by the Gaekwar of Baroda for Sayajirao, which two years later won the St. Leger. Several records were established when the late John A. Dewar's stock was offered at the Newmarket December sales in 1954. The 1,000 Guineas winner Festoon brought 36,000 guineas ($105,840), the highest price that had been paid for a filly just out of training; Festoon's half-sister Refreshed made 30,000 guineas ($87,200), surpassing the previous record of 18,000 guineas ($52,920) for a brood mare; Festoon's weanling full brother made 19,000 guineas ($55,860), the record for a foal; and a yearling filly by Chanteur II—Minaret—reached 17,500 guineas ($51,450). These exceptional prices are far removed from the economic norms of thoroughbred breeding, which by and large is an extremely hazardous enterprise.

Great Britain and the Republic of Ireland, though politically separate, still use the same stud book. About 40% of the brood mares registered for the two countries are in Ireland, the shift of breeding anay from England constituting another example of the result of economic pressure. Anglo-Irish breeding, bolstered by importation of staying stock from the continent. remained the principal source from which other countries made replenishment, but competition was rising.

Queen Elizabeth II, continuing a long tradition of the royal family, had a strong personal interest in racing, and her own stable was at the head of the list of winning owners in 1954. Among the first honours bestowed after her coronation was a knighthood for Gordon Richards, the first professional jockey to be accorded such a distinction. A few days after he had received the accolade, Sir Gordon rode his first Derby winner, Sir Victor Sassoon's Pinza, with the Queen's colt Aureole in second place. When Sir Gordon retired from the saddle he had ridden a total of 4,870 winners, a record surpassed in 1956 by the English-born G.S. rider Johnny Longden. Eddie Arcaro (U.S.) in 1958 became the third man in the world to attain 4,000 or more victories.

III. NORTH AMERICA

In 1664 when the English invaded New Amsterdam and renamed it New York, the commander of the English forces was Col. Richard Nicolls, who was to establish organized racing in the colonies. The next spring he laid out a a-mi. course on what then was called Salisbury Plain, Long Island, and announced that he would offer a silver cup each spring and fall, to be contested for over the course, which he called Newmarket. Racing persisted there for more than a century, during which time the racer was attaining the status of a breed. The first "bred" horse in the colonies was a son of the Darley Arabian called Bulle Rock, imported to Virginia in 1730; and in the next 45 years the planters of New York, Maryland, Virginia, the Carolinas and other colonies imported from England 113 stallions and 73 mares which became the foundation of U.S. thoroughbred breeding.

The American Revolution damaged, but did not destroy, the foundation, upon which soon rose an imposing edifice. Among the more than 100 stallions imported between 1783 and 1800 were four winners of the Epsom Derby, including the first one, Diomed, whose influence was a dominant force for many years. Except for the setbacks occasioned by the War of 1812 and the Civil War, racing and breeding continued to expand until the late 1890s, the beginning of a period of repression. Though New York was to remain the principal and most enlightened centre of racing, the breeding of race horses was centred early in Virginia and finally in Kentucky, whose inner bluegrass area for years has been more densely populated with light horse breeding stock—mainly thoroughbred and standardbred (see HORSE: *Classification*)—than any other region in the world. After the middle 1930s, however, Kentucky accounted for only about one-fourth of North American breeding; there were important studs in numerous other states. Swaps, winner of the 1955 Kentucky Derby, was bred in California, and Needles, the winner in 1956, in Florida; Tomy Lee, winner in 1959, was bred in England; other winners have come from Tennessee, Texas, Montana, Missouri, Ohio, New Jersey, Virginia and Kansas.

1. U.S. Racing Policy.—Before the Civil War the hallmark of excellence for an American thoroughbred was the ability to outdo the best competition in races of 4-mi. heats. (On one occasion, Oct. 13, 1832, at the Union course on Long Island, a field of America's best race mares ran a total of 20 mi. in one afternoon before the winner was determined.) It was during the Reconstruction period after the Civil War that American racing made its nearest approach to the English model, establishing the 14-mi. classic as the highest test of merit and setting up other fixtures, many of them still renewed annually. at distances between 1 mi. and 2 mi. The trend of the 20th century, steadily reinforced by considerations of a commercial nature and by competitive expediency on the part of the growing number of race tracks, was toward races which made no pretense of testing stamina. The most common distance for American races was three-quarters of a mile, and contests of 1¼ mi. or more became infrequent, even for horses of the highest class.

A corollary development which sets American racing apart from that of other countries is an inordinate emphasis on precocity. Two-year-olds begin running two- and three-furlong dashes in January, and the best of those which survive the excessive strain on immature bodies may compete in October for "the richest race in the world," the 1 1/16-mi. Garden State stakes at Garden State park in New Jersey. The winner of this race, which was inaugurated in 1953, earns more than $150,000. American racing tests

its cheaper horses, which constitute the great majority of runners, almost exclusively in claiming races (where each starter is eligible to be claimed from its owner at a given price). The best older horses are raced almost exclusively in handicaps, many of which have added-money values of $50,000 to $100,000. Contrary to the European custom of assigning such high weights to top-class horses that chances of victory are more or less equalized, the American handicapper, except in New York, seldom gives a champion more than 130 lb. to carry. Partly as a result of the arbitrary policy of limiting the range of weights, many moderately good horses have earned more than $100,000, and a number of the best have had total earnings ranging from $400,000 to more than a million. U.S. racing policies result in genetic debility which is remedied only by constant importations from countries with more respect for stamina.

The whole problem ties into that of the modern system of end-to-end (full-speed) race riding, just as in England. In order to facilitate this, the machine age has been invoked; and whereas in England the old-fashioned starting barrier is still used, in the United States it has been replaced by the starting gate, a mechanical device mounted on wheels and movable to any base. Into this the starters are locked, each in a separate stall, the front doors being electrically released by the starter when ready. The entire field then plunges headlong from the gate, reaching top speed in a few strides; they also get off on even terms. The starting gate is very old in principle, going back to the Roman Coliseum and Hippodrome, where its use seems to have originated. It expedites the starts, but many horses are injured in their effort to leap at once into full speed.

U.S. racing shows other wide departures from English racing in the plan and conduct of the meetings, and most especially in their length. The average English meeting lasts but three or four days, even in the case of the most important ones at Epsom, Ascot and Newmarket; in the U.S. they endure in numerous instances for 50, 60 and up to nearly 100 consecutive days, Sundays excepted. There is no centralized governing body like the English Jockey club; racing is controlled as a separate entity in each of the states where it is conducted under laws giving legal status to pari-mutuel betting.

Off-course betting is illegal in the United States, and the considerable amount of such illegal gambling has been a law enforcement problem of considerable difficulty. The controlling body, responsible to the state, is an appointed racing commission—usually consisting of three to five men—which operates independently of other commissions but recognizes and aids in the enforcement of their disciplinary actions. For purposes of parley and exchange of information the groups are organized as the National Association of State Racing Commissioners, with headquarters in Lexington, Ky. The existence of commissions as a means of control is largely a consequence of the pari mutuel, a system of betting originated in France. The money wagered goes into three pools, straight (winner), place (first or second) and show (first, second or third), and is distributed after the race among the holders of the winning tickets. There is also, at most tracks, a "daily double" in which the pool is divided among those who have placed their wagers on the winners of two designated successive races. Before the pools are distributed to the winning players they are reduced by a take-off which ranges up to 15% and slightly higher in some states. A part of this take is retained by the track for the payment of purses and other expenses and for the promotion of the breed; and the remainder, a fixed percentage of the gross total wagered, is paid to the state as a tax. The total of such taxes in the states where racing is organized under the supervision of racing commissions has reached annual figures in excess of $150,000,000, more than twice the amount paid out in stakes and purses. In terms of monetary gain the state governments received the principal benefit from the sport.

Racing is also conducted, on a smaller scale, in eastern and western Canada and in Mexico and Cuba, and for practical purposes the annual statistics usually include these in North American, rather than national, totals. The oldest fixed event run annually in North America is the Queen's Plate at Toronto, Ont., originally endowed in 1836 by King William IV and ever since by the British sovereigns.

All American tracks are prepared dirt ovals, usually of 1 mi., the largest being that at Belmont park, of 1½ mi.; they are scientifically constructed and almost precisely dead level. Most of them have chutes from which starts are made. There is only one straight course, the Widener at Belmont park, which is slightly more than six furlongs. Because of this quasi-uniformity, time is considered most important and enters into betting and handicapping calculations. California tracks are elevated in relation to the viewing area; this is thought to aid drainage and thus permit faster times.

As to the handicapping, this is usually done by the secretary of each club, an exception being that the Jockey club's official handicapper assigns all weights for the New York tracks. The weight scale of the Jockey club, formed in 1873 in New York state on the pattern of the English Jockey club, is basic throughout the country, but not mandatory. The scale was revised in 1953.

Betting on horse races increased after World War II, providing the tracks with such revenues that purses became larger than ever before. By the 1950s, more than 20 races with $100,000 purses were run annually in the United States, and minimum purses at some tracks rose almost to the levels at which important stakes races were being run before 1940. Total North American racing attendance rose to more than 30,000,000 annually, of which all but about 3,000,000 was accounted for in the U.S.; total wagering, to more than $2,000,000,000, of which about $35,000,000 was outside the U.S. (Most of the more than $2,000,000,000 total was comprised of the same money played and replayed numerous times.) Such totals were far higher than those of the years prior to World War II, but the increase was largely due to increase in number of tracks in operation and number of races offered annually; in the 1950s racing was not keeping pace with population growth or per capita income.

The Thoroughbred Racing Associations of the United States, Inc., or T.R.A., is perhaps the most important of a considerable number of organizations concerned with the maintenance and improvement of high standards, ethical and otherwise, in racing. Its membership consists of leading tracks whose pooled contributions support the Thoroughbred Racing Protective bureau, an investigative body which constitutes in racing an analogue of the Federal Bureau of Investigation in the affairs of the federal government and is in fact staffed by experienced investigators trained in FBI methods. This effective self-policing tended to minimize infractions of rules and to raise public confidence in the sport.

Racing is the most nearly universal of the great spectator sports. The most important racing countries place strong emphasis upon, and provide high values for, their leading international races, such as the Prix de l'Arc de Triomphe in France, the King George VI and Queen Elizabeth stakes in England, the Grande Premios Brasil and São Paulo in Brazil and others of like nature, usually testing mature horses over a distance of 1½ mi. or more. Because of its great distance from other major racing countries, and also because of its grassless tracks, the United States found it difficult to offer such international races. The situation was changed by the development of air transport and the construction of numerous turf courses inside the standard dirt tracks. Laurel Race course at Laurel, Md., inaugurated an international whose first running. in 1952, was won by an English runner, Wilwyn, and the second by a French horse, Worden. Santa Anita park, Arcadia, Calif., constructed an unusual turf course which begins outside the main track, covering sloping terrain like that of European courses, and finishes inside the dirt track.

2. Genealogy.—Racing is essentially international insofar as breeding is concerned. The modern American thoroughbred became thoroughly internationalized in blood. There are three long-established male lines, peculiar to America alone and popularly known as the Domino, Fair Play and Ben Brush families, but the breeding fabric represents a particoloured pattern, with these strains and the most fashionable English, French, South American, Australian and other foreign ones complexly interwoven. Kentucky retains its supremacy as the great breeding ground, with

Virginia, Maryland, New Jersey and California also prominent. Annual production of foals is almost 10,000, or about double that of England and Ireland. The American *Stud* Book is published by the Jockey club, and all thoroughbred foals must be registered. No horse not so registered can start at any recognized meeting.

The inheritance of racing class has fascinated students of the thoroughbred horse for generations, but the emphasis has been on genealogy rather than on genetics, with the result that race-horse breeding has a somewhat less scientific background than the breeding of other livestock. Because certain families (female lines) were more numerous and hence tended to produce more horses of exceptional class, various qualities were ascribed to different families — as, for instance, the postulate made by the Australian Bruce Lowe in the 1890s that families no. 3, 5, 8, 11 and 14 were the ones responsible for successful sires. The frequent recurrence in the pedigrees of noted runners of such names as St Simon, Isonomy, Hermit, Hampton and Bend Or led Lieut Col. J. Vuillier in France to construct a "theory of dosages" based upon a supposed optimum in the proportions in which these strains should be combined — a system which had some acceptance in continental Europe and in South America. Many breeders place their hopes upon the repetition or approximation of a "nick," or combination of bloodlines which already has produced one or more good horses. Such practice gradually gave way in the face of a growing comprehension of the elementary principles of genetics. Only one thoroughly scientific attempt to estimate the complicated probabilities in race-horse breeding was made in the first half of the 20th century — at the Eugenics Records offices of the Carnegie institution at Cold Spring Harbor, Long Island, N.Y., in the 1920s under the direction of Dr. H. H. Laughlin. Most breeders remained unaware of the conclusions reached and would find it difficult to apply them if they were understood. The American Thoroughbred Breeders association at its offices in Lexington, Ky., where the breeding industry centres, established a small research program to determine some of the more important probabilities involved, using simple standards of measurement. Previous studies. excepting the work at Cold Spring Harbor, had yielded erroneous conclusions, partly because they were based on examination of the ancestry of the best horses only, without recourse to the fundamental statistical procedure of using control groups, and partly because there was available no constant arithmetic measure for appraising individual runners and groups of runners in different generations and in different countries. Laughlin's arithmetic measure was a "yardstick" based on speed, with corrections for weight carried and variations in tracks. The "biological handicap," or genetic prediction index, he used was obtained by compounding the measurements of the individual runner, his parents and his sibs and half-sibs. Laughlin's complex prediction index was never put to practical use, except for a brief and inconclusive trial in the early 1930s at the Mereworth farm of Walter J. Salmon, who had financed the investigation.

3. The Progeny Index. — The index developed in the offices of the American Thoroughbred Breeders association was simpler, less expensive and more effective in predicting genetic probability. It was based on the assumption that relative earning power provided an approximate measure of a horse's class, constitution and soundness, the principal factors to be accounted for in quantitative measurement of the inheritance of racing ability. The basis for all calculations was the average monetary distribution per runner in a given year; and the performance of any runner in that year was expressed as a ratio to this "average expectancy." In 1933 the North American average per starter was $928 (9,176 runners, $8,516,325 total monetary distribution) and in 1955 the average was $2,941 (26,056 runners, $76,643.696). Thus a horse which earned $928 in 1933 had an index of 1.00 for that year, and a horse which earned $928 in 1955 had an index of .32. The yearly indexes, representing division of actual earnings by a corrective constant, are additive without the distortion entailed by summing the inconstant monetary units. The annual differences in opportunity are largest, of course, in countries with the most pronounced inflation; in France the average distribution per runner in 1925 was 9,773 francs, and 30 years later in 1955 it was 371,188 francs.

Studies making use of the average-earnings index have demonstrated that the earning power of the parent is directly proportional to the probable earning power of the offspring, within the limits circumscribed by chance assortment of genes and by environmental factors. (John Pirri. Jr., and Dr. Dewey G. Steele, professor of genetics at the University of Kentucky, using earnings as a measurement of relative success, were able to make a tentative estimate that heredity accounts for about 50% of the differences in racing class in the thoroughbred.) The most successful sires, with only occasional exceptions, are animals which, as race horses, ranked in the top 1% of their male contemporaries. The highest known full-lifetime progeny index for a thoroughbred sire is 4.75, indicating earning power at a rate 4.75 times the average expectancy; this index was computed for the unbeaten St. Simon, whose offspring raced in Great Britain from 1889 to 1912. Blandford, foaled in 1919, had a lifetime progeny index of 4.29 in Great Britain and Ireland. The sons and daughters of Bull Lea, outstanding American sire of the century, had a group index of 5.01 at the end of 1955; this stallion's 816 year-starters had earned a total of $10,758,394, an average of $13,184 per runner per year. The offspring of Nasrullah, a highly temperamental horse imported to Kentucky in 1950, had a joint British-Irish-American index of 5.05 at the end of 1956. In general, a sire with a progeny index of 1.80 or higher is recognized as successful, and in North America about 7.5% of stallions reach this level, though only about 1% maintain indexes of more than 3.00.

As with stallions, the probable genetic merit of females is best estimated by reference to their racing ability. Of course, a much larger proportion of females have relatively high chances of becoming good producers. About 5.7% of brood mares have racing indexes of 2.00 and upward; the top 10% begins at 1.20, the top 20% at 0.65. More than one-fourth of the thoroughbred brood mare population in North America is comprised of females never tested in competition on the race course.

It is common practice in all racing countries for breeders to select prospective brood mares largely, if not primarily, on the basis of ancestry; particularly they prefer the daughters of a sire already distinguished as a sire of brood mares or the daughters of mares already distinguished by their own racing or that of their offspring. This method frequently yields satisfactory results, but selection based on ancestry compares unfavourably with selection based on individual racing capacity. The highest known index for a group chosen on the basis of ancestry is that of 2.40 (at the end of 1954) for the progeny of daughters of the excellent stallion Blue Larkspur. This figure would be lowered considerably if the best race mares among Blue Larkspur's daughters were subtracted from the totals. On the other hand, the progeny index for the best American race mares as a group was 3.66; for winners of the English 1,000 Guineas (one mile), 3.61; for winners of the English Oaks ($1\frac{1}{2}$ mi.), 3.81. A study completed in 1952, based on actual results in North America, showed that high-class race mares produced 3 times as many horses with over-all racing indexes of 2.00 or higher as equal numbers of mares representing the average of the breed; 6 times as many with indexes of 4.00 and upward; 12 times as many with indexes of 10.00 and up; and 24 times as many top-class runners, as indicated by indexes above 20.00.

4. Breeding Race Horses. — Few games of chance are as hazardous and expensive as that of breeding race horses. An average-of-the-breed study completed in 1956 and based on North American results showed the following expectancies from 1,000 mares covered in 1945: 520 registered foals of 1946, 387 starters, 270 winners, 45 runners with racing indexes of 2.00 and upwards, 15 at 4.00 and upwards. Since a horse must earn about twice the average to pay his expenses in training, and about four times the average to account for production costs plus expenses in training, it is clear that the gold in the hills of race horse breeding is rather low-grade ore, except for the few studs whose refining methods have led them, by accident or design, to choose the best breeding stock. The rewards of breeding and owning race horses are primarily the intangible satisfactions of a sport. But such is the fascination of pursuing these satisfactions that prices of racing and breeding stock

have reached figures which have only the most tenuous connection with fiscal probabilities.

In 1955 executors of the estate of William Woodward, Jr., dispersed the 62 horses of his Belair stud and stable for $2,476,600 in an auction by sealed bids. One of the horses in the racing stable was the three-year-old Nashua, who had won 16 of his 20 races and earned a total of $945,415. There were five bids of more than a million dollars. Nashua went to a syndicate that had offered $1,251,200, and that later reported that it had been offered a still higher price for the colt. When he was retired to the stud at the end of the 1956 season, Nashua had earned a total of $1,288,565, surpassing Citation's record of $1,085,760. Round Table in 1958 became the third winner of more than $1,000,000, topping Nashua with $1,336,364. Nashua was an exceptional runner, and exceptionally sound, though not necessarily superior to champions that had earned smaller amounts in periods of less extravagant purses, or even to his contemporary the California-bred Swaps, who defeated him in the Kentucky Derby and lost to him in a special race later, and whose total winnings were $848,900. The famous Man o'War, who ran in 1919–20, had earned only $249,465 in winning 20 of his 21 races.

The other Belair horses brought large profits, totaling $610,000, when they were resold by auction early in 1956. One of these was Nashua's dam, Segula, who went to the Greek shipping magnate Stavros Niarchos for $126,000, the highest price ever paid for a brood mare in the U.S. (The top-class fillies Busher and Honeymoon were still in training when they brought $135,000 each at the Louis B. Mayer dispersal in 1947.) The Woodward estate's five shares in the syndicated stallion Nasrullah, sire of Nashua and other good horses, were sold for $251,000, a figure which indicated an approximate total valuation of $1,700,000 for the 16-year-old stallion. In the yearling auctions at Keeneland race course, Lexington, Ky., colts by Nasrullah brought $80,000, $86,000 and $80,000 in three successive years, 1954, 1955 and 1956. The $86,000 record was broken in 1956 at Saratoga Springs, N.Y., headquarters for the principal yearling sales in the east, when Rise 'n Shine, an English-bred son of Hyperion, was sold for $87,000. The highest priced yearling filly, sold at Keeneland, Ky., in 1956 for $63,000, was Idun, who went unbeaten in 1957, earning $220,955, the largest sum ever accumulated by a two-year-old filly.

IV. OTHER COUNTRIES

1. Continental Europe.—While Great Britain and Ireland are still the principal exporters of bloodstock, the studs of these countries have found it necessary to draw recruits from abroad in such pumbers that the British-Irish thoroughbred has become a product of international ancestry. The changing situation is largely due to the strength of competition from continental Europe; this rising strength, in turn, probably stems from the fact that racing in Europe adheres more strictly to what may be called the classic pattern than it does in Great Britain, the country from which the pattern was taken. (See also Great Britain: The Rise of Commercialism, above.)

Racing has long been established in most of the major countries of Europe and attained new heights of popularity after World War II. The British model for three-year-old classics is followed rather closely, each country having its equivalent of the 2.000 Guineas and the 1,000 Guineas races at a mile (1,600 m.), the Derby and Oaks at $1\frac{1}{2}$ mi. and the St. Leger at about $1\frac{3}{4}$ mi. There is, however, a major difference in that the courses in continental Europe have fewer races for two-year-olds and fewer races at the very short and very long distances. The cumulative effect of generations of selection for the classic distances, with only minor accents on precocity and speed on the one hand and extreme distance on the other, has been to render the British and Irish studs largely dependent upon bloodlines developed from the less diverse standards of continental racing.

France, which has attained a position of eminence in racing and breeding, has a limited program of two-year-old races, climaxed by the 1,600-m. Grand Criterium in October. The Derby and Oaks equivalents were founded in 1836 and 1843 respectively, the Poules d'Essai (Guineas) in 1841 and the Prix Royal Oak (St. Leger) in 1872. Older and richer than any of these is an additional classic, the 3,000-m. Grand Prix de Paris, dating from 1834; it is run at Longchamp at the end of June. Most important of the races for three-year-olds and upward is the 2,400-m. Prix de l'Arc de Triomphe at Longchamp in October, an international test with a larger value than any other race in Europe. French breeding is under government supervision, and the Société d'Encouragement, roughly equivalent to England's Jockey club, administers the conduct of horse racing.

In Germany and Italy and elsewhere in Europe, racing tends to follow the French pattern, rather than the British. Stallions from France and Italy have exercised such persistent influence that it is the exception to find a British classic winner, especially beyond the one-mile distance of the Guineas, without parents or near ancestors from Europe. Italy has produced so many horses of exceptional merit, such as the unbeaten Nearco, his half brother Niccolo dell'Arca, Donatello II, Tenerani and the unbeaten Ribot, best runner in Europe in 1955–56, that its influence on breeding in Great Britain and elsewhere is far out of proportion to its relatively small annual production. Among the most successful sires in the U.S. after World War II were Nasrullah, a son of the Italian Nearco (himself descended from English, French and American stock); Bull Lea, a son of the French-bred Bull Dog; and Princequillo, by Prince Rose, one of the best horses bred in Belgium.

European racing is under the direction of organizations whose authority is delegated by the government, usually through the ministry of agriculture. The fortunes of the sport have varied with military and economic conditions, but there has been no suppression like that in the U.S. In areas under Soviet domination, the horses, as well as the race courses, are owned by the state, and successful trainers and jockeys are rewarded less liberally than in countries where private enterprise persists. Hungary, one of the nations where Communism has created the anomaly of competition between horses under state ownership, was the birthplace of the phenomenal mare Kincsem, unbeaten in 54 races, and of Kisber, winner of the 1876 English Derby.

2. British Commonwealth.— In countries of the British commonwealth racing has been sedulously cultivated, rising to the greatest success and importance in Australia, New Zealand, Malaya, India, the Union of South Africa and Canada. Canadian turf affairs are so closely connected with those of the U.S. that they are generally considered together. Climatic conditions make Canadian breeding of local importance only; thoroughbreds produced north of the Great Lakes are, however, improving as a result of recent improvements in racing itself. Many of the fixed events of the Canadian meetings are restricted to Canadian breds. Conversely, countries which have long seasons of intense tropical heat, such as India and South Africa, have found it difficult to maintain thoroughbred production at a high level without making frequent importations of racing and breeding stock from areas of more favourable climate. Meetings were held in India as early as 1795, but it was not until 1857 that the Viceroy's cup was first given, which eventually became the most important fixed event of the Indian racing calendar. (After India attained independence the name was changed to that of the reigning British monarch.) The valuable Eclipse stakes is raced at Bombay. The first thoroughbreds from England reached Cape Town in 1792 but it was a long trek to organized racing of any scope, and the South African Derby was not established until 1885, the Oaks and St. Leger both dating from 1913. The chief all-ages event, the Johannesburg Summer handicap, was first run in 1896. The principal meetings are those held at Johannesburg, Cape Town and Natal.

Among the commonwealth countries, therefore, Australia and New Zealand easily stand first, both in the character of their racing and the class of horses they have produced. It is recognized that the breeders of "down under" have turned out animals comparing with the greatest ones of England, France and the U.S., and that to win their classics, cups and handicaps affixes a stamp of international significance. The Melbourne Cup race, run annually at the Flemington course, near that city, distance 2 mi., is among the most famous handicap races in the world; it was established in 1861 and the roll of winners includes the names of many grand per-

formers, headed by that of Carbine, whose feat of carrying 145 lb. to easy victory in 1890 in what was then record time, 3:28¼, stands unequaled in modern turf history as a weight-carrying feat. His intrinsic greatness he further demonstrated by his stud career in both Australia and England. Today his blood appears in the pedigrees of many of the best horses of all racing countries. Carbine was bred in New Zealand, which produced also the great gelding Phar Lap (1926) and numerous other runners which have dominated the turf in Australia. The two great racing centres of Australia are the Flemington course at Melbourne and the Randwick course at Sydney, but there are many other meetings, and Australia ranks second only to the U.S. in the number of races run annually. New Zealand's principal courses are at Auckland in the North Island and Christchurch in the South Island. The New Zealand Derby at Christchurch was established in 1860.

3. South America.—Racing is firmly established in the majority of the greater South American countries, with Argentina the leader and Brazil, Uruguay, Paraguay, Chile, Peru, Ecuador, Colombia and Venezuela all active. The courses at Buenos Aires, Santiago, Rio de Janeiro and São Paulo are among the most luxuriously appointed in the world.

In the matter of breeding Argentina ranks first and Chile second, though many successful studs are maintained in other countries. The "Purple Land" of Argentina is perhaps unexcelled for purposes of race-horse production, and its great stud farms, lavishly equipped, produced many runners which presumably could be ranked with the world's best. Both Argentina and Chile have a considerable export trade in thoroughbreds, of which many good ones have gained distinction in the United States. There is very little exportation of breeding stock from either North or South America to Europe.

In general, racing in South America is under the direction of Jockey clubs, which may have hundreds or even thousands of members but exercise their control through small boards of governors. These bodies have a lesser degree of autonomy than the Jockey club in England; usually they operate within the limits prescribed by, and under the immediate direction of, the national government. Venezuelan racing is administered directly by the government.

V. STEEPLECHASING AND HURDLE RACING

These forms of racing trace their ancestry directly back to the chase and the field of war, where the necessity of clearing the most formidable obstacles was paramount, and horses of great size, strength and agility, as well as speed, were required. In fact, if the history of the steeplechase (of which the hurdle race is a miniature form) is investigated, it mill be found almost invariably to have been sponsored in the beginning by cavalry officers and sportsmen avid for the excitement and danger of the hunt. It is therefore natural that in its organized form it still attracts many gentlemen riders, the weights being such as to allow their constant participation; and its administration is usually left to the National Hunt committee in England and to the National Steeplechase and Hunt association in the U.S. Many of the most important fixed events, with valuable and coveted trophies, are run at the various hunt club meetings over cross-country courses of great difficulty.

Steeplechasing reaches its annual apogee in the Grand National, which was first run in 1839 over the Aintree course at Liverpool, and attracts world-wide interest and enthusiasm, in which regard only the Derby at Epsom may be said to exceed it. The honour of winning it has been sought by sportsmen of many different nationalities, not only because of the lasting prestige that goes with a victory, but for the material reward; in value to the winner it has ranged as high as $64,625 (1929), though originally it was almost negligible. The course is of great danger and difficulty, being an irregular triangle in shape, which must be covered twice, making a total run of 4 mi 856 yd. and calling for 30 jumps. A number of these jumps, such as Becher's and Valentine's Brooks, the water jump, etc., are of tremendous hazard, causing many starters to come to grief during the course of the race. All told, during the 100 years and more of Grand National history, the number of contending horses that have either met their deaths or been permanently crippled is large; the human toll taken from the riders has also been considerable. This, however, seems merely to add to the fascination of the event, both to the participants and the public. Thirty or more horses often go to the post, of which sometimes but a scattering few ever finish, while on one occasion only a single horse completed both rounds without falling.

The Grand National is a handicap, with very high imposts. On three occasions 12 stone 7 lb. (175 lb.) has been carried to victory. While the general belief prevails that only a horse of prodigious strength and stamina and great size can win it, as a matter of fact it has been won by animals of many different shapes, sizes and types. Its nearest analogue in the U.S. is the American Grand National, run at Belmont park. The only horse that has ever won both events, Mrs. Marion du Pont Scott's Battleship, was a little horse standing but 15.1¾ hands (5 ft. 1¾ in.) and weighing less than 1,000 lb. in racing trim. Nevertheless, he carried 11 stone 6 lb. (160 lb.) at Aintree and defeated a field of 35 in 1938. He was then 11 years old and had won the American event four years before when 7 years old, under 147 lb. Battleship was bred in the United States, a son of Man o' War. Many of the renewals at Aintree have been won by Irish horses, and the belief prevails that the Irish hunting type is the most approved one for cross-country racing. It remains also to be said that many of the most famous Grand National winners have been half-bred, not purely thoroughbred. (J. L. HE.; J. A. ES.)

VI. HARNESS RACING

The trend in harness racing in the United States and Canada after World War II was away from the old country fairs, still the more numerous in number, to the arc-light mutuel circuit headlined by the two largest circuits, Yonkers raceway in Yonkers, N.Y. and Roosevelt raceway in Westbury, N.Y., both in the metropolitan New York area.

When the Old Country Trotting association pioneered nighttime light harness racing over a half-mile oval in the fall of 1940 at Westbury, there were but 126,000 fans for the season, who wagered oniy $1,704,000. The climb in interest and activity was steady after the end of World War II. Early in the second half of the 20th century the national annual attendance at harness races had grown to more than 10,000,000. The mutuel handle was more than $600,000,000.

Annual sales of horses were more than $5,000,000, and the leading sale at Harrisburg, Pa., was more than $2,000,000. L. B. Sheppard's Hanover Shoe farm of Hanover, Pa., paid $500,000 for the 1j-year-old bay stallion Adios in 1955 to Delvin Miller of Meadow Lands, Pa.

Not only did attendance and mutuel figures skyrocket on a national basis, but purses tripled in a decade from $7,338,876 immediately after World War II to $21,862,611. The famed three-year-old trot, the Hambletonian, was worth $117,117.98 in 1953.

While Roosevelt raceway and Yonkers raceway combined produced more than 50% of the national attendance and mutuel figures, there was a constant growth in the Maryland and Delaware areas, Detroit, Cleveland, Chicago and the west coast. Even the fairs through the middle west started to swing to night racing.

The Illinois State fair, in Springfield, held a one-week meeting worth almost $500,000 annually. On the night circuit the Messenger stake, William H. Cane stake, the American Classics and the Trans-America series were among the major events. The pacing side of the sport started to outstrip its trotting rivals.

1. The Standard-bred Horse.—The American standard-bred trotter is descended chiefly from thoroughbred ancestry and, as a breed, closely resembles the thoroughbred in many respects, the differences between the two being, at best, chiefly those of detail. As a recognized breed, while the beginnings date back to post-Revolutionary times, it was with the creation of the *American Trotting Register* in 1871, followed by the erection of the standard government admission thereto in 1879, that its history officially began. *(See* also HORSE.) The breed has been disseminated over almost the entire globe, and thousands of its select members have

been exported for racing, breeding and other purposes to most European countries, to the antipodes and elsewhere. In England it received little recognition and never gained a foothold, being unable to make headway there against the thoroughbred. However, in such countries as France, Germany, Italy, Belgium, Denmark, Sweden, Austria, Hungary, the U.S.S.R., Australia and New Zealand, the influence of American blood and American training and racing methods became dominant, though marked by diverse national differences.

To Messenger, an English thoroughbred stallion of fame upon the British turf, is given the credit of being the "great father" of the standardbred. He was foaled in 1780, imported in 1788 and died in 1808, leaving a large progeny. While his success as a thoroughbred progenitor was great, it was the remarkable trotting capacity of his descendants that rendered him a monumental figure. This came to a climax in his great-grandson Rysdyk's Hambletonian (1849), a stallion who was thrice inbred to him and who became the patriarch of the modern standard breed, which, indeed, might with equal propriety be termed a Hambletonian breed, so all-pervasive is his blood throughout its entire structure.

2. Records.—The standardbred, in the beginning built up from heterogeneous elements, has evolved into a breed which, like the thoroughbred, is established upon a basis of blood alone, whereas in the beginning it was founded principally upon that of performance. Selective breeding, long continued, has not only purified its blood and refined its physical structure, but has improved its speed until it has attained a rate once considered impossible.

The trotting records marking this progress were as follows (for one mile):

First 2:30 trotter—Lady Suffolk, 2:29½ (1845)
First 2:20 trotter—Flora Temple, 2:19¾ (1859)
First 2:15 trotter—Goldsmith Maid, 2:14 (1874)
First 2:10 trotter—Jay-Eye-See, 2:10 (1884)
First 2:05 trotter—Nancy Hanks, 2:04 (1892)
First 2:00 trotter—Lou Dillon, 1:58½ (1903)

The mile record for trotters, 1:55¼, was made in 1938 by E. J. Baker's Greyhound.

Harness race horses are divided into two classes, trotters and pacers, which ways of going are variants of one original gait; but whether trot or pace was first common to the prehistoric Equidae it is impossible to say. Within the present standardbred there is little difference in ancestry between performers at the two gaits; many animals have made fast records at both, the most notable instance being that of Calumet Evelyn (1:59½ trotting, 1:59¼ pacing), winner of many rich events in each division. The mile record for pacers at mid-20th century stood at 1:55 flat, by Billy Direct in 1938. As will be seen, the extreme rate of speed attained by trotters and pacers is practically the same.

All racing is over prepared dirt and clay tracks, which, to facilitate extreme speed, have a harder surface than those used by running horses. Many tracks are ovals of one mile but the great majority of those in use are a half mile and five-eighths of a mile in length. There is one notable three-quarter mile track at Vernon, N.Y.

The principal mile tracks belong to the Grand Circuit, an organization which was formed in 1873. Half-mile tracks also form part of the Grand Circuit schedule now. All racing is to sulky, a two-wheeled vehicle of the lightest possible construction, weighing about 25 lb., with pneumatic tires. The average driver weighs about 170 lb., though some famous reinsmen have scaled more; thus the gross weight pulled on most occasions is approximately 200 lb. In the early days of trotting in the U.S., racing under saddle was popular, but this has long since been discontinued. However, the champion Greyhound was sent for a saddle record in 1940 and was ridden a mile in 2:01¾ by Mrs. J. B. Johnson (later Mrs. Fred Van Lennep of Castleton farm), a lady who never before had attempted such a feat. With his professional trainer, the late S. F. Palin, up, Greyhound in 1937 set the record for 1½ miles at 3:02½ and in 1939 that for two miles at 4:06.

Racing to four-wheeled wagon is another form of the sport now discontinued. The record at this hitch was 2:00 minutes flat, first set in 1903 by Lou Dillon and equaled in 1911 by Uhlan. Both were owned and driven by C. K. G. Billings, an amateur, who weighed about 175 lb. and whose wagon weighed 49 lb., making the total weight pulled about 225 lb.

Harness racing in the U.S. and Canadian fair circuit is usually at one-mile heats, best two in three, or with three heats the limit, the horses being placed as they stand at the conclusion of the third. In case of ties the heat winners race off. The mutuel tracks dominantly hold all races as one-mile, single dash events. The administration of the sport is vested in the United States Trotting association, a central governing body, which also owns the *Trotting Register* and publishes it and the annual *Year Book* in which official summaries of all meetings appear. State racing commissions and the Harness Tracks of America, Inc., embracing the larger mutuel tracks, appeared with the growth of the mutuels and became increasingly active.

3. Futurities—There are numerous fixtures for two- and three-year-olds of high value, many of them classified as futurities. Older fixtures include the Hambletonian, Little Brown Jug, Kentucky futurity, Fox stake and the Horseman stake. With the evolution of the breed, the production of early and extreme speed became the great goal, and the two-year-old record of 1:58 was set by the pacer Torpid in 1956. The two-year-old trotting mark of 2:00 was made by Titan Hanover in a time trial in 1944 and was equaled in a race by Scott Frost in 1954. Titan Hanover also held the trot mark as a three-year-old, 1:58. The three-year-old pacing mark is held jointly by Tar Heel and Solicitor at 1:57⅖ for one mile, made in 1951; Torpid (retired to stud in 1958) did 1 1/16 mi. in 2:90⅝ in 1957. One of the leading breeding grounds is Kentucky; there Greyhound, a gelding, was bred by H. H. Knight, as was the champion mare Rosalind (1:56¾) by B. F. White, her trainer and driver. Billy Direct (1:55), the champion pacer, was a stallion and was bred in Tennessee by H. H. Ridge of Massachusetts, Adios Harry (1:55), who tied Billy Direct's mark in a race at Vernon, N.Y., in 1955, was bred by L. T. Hempt of Harrisburg, Pa. The champion pacing mare, Her Ladyship (1:56¾), was bred in Indiana by Clair Wolverton, a professional reinsman, as was the world's champion trotting stallion, Star's Pride (1:57⅛), bred by Henry J. Warwick of Westfield.

In extreme speed over fractional distances the harness race horse has attained rates which compare favourably with those of running horses. Billings in 1911 drove Uhlan to a four-wheeled wagon over a half-mile distance in 56¾ sec., and in 1913 his trainer, Charles Tanner, drove him one-quarter mile in 27 seconds flat. Joe O'Brien approached such clockings with Scott Frost in 1955 and again in 1956. Directum I, the pacing stallion, set a half-mile record of 55¾ sec. in 1916 with trainer Thomas W. Murphy.

The blood of Hambletonian has submerged all others in production of the standard type. On the trotting side it is now confined almost exclusively to two direct male lines known as those of Axworthy and Peter the Great. Axworthy traces to Hambletonian's son George Wilkes, and Peter the Great to his son Happy Medium. In the pacing genealogy, the principal male lines are those founded by Abbedale, descended from Hambletonian's son Electioneer, and by Direct, descended from his son Dictator. Individually there is no difference in type between trotters and pacers, as might be expected when their blood is in such large measure identical. The average standardbred stands about 15 to 15¾ hands (5 ft. to 5 ft. 3 in.) tall and weighs in racing trim between 850 and 1,000 lb., being smaller in pattern than the thoroughbred but upon sturdier lines.

Canada has produced few thoroughbreds capable of holding their own with those below the border, but many standard-bred stars on both gaits, the trot and the pace; including a two-minute trotter in Lee Hanover and several pacers led by Winnipeg (1:57¾), holder of the world record for geldings at that gait. None will forget Dr. Stanton, a two-minute trotter of more recent vintage.

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tion Register (annual). (J. L. HE.; J. C. HN.; E. C. BG.)

VII. TOTALIZATOR

The totalizator, a complex mechanism employing both electrical and mechanical devices, is used on race courses for wagering under the pari-mutuel system. Its major functions are to print and issue tickets acknowledging wagers on various contestants; to summarize the sale of such tickets; and to display to public view the progress of wagering. Its popularity and the popularity of racing itself derive largely from the totalizator's speed and efficiency and from its numerous safeguards against unethical practice.

1. The Pari Mutuel.—The pari-mutuel method of wagering was developed in France by Joseph Oller. The descriptive French term (from *pari,* "bet," and *mutuel,* "mutual") is still in use, though the half-anglicized term mutuel betting is commonly heard in the United States. Oller's first *voitures des Poules* made their appearance at the Hippodrome de La Marche on March 5, 1865. The wagons carried equipment and personnel for selling numbered tickets. assigning the horses by lot and paying, after the race. the players who held the winning number. The pools, equivalent to American "jackpots." were simple lotteries. and later were suppressed by the courts for this reason. Oller at first provided only a larger facility for the popular practice of drawing the names of contestants from a hat and awarding the pool (in the U.S., the "pot") to the person who had drawn the winning horse.

In 1869 Oller instituted the pari-mutuel method, in which the player chose the horse he wished to back, and the payoff to the winners was made from the pool (the sum of wagers on the various runners) after deduction of a commission. The innovation gained quick popularity, since it allowed the player not only to make his own selection but to choose, by rough estimate at least, between long and short odds. The system was declared illegal in 1874, the courts holding that it violated the antilottery act of 1836, but in 1887 it was reinstated in favour. Except for the lottery operated under government direction, it remained as the only legal form of wagering on horse races in France, where—as in New Zealand—it included numerous off-course urban centres for accepting wagers which became a part of the pools at the course.

The pari mutuel was introduced into the United States in the 1870s, but proved less popular than bookmaking, a method imported from England about 1871. Churchill Downs, which also had auction pools and bookmakers, maintained a few machines for mutuel betting from the spring of 1878 until 1889, and revived it in 1908, when it was established by court decision as a legal method of betting on races in Kentucky. Thereafter mutuel betting became the predominant form of wagering on horse races in the United States, though it did not supersede the bookmaker in New York until 1940.

Mutuel betting does not thrive in competition with bookmakers, as was demonstrated by its early history and by the situation in England into the second half of the 20th century, where the books continued to be more popular. (*See* also *Great Britain: Matches and Handicaps,* above.) It had, before the totalizator was developed, two great deficiencies. Tickets were sold by hand, and each sale was recorded on a hand-operated tally machine; since the totals shonn on the various "clickers" were not summed up until after the race, the player had no accurate estimate of the odds Further, the integrity of the system depended upon the integrity of management and of many employees; and however honest the workers in the mutuel department may have been, the public mas alnays free to speculate upon the degree of dishonesty among them. The tote corrected both of these deficiencies, leaving the bookmaker with one major advantage, that he could offer the player a fixed price at any stage in the progress of wagering In the United States and in most other countries the tote came into favour because of its safeguards against sharp practice and the fact that, with bookmakers excluded, it submitted all wagers to the easy collection of commissions and taxes.

The pari-mutuel system is adapted to many types of wagering, including doubles and triples (combinations of horses in different races) and the involved cumulative bets which have their greatest popularity in South and Central America (*see* also *Double and Quinella Pools,* below); but its most common use is for straight (win), place and (in the United States) show pools. Except in North America, the general practice is to operate straight and place pools. Money in the win pool, after deduction of the stakeholder's fee, is divided among those who backed the winner. In the place pool, after commission has been deducted, the remainder is divided into three equal parts, and each third is divided among backers of the horses which placed (in the United States, showed); that is, which finished first, second or third. This method of calculation makes possible a return less than the amount wagered.

The North American methods are different; there are three pools instead of two, and the calculation is made in such a way that the return on a winning ticket must be greater than the sum wagered, even if the stakeholder must forfeit a part or all of its commission, and possibly more, to pay the winners a stipulated minimum of five or ten cents on the dollar as profit. The straight pool is for the winner only; the place pool is for the horses which finish first and second; the show pool, corresponding to the place pool of other countries, pays off on the horses which finish third or better. In calculating the place payoff the commission is taken off first; the money bet on the first two horses is subtracted from the pool; the remainder is divided into two equal parts; and each part is distributed among the backers of the first and second horses, plus their original stake. The show pool is calculated in the same manner, except that three horses, instead of two, must be accounted for.

*The **Two** Methods of Calculating Pari-Mutuel Returns*

	In U.S. ("Show" pool)	Elsewhere ("Place" pool)
Example		
Total pool	100,000 units	100,000 units
Amount bet on winner	50,000 units	50,000 units
Amount bet on second horse	10,000 units	10,000 units
Amount bet on third horse	5,000 units	5,000 units
Method of calculation		
Total pool	100,000 units	100,000 units
Stakeholder's fed (10%)	10,000 units	10,000 units
Amount returned to public	90,000 units	90,000 units
Amount bet on first three horses	65,000 units	(not considered)
Profit or actual winnings	25,000 units	(not considered)
Amount (of profit) shared by each group	8,333 units	30,000 units
Amount returned per unit wagered on winner	$\frac{8,333}{50,000} + 1 = 1.15$*	$\frac{30,000}{50,000} - .60$†
Amount returned per unit wagered on second horse	$\frac{8,333}{10,000} + 1 = 1.80$*	$\frac{30,000}{10,000} = 3.00$
Amount returned per unit wagered on third horse	$\frac{8,333}{5,000} + 1 = 2.65$*	$\frac{30,000}{5,000} = 6.00$

*Odd pennies above the nearest five cents are called breakage and are retained by the stakeholder. A two-dollar bet would return twice the amount shown.
†This is a loss of .40 units.

2. Totalizators.— A totalizator developed by George Julius was first used at the Ellerslie race course, Auckland, N.Z., in 1913. The electromechanical device was first called the Julius tote. later the Premier tote and, more recently, the Automatic tote. A company organized by Julius provided totalizators for several countries, including the United States, where the so-called American tote superseded it in popularity. The American Totalisator company was organized by Henry L. Straus of Baltimore, Md., with primary assistance from the brothers Charles A. and Gurnee Munn of Palm Beach, Fla. The first engineering development was directed by A. J. Johnston of the General Electric company, who was later assisted by O. C. Levy and H. C. Robinson of the Automatic Electric company. The first American totalizator, built in 1927–28 by Johnston, was taken in 1929 to England, where it was adopted. with modifications, by the Race Course Betting Control board, and was used first at Newmarket in 1930 and later at many other courses. This tote, based on automatic telephone equipment, had a minimum of mechanical parts.

The ticket-vending machines most widely used in the U.S. and Great Britain were developed in England by the Bell Punch and Printing company of Uxbridge. The simplest of various types of such machines is a hand-operated box which ejects preprinted tickets by means of a lever or slide. Most modern totes use a complicated device which prints and issues a ticket in the same

operation. When the better has given the program number of the entry he wishes to back, the vendor presses the corresponding key. Electrical impulses record the wager in the appropriate adding machine for the contestant and in the grand-total machine for the pool. The machines record the wager simultaneously and return an acknowledging impulse which sets the rotary press in motion. The press prints the mutuel ticket from a roll of specially designed laminated paper, cuts the ticket from the roll, ejects it from the machine and returns to a neutral position. The machines are capable of issuing from 40 to 55 tickets per minute.

The American tote uses a mechanical counter from which each vending machine produces a printed record of its sales. This device provides the only method for a complete audit of the tote operation and for checking against the possibility of error in the various money totals. Another type of vending machine is capable of issuing tickets in more than one pool and in more than one denomination from the same unit. In some situations they are more convenient than the one-pool, one-denomination machines, but they are slower in operation and have no mechanical counters to provide data for a complete audit. They were not generally adopted in the United States.

All vending machines are electrically locked by a designated official to render impossible any sale of tickets after a race has begun. They remain locked until precautions have been taken to ensure that they can issue tickets only for the next race. So many protective devices are in use that counterfeiting of winning tickets has been rendered virtually impossible. (J. A. Es.)

The adding machines in general use fall into two categories: (1) the electromechanical and (2) the electrical. The first makes use of a motor-driven collecting or accumulating device which actuates an electrically operated escapement mechanism, usually driven through slipping belts. As wagers are received, the locking gears are disengaged, and the driven shaft is permitted to turn a distance calibrated to correspond to the value of the wager (for example, 2° for a $2.00 bet and 10° for a $10.00 bet). The turning shaft either actuates a self-synchronous motor which keeps a similar motor operating the indicator board in step or actuates indicator drums by direct gearing or by means of chains and sprockets. This is the method used by the machines operating in most countries. In the U.S. and, to a large extent, in England, the electrical totalizator is used.

The electrical totalizator operates on an entirely different principle. Wagers are collected by means of either a multiple bank rotary switch or by a relay chain. As bets are collected, betting relays are actuated which correspond to the value of the wagers. These relays step appropriate rotary switches, in the units, tens, hundreds and thousands positions, etc. Each position of these switches energizes a combination of indicator relays which cause illuminated numerals to appear on the display boards. (H. L. Str.; Tm. S.)

In both systems, the problem is complicated by the necessity of maintaining not only great speed and accuracy, but of obtaining instantaneous alarms if a bet fails to get through. This alarm system must indicate both the source and the cause of trouble.

3. Tote Boards.—Totalizator indicator boards display either the number of units or the amount of money wagered on each contestant in each pool and the total for each pool.

In some cases the approximate odds are given for the win pool, instead of the amount wagered on each entry, but more usually both the amounts and the approximate odds are shown. The American tote uses an electric analogue computer for automatic calculation of the odds. In the place pool (place and show pools in the C.S.) only the amounts are shown; it is impossible to estimate the odds, since the payoff on any one horse will vary in accordance with the amount wagered on the other horse or horses whose backers are to share in a division of the pool. The tote boards display results of races, payoff prices, running time of the race, time of day, post time for the next race, a signal to indicate an inquiry by the stewards, and other information.

Early types of indicator boards were built on the cyclometer principle, using large drums driven by gears or by chains and sprockets. The mechanism was cumbersome, and the drums were so heavy that they were difficult to start and difficult to stop at the proper point. A more ingenious device was of the "flapper" type, with the top half of the numerals painted on a nest of flat plates and the bottom half on a similar nest of plates which flipped into position in sequence as the actuating shafts rotated. A third method used a vertical ribbon against a calibrated background on which the odds could be read as on a thermometer.

None of these devices approached, in speed or readability, the modern indicators consisting of nests of incandescent lamps, 24 lamps to the unit, combinations of which may display any numeral from 0 to 9. In the section showing approximate odds two nests of lights are placed opposite each betting entry, so that odds up to 99 to 1 may be indicated, but not 100 to 1. The only moving units are small telephone-type relays. Changes in indication are made automatically at extremely high speed, since there is no inertia and no necessity for running through a sequence before coming upon the correct digit. Indicator boards with such equipment may be placed anywhere, without reference to the distance from other units of the tote.

4. Double and Quinella Pools.—The totalizator operation includes wagering in the double and quinella, or quiniela, pools. In the daily double, as it is called in the U.S., the better attempts to select the winners of two races. In the quinella the payoff is made on tickets picking the horses which finish first and second in a given race, without reference to the order of their finish. These wagers require special vending machines, and the pools, of course, are separate from those of other types of betting. The vending machines most commonly used in North America for the double and the quinella have mechanical counters which register separate totals for each combination. Each machine, at the close of betting, produces a printed record of the wagering, and from the total and subtotals thus made available, the payoff price for the winning combination is computed. In another type of vending machine the wagers on each combination are summed automatically in the same manner as in straight, place and show betting.

See also Gambling and Betting. (J. A. Es.)

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HORSE-RADISH (Armoracia rusticana or *Radicula armoracia*), a hardy perennial plant of the family Cruciferae, grown for its fleshy pungent root which is used mainly as a condiment or table relish to promote appetite, but earlier occasionally used in medicine. Horse-radish, native to Mediterranean lands, is now grown generally over the temperate zones, and in many cool, moist areas it has become a troublesome weed. Large, coarse, glossy green basal leaves arise from the crown atop the large white root; petioles are long; blades are up to 1 ft. long and 4 to 6 in. wide, generally with wavy or crenate margins; leaves of the flower stalk are smaller, not petioled, and oblong or lance-shaped. Small white flowers are borne in terminal or axillary racemes; pods are small, oblong and tipped by a short, persistent style; seeds rarely are borne under field conditions.

Processors of horse-radish desire roots that are large, free of crown or root branches and free of woodiness due to age. For producing such roots, deep rich moist soil free of stones and trash is essential. Horse-radish is usually propagated in the spring by planting pieces of pencil-sized roots about 2 ft. apart in rows about 2½ ft. apart. They are planted at a slight angle with the upper ends covered about ½ in. deep. All but the terminal shoot should

be removed to prevent later formation of multiple crowns; the side roots are also rubbed off to minimize formation of crooked and branched roots. This is done by hand, removing the soil from the upper part of the root piece, rubbing off excess shoots and roots, then replacing the soil. The procedure is repeated after 6 weeks.

Roots should be harvested after only one growing season. They are plowed from the soil, washed and trimmed for sale. The root tissue is grated and packed in white or distilled vinegar in glass containers; cider vinegar causes undesirable darkening of the product. (V. R. B.)

HORSESHOE PITCHING. The origin of horseshoe pitching, as well as that of quoits from which it probably derived, is uncertain in place and date. Legend ascribes the origin of both games to the early centuries of the Christian era when the games were played by soldiers in their camps. Both games involve the attempt to throw an object, usually iron or steel, so as to encircle a stake, or hob (as it is called in quoits), or to get the-object as close to the stake as possible. The throwing object in quoits is a ring, usually metal, though in deck quoits played on shipboard the quoit is made of rope; in the 20th century rubber quoits sometimes replaced metal ones as a safety measure, the striking of the metal quoit on the metal hob occasionally striking off shards dangerous to the eyes. A miniature quoit game was once a favourite in English public houses. In Canada and Scotland quoits is often the summer game of curling clubs.

Horseshoe pitching is usually played by two or four players. When two play, they pitch from one pitching box, 6 ft. square, in the centre of which is an iron or steel stake 1 in, in diameter extending 14 in. from the surface and inclined 3 in. toward the opposite stake 40 ft. away (30 ft. for women and juniors). After both players have pitched two shoes each (an inning), they walk to the opposite box and pitch from it. When four play, each pair of partners pitches from opposite boxes. Singles are played to a winning score of 50, doubles to 21. After all shoes have been pitched in an inning, scoring is as follows: one point for each shoe closer than an opponent's if the shoe is six inches or closer to the stake; three points for each ringer (shoe enclosing the stake); four points for ringer and closest shoe. If shoes are equally distant or if opponents have the same number of ringers, these are considered ties and no points are scored. A leaning shoe has no value over one touching the stake. Horseshoes designed for pitching weigh 2½ lb., are 79 in. long, 7 in. wide at the greatest width, with a 3½ in. space between the calks, as the small toes at each open end are called.

The National Horseshoe Pitchers association was incorporated and became the governing body of the sport in 1921. World championship tournaments are held annually, 36 contestants engaging in round-robin play so that each plays all the others. Outstanding pitchers have been Ted Allen and Fernando Isais; the former holds the record (72) for consecutive ringers in tournament play. (E. O. BR.)

HORSESHOES. The horny casing of the foot of the horse and other solidungulates, while quite sufficient to protect the extremity of the limb under natural conditions, is found to wear away and break, especially in moist climates, when the animal is subjected to hard work of any kind. This, however, can be obviated by the simple device of attaching to the hoof a rim of iron, adjusted to the shape of the hoof. The animal itself has been in a very marked manner modified by shoeing, for without this we could have had neither the fleet racers nor the heavy and powerful cart-horses of the present day. Though the ancients were sufficiently impressed by the damage done to horses' hoofs to devise certain forms of covering for them (in the shape of socks or sandals), the practice of nailing iron plates or rim-shoes to the hoof does not appear to have been introduced earlier than the 2nd century B.C., and was not commonly known till the close of the 5th century A.D., or in regular use till the middle ages. The evidence for the earlier date depends on the doubtful interpretations of designs on coins. etc. As time went on, however, the profession of the farrier and the art of the shoesmith gradually grew in importance. It was only in the 19th century that horse-shoeing was introduced in Japan, where the former practice was to attach to the horse's feet slippers of straw, which were renewed when necessary, a custom which may indicate the usage of early peoples. In modern times much attention has been devoted to horse-shoeing by veterinary science, with the result of emphasizing that methods formerly adopted caused cruel injury to horses and serious loss to their owners. According to modern principles (1) shoes should be as light as compatible with the wear demanded of them; (2) the ground face of the shoe should be plain, and the face applied to the foot concave; (3) heavy draught horses alone should have toe and heel calks on their shoes to increase foothold; (4) the excess growth of the wall or outer portion of horny matter should only be removed in re-shoeing; care being taken to keep both sides of the hoof of equal height; (5) the shoe should fit accurately to the circumference of the hoof, and project slightly beyond the heel; (6) the shoe should be fixed with as few nails as possible, six or seven in fore-shoes and eight in hind-shoes, and (7) the nails should take a short thick hold of the wall, so that old nail-holes may be removed with the natural growth and paring of the horny matter. (For game, Horseshoes, *see* HORSESHOE PITCHING.)

HORSETAIL, common name for plants of the genus *Equisetum,* the only living genus of a unique subdivision of vascular plants, the Sphenopsida.

Members of this subdivision, fossil and living, characteristically have whorled leaves and, in some species, branches. When branches do occur, they develop in alternating radii with the leaves. This arrangement is known in no other group of living plants for elsewhere buds tend to occur in the axils of leaves.

The jointed, slender, herbaceous stems of *Equisetum* have hollow internodes. Superficially, the internodes are ridged and grooved. In living species the whorled leaves are arranged in a toothed sheath but are without chlorophyll; photosynthesis is

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HORSETAIL SHOOTS. FERTILE SHOOTS ARE CAPPED BY CONICAL SPORE HEADS

accomplished in the green stems. The fossil forebears of the horsetails apparently were sizable trees with larger leaves, probably photosynthetic, which, at least in some forms, were separate from one another and not arranged in a sheath.

In reproduction, some horsetails have terminal, conelike strobili on aerial branches which later become vegetative. Other species, however, have separate, upright, aerial branches for vegetative and for reproductive shoots. In the latter, the strobilaceous branches appear first and, after the spores are shed, the green, vegetative shoots develop. Fertile appendages are whorled; each consists of a stalk bearing a flattened disk at its apex on the inner side of which is found a cycle of sporangia, each opening and shedding spores by a longitudinal slit on its inner side. The carboniferous, treelike horsetails and their sphenopsid allies are believed to have possessed the most elaborate reproductive strobili known among the vascular plants.

The spores, under low light intensity, grow to green, branched, small bisexual prothallia. The outer spore wall regularly breaks into four bands, which are hygroscopic and so coil and uncoil with moisture changes. Entangled by bands the spores, and the prothallia they grow into, are frequently shed in clusters.

This genus is comprised of about 27 living species, found on all continents. In the United States 13 species are described; of these 8 species are known in the eastern states and eastern Canada and 11 species in the west coast states and in adjacent Canada. Nine species are known in Great Britain. Generally horsetails are 30 in. or less in height. In the tropics, however, taller species are known. Accounts are given of specimens of *Equisetum giganteum* of the American tropics which attain heights of 10 to 12 yd. but which have a diameter of less than an inch. By contrast, a Mexican species two yards in height may have a diameter of up to four inches.

The horsetails have had little economic importance. At times, they have been used for scouring dishes and utensils of diverse kinds; their cleaning value is attributed to the silica in the walls of the epidermal cells, Undoubtedly the scouring rushes, as certain species were known, were beneficial in removing tarnish and dust from metallic surfaces, but the silica must have been equally hard on the metal itself. *See* PTERIDOPHYTA. (R. H. WE.)

HORSHAM, a market town and urban district in the Horsham parliamentary division of West Sussex, Eng., 38 mi. S.W. of London by road. Pop. (1951) 16,682. Area 3.0 sq.mi. The town, with houses dating from the 15th century onward, lies in the Weald near the source of the Arun. The name (Horsham in 947) indicates a place where horses were kept. The town is not mentioned in Domesday Book, but the Rape of Bramber, in which it lies, belonged then to William de Braose. His descendants held the borough and the manor of Horsham, which passed to the Mowbray family, afterward dukes of Norfolk. The church of St. Mary is mainly Early English and Perpendicular with remains of Norman work and a lofty spire. The grammar school, founded in 1532, was rebuilt in 1893. There is a local museum. Christ's Hospital school at West Horsham was removed thither from London in 1902.

Anciently the chief products were horseshoes and quarrels or wooden bolts for crossbows; today trade is mainly agricultural and there is a pharmaceutical factory. The town was represented in parliament from 1295 to 1885.

HORSLEY, JOHN (*c.* 1685–1732), British archaeologist. There is evidence that he was settled in Morpeth as a Presbyterian minister as early as 1709. At Morpeth Horsley opened a private school. Respect for his character and abilities attracted pupils irrespective of religious connection, among them Newton Ogle, afterward dean of Westminster. He gave lectures on mechanics and hydrostatics in Morpeth, Alnwick and Newcastle, and was elected a fellow of the Royal society on April 23, 1730. Horsley's great work, *Britannia Romana, or the Roman Antiquities of Britain* (1732), is one of the scarcest and most valuable of its class. There is in the British museum a copy with notes by John Ward (*c.* 1679–1758), biographer of the Gresham professors.

Horsley died on Jan. 12, 1732.

HORSLEY, JOHN CALLCOTT (1817–1903), English painter, was born in London, Jan. 29, 1817, and died there on Oct. 18, 1903. He was great nephew to Sir Augustus Wall Callcott. R A, and brother-in-lam to the engineer I. K Brunel and youthful intimate of Felix Mendelssohn. After studies at Sass's academy and the Royal Academy schools he became popular in the rustic genre of Sir David Wilkie and the 17th-century Dutch. He also painted murals ("Spirit of Religion." house of lords, 1845, etc.) and portraits ("Martin Colnaghi." exhibited at the Royal academy, 1889, now Tate gallery). He was elected A.R A. in 1855. R.A. in 1856, and was treasurer 1882–97. He was an early patron of the architect Richard Norman Shaw.

See J. C. Horsley, *Recollections of a Royal Academician* (London, 1903).

HORSLEY, SAMUEL (1733–1806). English divine, was born in London on Sept. 15, 1733. Entering Trinity college, Cambridge, he became LL.B. in 1758, and in 1759 succeeded his father as rector of Newington Butts, Surrey. Horsley was elected F.R.S. in 1767 and secretary in 1773, but, in consequence of a difference with the president (Sir Joseph Banks), he withdrew in 1784. In 1781 he became archdeacon of St. Albans. Horsley now entered in earnest upon his famous controversy with Joseph Priestley, who, in his *History of the Corruptions of Christianity,* had included among those corruptions the orthodox doctrine of Christ's divinity. Horsley sought to show that Priestley was "altogether unqualified to throw any light on a question of ecclesiastical antiquity" (*Tracts,* 1789, p. 85). The controversy was prolonged until 1790 when Priestley published his maturer book on the *History of Early Opinion,* which Horsley refused to read. In 1788 Lord Thurlow procured Horsley's promotion to the see of St. David's. As a bishop, Horsley was energetic both in his diocese, where he strove to better the position of his clergy, and in parliament. On Jan. 30. 1793, a few days after the death of Louis XVI, he preached before the house of lords a famous sermon at Westminster abbey on the dangers of the revolutionary spirit. At his eloquent peroration the whole assembly rose involuntarily from their seats. His support of the government was acknowledged by his successive translations to Rochester in 1793, and to St. Asaph in 1802. With the bishopric of Rochester he held the deanery of Westminster. He died at Brighton on Oct. 4, 1806.

See H. Horsley Jebb, *Life of Bishop Samuel Horsley* (1909).

HORSLEY, SIR VICTOR ALEXANDER HADEN (1857–1916), English surgeon and physiologist, was born at Kensington, London, on April 14, 1857. He studied medicine at University college. London, and, after qualifying in 1880, rapidly made his mark as an original investigator. In 1884 he was appointed superintendent of the Brown institution. London university, and in the following year assistant surgeon at University College hospital. These posts provided ample scope for his early researches on the role of the thyroid gland in the causation of myxoedema and cretinism, on epilepsy. on rabies, on the pituitary body and on the localization of function in the brain. He also carried out self-experiments in connection with various methods of anaesthesia. In 1886 he became surgeon to the National Hospital, Queen square, London, and was also secretary to the commission appointed to report on Pasteur's preventative treatment against rabies. In the following year he was appointed professor of pathology at University college. His work on cerebral localization had familiarized him with brain surgery, and after his appointment to Queen square he became famous for his pioneer work in neurosurgery. Before the end of 1886 he had done ten brain operations at Queen square, most of them successful. On June 9, 1887, he successfully carried out the first operation ever to be performed for removal of a tumour of the spinal cord. He had been elected F.R.S. as early as 1886, and was knighted in 1902. Horsley was a born reformer with an almost fanatical belief in the justice of his cause. He was violently opposed to the use of alcohol and tobacco, and was co-author with Mary Sturge of a well-known work on *Alcohol and the Human Body* (1907). During World War I he served in France, Egypt and Mesopotamia and carried his reforming zeal into the military hospitals of the middle east. He died of heat stroke at Amara, on July 16, 1916.

See Stephen Paget, *Sir Victor Horsley, a Study of His Life and Writings* (1919). (W. J. Bp.)

HORSLEY, WILLIAM (1774–1858), English musician, was born in London on Nov. 15, 1774, and died there on June 12, 1858. He was organist successively of Ely chapel, Holborn; the Asylum for Female Orphans; Belgrave chapel; and the Charterhouse. His compositions include three symphonies, but of greater importance are his delightful glees, such as "By Celia's Arbour," "O Nightingale," "Now the Storm Begins to Lower."

HORST, the term used in geomorphology more definitely for a block of the earth's crust that has remained stationary while the land has sunk on either side of it; *e.g.*, the Vosges. The word is also applied to those larger areas, such as the Deccan of India, where the continent remains stable, with horizontal beds forming a tableland, in distinction to the folded region such as the Himalaya mountains.

HORT, FENTON JOHN ANTHONY (1828–1892), British theologian, was born in Dublin. Ire., on April 23, 1828, and was educated at Rugby school and at Trinity college, Cambridge, where he was the contemporary of E. W. Benson, B. F. Westcott and J. B. Lightfoot. The four men became lifelong friends and fellow workers. In 1854, in conjunction with J. E. B. Mayor and Lightfoot, he established the *Journal of Classical and Sacred* Philology, and plunged into theological and patristic study. In 1857 he married and accepted the college living of St. Ippolyts, near Hitchin, Herts., where he remained for 15 years. In 1870 he was appointed a member of the committee for revising the translation of the New Testament. In 1872 he became fellow and lecturer at Emmanuel college and in 1887 Lady Margaret reader in divinity. In the meantime he had published, with his friend Westcott, the reconstructed Greek text of the New Testament. The revision committee had very largely accepted this text, even before its publication, as a basis for its translation of the New Testament. The text was vehemently attacked, but on the whole it was received as being the nearest approximation yet made to the original text of the New Testament. Hort died on Nov. 30, 1892. Next to his Greek Testament his best-known work is *The Christian* Ecclesia (1897).

HORTA, the capital of an administrative district comprising the islands of Pico, Fayal, Flores and Corvo, in the Portuguese archipelago of the Azores. Pop. (1960) 20,685 (mun.). Horta is a seaport on the southeast coast of Fayal and base for transatlantic air service via the Azores. The harbour, a bay 2 mi. long and nearly 1 mi. broad, affords good anchorage in 5 to 20 fathoms of water, but is dangerous in southwesterly and southeasterly winds. It is the headquarters of whale, tunny, bonito and mullet fisheries. Its exports include sperm oil, fruit. wine and grain.

HORTEN, a seaport of Norway, in Vestfold fylke (county), beautifully situated on Oslo fiord, opposite Moss. 38 mi. by water and 66 mi. S. of Oslo by rail. Pop. (1959 est.) 13,205. It is practically united with Karl-Johansvaern, which is defended by strong fortifications and possesses an arsenal and shipbuilding yards. There are also an observatory and a nautical museum.

There on April 9. 1940, the German cruiser "Emden" was badly damaged by the old minelayer "Olaf Trygvason," and some transports were sunk. At the narrows to the north of Horten the fort of Oscarsborg sank the cruiser "Blücher" and damaged the battleship "Gneisenau." This, the most effective Norwegian resistance, forced the Germans to proceed by land to Oslo.

HORTENSE (EUGÉNIE HORTENSE DE BEAUHARNAIS) (1783–1837), queen of Holland. was born in Paris on April 10, 1783. She was the daughter of the empress Josephine by her first marriage, and in 1802 married Louis Bonaparte. who was proclaimed king of Holland on June 6, 1806. The marriage was an unhappy one, and Louis endeavoured unsuccessfully to obtain a divorce, but Napoleon at length agreed to allow them to separate. Hortense was involved in the fall of Napoleon, and wandered from country to country, finally settling in Arenenberg, Switz., where she died on Oct. 5, 183;.

She was the mother of Napoleon Louis Charles, who died in infancy; Louis Napoleon (1804–31), crown prince of Holland; and Charles Louis Napoleon, afterward h'apoleon III (*q.v.*). She was the author of several songs, including *"Partant pour* la Syrie." Queen Hortense's *Mémoires* passed into the possession of Prince Napoleon, who died in 1926 before he had finished editing them. The work was completed by Jean Hanoteau: Les *Mémoires* de la reine Hortense (3 vol. [1928]; Eng. trans., 2 vol. [1928]).

HORTENSIA, the daughter of the Roman advocate and orator, Quintus Hortensius (*q.v.*), became known for the speech she made against the taxation of women without representation.

Nothing is known of Hortensia's life except for this episode, related by Appian. In 43 B.C. the second triumvirate was in great need of funds to carry on the war against Brutus and Cassius and proposed to raise money by taxing the property of 1,400 rich women. The women first applied for help to Octavia, sister of Octavian, and to the mother of Antony and were not repulsed, but the virago Fulvia, Antony's wife, drove them away with insults. Thereupon they proceeded to the Forum, and Hortensia spoke for the group before the tribunal of the triumvirs. She said that the triumvirs had deprived them of fathers, sons, husbands and brothers and now proposed to seize their property. She asked why, when the women had no part in the government or in the conduct of the war, they should be taxed for what the men had done. She declared further that the women would help resist a foreign enemy but they would never contribute their wealth for civil wars. The speech angered the triumvirs, Antony, Lepidus and Octavian, but they reduced the number of women liable to the tax from 1,400 to 400 and imposed a similar tax on the men.

HORTENSIUS, QUINTUS, dictator of Rome 286 B.C. When the people, pressed by their patrician creditors, "seceded" to the Janiculum, he was commissioned to put an end to the strife. He passed a law (*Lex Hortensia*) whereby the resolutions of the multitude (plebiscita) were made binding on all the citizens without the approval of the senate being necessary. He is said to have died while still dictator.

HORTENSIUS, QUINTUS (114–50 B.C.), surnamed Hortalus, Roman orator and advocate. At the age of 19 he made his first speech at the bar, and shortly afterward successfully defended Nicomedes III of Bithynia, one of Rome's dependants in the east, who had been deprived of his throne by his brother. From that time his reputation as an advocate was established. As the son-in-law of Q. Lutatius Catulus he was attached to the aristocratic party. The senatorial control of the courts reintroduced by Sulla helped him since many of his clients were former governors accused of extortion. He became quaestor in 81, aedile in 75, praetor in 72 and consul in 69. In the year before his consulship he came into collision with Cicero in the case of Verres, and from that time his supremacy at the bar was lost. But after 63 Cicero joined the party to which Hortensius belonged. Consequently, in political cases, the two men were often engaged on the same side (*e.g.*, in defense of Rabirius, Murena, Publius Cornelius Sulla and Milo). After Pompey's return from the east in 61, Hortensius withdrew from public life and devoted himself to his profession. In 50, the year of his death, he successfully defended Appius Claudius Pulcher when accused of treason and corrupt practices by P. Cornelius Dolabella.

Hortensius' speeches are not extant. His oratory, according to Cicero, was of the Asiatic style, a florid rhetoric, better to hear than to read. He had a wonderfully tenacious memory (Cicero, *Brutus,* 88, 95), and could retain every point in his opponent's argument. His action was highly artificial, and his manner of folding his toga was noted by tragic actors of the day (Macrobius, Sat., iii, 13, 4). He also possessed a fine musical voice, which he could skillfully command. He was very rich, and noted for the luxury of his houses and table. He wrote a treatise on general questions of oratory, erotic poems (Ovid, *Tristia,* ii, 441), and an *Annales* (Vell. Pat.. ii, 16, 3).

In addition to Cicero *(passim), see* Dio Cassius, xxxviii, 16, xxxix, 37; Pliny, *Nat. Hist.,* ix, *81,* x, 23, xiv, 17, xxxv, 40; Varro, R.R., iii, 13, 17.

HORTHY DE NAGYBÁNYA, MIKLÓS (NICHOLAS) 1868–1957), admiral in the Austro-Hungarian navy and regent of Hungary from 1920 to 1944, was born on June 18. 1868. at Kenderes, of an ancient Protestant family. He entered the naval academy at the age of 14 and after active service and various commands at sea, as well as at the Austro-Hungarian embassy in Con-

stantinople, he served at the military and naval chancellery of the emperor Francis Joseph I and in the naval department of the war ministry in Vienna. In World War I he distinguished himself as an able and daring naval commander and several times broke through the Allied blockade of the Adriatic sea. On May 14, 1917, in command of a squadron of three cruisers, he was wounded in action in the Straits of Otranto; he was promoted admiral and in Jan. 1918 commander in chief of the Austro-Hungarian navy.

In May 1919, at Kenderes, Horthy received an appeal by the Hungarian national government of Szeged to organize a national army to fight the Communist regime installed in Budapest, but the French, in control of the Szeged region, refused to help him in this task. The national army took shape only after the Rumanians had occupied Budapest and the "people's commissars" left the country. Horthy's troops entered Budapest on Nov. 16, 1919, after agreement with the Allied Supreme council, by which Horthy undertook to submit to a coalition government, until a constituent assembly had been elected. This assembly restored, on March 1, 1920, the principle of monarchy and proclaimed him regent.

Although Horthy was elected almost unanimously, partisans of the immediate restoration of King Charles clashed both with the more moderate Legitimists and the partisans of a new national monarchy. Horthy was considered by the firmest Legitimists as their man, but later they reproached him for frustrating the attempts at restoration in March and October 1921 and engaged in polemics against him. At the same time, the Democrats and Socialists considered Horthy the symbol of the reactionary "white terror," after the fall of communism. In the decade following 1921, Horthy's influence declined under the premiership of Count Stephen (István) Bethlen (q *v.)* and only reappeared in 1932 with the government of Gyula Gombos, head of the military party, who was considered to be the regent's personal choice. At this stage, the regent became somewhat unexpectedly a moderating factor. Though opposition to the peace treaties made Hungary an ally of Germany and Italy, Horthy contributed to the preservation of a constitutional system with substantial liberties and to the dissociation of Hungary from the German aggression against Poland. Although in June 1941 Hungary associated itself with the German war against the Soviet Union, the internal situation underwent little change and this was due partly to Horthy's more conservative than fascist views. On March 19, 1944, he was removed from Hungary by a ruse. while German troops occupied the country and deposed the government. On Oct. 15 Horthy concluded an armistice with the Russians and appealed to Hungarian troops to cease hostilities. He was taken prisoner, while the Nazi-controlled Arrow Cross movement formed a government. Horthy's captivity ended on May 1, 1945, when U.S. troops entered Bavaria. He retired to Estoril, Port., where he died on Feb. g, 1957.

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HORTICULTURE, the division of agriculture which relates to the cultivation of fruits, vegetables and ornamental plants, is both an art and a science. It is an art in that through practice certain skills are developed in necessary operations, such as propagation, pruning and spraying, which are essential to successful culture. It is a science in that underlying these practices is an orderly array of fundamental facts uhich explain and direct their performance. "Horticulture" originally meant the culture of a garden or enclosure, in contrast with "agriculture," meaning the cultivation of a field.

This article is divided into the following sections:

I. INTRODUCTION

The association of horticulture with intensive culture of plants in small areas is a popular conception; yet some phases of horticulture have developed into industries which occupy important economic positions in the field of agriculture.

There are no hard and fast rules that determine when a crop or an operation is horticultural. The type of culture, the general custom and the purpose for which a crop is grown are determining factors. Sweet corn, cabbage and Irish potatoes are, for example, generally classed as horticultural crops; yet in some areas of the U.S. where they are grown extensively for processing and market they are classed as field crops. Even the tomato approaches field-crop status in some locations. Nut trees are considered horticultural crops when grown in orchards for nut production, but they become forest crops when grown for timber. Grasses are treated from the horticultural viewpoint when used for lawns but become agronomic when used for pastures.

Horticultural crops may be divided into four main groups, namely: (1) fruits; (2) vegetables; (3) flowers and ornamentals; and (4) nursery stock and seeds. The culture of fruits is known as pomology or fruit growing; of vegetables, as olericulture or vegetable gardening; of flowers, as floriculture; and of ornamental plants other than flowers, as ornamental horticulture. The planning and grouping of plants for the purpose of enhancing the beauty and value of the landscape is called landscape gardening or landscape architecture (*q.v.*).

A fruit. horticulturally, is the edible product of a perennial plant. usually moody; it is closely associated with the development of a flower. Fruits are divided into tree fruits. including deciduous forms such as apple, pear, quince, peach. cherry, plum and apricot; evergreen forms such as orange, grapefruit, lime, lemon, citron, avocado and mango; and small fruits, such as grape, strawberry, currant, gooseberry, raspberry and blackberry. (See FRUIT.)

A vegetable is popularly defined as the product of a herbaceous plant which provides fresh material either for culinary purposes or for salads. Vegetables may be botanically grouped according to the part of the plant which is used, as tuber—potato; *root*—beet, carrot, horseradish, parsnip, rutabaga, turnip, salsify, sweet potato; bulb—chive, garlic, onion, shallot; stem—asparagus; *bud*—cabbage. Brussels sprouts; leaf—lettuce, spinach, kale, mustard, chard; leafstalk—celery, rhubarb; *flower*—cauliflower, broccoli; seed—pea, bean; and *fruit*—cucumber, muskmelon. tomato, watermelon, pepper, eggplant. (See VEGETABLES)

Flowers and ornamentals are plants used for their aesthetic or decorative value. They may be grouped for convenience as shown below:

Flowers.—(1) *annuals,* completing the life cycle and dying within a year, requiring reseeding each season (cosmos, petunia, zinnia); (2) biennials, requiring approximately two years to complete the life cycle, requiring reseeding every other season (foxglove, Canterbury bell); and **(3)** perennials, living more than two years, not requiring frequent reseeding (chrysanthemum, phlox, peony).

Shrubs and Vines.—(1) *deciduous,* shedding the foliage each year (deutzia, honeysuckle, spiraea); and (2) evergreen, retaining the leaves the year round (narrow-leaved—mugho pine, Pfitzer juniper, yew; and broad-leaved—laurel, rhododendron).

Trees.—(1) deciduous, shedding the foliage each year (elm, maple, oak); (2) evergreen, retaining the leaves the year round

(narrow-leaved—fir, spruce, pine; and broad-leaved—citrus, holly).

Such arbitrary groupings, however, are not rigid. The petunia, snapdragon, and wax begonia are annuals in the north, where they are killed by winter cold, but they remain perennial where mild winter temperatures prevail. Candytuft, which is commonly called a herbaceous perennial, is shrublike and may properly be called a small shrub. See FLOWER; WILD FLOWER; TREE.

II. ORIGIN OF HORTICULTURAL CROPS

The first agriculture was in a sense horticulture. The first cultivated plants were taken from the wild. As cultivation advanced, culture became more intensive and more critical, and improved forms took the places of less desirable ones. Little by little, seed lines were improved, purified and standardized, and improved strains of fruits and ornamentals were perpetuated and increased by such methods of vegetative propagation as division, layering, suckering and grafting. New species and types were brought together and were hybridized in nature to give still more forms, some of which were improvements over the old. Finally, with the development of scientific methods, such as plant exploration, breeding and systematic testing, improved forms were produced by man to meet local conditions in various parts of the world.

This general outline can be followed in those areas and with those horticultural crops whose history is recorded. For example, the development of the grape in eastern North America prior to 1700 was nith native wild grapes, as *Vitis* labrzcsca, *V. vulpina* and V. aestivalis, raised from seed. About 1800, selections from these wild forms were made and propagated vegetatively by cuttings. as the Alexander or Cape grape. Gradually, other species, including the old-world grape (Vitis *vinifera*), were blended with native species by natural crossing and such improved varieties were produced as Catawba (1819), Concord (1843) and Delaware (1849). Finally, toward the close of the 19th century, systematic breeding methods began to raise the standards of quality, adaptability and production to the high level seen in such varieties as Ontario, Fredonia, Niagara, Golden Muscat and several seedless varieties. Likewise, the Persian walnut industry on the Pacific coast of North America was, until the beginning of the 20th century, based largely upon seedling trees, which have, however, gradually given way to selected varieties propagated by budding and grafting. Flowers, ornamental plants and vegetables have all shown this same general pattern of development. To protect originators of new plant materials, the U.S. established a plant patent law. July 1 1931. See PLANT PROPAGATION; GRAFTING (IN PLANTS); PLANT BREEDING.

III. HORTICULTURE AND THE HOME

Socially, horticulture has been and continues to be of great significance through its influence upon the settlement, development and refinement of areas and of peoples. It is closely identified nith the establishment of the home in which fruits, vegetables and ornamental plants are combined in a plan of unity and utility, and this has become the 20th-century conception of the private home garden. Gardening has passed through a number of widely differing styles and vogues. There have been the eras of very formal gardens with geometrically arranged beds and with trees and hedges trimmed to artificial forms, of gardens on the grand scale which involved removal of walls and boundaries and took gardening into the parks and fields, of wild gardens and of Victorian gardens with flower beds set in lawns. Trees and hedge plants are now commonly permitted to assume natural forms, the lawn is kept open. flower beds have given may to herbaceous borders, the rock garden has assumed a place of importance and sometimes provision is made for semiaquatic plants.

It is most important that there be a plan. In the U.S., for example, the areas in a home plan may be divided into: (1) a public area nhich is open to view of the public and which furnishes a setting for the home; (2) a private area which is in a sense an outdoor living room; and (3) a service area which includes drives, clothesyard, outbuildings and fruit and vegetable gardens. There is a wide range of plant materials from which to choose, and the choice should be made in consultation with local residents, nurserymen or professional horticulturists, or with the advice of nearby schools, colleges and experiment stations.

1. Lawn.—The lawn is one of the first considerations, since it serves as the floor covering of the outdoor living room, so to speak. Bluegrasses (Poa species) make good turf grasses, well suited to the temperate zone and widely used where the soil is neutral and of fair fertility. The Merion strain of Kentucky bluegrass (*Poa pratensis*) develops a thick, dark turf which is well suited to close mowing and which is resistant to leaf spot. Bermuda grass (Cynodon dactylon) is used in warmer regions, and bent grasses (Agrostis species) do well in moist cool climates, as in northeastern U.S. and along the west coast north from San Francisco. Fescues (Festuca species) are useful for shaded northern areas with low rainfall, and Roughstalk bluegrass (Poa trivialis) is good in moist, shaded conditions. A mixture of basic grasses is usually preferred: as 60% Kentucky bluegrass, 20% red fescue (Festuca rubra), 15% rye grass (*Lolium* species) and 5% redtop (Agrostis alba); or 80% Colonial bent (Agrostis *tenuis*) and 20% redtop. One-half to two ounces of seed are needed for a square yard of soil. Seeding should be done at the time of year when cool temperatures and moderate moisture can be expected. This means late summer, early fall or early spring in most regions. The introduction of selective herbicides such as 2,4-D (2,4-dichlorophenoxy-acetic acid) revolutionized lawn maintenance by controlling such common broadleaf weeds as dandelion and plantain. (See LAWNS, CARE OF.)

2. Trees.—Trees are employed to frame views, to provide points of interest, for shade, as screens, as background and as windbreaks. Some of the more common and dependable kinds, of which there are many, are listed below:

Deciduous.—Maple (Acer), hickory (Carya), dogwood (*Cornus*), hawthorn (*Crataegus*), beech (*Fagus*), honey locust (*Gleditsia*), walnut (*Juglans*), sweet gum (Liquidambar), tulip tree (Liriodendron), plane tree (Platanus), oak (Quercus), linden (Tilia), elm (*Ulmus*).

Evergreen.—Fir (*Abies*), cedar (Cedrus), cypress (*Cupressus*), spruce (Picea), pine (*Pinus*), yew (*Taxus*), arborvitae (*Thuja*) and hemlock (Tsuga). (See TREE; ARBORICULTURE.)

3. Shrubs.—Shrubs are used for much the same purposes as trees and, in addition, are used to separate areas and as foundation plantings. The shrub border outlines boundaries, and consists of high-growing plants in the background and low-growing plants in the foreground. Foundation plantings serve to visually tie the house to the ground, employing higher specimens at the corners and lower kinds between. A list of some common forms follows:

Deciduous.—Barberry (Berberis), butterfly bush (*Buddleia*), sweet shrub (Calycanthus), Ceanothzts, flowering quince (*Chaenomeles*), rockrose (*Cistus*), dogwood (Cornus), Cotoneaster, *Deutzia, Euonymus,* Forsythia, witch hazel (*Hamamelis*). *Kerria,* beauty bush (*Kolkwitzia amabilis*). privet (*Ligustrum*), honeysuckle (Lonicera). mock orange (*Philadelphus*), flowering currant (Ribes), rose (Rosa), flowering raspberry (*Rubus*), Spiraea, lilac (Syringa), *Viburnum* and *Weigela.*

Evergreen.--Abelia, Azalea, box (*Buxus*), *Camellia,* Cotoneaster, Daphne, juniper (*Juniperus*), mountain laurel (*Kalmia latifolia*), Rhododendron, fire thorn (*Pyracantha*) and yew (*Taxus*).

4. Herbaceous Annuals and Perennials.-Herbaceous annual and perennial flowering plants are employed in the foreground of the shrubbery border, usually in long narrow beds at the sides of the lawn, or in separate beds in the garden to provide cut flowers. The best effects are produced by group plantings so that as each group blossoms, a mass of colour is produced. Annuals must be reseeded each year, but perennials will grow up again each spring. In the fall. the old leaves and stems should be cleaned out of the bed. When the plants become overcrowded, they should be lifted, divided and replanted. Some common herbaceous flowering plants are listed below:

Annuals.—Ageratum, snapdragon (*Antirrhinum*), Aster, *Browallia,* Calendula, China aster (*Callistephus*), Centaurea, *Clarkia,* Coreopsis, Cosmos, larkspur (Delphinium), Gaillardia, *Gypsoph-*

ila, hound's-tongue (Cynoglossum), candytuft (Iberis), snapweed (*Impatiens*), sweet alyssum (Lobularia), stock (Mathiola), Petunia, Portulaca, *Salpiglossis,* sage (Salvia), scabious (Scabiosa), marigold (Tagetes), nasturtium (Tropaeolum), Verbena and Zinnia.

Biennials and Perennials.—Hollyhock (Althaea rosea), columbine (Aquilegia), hardy aster (Aster), Astilbe, bellflower (Campanula), Chrysanthemum, Coreopsis, Delphinium, pink (Dianthus), bleeding heart (Dicentra), Gaillardia, Gypsophila, day lily (Hemerocallis), Iberis, flax (Linum), lupine (Lupinus), forget-me-not (Myosotis), evening primrose (Oenothera), poppy (Papaver), Phlox, hardy primrose (*Primula*), speedwell (Veronica) and violet (Viola).

Perennials from Bulbs, Roots and Corms.—Canna, Crocus, Dahlia, snowdrop (Galanthus), Gladiolus, Iris, lily (Lilium), grape hyacinth (Muscari), Narcissus, *Oxalis,* peony (Paeonia), squill (Scilla), Trillium and tulip (*Tulipa*).

5. Vines.—Vines are used as ground covers and to cover walls. fences, trellises and pergolas. They are much more used in Europe than in the U.S., due in part to a less rigorous climate and to the preponderance of stone structures, to which vines more readily cling and with less injury to the structure. Some of the more common vines are Dutchman's-pipe (Aristolochia), bittersweet (*Celastrus*), Clematis, ivy (Hedera), morning-glory (*Ipomoea*), creeper (*Parthenocissus*) and wistaria (Wistaria).

6. Hedges.—Plants which are sufficiently dense in growth habit may be used as hedges, to serve as a mark of the property line, as a barrier, as a protection to privacy, as a means of providing a formal atmosphere and as a screen.

Most hedges should be pruned so that they are wider at the base than at the top, to avoid shading out of the lower branches. However, some narrow-growing materials, such as American arborvitae. and some vigorous-growing kinds, such as privet, may be clipped vertically on the sides without causing the lower branches to die.

Representative plants for several hedge purposes are: Formal ornamental—true dwarf box (Buxus sempervirens *suffruticosa*); informal ornamental—true hedge columnberry (Berberis thunbergi erecfa); flowering ornamental—Japanese rose (Rosa multiflora); evergreen—arborvitae (*Thuja*); coloured fruits—fire thorn (Pyracantha); coloured twigs—Tatarian dogwood (*Cornus* alba); protective thorny—English hawthorn (Crataegus oxyacantha); protective dense—box (*Buxus*); low, under 2-ft. high—dwarf Japanese yew (*Taxus cuspidata* nana); medium, about 4 ft.—Amur privet (Ligustrum amurense); Japanese barberry (Berberis thunbergi); high, 6 ft. or taller—Eastern arborvitae (*Thuja occidentalis*); and windbreaks and screens—Norway spruce (Picea abies).

(See also articles on the more important ornamental plants.)

7. Rock Garden.—Rock gardens are especially suited to sections where the climate is neither too cold nor too hot, and where sufficient moisture either is available or can be provided. They are especially popular in Great Britain, on the continent of Europe, in Japan and on the north Pacific coast of North America. In Japan a feature of the rock garden is the rocks themselves, many of which are of foreign origin. For the most part, the rock garden is a garden of alpine plants, commonly, plants which grow in mountain habitats.

The garden is constructed so as to provide the conditions required by the different plants which are to be grown, as sheltered crevices, boggy spots, dry banks, peaty soil, leaf mold and limestone rubble. Conditions should be made as nearly natural as possible. A north-and-south direction provides a variety of exposures for different plants. (See also LANDSCAPE ARCHITECTURE.)

Plants commonly used in rock gardens may be grouped according to their requirements for culture:

1. Woodland and pasture plants of the mountain regions—aconites, delphiniums, tulips, colchicums, campanulas, helianthemums, anemones, pinks, aquilegias, centaureas, geraniums, thalictrums and gentians (Gentiana asclepiadea and G. cruciata).
2. Shade-loving plants—ferns, certain lilies and some aconites.
3. Plants favouring moist or marshy places—buttercups, trilliums, cypripediums, bog orchids, parnassias, loosestrifes (*Lysimachias*), mimuluses and saxifrages.
4. Wall plants which love full sunshine—Corydalis lutea and C. *ochroleuca,* toadflax (Linaria), some campanulas and *Erinus alpinus.*
5. Plants of the peat bog—heath, blueberry, rhododendron.
6. Ordinary rock and alpine plants—golden tuft (Alyssunz saxatile *luteum*), alpine rock jasmine (Androsace alpina), anemones (Anenzone baldensis and A. *pulsatilla*), aubrieta (Aubrieta deltoidea Dr. Mules), rose daphne (Daphne *cneorum*), alpine pink (Dianthus *alpinus*), checkerberry wintergreen (Gaultheria procumbens), gentians (Gentiana *acaulis,* G. *sino-ornata* and G. verna), evergreen candytuft (Iberis *sempervirens*), saxifrages (*Saxifraga* cotyledon, S. umbrosa, S. burseriana), stonecrops (Sedum acre, S. album), cobweb houseleek (Sempervivum arachnoideum), moss campion (*Silene* acaulis), Sicily thyme (Thymus *nitidus*) and violet (Viola bertoloni).
7. Bulbous plants—snow-drops, narcissuses, scillas, fritillaries and crocuses.
8. Pioneer plants—willowweed (*Epilobium* dodonaei), alpine toadflax (*Linaria* aalpina), mountain wormwood (*Artemisia spicata*), twinleaf saxifrage (Saxifrage oppositifolia).
9. Dwarf trees and shrubs—redleaf Japanese barberry (Berberis thunbergi *atropurpurea*), rock cotoneaster (Cotoneaster *horizontalis*), Lawson false cypress (*Chamaecyparis* lawsoniana Fletcher), broom (*Cytisus* kewensis), winter daphne (Daphne odora) and spring heath (*Erica* carnea).

8. Rose Garden.—The rose offers a wide variety which makes it adapted to a great range of climatic conditions and individual tastes. Good effects are secured in a variety of ways, as with ramblers over a lattice, fence or pergola; with polyantha roses in mass plantings and in borders; and with a few plants in a bed for cut flowers. If a portion of the grounds is set aside for a rose garden, a good plan is to use climbers and pillar types as the border or enclosure. The rugosas and shrub roses are then used in a parallel planting inside the border and within this are the beds of hybrid perpetuals with the hybrid teas in the centre.

Roses will grow in most soil types if given plenty of sunshine and an adequate supply of moisture. They do especially well in heavy soils where a uniform climate and an even moisture supply are provided. Protection from insects and diseases is most important and can be secured fairly easily by using a combined fungicide-insecticide dust or spray, obtainable in ready-mixed formulations. Much winter injury is traced to weakening of plants through insect and disease attack. While there are hardy forms for colder sections, most roses need some degree of winter protection.

Roses require careful pruning. The operation is best left until late spring when danger from severe winter cold is past. All dead, weak and unripe wood should first be removed and the remaining wood should then be cut back for the results desired. Climbers need vigorous pruning. Wood more than two years' old should be removed and the six or eight new shoots which are left should be cut back and tied in place. If exhibition blooms are desired, hybrid perpetuals should be cut back to seven to nine buds per cane and hybrid teas to three or four buds per cane. On the other hand, if a quantity of flowers is desired, the canes should be merely cut back to live wood.

Roses are propagated on many different types of stocks, including the mul'tiflora, the manetti and the rugosa. Of these, manetti is most used for greenhouse roses and multiflora for garden roses.

The wide interest in roses throughout the world stimulates constant improvement and change, so that a list of desirable types and varieties changes in a short time. Of the five following popular types the hybrid tea roses are among the most popular.

Rambler and Pillar Roses.—Blaze (red), City of York (white), Climbing Talisman (yellow and copper), Dr. J. H. Nicolas (pink), Dorothy Perkins (pink), Doubloons (yellow), High Noon (yellow), New Dawn (pink), Silver Moon (white), Spectacular (red), Tausendschon (pink) and Torch (orange).

Hybrid *Perpetuals.*—Baroness Rothschild (pale pink), Frau Karl Druschki (white), General Jacqueminot (clear red), American Beauty (red), Georg Arends (light pink), Henry Nevard (pink), Mrs. John Laing (clear pink), Paul Neyron (deep pink) and Ulrich Brunner (cherry red).

Grandifloras.—Gold Coast (deep yellow), Merry Widow (red), Queen Elizabeth (pink) and June Bride (white).

Hybrid Teas.—Katherine T. Marshall (pink), Comtesse Vandal (white), Crimson Glory (red), Eclipse (yellow), Etoile de Hollande (red), Golden Dawn (yellow), McGredy's Ivory (white),

McGredy's Yellow (yellow), McGredy's Sunset (yellow orange), Mme. Edouard Herriot (salmon), Margaret McGredy (brick red), Mrs. Pierre S. du Pont (yellow), Nocturne (red), Peace (yellow blend), Radiance (pink), Red Radiance (red), Sutter's Gold (yellow) and Talisman (yellow and copper).

Small-flowered *Polyanthas*.—Chatillon Rose (pink), Miss Edith Cavell (red), Gloire du Midi (salmon), Pinocchio (pink) and Red Pinocchio (red).

Large-fiowered Polyanthas, Often Called *Floribundas*.—Betsy McCall (pink), Betty Prior (pink), Donald Prior (red), Else Poulsen (salmon pink), Fashion (pink), Irene of Denmark (white), Spartan (salmon red), Summer Snow (white), Vogue (pink), World's Fair (Minna Kordes) (red).

For more botanical and horticultural information see ROSE.

9. House Plants.— Accompanying an increase in city living was a fuller appreciation of plants in the home. Certain plants are useful as flowering pot plants, others as foliage plants and others (principally cacti, succulents and foliage plants) as terrarium and dish garden subjects. Trees dwarfed in the manner of the Japanese art of bon-sai (*q.v.*) make very effective arrangements. The following plants are generally successful in ordinary rooms:

Flowering Plants.—Begonia, airbrom (Billbergia), poinsettia (*Euphorbia* pulcherrima), *Fuchsia,* Gardenia, Amaryllis, Narcissus, florist's geranium (Pelargonium), azalea (Rhododendron), rose, African violet (Saintpaulia), gloxinia (Sinningia), Jerusalem cherry (*Solanum pseudocapsicum*) and tulip.

Foliage Plants.—China green (Aglaonema simplex), Norfolk Island pine (Araucaria excelsa), fern asparagus (Asparagus plumosus), cast-iron plant (Aspidistra elatior varieties), bird's-nest fern (*Asplenium* nidus), *Caladium,* treebine (*Cissus*), leaf-croton (Codiaezim), Coleus, tuftroot (*Dieffenbachia*), Dracaena, rubber plant (Ficus), English ivy (Hedera helix), baby tears (Helxine), sentry palm (Howea), Boston fern (*Nephrolepis* exaltata *bostoniensis*), screw pine (*Pandanus*), *Peperomia,* Philodendron, date palm (Phoenix), bowstring hemp (Sansevieria), strawberry saxifrage (Saxifraga sarmentosa), ivy arum (*Scindiapsus*), *Selaginella,* wandering Jew (Tradescantia *fluminensis*) and periwinkle (Vinca).

Cacfi and Succulents.—Agave, Aloe, Cereus, Crassula, *Echeveria, Epiphyllum,* Gasteria, *Haworthia,* Kalanchoe, *Mammillaria,* fig marigold (Mesembryanthemum), prickly pear (*Opuntia*) and houseleek (*Sempervivum*).

10. Vegetable Garden.— The vegetable garden is primarily to provide food for the family, yet it may reach considerable economic importance in the aggregate.

The size of the garden will be dictated by the size of the family, the interest in gardening, the labour available and the geographical location. Following is a suggested plan for a garden 30 by 60 ft. for temperate zone conditions and arranged in numbered rows according to season of planting: (1) asparagus; (2) lettuce and radishes; (3) spinach, followed by cucumbers and bush squash; (4) onion sets; (5) early turnips, mustard, cress; (6) early beets, followed by late cabbage; (7) onions; (8) parsley, carrots; (9) parsnips; (10) early peas, followed by string beans; (11) cabbage, cauliflower; (12) lettuce, followed by celery; radishes, followed by celery; (13) late peas; (14) string beans; (15) early sweet corn, followed by turnips; (16) late sweet corn; (17) dwarf lima beans, peppers; and (18) tomatoes and eggplant.

The garden soil should be well drained and should be kept both in good fertility for satisfactory crop yields and in good physical condition for ease in handling. Animal manures are no longer easy to procure, but where they are, there is nothing better. In order to destroy weed seeds it is a good plan to compost the manure. Peat moss, grass clippings, leaves and any other available types of organic matter are valuable and may be added to the compost pile. Peat moss is especially useful in the garden. A 2-in. top-dressing will produce most satisfactory results. Certain organic chemicals (synthetic resins) tend to granulate heavy clay soils and improve their structure. Where manures cannot be secured, commercial fertilizers may be used, employing them in the manner and at the rates recommended by the manufacturers. The use of so-called starter solutions, employing commercial fertilizers in water in small amounts, has been found beneficial in transplanting, and the side placement of concentrated fertilizers in bands a few inches from the plant and at a depth of 2 to 6 in. rather than broadcast over an entire area, has not only proved economical but has also resulted in increased yields. (See FERTILIZERS AND MANURES and articles on specific vegetables.)

11. Fruit Garden.— The fruit planting will be largely of small fruits where the available area is small and may include tree fruits where more room is available. For the temperate zone, the selection may include strawberries, red raspberries, black raspberries, purple cane raspberries, blackberries, currants, gooseberries, grapes, peaches, plums, sweet cherries, sour cherries, apples, pears and nut trees. Subtropical areas and warmer parts of temperate zone areas include citrus fruits, figs, persimmons and vinifera grapes. The choice of varieties is dependent upon local adaptation, so that advice should be sought from local residents, professional horticulturists, or nearby agricultural colleges or experiment stations. The tendency is to overplant the fruit garden. A few good selections well cared for are the most satisfactory.

Dwarf fruit trees, especially dwarf apple trees propagated on standardized East Malling (EM) rootstocks, are useful in the garden. The Angers quince is the best rootstock for dwarfing the pear. The Mahaleb cherry (*Prunus* mahaleb) is used for dwarfing the cherry and the St. Julien plum for the European-type plum (Prunus *domestica*), but there is as yet no thoroughly satisfactory d arfing rootstock for the stone fruits. (See Propagation of Plants, below.)

Planting distances for fruit trees will vary with the variety and geography, but are approximately as follows: Apples, 30 to 40 ft. each way; apples (dwarf, EM IX), 8 to 10 ft. each way; apples (semidwarf, EM I), 20 to 25 ft. each way; pears, 20 to 30 ft. each way; pears (dwarf) 10 to 15 ft. each way; plums. 16 to 25 ft. each way; peaches. 16 to 20 ft. each way; cherries (sour), 16 to 22 ft. each way; cherries (sweet), 20 to 30 ft. each may; apricots, 16 to 20 ft. each way; nectarines, 16 to 20 ft. each way; quinces, 8 to 14 ft. each way; figs, 20 to 25 ft. each may; mulberries, 25 to 30 ft. each way; Japanese persimmons, 20 to 25 ft. each way; loquats, 15 to 25 ft. each way; pecans. 35 to 40 ft. each way; walnuts, 40 to 50 ft. each way; oranges and lemons, 25 to 30 ft. each way; grapes, 8 to 10 ft. each way; currants, 4 by 5 ft.; gooseberries, 4 by 5 ft.; raspberries (black), 3 by 7 ft.; raspberries (red), 3 by 7 ft.; blackberries, 4 to 7 ft. by 6 to 8 ft.; cranberries, 1 or 2 ft. each way; blueberries, 4 by 8 ft.; and strawberries, $1\frac{1}{2}$ by $3\frac{1}{2}$ ft. Important varieties and details of cultivation are given in the article FRUIT FARMING.

IV. COMMERCIAL HORTICULTURE

Horticultural crops, with the exception of the Irish potato. are more important as a group than as individual crops. They include fruits, vegetables, ornamentals and nursery stock and seeds.

1. Fruits.— Principal fresh fruits of world commerce are the grape, apple, orange, pear, plum and banana; principal nuts are the almond, Brazil nut, chestnut, coconut, filbert, pecan and walnut. Large quantities of fruits are dried, canned, frozen and otherwise processed. The grape, including grapes grown for wine, for drying and for table use, is the leading fruit of the world.

The apple is the most important tree fruit of the temperate zone. The U.S. is the largest producer of apples and oranges, producing more than one-third of the annual world crop of each. The orange is the most important commercial tree fruit of tropical and subtropical regions. The principal orange-producing countries are the U.S., Spain, Brazil, Italy and Mexico. The date is an important crop in the drier areas of the world, especially in Asia Minor, Arabia and the Sahara desert region. There are more species of fruit in the tropics than in any other region, but most of them are only of local importance because of their highly perishable nature. The four of greatest commercial value are the banana, pineapple, coconut and Brazil nut. Others include mango, avocado, papaya, guava, sapodilla, cherimoya and prickly pear. The mango is as important to the people of India as is the apple to the inhabitants of the temperate regions. The banana is the great starch food of the tropics.

There is perhaps no period in the history of commercial horticulture in which so many changes have occurred on such an extensive scale and over so wide an area as during the period since 1920. Substantial increases have occurred in both production and consumption and important shifts have occurred in locations of the industry. Many new types and varieties have been introduced which have markedly altered consumer habits and trade customs. Great strides have been made in production methods and in harvesting and handling. Nut crops are both shaken from the tree and gathered mechanically. Modifications of this method of harvesting are used for blueberries, cherries and apricots for processing. Although not harvested mechanically, other fruits are transported and stored in large bins and boxes which reduces labour and handling costs. The results of this trend will be the groning of more fruit for processing. Higher packing standards have been almost universally adopted, and significant progress has been made in precooling, refrigeration, preripening and conditioning. The world transportation system has been revolutionized. Fast trucks, freight cars and ships designed and constructed essentially for carrying fruit play an important part, so that highly perishable products are transported over great distances to provide an abundance and a variety formerly considered impossible.

2. Vegetables. — Because of their bulk and their perishable nature, fresh vegetables do not figure prominently in world commerce as do fruits and nuts, yet large quantities are shipped into England from France. Spain and Italy, and the whole region north of the Alps receives early vegetables from the south. As canned, frozen and dried products, vegetables attain considerable importance in world commerce. In domestic commerce, however, vegetables surpass fruits in value. The sweet potato is a universal food crop in the tropics and offers much promise for development. Improvements in mechanical harvesting and handling of vegetables for processing have been rapid. Among crops handled successfully are beets, carrots, potatoes and onions. Modest success has also been realized with tomatoes and pickling cucumbers. Trends in this direction point toward further increases in vegetables grown for processing.

3. Flowers, Nursery Products and Seed. — Flowers and nursery products are relatively less important in world commerce than other horticultural crops. Nevertheless, the production of bulbs for export is of considerable importance in the Netherlands, and prior to the restrictive embargo placed by the U.S. on fruit-tree and rose rootstocks in 1930, considerable quantities of these materials were imported each year. Vegetable and flower seeds are of relatively greater importance in world trade than ornamental plants and nursery stock In California are located districts for the production of seed of onion. lettuce, carrot, radish, sweet pea, nasturtium, celery, aster and zinnia. In Washington are areas for spinach, turnip and beet seed; in Montana and Idaho, for garden pea seed; and in Indiana, for tomato seed. Denmark produces cauliflower seed; France and Italy, celery seed; England, seed of cabbage, broccoli and Brussels sprouts; and there is an important general seed-producing region at St. Rémy, France.

In domestic commerce, on the other hand, flowers, ornamentals and nursery stock are of great importance, especially in areas of older world civilization.

4. Propagation of Plants. — Horticultural plants are propagated (*i.e.*, increased in numbers) by two methods, namely, by seedage (sexual propagation) involving the formation and planting of seeds, and by vegetative means (asexual propagation) involving the use of a portion of the plant other than the seed. Propagation by seed is employed for plants which provide an abundance of seed and which can be bred readily to uniform and pure lines, as most annual flowers and many vegetables. Hybrid seed, such as that used for sweet corn, is produced by developing tno pure lines and then combining them by cross-fertilization. Such seed may produce superior yields, but seed taken from plants raised from hybrid seed should not be used for reseeding.

Seed of herbaceous plants. such as tomato. onion and zinnia. will germinate as soon as it is mature. On the other hand, seed of many wood plants must be afterripened before it will germinate. Thus, peach seed requires 12 weeks at about 41" F., under moist surroundings, and apple seed requires 8 weeks at approximately the same temperature. In nature, these conditions are provided out-of-doors in winter. Nurserymen and plant breeders either plant such seed in the early fall, or provide similar conditions by stratification in which seeds are placed in boxes or trays in alternate layers with sand, soil or peat moss and stored at temperatures of about 41° F. for the period of time required for the particular seed under treatment. (See SEED; SEED TESTING.)

Plants are propagated vegetatively from portions of leaves, stems or roots. Although in propagation by seed each plant varies somewhat from every other plant in the lot, in vegetative propagation all daughter plants are identical in genetic make-up and are also identical to the parent plant from which they are secured. This is of great importance in horticulture, since it means that a single plant with desirable characteristics can be retained and perpetuated, identical in all respects to the original. None of the common tree fruits, such as the apple, pear, cherry, plum and peach will produce true from seed; distinctive horticultural varieties, such as the Northern Spy apple and the Washington Navel orange, are propagated by vegetative means.

A combination of both seedage and vegetative propagation is common with many woody plants, such as fruit trees and roses, in which an inexpensive seedling root is raised from seed and upon which the desired variety is then budded or grafted. The portion of a plant which serves for the root or underportion is called the rootstock or stock, and the portion of a plant which is placed upon the stock is called the scion. The resulting plant is thus composed of a seedling root and a known-varietal top and may be termed a stion (combination of stock and scion). In combining a stock and a scion, various techniques are employed, all of which are a form of grafting. A common form is called budding, in which a single bud is grafted onto the stock during the active growing season, as contrasted with grafting with dormant scions in midwinter or early spring. Strains of plants which are propagated by vegetative means are called clones.

The standard rootstock upon which to propagate the apple has been crabapple seedlings grown from French-produced seed. Seedlings from seed of cultivated varieties of apple, such as Delicious and Rome Beauty are also used. Wide interest has developed in clonal, or vegetatively propagated, rootstocks, which has been intensified by the standardization and introduction of the EM rootstocks, named for the East Malling Horticultural Research station in England where they were standardized. Many of the EM rootstocks are dwarfing in nature, as EM IX (Jaune de Metz), which produces a tree 4- to 6-ft. tall. Others, in approximate ascending order of size tree which they produce, are EM VII, IV, II, I, XIII, XVI and XII, the last named producing a tree of standard size. EM VII and II are especially esteemed for commercial fruit production when a small tree is desired.

For the pear, seedlings of French-grown pears are commonly used, and, since about 1930, seedlings of such cultivated varieties as Bartlett and Winter Nelis have been employed. The oriental rootstocks have not proved generally as compatible with the more commonly cultivated varieties of pears (Pyrus *communis*), although they are superior for such a variety as Kieffer, which is a hybrid between the common pear (P. *communis*) and the sand pear (P. pyrifolia). For dwarfing, the Angers quince (Cydonia *oblonga* variety) is used, of which the EM A and B represent standardized types and EM C a very dwarfing type.

For the plum, seedlings of the myrobalan plum (*Prunus cerasifera*) are widely used. For the sweet cherry, seedlings of the wild mazzard (*Prunus avium*) are preferred; while for the sour cherry both the Mahaleb cherry (P. nzahaleb) and the mazzard are used, the former producing a tree slightly smaller, earlier-bearing and shorter-lived than the latter. For the peach, seedlings are from pits collected from wild trees ("naturals"); however, because of the gradual disappearance of wild peach trees, seed of Lovell and Muir canning peaches from California has been widely employed. Apricots are propagated upon seedlings of the Blenheim and Royal varieties; almonds, on seedlings of the bitter almond (*Prunus amygdalus* amara). The most popular rootstock for the pecan is the common pecan (Carya *illinoensis*); for the black walnut,

seedlings of the Eastern black walnut (*Juglans* nigra); and for the English walnut, seedlings of the California black walnut (J. californica).

Where the grape phylloxera (Phylloxera vitifoliae) is a problem, as with vinifera varieties of grapes (*Vitis* vinifera), resistant rootstocks are used, such as riverbank grape (*V.* riparia), sand grape (V. rupestris) and various species hybrids such as those between V. *riparia* and *V.* rupestris (no. 3306 and 3309).

The most widely used rootstock for the orange and grapefruit is the sour orange (Citrus *aurantium*), though the rough lemon is used on sandy soils and the grapefruit is used to some extent. The trifoliate orange (Poncirus trifoliata), because of its hardiness to winter cold is used along the Gulf coast areas outside the commercial citrus belt. The sweet orange is the standard stock for the lemon in California.

For the avocado, seedlings of the Guatemalan type are preferred; for the loquat, seedlings of the loquat (Eriobotrya *japonica*) or of the Angers quince; for the native persimmon, seedlings of native persimmon (Diospyros virginiana); for the Japanese or kaki persimmon, seedlings of the kaki persimmon (D. kaki) and the date plum persimmon (D. *lotus*).

Seedlings of Rosa *multiflora* are used largely for field roses, R. noisettiana Manetti and R. odorata for greenhouse roses, and R. rugosa for tree roses.

Plants may be propagated vegetatively in many ways, different methods being employed with different plant materials under different conditions and at different seasons. Thus, the quince may be propagated by hardwood stem cuttings in early spring; the strawberry by runners; lily of the valley by underground stems or rhizomes; black raspberry by tip layerage; dwarf apple by mound layerage; lychee or litchi nut by air layerage or Chinese layerage; blackberry by root cuttings; chrysanthemum by softwood stem cuttings during the growing season; sedum by leaf cuttings; and fruit trees and roses by budding and grafting.

Humidity, light, temperature, soil, rooting medium and the nature of the material itself play important parts in the method of propagation selected and the results secured. Continuous artificial mist has aided in the rooting of softwood cuttings; synthetic growth substances, such as indolebutyric acid, have increased the speed and degree of rooting; and synthetic plastic films, such as polyethylene, having proved of great value in air layerage and in propagation of cuttings. See PLANT PROPAGATION and GRAFTING (IN PLANTS) for further details.

5. Pest Control. — Pests of horticultural plants are controlled by both natural and artificial means. The development of varieties which are resistant to certain pests has become one of the important functions of plant breeding. For example, resistance to mosaic virus has been bred into red raspberries, wilt resistance into tomatoes, powdery mildew resistance into canteloupe and nematode resistance into peach understocks. Artificial controls include crop rotation, purification and grading of seeds, soil cultivation, sanitation, soil fumigation, placing of mechanical guards as protection against rodents and spraying, dusting and dipping with various fumigants, fungicides and insecticides.

Common insecticides include arsenate of lead, used as a stomach poison against chewing insects; nicotine, pyrethrum, rotenone, dinitro compounds and oils, used as contact insecticides; and hydrocyanic acid, carbon disulfide, paradichlorobenzene. ethylene dichloride. used as fumigants. Common fungicides include various sulfur compounds, bordeaux mixture and copper and mercury compounds. Intensive industrial research continues to develop many organic compounds which, in many instances, are replacing some of the old, standard materials enumerated above.

Pest control has become a highly specialized and essential part of the production of many horticultural crops. Mobile spray equipment has been developed which is tractor drawn and which may deliver 30 to 50 gal. a minute at 600-lb. pressure from tanks of 600- to 800-gal. capacity. With air-blast equipment, concentrated spray may be successfully applied with one-half, one-third or even one-tenth the standard amount of water. The airplane and helicopter are effective in the application of dusts and concentrate sprays, especially to row crops of vegetables and small fruits. Control of weeds is dealt with in the article WEED. For more detailed information on plant diseases and garden pests see PLANT DISEASES; ENTOMOLOGY.

Foliar nutrients and plant regulators for blossom thinning, prevention of preharvest drop and control of colour and maturity are also applied with spray equipment. (See SPRAYS AND DUSTS IN AGRICULTURE.)

6. Harvesting and Storing. — The time of harvest is dependent upon the nature of the crop itself, the use which is to be made of it and the facilities for storage. Beans are harvested in the green, immature stage when used as snap beans, but are left until full maturity when used as hard-shell beans. Daffodils are harvested when half open, roses, peonies and poppies in early bud stages and chrysanthemums, China asters and zinnias when fully open. Apples, pears and peaches for commercial shipment are harvested when the green fruit takes on a slightly yellowish tinge. In commercial fruit operations, careful inspections are made to determine the correct time to harvest; for if the fruit is harvested prematurely it will shrivel in storage, and if it is left too long on the tree it will lack long-storage qualities. Among the indexes of maturity are changes in colour, changes in the pressure required to puncture the flesh as measured by a mechanical pressure tester, and the predetermined time interval between full bloom and the usual harvest season.

Both common storage and artificial cold storage are used for horticultural products. Common storage depends upon natural outdoor temperatures and is provided by basement storage rooms in residences, by boxes or barrels sunk into the ground and by specially designed pits, caves and ventilated buildings. Cold storage is provided by refrigeration in specially constructed and insulated buildings. By the use of sealed chambers in which the concentration of carbon dioxide and other gases in the atmosphere is controlled and regulated, great improvement has been made in the storage life and quality of certain produce. Certain growth regulators, such as maleic hydrazide, applied to onion and potato plants several days prior to harvest, have inhibited sprouting and markedly lengthened the storage life of these vegetables. Large quantities of fruits and vegetables are also stored frozen.

V. SCIENTIFIC HORTICULTURE

Great development has occurred in the application of science to horticulture, particularly since 1900, which is reflected in horticultural organizations. For example, in 1849 in the U.S.. the American Pomological society was formed and focused its attention largely upon varieties of fruits, their performance and adaptation. In 1903 the American Society for Horticultural Science was formed and was concerned with the application of science to horticulture. Emphasis was placed first upon fruits; next, beginning about 1920, upon vegetables; and then, beginning about 1930, upon ornamentals and nursery crops.

The commercial application was the force initially responsible for the introduction of modern science to horticulture. Later, however, horticultural research institutions, given good financial backing, began to support much fundamental work in the theoretical plant sciences.

Among some of the applications of science to horticulture may be mentioned: *photoperiodism*—in which chrysanthemums, typically flon-ering during the short days of autumn, are induced to flower at any month of the year by prolonging day length with artificial lighting and shortening day length with black cloth, as desired (see FLOWER: *Commercial* Flower *Growing*); photosynthesis—in which it has been found that lime-sulfur sprays reduce photosynthetic activity in comparison with the milder, wettable sulfur sprays; carbolzydrate-nitrogen relation—in which the relation of carbohydrates to nitrogenous compounds within the plant is correlated with vegetative growth and with fruiting; *genetics* and plant breeding—in which varieties are produced to meet desired specifications, such as season of fruit ripening and disease resistance. Further applications of scientific findings derive from studies of: developmental morphology—explaining the changes which occur in developing fruits and the relation of these changes

to commercial fruit culture; mineral deficiencies — including the correction of internal corking of apples by the use of boron and the control of rosette of citrus by zinc; *hormones*—including the use of such growth-regulating substances as indoleacetic acid, indolebutyric acid, naphthaleneacetamide and others to promote the setting of fruits without fertilization, to thin blossoms, to hasten the rooting of cuttings, to increase fruit size, to prevent preharvest fruit drop and to prolong dormancy; *physiology of* storage — including storage of fruits and vegetables in atmospheres of relatively high concentrations of carbon dioxide; and physiology *of* ripening — involving the ripening of bananas under controlled temperatures, colouring of oranges with ethylene gas, removal of leaves from rose plants in storage by ethylene gas, ripening of pears at controlled temperatures and use of chemicals to prevent decay and to regulate rate of ripening. (*See* PLANTS AND PLANT SCIENCE.)

1. Research Agencies. — Horticultural research is conducted for the most part by public institutions, though private support is supplied to some degree by organizations dealing in such commercial crops as pineapples, flower seeds and roses, which support their own research workers and laboratories. Further, support is provided to established public institutions through private endowments and grants-in-aid, usually to work upon some special problem which is of importance to the donor. In most countries, horticultural research is a part of a larger research organization, yet the relative emphasis placed upon horticultural crops by some has made them outstanding in the field.

In the U.S., horticultural work is conducted at the various state experiment stations and land-grant colleges throughout the country, supported in part by state funds and in part by federal funds. Among these, the following stations may be specially mentioned for their interest in horticultural work: Massachusetts (pomology); New Jersey (pomology, peach breeding, floriculture); New York, at Ithaca (pomology, vegetable crops, floriculture, ornamental horticulture), at Geneva (systematic pomology, truck crops, fruit breeding, rootstocks); Ohio (pomology, vegetable crops, floriculture, ornamental horticulture); Michigan (pomology, fruit breeding, floriculture, ornamental horticulture, vegetable crops); Indiana (pomology, vegetable crops); Minnesota (fruit breeding); Iowa and South Dakota (breeding of hardy fruits); Oregon (pomology); Washington (pomology); California, at Davis (pomology, vegetable crops), at Riverside (citrus); Hawaii (tropical fruits, pineapple); Pennsylvania (pomology, floriculture, vegetable crops); Illinois (fruit breeding, floriculture, vegetable crops); Louisiana (vegetable crops); Texas (citrus); and Puerto Rico (vegetable crops). The U.S. department of agriculture expanded its work in horticulture markedly after 1930. Its research centre at Beltsville, Md., is linked with branch stations and works in co-operation with state institutions in all parts of the country.

In England, important contributions have been made on storage and transportation of horticultural crops at the Low Temperature Research station at Cambridge university. The Cheshunt Experimental and Research station has carried on experimental work with greenhouse crops such as tomatoes, cucumbers and chrysanthemums. The East Malling Horticultural Research station has made important contributions in general pomology, pathology, pest control and hop culture, and is internationally recognized for the standardization and propagation of rootstocks for fruit trees. The John Innes Horticultural institution has concerned itself largely with genetics and plant breeding. The Long Ashton Agricultural and Horticultural Research station, University of Bristol, which began as the National Fruit and Cider institute, has expanded its endeavours to include general fruit culture, and has made notable contributions on cider making, fruit nutrition and pathology. At the trial grounds of the Royal Horticultural society at Wisley valuable work has been done on general horticultural problems.

Research stations doing horticultural work are also maintained in China, Japan, India, the U.S.S.R., Israel, Egypt, Argentina, New Zealand, Australia, South Africa and Canada. The Canadian experimental work is centred at the Dominion Experimental farms at Ottawa, Ont., and is linked with branch farms and stations located in the various provinces, as Kentville, N.S.; Vineland, Ont.; and Summerland, B.C.

2. Horticultural Education and **Organization.**—Horticulture is a recognized subject for a degree at many colleges and universities. In the U.S. and Canada, the development of horticultural courses and institutions has been very rapid. High schools employ teachers of vocational agriculture who give courses in horticulture. In addition, there are state and county schools of agriculture in some states (New York, California, Wisconsin) where horticulture is taught.

The land-grant colleges and state universities have developed special departments of horticulture and often special departments of pomology, vegetable crops, floriculture and ornamental horticulture. They maintain extensive orchards, greenhouses and laboratory facilities and affiliated substations in the more intensive commercial horticultural areas where students may work, study and supplement academic training with practical experience. The B.S. degree is given upon completion of the course and some institutions offer the M.S. degree and the Ph.D. degree.

Among institutions which have well-developed specialized courses in horticulture offering advanced degrees are: the University of Massachusetts, Amherst; Cornell university, Ithaca, N.Y.; Ohio State university, Columbus: University of Maryland, College Park, Md.; Michigan State university, East Lansing; Rutgers university, New Brunswick, N.J.; University of Illinois, Urbana; Iowa State University of Science and Technology, Ames; Purdue university, Lafayette, Ind.; University of Missouri, Columbia; University of Wisconsin, Madison; University of Minnesota, Minneapolis; University of California, Davis; Washington State university, Pullman; Oregon State college, Corvallis; Ontario Agricultural college, Guelph; University of British Columbia, Vancouver; and MacDonald college of McGill university, Ste. Anne de Bellevue, Que. In addition, the basic sciences, such as botany, chemistry, geology and zoology, in many leading universities have been oriented so as to attract students seeking a basic scientific training which may be applied in the horticultural field. Among such institutions are Harvard university, Columbia university, The University of Chicago, University of Toronto, and McGill university, Montreal, Que.

In Great Britain, horticultural courses for degrees are given at the universities of Leeds, London (Wye college), Cambridge and Reading. Horticultural work toward advanced degrees is offered by the Long Ashton Agricultural and Horticultural Research station, the East Malling Horticultural Research station, and by other similar centres in affiliation with accredited colleges and universities. Horticultural courses are given at the Midland Agricultural college, East Anglian institute, Chelmsford and at the farm schools of many county councils. The Royal Horticultural society has a school at the horticultural gardens at Wisley. Each British county council employs one or more skilled horticulturists to teach in the village. Kew gardens, Surrey, has an international reputation in the training of gardeners.

In France, Belgium, the Netherlands and Europe generally, the land and agricultural schools give special courses in horticulture, and a well-developed trade school and apprentice system has been established, as at the École Nationale d'Horticulture de Versailles in France.

Public Parks and Arboretums. — Public parks and arboretums are no longer merely recreational areas and botanical collections. The trend has been toward horticultural treatment. Low spots may be accentuated by groupings of low plants, and high spots by arrangements which accentuate height. Certain formal areas may be devoted to lilac plantings or to rose gardens, a rocky wall may become walled with rhododendrons, slopes may be covered with shrubs, one area may be devoted to flowering magnolias, and another area may be devoted to conifers. Trials are held of flowering plants such as roses, irises, gladioluses, dahlias, peonies, tulips and narcissuses.

Most large cities and many of the smaller ones have attractive parks which show this horticultural influence, including Boston, New York, Washington, D.C., Philadelphia, Rochester, N.Y.,

Chicago, San Francisco, Edinburgh, London, Paris, Vienna, Berlin, Ottawa, Montreal, Sydney and Melbourne.

The Arnold arboretum at Jamaica Plain, Mass., is world renowned. Highland and Durand-Eastman Park arboretum at Rochester, N.Y., is recognized for its displays of lilacs, rhododendrons and azaleas. Golden Gate park in San Francisco presents a wide display of excellent horticultural plant material. Other outstanding parks and arboretums showing the horticultural touch are Morris arboretum, Philadelphia, Pa.; Morton arboretum, Lisle, Ill.; the Brooklyn Botanic garden, Brooklyn, N.Y.; the New York Botanical garden, New York city; Longwood gardens, Kennett Square, Pa.; and Kingwood Center, Mansfield, O. As populations increase, the trend is for individuals to develop small private gardens, which are supplemented by an increasing number of large public gardens and arboretums. (*See* ARBORETUM; BOTANICAL GARDEN)

Horticultural Organizations. — Horticultural organizations, through meetings, publications and trial grounds, are of great importance in horticultural education. These are of three main types, namely, general, official and trade. The general organization takes the form of national horticultural societies with numerous smaller, local affiliated societies. The Royal Horticultural society, London, founded in 1804, has more than 35,000 fellows and associates. Similar national bodies exist in most European countries. In the U.S. there is no general organization of this kind; instead, there are more than 1,500 local societies based upon geography and upon particular crops, as the Vegetable Growers Association of America, the Massachusetts Fruit Growers' association and the American Rose society.

International horticultural congresses have been held from time to time under arrangements made by international committees consisting of members nominated by various governments, as follows: Paris, 1889; Chicago, 1893; Paris, 1900; Paris, 1905; Brussels, 1910; Ghent, 1913; Amsterdam, 1923; Vienna, 1927; London, 1930; Paris, 1932; Rome, 1935; Berlin, 1938; London, 1952; The Hague-Scheveningen, 1955; and Nice, 1958. An International Society for Horticultural Science was formed in 1958 with permanent headquarters at The Hague.

Trade associations are numerous and are concerned with protecting and informing their memberships as the International Apple association, American Association of Nurserymen and the Society of American Florists and Ornamental Horticulturists.

(*See* HORTICULTURE AND BOTANY, SOCIETIES OF.)

Publications. — Journals and periodicals of special horticultural interest are: American Fruit Grower; American Nurseryman; American Vegetable Gardener; Blue Anchor (California); Florist's Exchange and Horticultural Trade World (U.S.); Fruit World (Australasia); Gardeners' Chronicle (England); Gartenbauwissenschaft (Germany); Horticulture (U.S.); Journal of Horticultural Sciences (England); Journal of the Royal Horticultural Society (England); Proceedings of the American Society for Horticultural Science; Revue Horticole (France); reports and bulletins of research institutions, government agencies, colleges and experiment stations; transactions and proceedings of special subject societies and local horticultural societies as the American Rose society, Northern Nut Growers association, New York State Horticultural society, Pennsylvania Horticultural society, Massachusetts Horticultural society and Minnesota Horticultural society.

See also Index references under "Horticulture" in vol. 24.

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HORTICULTURE AND BOTANY, SOCIETIES OF.

Only strictly botanical and horticultural societies and their dates of founding, together with their publications, are listed below. Museums, botanic gardens and educational institutions publishing botanical or horticultural journals are not included. Academies of science within the various countries are not usually included.

Many of the following societies do not have permanent addresses; they are centred where their editors and officers are located. For up-to-date locations see the latest editions of The World of Learning and (especially for the U.S. and Canada) Union List of Serials.

BULGARIA: Botanicheskiya Institut, Bulgarska Akademiya na Naukite (1947), Izvestiya na Botanicheskzya Institut (Botanical institute, Bulgarian Academy of Sciences, Bulletin of the Botanical institute); Bulletin de l'Institut.

CANADA: Canadian Phytopathological society (1929), Proceedings; Quebec Society for the Protection of Plants (1908), Reports; Canadian Forestry association (1900, inc. 1936), Forest and Outdoors; Canadian Institute of Forestry (1908, inc. 1950), Forestry Chronicle.

CHINA: Botanical Society of China (1933), Acta Botanica Sinica; Chinese Society of Forestry (1951), Forestry.

EGYPT: Botanical Society of Egypt, Egyptian Journal of Botany.

FINLAND: Suomen Metsatieteellinen Seura (Society of Forestry in Finland) (1909), Acta Forestalia Fennzca, Szlva Fennica; Societas pro Fauna et Flora Fennica (1821), Acta Botanica Fennica.

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HORUS (Egyptian HOR), an Egyptian sky-god in the form of a falcon whose eyes were the sun'and the moon. The falcon therefore was sacred to him, and Horus' name was usually written with the figure of this bird  . Originating probably in the delta of the Nile. the cult of Horus spread in prehistoric times over the whole of Egypt. Thus there arose several distinct falcon gods, particularly at Nekhen (Gr. Hierakonpolis, "falcon-town"), which was the capital of the upper Egyptian kingdom before the country was unified and the site of which is opposite the modern el-Kab; and at Edfu (Egyptian Behdet), where Horus, called there "the Behdetite," assumed the form of a winged sun disk. At Nekhen the conception arose that the reigning king was an incarnation of Horus and, after Egypt had been united by the kings from Nekhen, this conception became a generally accepted dogma. The first of the Egyptian king's five names was the Horus name; *i.e.*, the name which identified him with Horus.

With the god Setekh of Ombos in upper Egypt Horus lived in peace during the first dynasties as a partner in a joint incarnation of the king; Setekh remained the representative of upper Egypt, while Horus represented lower Egypt. Not later than the end of the 5th dynasty, however (*c.* 2425 B.C.), the cult of Osiris spread over Egypt, and Horus was introduced into the Osiris cycle. The deceased king having been by then identified with the god Osiris and the living and reigning king being an incarnation of Horus, Horus became the son of Osiris and of the goddess Isis, Osiris' sister-wife. As such he now became an opponent of Setekh, the murderer of Osiris and the contestant of Horus' heritage. the royal throne of Egypt. According to the myth Horus defeats Setekh, thus avenging his father and assuming the rule. In the fight his left eye (*i.e.*, the moon) was damaged—this being the mythological explanation of the moon's phases—and was healed by the god Thoth. The figure of the restored eye (zrdjat-eye) became a powerful amulet. After the battle, Horus mourned Osiris and conducted his funeral rites.

In later times Horus appeared as a local god in many places and under different names and epithets: as Harmachis (Har-em-akhet, "Horus in the horizon"); as Harpocrates (Har-pe-khrad, "Horus the child"); as Harsiesis (Har-si-Ese, "Horus, son of Isis"); at Kom Ombo as Haroeris (Har-wer, "the elder Horus" as distinct from "Horus the child"); at Dendera as Harsomtus (Har-sem-tow. "Horus, the unifier of the Two Lands"); and as Harendotes (Harend-yotef, "Horus, protector of his father"). Horus was identified by the Greeks with Apollo, and Edfu was called Apollinopolis ("Apollo's town") in the Greco-Roman period. Horus harpooning his enemy Setekh in the form of a crocodile was a potent magical figure and seems to have served as the model for St. George killing the dragon.

See S. A. B. Mercer, ***Horus,*** *Royal God* of *Egypt* (1942). (J. ČÝ.)

HOSANNA. A word cried in salutation of Christ when He entered Jerusalem (Mark xi, 9 *sq.;* Matt. xxi, 9, 15; John xii, 13). We find in Ps. cxviii, 25, *Hōshī'āh nā* ("Save, Oh!") and in Ps. lxxxvi, 2, the shortened form *Hōsha'*. In Zech. ix, 9, the Messiah is said to be *nōsha'* ("saved" or "victorious") and thus to enter Jerusalem on an ass. Perhaps the multitudes, and certainly the primitive Christians (Matt. xxi, 5, 9), connected the cry of Hosanna with this. In John xii, 13, it may have to do with the palm branches in the hands of the multitude who went out to meet Him. For the term Hosanna is used (Bab. Talmud *Sukka* 30 b) of the festive posy (*lulab*, a palm shoot, myrtle and willow) carried with a citron (*ethrog*) on the Feast of Tabernacles, and possibly at the original Feast of the Dedication (II Macc. x, 7). The origin of this custom is unknown and perhaps goes back to a primitive celebration in nature worship. (A. L. W.)

HOSEA, BOOK OF is one of the Old Testament books of the Latter Prophets, and the first of the Book of the Twelve or Minor Prophets (Hosea [Osee in the Douai version], Joel, Amos, Obadiah, Jonah, Micah, Nahum, Habakkuk, Zephaniah, Haggai, Zechariah and Malachi). Ch. i is the account of Hosea's marriage to Gomer and the birth of his three children. Ch. iii is generally taken as the story of the prophet's remarriage to Gomer after he had divorced her, symbolizing the reconciliation of Israel after the judgment. The rest of the book consists of oracles of judgment on Israel, primarily for its religious apostasy, with occasional predictions of redemption and restoration and pleas to repent.

Times and Life of the Prophet.—Hosea began to prophesy during the prosperous reign of Jeroboam II of Israel (*c.* 786–746 B.C.), when Israel's borders extended from Lebo-hamath (Revised Standard Version: "the entrance to Hamath") in Syria to the Sea of the Arabah (the Dead sea; *see* II Kings xiv, 23–27). Ch. i–ii (iii) come from this period. Ch. iv ff. come from the period of confusion and regicides that followed (*cf.* iv, 1–3; vii, 7). Jeroboam's son, Zechariah, reigned only six months, and his murderer, Shallum, only one month. Hosea may have continued to prophesy through the reigns of Menahem and Pekahiah into the reign of Pekah, whose alliance with Rezin of Damascus brought Tiglath-pileser III of Assyria against Israel, *c.* 734–732 B.C. (*see* v, 8–11, *13*; compare II Kings xv, 29; xvi, 5–9). Hosea was thus a contemporary of Amos and Isaiah.

In contrast with the meaning of his own name, Hosea ("Deliver" or "Save") began with a message of judgment, evidenced in the names he gave his children—Jezreel, Not pitied and Not my people. He was a native of the kingdom of Israel and perhaps did most of his prophesying at the Bethel sanctuary, as did the Judean prophet Amos. Much obscurity surrounds his marriage. To dramatize Israel's apostasy (harlotry), Hosea married Gomer, "a

woman of harlotry" (a cult prostitute?), and gave symbolic names to the children. Variant answers are given to the following questions raised by ch. i–iii: (1) Was Gomer a harlot before her marriage? (2) Was Gomer faithless to Hosea after her marriage? (3) Was Hosea the father of the children? (4) Does the Lord's divorce of his faithless wife Israel in ii, 2 imply that Hosea had divorced Gomer? (5) Is Gomer the adultress bought by the prophet for a price in ch. iii? (6) Is ch. iii a sequel to ch. i, or is it the prophet's own account of his marriage, in contrast with the biographer's account in ch. i? (7) Does ch. iii refer to Gomer's life of shame before her marriage? (8) Does ch. iii recount a second marriage of Hosea? (9) Is ch. i or ch. iii an allegory, not an actual incident? (10) Is ch. iii a postexilic allegory, the editor using autobiographic style (cf. Jer. xvii, 1 ff., also editorial)? (11) Should iii, 1 be translated, "And the Lord said to me again, 'Go, love a woman . . .'"? Most scholars assume that in divorce and remarriage Hosea learned or expressed the love of God for wayward Israel. The data remain inconclusive.

Themes of the Book of **Hosea.**—*Judgment* From a God of Love.—The historic love of God for Israel is a central premise of the prophet. When Israel was a child, the Lord loved him, carrying him in his arms, leading him with cords of compassion, with bands of love (xi, 1–4). The names of Hosea's children, Not pitied and Not my people, imply an earlier time when the Lord was compassionate and regarded Israel as his people. Israel, as the Lord's wife, had been showered lavishly with the good things of the earth (ii, 8). Israel was to him like the cherished first fruits of the fig tree, like grapes in the desert (ix, 10). Only reluctantly the Lord brings judgment; he is pained that Israel forced him to bring retribution, for he would prefer to be Israel's healer (vi, 4, 11b; vii, 1, 13). The God of love is naturally prominent in the oracles of hope: the Lord loves the people of Israel despite their sins and will take Israel to himself (iii, 1–3), speaking tenderly to her and bethrothing her to himself forever (ii, 14, 19–20); his compassion grows warm and tender, and his sons will return to their homes, and he will love them forever (xi, 8–11; xiv, 4).

But judgment must come on faithless Israel. The Lord had warned Israel but received only bitter provocation (xii, 10–14). He cannot ransom or redeem them from their deserved fate, and compassion is now hidden from his eyes (xiii, 14). He will no longer have pity and will love them no more (i, 8; ix, 15). Repentance comes too late (v, 6; vi, 1–4). The Lord will be as a moth or dry rot to Israel (v, 12), as a lion rending its prey (v, 14), as a lion or leopard lurking by the road, as a bear robbed of its cubs (xiii, 8). He will catch them like birds in his net (vii, 12). He will drive them from his house (ix, 15). The land will be devastated of its produce (ii, 9, 12; viii, 7; ix, 2, 6, 16). The trumpet of war will sound against Israel and the sword rage against its cities (v, 8; xiii, 16). Israel's kings will be killed and the kingdom come to an end (i, 4; vii, 7; x, 15). Israel will return to slavery in Egypt and eat unclean food in Assyria (vii, 16; viii, 13; ix, 3, 6; xi, 5; xii, 9). Israel is destined for prey, bereavement and exile (ix, 12–16). The sanctuaries will be devastated and abandoned (x, 2, 8; xii, 11), and the calf image at Bethel will be carried into exile (viii, 5; x, 5, 6).

Apostasy of *Israel.*—Whereas Amos (*q.v.*) was concerned primarily with Israel's disobedience of the ethical requirements of the covenant, the injustice and oppression in the social order, Hosea's chief care was Israel's worship of pagan gods and the licentious fertility cult practices. In Hosea the term harlotry designates both the apostasy of Israel, the wife of the Lord, and participation in the cult prostitution rites. The worship of Baal, the Canaanite god of rain (ii, 8; vii, 16; ix, 10; xiii, 1), and the Baals, the various Canaanite deities (ii, 13, 16; xi, 2), is harlotry. The calf image at Bethel, although part of the cult of the Lord, is condemned as idolatry (viii, 5–6; x, 5–8). Israel (Ephraim) was joined to idols (iv, 17). Wine flowed too freely at the sanctuaries (iv, 11, 18). The shrines flourished, but the Lord took no pleasure in the sacrifices (vi, 6; viii, 11–13; ix, 4; x, 1–2). Guilty priests misled the people (iv, 4–10; v, 1; vi, 9), and the prophets were corrupted (ix, 7–8). Israel had transgressed the law and broken the covenant (viii, 1). There was no true knowledge of the Lord (iv, 1, 6; v, 4; vi, 6; viii, 2; xi, 3). Ethical evils also are condemned, including lying, killing, stealing, adultery, empty oaths, false balances and land grabbing by the princes (iv, 2, 13; v, 10; vi, 9; vii, 1, 4; xii, 7). The wicked kings are called to account (v, 1; vii, 3–7; viii, 4; x, 7; xiii, 10, 11). Like the later prophets, Hosea decried dependence on foreign alliances for the salvation of Israel (v, 13; vii, 8–12; viii, 9–10).

Forgiveness and Restoration.—The message of the Book of Hosea culminates in its picture of reconciliation and restoration of Israel. Israel will return to her husband (ii, 14–23; iii, 1–5; cf. Isa. 1, 1–2). The exiles will come back from the lands of the Dispersion (xi, 10–11). As in Deutero-Isaiah the return from Exile is pictured as a second Exodus (ii, 14–15; cf. Isa. xliii, 16 ff.; xlviii, 20–21; li, 9 ff.). A covenant will be made with wild animals, birds and creeping things (ii, 18). War will be abolished (ii, 18; cf. Isa. ii, 4), and the land will be fruitful (ii, 21–23; xiv, 4–7). The government will be in the hands of the Davidic Messiah (i, 11; iii, 5). There will be no more reliance on foreign help or idols (xiv, 3, 8). In the style of wisdom literature, a separate editorial addition at the end of the book admonishes him who is wise to understand these things, for the ways of the Lord are right.

Literary History.—By the time the Book of the Twelve took its final form in the late postexilic period, the prophetic writings had undergone expansions, additions and changes. The literary form of the book of Hosea suggests it is a compilation; ch. i is biographical, ch. ii, iv–xiv a collection of poetic oracles and ch. iii autobiographical. The superscription (i, 1), giving data about the prophet, is editorial. Other editorial activity was in part an adaptation of the prophet's message to the needs and ideals of the postexilic community. It is found largely in the oracles of hope and restoration, some of which seem out of context and reflect more obviously than others the background and diction of the later period. A few scholars consider most or all of such passages to be late. Editorial activity may also be seen in the references to Judah, extending Hosea's message to include Judah or excluding Judah from some of Hosea's bitterest condemnations; in v, 12–14; vi, 4; viii, 14 Judah has been substituted for an original Israel or Ephraim. The Hebrew text is often corrupt, but the Greek and Syriac versions particularly give some help in its reconstruction. See also BIBLE.

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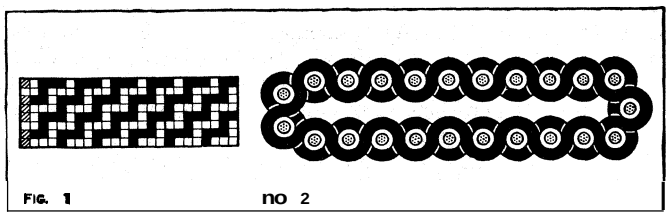
HOSE-PIPE, or simply "hose," the name given to flexible piping by means of which liquid (generally water but occasionally petrol, etc.) may be conveyed. One end of the pipe is connected to the source of the water, while the other end is free, so that the direction of the stream of water which issues from the pipe may be changed at will. The method of manufacture and the strength of the materials used depend naturally upon the particular use to which the finished article is to be put. Simple garden hose is often made of india-rubber or composition, but the hose intended for fire brigade and similar important purposes must be of a much more substantial material. The most satisfactory material is the best long flax, although cotton is also extensively used for many types of this fabric.

The flax fibre, after having been carefully spun into yarn, is boiled twice and then beetled; these two processes remove all injurious matter, and make the yarn soft and lustrous. Several threads may be twisted together to secure uniformity and strength, and then the compound yarns are wound on to large bobbins, and made into a chain or warp; the number of threads in the chain depends upon the size of the hose, which may be anything from half

an inch to 15 in. or even more in diameter. When the chain is warped, it is beamed upon the weaver's beam, and the ends—either double or triple—are drawn through the leaves of the cambs, healds or heddles, passed through the reed and finally tied to the cloth beam. The preparation of the warp for any kind of loom varies very little, but the weaving may vary greatly. In all cases the hose fabric is essentially circular, although it appears quite flat during the weaving operation.

There are very few hand-made fabrics that can compete with the machine-made article, but the very best type of hose-pipe is



FIGS. 1 AND 2.—COMMON DESIGNS IN WEAVING SEAMLESS HOSE-PIPES
Point-paper design (left) and (right) diagrammatic section of cloth

certainly one of the former class. The cloth can be made much more cheaply in the power-loom than in the hand-loom, but, up to the present, no power-loom has been made which can weave as substantial a cloth as the hand-loom product; the weak part in all hose-pipes is where the weft passes round the sides from top to bottom of the fabric or vice versa, that is, the side corresponding to the selvages in an ordinary cloth; the hand-loom weaver can draw the weft tighter than is possible in the power-loom, hence the threads at the sides can be brought close together, and by this means the fabric is made almost, but not quite, as perfect here as in other parts; in addition, the ends of weft can be made to overlap in hand-loom weaving—thus preventing a weak spot. It is essential that the warp-threads be held tightly in the loom, and to secure this, they pass alternately over and under three or four back rests before reaching the heddles or cambs, which are almost invariably made of wire. Although the warp yarn is made very soft and pliable by boiling and beetling, the weaver always tallows it in order to make it work more easily.

Structure of Fabric.—The commonest type of hose-pipe is made on the double-plain principle of weaving, the cloth being perfectly plain but woven in such a manner that the pipe is without seams of any kind. Fig. 1 is a design showing two repeats or eight shots in the way of the weft, and six repeats or 24 threads in the way of the warp, consequently the weave is complete on four threads, or leaves, and four picks. Fig. 2 illustrates the method of interlacing the threads and the picks: this figure shows that 23 threads only are used, the first thread—shown shaded in fig. 1—having been left out. It is necessary to use a number of threads which is either one less or one more than some multiple of four—the number of threads in the unit weave. The sectional view (fig. 2), although indicating the crossing of the warp and the weft, is quite different from an actual section through the threads: the warp is almost invariably two, three or more ply, and in addition two or more of these twisted threads pass through the same heddle-eye or mail in the camb; moreover, they are set very closely together—so closely, indeed, that the threads entirely conceal the weft; it is, therefore, impossible to give a correct sectional view with satisfactory clearness, as the threads are so very rank, but fig. 3 gives some idea of the structure of the fabric. This view shows ninety-nine threads and one complete round of weft; this round is, of course, equal to two picks or shots—one pick for the top part of the cloth and one for the bottom part. A comparison of this figure with fig. 2 will, perhaps, make the description clearer. The weft in fig. 3 is thinner than the warp, but, in practice, it is always much thicker, and may consist of from two to seventy threads twisted together.

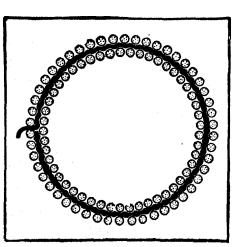


FIG. 3.—SECTION THROUGH WARP OF HOSE-PIPE SHOWING 99 THREADS AND ONE COMPLETE ROUND OF WEFT

Hose-pipes are also woven with the three-leaf twill on both sides, and occasionally with the four-leaf twill. These pipes, woven with the twill weaves, are usually lined with a pure rubber tube which is fixed to the inside of the cloth by another layer of rubber after the cloth leaves the loom. Such pipes have usually, but not invariably, a smoother inner surface than those which are unlined, hence, when they are used, less friction is presented to the flow of water, and there is less tendency for the pipe to leak. They are, therefore, suitable for hotels, public buildings and similar places where their temporary use will not result in undue damage to articles of furniture, carpets and general decoration.

The greatest care must be observed in the weaving of these fabrics, the slightest flaw in the structure rendering the article practically useless. After the cloth has been woven, it is carefully examined, and then steeped in a chemical solution which acts as an antiseptic. The cloth is thus effectively preserved from mildew, and is, in addition, made more pliable.

Finally the hose-pipe is dried artificially, tested for strength and resistance to pressure of water, and finally, fitted with the necessary couplings and nozzles.

See T. Woodhouse and T. Milne, ***Textile Design: Pure*** *and* Applied (1912). (T. W.)

HOSHANGABAD, a town and district in the Jubbulpore division of Rfadhya Pradesh, India. Pop. (1951) 14,989.

Founded by Hoshang Shah, a Malwa king, in the 15th century, the town came to prominence after its capture by Bhopal in 1720. Between then and 1818, when it came under British rule, it was the scene of many conflicts between the Marathas and the Bhopal rulers. It has never been a big trading centre but has enjoyed some importance as the district headquarters. and its position on the left bank of the Narbada river and on the Western railway (Indian Midland section) is a favourable one. It is 40 mi. S.S.E. of Bhopal city.

HOSHANGABAD DISTRICT (5,864 sq.mi.; pop., 1951, 847.898) lies in the Narbada valley between the Vindhyas on the north and the Satpura range on the south. The central plain contains rich black soil, wheat being the principal crop. The Western railway from Bombay to Jubbulpore runs up the valley, and at Itarsi, near Hoshangabad, two branches take off, the northern to Delhi through Bhopal and Gwalior, the southern to Nagpur across the Satpuras. The district had a wheat boom in 1888, and in 1891 its population was 493,000, but bad years followed by plague and influenza caused a serious temporary decline; the people later, however, became prosperous. Cotton is grown in the west. and in the poorer tracts in the south and east there are millets and oilseeds. Apart from these it is one of the principal wheat-growing districts of the state.

Wheat, cotton and oilseeds are largely exported. Dyeing, brasswork and weaving are the chief local industries. There is a large area of government forest on the south, and the Bori teak forests are very valuable.

The town of Harda, in the west, had a population of 18,640 in 1951.

HOSHEA (Heb. for "deliverance"), the last king of Israel, in the Bible. The attempt of his predecessor, Pekah, to take Jerusalem with the help of his ally Rasun (Rezin) of Damascus was frustrated by the intervention of Tiglath-Pileser III *(see* AHAZ), who attacked Gilead, Galilee and the north frontier and carried off some of its population (*cf.* I Chronicles v, 26). Pekah's resistance to Assyria led to a conspiracy in which he lost his life. and Hoshea the son of Elah became king (II Kings xv, 27–30). The Assyrian king held him as his vassal (and indeed claims to have set him on the thronej and exacted from him a yearly tribute. After the death of Tiglath-Pileser, Israel regained confidence (Isaiah ix, 8–x, 4) and took steps to recover its independence. Its policy vacillated—"like a silly dove" (Hosea vii, 11)—and at length negotiations were opened with the Egyptian So, possibly Shabaka or one of the Delta princelets. The annual payment of tribute ceased, and Shalmaneser V (who began to reign in 727 B.C.) invaded Israel, imprisoned Hoshea and laid siege to Samaria, which fell at the end of three years (722 B.C.). The achievement is claimed by his successor: Sargon. The land was again partly de-

populated and a governor appointed (II Kings xviii, 9–12; cf. xvii, 1 et seq).

For other allusions to this period see HOSEA; ISAIAH.

HOSHIARPUR, a town, tehsil (subdivision) and district in Punjab, India. Pop. (1951) 45,291. The town. 40 mi. N. of the railway centre of Ludhiana, was founded, according to tradition, about the early part of the 14th century. In 1809 it was occupied by Ranjit Singh. There are manufactures of cotton goods. inlaid woodwork, lacquered ware, shoes and copper vessels. The town contains three colleges of Panjab university.

HOSHIARPUR TEHSIL (572 sq.mi.) had a population in 1951 of 274,126.

HOSHIARPUR DISTRICT has an area of 2,227 sq.mi.; pop. (1951) 1,091,986. It falls into two nearly equal parts of hill and plain country. Between the two chains of hills on the east stretches a valley of uneven width, known as the Jaswan Dun. Its upper part is crossed by the Sohan torrent, while the Sutlej sweeps into its lower end through a break in the hills and flows in a southerly direction till it turns the flank of the central range and debouches westward upon the plains. This western plain consists of alluvial formation, with a general westerly slope as a result of the deposit of silt from the mountain torrents in the submontane tract. Rice is largely grown in the marshy flats along the banks of the Beas. Religious fairs are held at Anandpur, Mukerian and Chintpurni which attract an enormous concourse of people. Cotton fabrics are manufactured. and sugar, rice and other grains, tobacco and indigo are produced.

The country around Hoshiarpur formed part of the old Hindu kingdom of Katoch in Jullundur. The state was eventually broken up, and the present district was divided between the rajas of Ditarpur and Jaswan.

They retained undisturbed possession of their territories until 1759, when the rising Sikh chieftains began a series of encroachments upon the hill tracts. By the end of 1818 the whole country from the Sutlej to the Beas had come under the government of Lahore. and after the first Sikh war of 1845–46 it passed to the British government.

HOSIERY. Hosiery is a covering for the legs and feet. (In Great Britain the word "hosiery" is used to include all types of knitted fabrics, whereas in the United States hosiery is restricted to mean socks, stockings, and other coverings for the legs and feet.) Hosiery is made to fit the feet and legs of all ages, short hose for children being known as socks, long hose, as women's stockings, while stockings for men are known as half-hose. Hosiery, almost without exception, is formed of looped fabric, of which there are two generic types — weft fabric and warp fabric. In weft fabric, as shown in fig. 1, the yarns of which the loops are formed extend crosswise of the fabric, whereas in warp fabric the yarns of which the loops are formed cross at an angle, as shown in fig. 2. Generally speaking, all the loops of a given area of weft knitted fabric are formed of one yarn, while in warp fabric many yarns are used as each vertical series of loops is formed of a separate yarn. In the fabric diagram shown in fig. 1, the front of the fabric is uppermost, with the last course formed at the top and the needle wales ending at the top of the figure as loops. Additionally, there are combination warp and weft fabrics in which all, or certain of the loops of the warp type are superimposed over the weft fabric loops. This type of fabric is usually produced for design purposes, the warp loops overlying the weft loops thereby producing the design, which most often is in a contrasting colour.

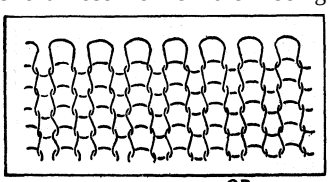


FIG. 1.—WEFT LOOP OR PLAIN FABRIC

Looped knitted fabric is used for hosiery, because it is elastic, weft fabric usually being used, as its elasticity or stretch is mainly crosswise or coursewise of the fabric and so provides better fitting hosiery, for varying sizes or parts of the leg. The fact that weft fabric has little vertical or walewise elasticity is an advantage in hosiery, as the few length variations required can be met by knitting a greater or lesser number of courses.

Warp fabric has been used for hosiery, but as its elasticity is less than that of weft fabric and is apt to be in both directions, it is not usually so used. Further, it is more difficult to produce warp fabric wider or narrower in the same piece as more or fewer warp threads must then be used and additionally, due to the many yarns used in warp fabrics, any of which may vary slightly in size or tension, undesirable streaks are much more difficult to eliminate than in weft fabric, which can be produced with only one yarn.

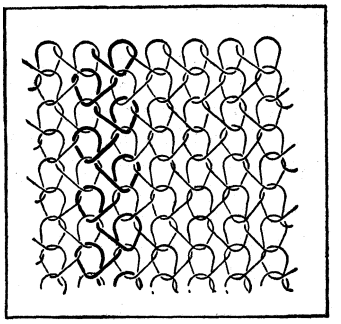


FIG. 2.— WARP FABRIC

Hand Knitting. — While hosiery today is usually produced on machines, all types can be, and even today sometimes are produced by hand knitting. The weft type is either produced on two or more thin, straight, hookless needles by a hand manipulation of the yarn, or in more recent years on a long, thin, hookless, flexible needle which can be readily bent into a circle for taking loops from one of the pointed ends and forming new loops one by one, by manipulating the yarn and the other pointed end.

Warp fabrics can be produced by hand crocheting; a single, simple hooked needle is used to draw a loop through an adjacent loop, thereby forming a chain of loops joined to adjacent loops, either vertically or at an angle to each other, as may be desired. The art of forming weft looped fabrics, either by hand or machine, is known as knitting, while the art of forming warp looped fabrics by hand is known as crocheting and when a machine is used, as warp knitting.

Fabric Characteristics. — A11 knitted fabrics have a back and a face side which differ somewhat in appearance, more particularly weft fabric, in which the back has ridges running crosswise of the fabric and a space between these ridges known as a course. The face of the fabric is distinguishable from the back by vertical lines known as wales, which present alternate raised and depressed lines, the former being known as needle wales, due to this portion of the loop being formed by the needles, while the depressed lines are known as sinker wales, due to this portion of the loop being formed by implements known as sinkers, which in machine-formed fabrics are located between each needle to kink the yarn against the needle shanks.

The horizontal ridges on the back of the fabric are the result of the intertwining of the sinker and needle wale loops. The back of the fabric is not as smooth as the face, so the face is usually visible when the stocking is being used, although some people wear their stockings inside-out and so take advantage of the rougher inner surface.

Warp fabrics differ as regards the face and back, only to the eye of an expert. Both sides can be made to show relatively distinct horizontal, vertical, or angular lines depending upon the way the chains of loops are connected to adjoining wales, but the difference between courses, needle wales, and sinker wales is never so distinctly noticeable as in weft fabrics.

Hosiery Knitting Machines. — Hosiery today is usually produced by machinery, of which there are three basic types. The machines usually used for producing the best quality of women's stockings are known as Cotton's system flat full-fashioned knitting machines.

The circular knitting machine can be used for knitting infants' socks, men's half-hose, or women's stockings, but as the quality of the fabric produced by these machines is inferior to the fabric

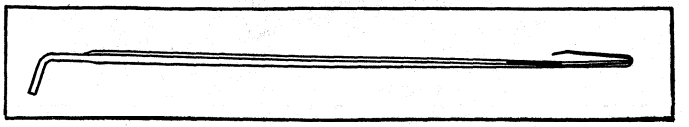


FIG. 3.—SPRING BEARD NEEDLE

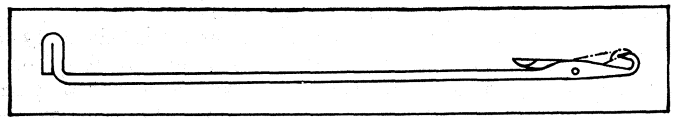


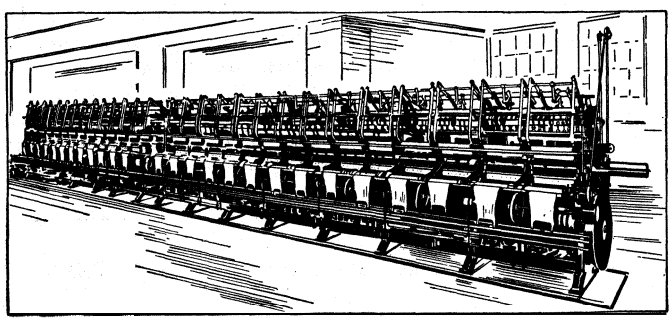
FIG. 4.— LATCH NEEDLE

produced on flat machines of the type hereinbefore referred to, only the cheaper grades of women's stockings are knitted thereon, but as the circular machine can produce fabric more rapidly than flat machines, the great majority of men's half-hose and infants' stockings are knitted thereon, as quality, perfect fit and appearance apparently are not so important in men's and infants' stockings as in women's stockings. Additionally, it is only in women's stockings that extreme sheerness is in demand, and sheer fabric of even appearance is most readily produced on Cotton's spring beard needle machines.

The third generic type, and the least common of the three, is known as the Lamb machine. This is a straight-bar machine having two sets of needles and while excellent fitting hosiery can be knitted thereon, its structural characteristics cannot be readily adapted for the production of sheer hosiery, so that only relatively coarse. heavy stockings are produced thereon.

Knitting Needles.—The needles used for producing hosiery fabrics are of two types—the spring beard needle and the latch needle. The former was probably invented by William Lee of Calverton, England, about 1589. A modern needle of this type, as shown in fig. 3, consists of a long shank with a right-angle bent butt at one end and a long flexible hook at the other. This latter is known as a beard. It is formed with a groove (or eye), into which the tip of the beard can be pressed and buried and so close the hook. In forming loops with this type of needle, the new yarn, kinked around the needle shank below the open needle beard, slides by the open beard toward the hook, while the previously formed fabric loop, which rests somewhat below the tip of the beard, likewise slides upwardly after the beard is closed over the new yarn. The previously knitted fabric loop thereby passes over the beard and so can be moved toward the hook, with the result that the new yarn in the hook is drawn through the previously formed loop, which is thereby cast off the needle as the new loop is formed. This new loop then slides down the shank of the hook, past the now open beard of the needle and below its tip, ready for the next loop-forming operation.

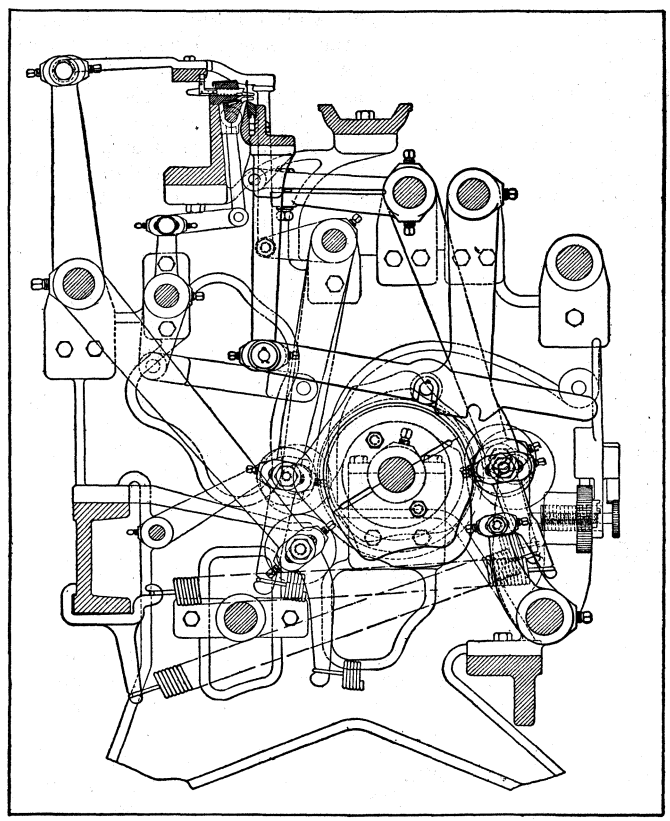
The latch needle, which was invented by Matthew Townsand of Leicester, England, about 1847, is constructed as shown in fig. 4, the shank of this needle being made as long as necessary, with a butt formed at right angles to the shank at the lower end. In forming a loop with this type of needle, the previously formed loop—at the time the new yarn is engaged by the hook—is on the needle shank somewhat below the open latch. As the needle moves downward with the new yarn in its hook, the previously formed loop contacts the open latch and swings it on its pivot into the closed dotted position shown in the figure, so that the previously formed loop can be cast off over the closed hook, with the new yarn formed into a loop by the needle hook. Thereafter, this new loop slides down, thereby opening the latch, and by continued downward movement the loop finally slides off the lower end of the open latch on to the shank of the needle.



COURTESY OI KARL LIEBERKNECHT, INC., READING, PA.

FIG. 5.— COTTON'S SYSTEM FULL-FASHIONED HOSIERY MACHINE

Cotton's Machine.—The Cotton system flat full-fashioned knitting machine, invented by William Cotton about 1864, was an improvement on the original flat knitting machine built by William Lee about 1589. The machines in common use, which produce practically all of the women's quality stockings in all countries of the world, are a refinement of Cotton's machine. These present-day machines are 50 to 60ft. long and produce from 20 to 32 pieces of flat hosiery fabric at once. Such a machine is shown in fig. 5; fig. 6 shows an end view of the knitting elements and their operating parts. In these machines the original Lee and Cotton basic principles are retained, although of course they are fitted with many refinements and so produce very much finer, sheerer fabric and operate at about 72 courses per minute. Additionally, there are a small number of modern single-section machines in use today.



FROM "KNITTING FULL-FASHIONED HOSIERY" BY MAX C. MILLER

FIG. 6.— COTTON'S MACHINE. END VIEW

The long machine is divided into what are known as sections, each of which produces a hosiery blank on a bar some 14in. long, in which there are rigidly fastened about 400 needles, the exact number depending upon the number of needles to each inch of bar.

The gauge of the machine depends upon the number of needles per inch, the gauges in use today being 39, 42, 48, 51, 57, 60, 66, the most common of which is 42-gauge. To determine the number of needles per inch when the gauge is known, divide the gauge number by three and multiply by two. The needles stand vertically and go through a quite complicated movement roughly resembling a figure eight. Between each pair of needles and sliding to and from the needle shanks at right angles thereto, are elements known as jack sinkers, which are notched at the end that goes between the needles to kink and position the newly fed yarn. Means is provided to project successively the sinkers between the needles when the latter are in a position with the tip of the needle beard somewhat above the sinker notch or throat, the inward coming of these sinkers being progressive; that is, they are moved between the needles in a wave-like motion, closely following the yarn that is being traversed to the beard side of the needles, with the result that at each traverse, yarn is successively kinked around each pair of needles, twice as much yarn being kinked as

is required for each loop. Another group of elements known as dividers is also provided, alternating with the jack sinkers. These are also fitted with yarn kinking notches and are projected en masse between each needle of the jack sinker pair of needles, after the successive kinking action of the jack sinkers, with the result that a kink is then formed around the shank of each needle. All this is done while the needles are standing in their highest position, so that the yarn can be kinked against the needle shanks somewhat below the tip of the beards. Slightly under each sinker and divider and projecting between each needle, are elements known as knockover bits, the fabric and the previously formed course on the needles lying on top of these bits and dnder the sinkers. After the yarn kinking operation, all the needles are drawn downward en masse, until the tips of their open beards are below the newly kinked yarn and slightly above the previously formed course lying on the knockover bits. Thereafter, the needles are moved bodily a slight distance, lengthwise of the fabric, that is, further between the sinkers which are still retaining a kinked yarn and which move in the same direction, so that the kinks can be maintained without straining. In this movement, the lower ends of the needle beards contact a fixed edge of the machine and thereby the open ends of the beards are closed by being pressed into the eyes of the needles, this closing taking place slightly above the previously formed loops. Thereafter, the needles continue to move downward, the sinkers retreat to release the newly kinked yam, which is drawn by the now closed needle hooks through the previously formed loops, a fabric tension assisting in the casting off of these previously formed loops ana holding same to the back side of the needles, as they rise to again be in position to have a new yarn kinked around them by the sinkers. **A** selvage is formed at each edge of the fabric by the successive back and forth traverse of the yarn.

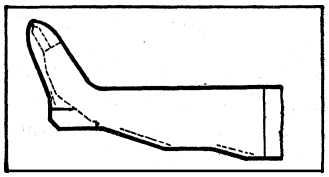
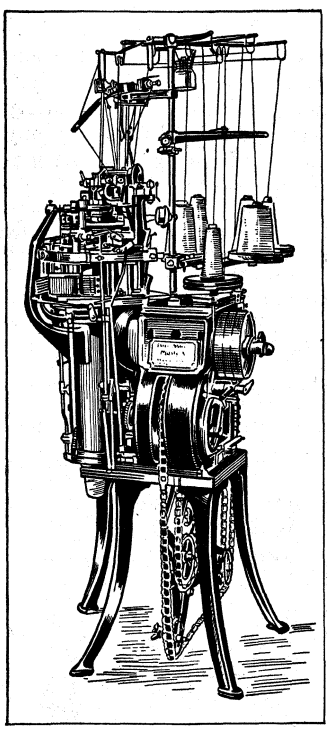


FIG. 7.—WOMEN'S FULL-FASHIONED STOCKING

Cotton's Shaping.— In order to shape the stocking blanks, each section of the machine is provided with automatically operating grooved points, which are caused to engage with the needle eyes, and by an en masse combined movement of the points and needles, about 20 selvage loops are lifted off outer needles and deposited inwardly on adjacent needles. This operation, known as narrowing, is repeated throughout the leg, heel, foot, and toe of the stocking and in this manner the blank is given the desired shape.



FURNISHED BY COURTESY OF SCOTT & WILLIAMS, INC., NEW YORK, N.Y.

FIG. 8.— CIRCULAR HOSIERY MACHINE

The top of women's hosiery is usually formed of doubled fabric known as the welt. Until recently, this folding and topping of the fabric was done by hand, but devices have recently been applied to the machines for doing it mechanically.

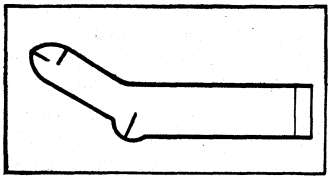
Cotton's Carriers. — Additionally, the machines are fitted with various traversing yarn carriers, usually eight to ten, so that a different quality or size of yarn can be knitted into different portions of the stockings. A more recent improvement is the feeding of three yarns in sequence, so that each yarn only recurs in each third course. This is known as 3-carrier ringless knitting and is done to make possible the production of reasonably even, translucent, sheer fabric, as it was found that unavoidable variations in the fine silk yarn usually used, when the same yarn recurred in each course, resulted in very noticeable thin and thick areas, called shadow bands.

These machines are also fitted with additional mechanisms for reinforcing for wear, or for producing ornamental thickened areas, known as splicing, at and around the heel, sole, and toe. These machines can also be arranged to produce rib, open mesh, lace or petinet, plated, reverse plated, striped, checked, tucked, spread loop, drop-stitch, anti-run, inlay, including elastic inlay, fleece or plush, reinforced designs, split and warp thread or warp shaped and design fabrics.

While the full-fashioned flat knitting machine was invented and first put into commercial operation in England, the labour guilds interfered with its use and the early builders were exiled first to France and later to Germany. Consequently, the evolution of this type of machinery was no longer an English monopoly, with the result that each company developed its own forms of this type of machinery and the Germans for a great number of years retained a monopoly on exports. This continued until the World War (1914–18), which gave the machine builders in the United States an opportunity to enter this field, so that by 1940 a great majority of the machines used in the United States are built there and the machines used in other leading industrial countries are either produced in such countries or bought from German machine builders.

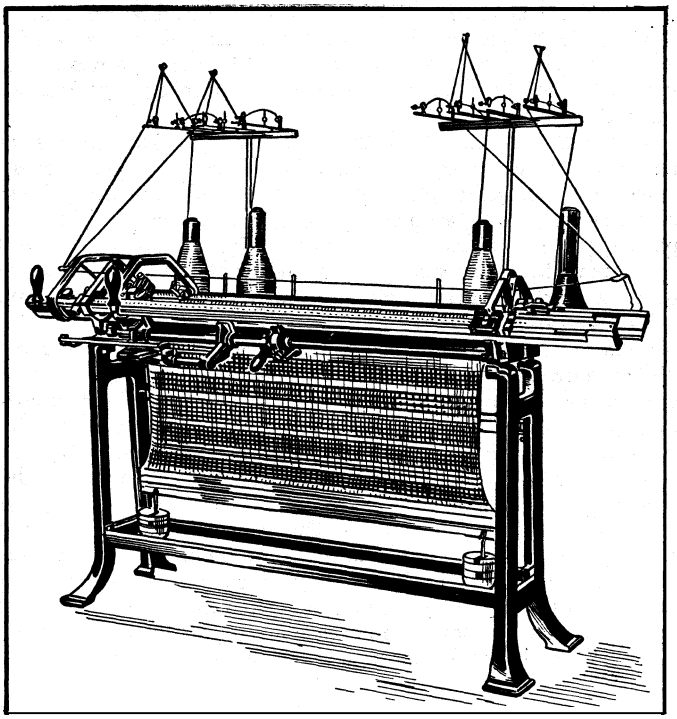
The evolution since 1925 has been largely in the direction of increasing the number of sections, so that one operator can readily attend the increased number of sections. While many refinements as regards gauge and speed have been introduced, up to 1940, the only step toward automaticity has been the evolution of automatic welt apparatus, which, however, still leaves a great number of manual movements to be made by the operator. Generally speaking, the down-time of modern machines without automatic welt apparatus is about 33%; when welt apparatus is used the down-time is reduced to about 8%. As in the past, it is still necessary to have one skilled operator in attendance at each machine and the effort of the industry is to bring about complete automaticity, so that one relatively unskilled operator can attend more than one full-fashioned machine.

Full-Fashioned Hosiery.— The stocking blank is usually knitted in two pieces on two machines. One machine, known as the legger, produces the welt, leg, and heel blanks, which are manually transferred to a footing machine. The footer is similar to the legging machine, except that it is especially organized to properly shape and produce the feet and toes of hosiery. Various types of machines have been evolved for producing the entire stocking on one machine, or combination machines in which the leg, foot, and toe are produced by a continuous process on one machine and the heels on another; or the leg, heels, foot, and toe may all be produced on one machine in a continuous operation. Regardless of how full-fashioned hosiery blanks are formed, they are all looped on a looping machine at the toe end and heel bottom and then seamed between the toe and heel bottom and up the back of the leg to and including the welt. The result is shown in fig. 7 and is known as women's full-fashioned hosiery, the distinguishing characteristics of which are sheerness, even-appearing wales, and excellent fit. Readily distinguishable features of full-fashioned hosiery are the interknitted welt, the narrowing marks spaced parallel to the seam line and a short distance inside thereof, the square heel, narrowed at the bottom, the narrowed foot with its fashioning marks, the diamond side-gored toe, the properly selvaged high splice above the heels and the similarly formed spliced soles. These machines have also been built to produce many other types of selvage fabric.



FROM "PRINCIPLES OF KNITTING" BY MAX C. MILLER

FIG. 9.—WOMEN'S SEAMLESS STOCKING



FROM THE GROSSER KNITTING MACHINE CO., NEW YORK, N.Y.

FIG. 10.—LAMB MACHINE

Circular **Hosiery** Machines.—Circular knitting machines are also used to produce hosiery, and while machines of this type have been used, fitted with spring beard needles, the machines of this type in universal use are fitted with latch needles of the type described above. These needles are mounted to slide individually in a vertical cylinder, additional implements functioning between the needles to assist in forming the loops. Small cams act on the needle butts to cause them individually and successively to move up and down, the cylinder being stationary with the cams revolving, or vice versa. With the former construction, the yarns used must revolve; with the latter construction, the yarns are stationary—the more common arrangement, especially in small machines producing seamless hosiery. **A** well-known machine to produce seamless hosiery is shown in fig. 8.

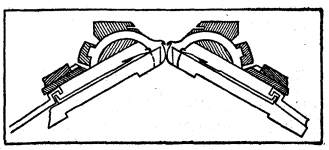
Circular Hosiery.—The stockings produced on the machine described above are coarser than those usually produced on full-fashioned flat machines, due to the fact that the latch needles used cannot be made as fine as spring beard needles, so that fewer needles can be placed in each circumferential inch of the cylinder. The fabric is not only coarser, but the opening and closing of the latches produce more irregular wales than when spring beard needles are used. The stockings are tubular and seamless and have the same number of wales at the ankle as they have at the top. They cannot be properly shaped to fit the varying circumferences of the heel and leg except by varying the size of the loops. This is the reason why the best quality of women's stockings cannot be produced thereon, since these stockings usually cover the limb well above the knee and so, in order to fit properly, the top of the stocking, as an example, should have a far greater number of loops than the ankle. Circular machines have never been able to knit the well fitting ankle, heel, and toe of full-fashioned hosiery. The resultant stocking is shown in fig. 9.

The major reason for using circular machines to produce hosiery is that their circular knitting action enables them to knit much more fabric in any given time than is possible on flat machines; also fewer finishing operations are required, and the latch needle lends itself to the simple production of a great variety of design fabrics, which will be explained below.

Circular Rib **Machines.**—Circular rib hosiery machines are also in use. In these a dial with needles or an additional cylinder is mounted over the other, with double hook latched needles that can be slid from one cylinder to the other so that either ribbed or plain fabric can be selectively produced, as for instance, the ribbed top of half-hose or entire ribbed stockings. This system does not lend itself as yet to anything but relatively coarse latch needle gauges. This type of machine has also been evolved to produce shaped, seamless, rib fabrics. Rib fabrics will be discussed below.

Lamb Machines.—Lamb type flat machines are also used for knitting hosiery. While this type of machine has used spring beard needles to a limited extent, it commonly uses latch needles, thereby producing fabric having the inherent latch needle advantages and disadvantages noted above. These machines can, however, produce fashioned fabrics either of the flat type with selvages or they can produce seamless fashioned hosiery or other garments. **A** machine of this type is shown in fig. 10.

Such machines carry their latch needles in parallel grooved beds placed at an acute angle to each other, the needles of one bed crossing the needles of the other bed near their hook ends, with the fabric passing down between the two beds. The needles are cammed up and down individually, so that their hook ends may engage with the feeding yarn successively, implements being interposed between the needles to assist in forming the loops. This process is similar to the system used in circular machines. **A** cross section of the fabric producing parts of this type of machine is shown in fig. 11.



FROM "PRINCIPLES OF KNITTING" BY MAX C. MILLER

FIG. 11.—CROSS-SECTION LAMB MACHINE

When these machines are to form seamless fabric, the carrier, which is traversed back and forth lengthwise of the needle series, feeds yarn first to one bed of needles and then to the other, producing tubular fabric which can be made wider by adding empty needles at one or both ends of the series. They have also been fitted with loop-lifting implements, so that the tubular fabric can be narrowed. When they are to produce flat selvaged, widened blanks, only one set of needles is used and empty needles are brought into action at either or both ends of the series. If the blanks are to be narrowed, loop-lifting implements can be used to shift the loops inwardly. These machines can also be used to produce flat selvaged rib fabric by feeding the yarn to both sets of needles simultaneously. Machines of this type have also been evolved to produce tubular, fashioned rib fabrics by using four sets of needles, and, too, they can produce perfect fitting heels and toes when equipped with loop transferring elements. It is obvious from all the above that with the Lamb machine, a greater variety of hosiery—seamless, flat, and rib—can be knitted than with any other type of machine. The difficulty has been to build the machines so that spring beard needles of fine gauge can be used.

Warp Hosiery.—Machines to produce warp fabric stockings have met with little success, mainly for the reason that it is mechanically difficult to increase and decrease the number of warp threads used. This is necessary when fabric of varying widths is to be produced. **A** limited quantity of stockings are produced of warp fabric, however, by resorting to cutting the shaped blanks required out of wide warp knitted cloth and seaming the various parts together. Such stockings have objectionable bulky seams; if sheer, they are elastic in both the horizontal and vertical directions—the latter being objectionable—and it is difficult to eliminate vertical or diagonal streaks.

Knitted Garments.—All the machines that have been described can also be used to produce other garments, such as those for outerwear and underwear, in which the stretch inherent in knitted fabrics is desirable. In some, the warp fabric horizontal and vertical stretch is wanted; in others, only the weft horizontal stretch is found desirable.

Warp machines and, to a limited extent, weft machines can both produce what is known as inlay fabric, in which unkinked and unlooped yarns are interknitted into the fabric by the knitted loops, thereby thickening the fabric and/or making it nonelastic in either or both directions. Such knitted cloth

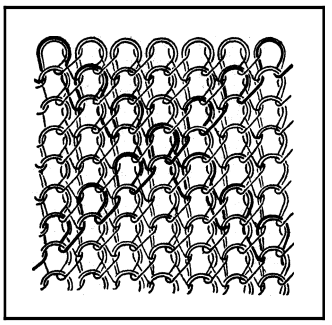


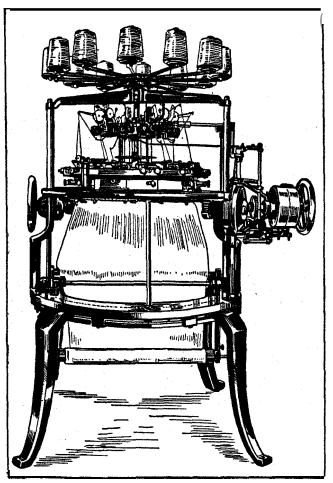
FIG. 12.—MILANESE FABRIC

is usually used for women's outer garments, men's suiting and overcoats; and if this inlay thread is made of rubber or has a rubber core, garments with greater elasticity than those knitted of non-elastic yarn, such as women's girdles, surgical stockings, etc., can be produced.

Milanese Machines.— Another type of flat machine used to a limited extent is the Milanese warp machine, with which it is possible to produce the type of warp fabric shown in fig. 12. They are usually built as flat machines up to 20ft. wide, using latch or spring beard needles, with the warp yarns running diagonally through the fabric in opposite directions. The two groups of warp yarns used are shifted step-by-step, in opposite directions, across the machine. Each warp yarn, as it reaches the end of the machine, moves step-by-step backwards across the machine again by the use of very ingenious mechanism, the warp threads being mounted on spools which are gradually traversed around an endless chain under or over the machine. More modern machines, which can operate 600 times per minute, and in which the thread traversing motion is very much simplified, are just becoming available. As is common in plain warp machines, Milanese warp fabrics are especially adapted to produce diagonally designed fabrics by making use of coloured warps, and the stretch of the fabric is likewise in both directions. While circular plain warp, as well as circular Milanese warp machines are not used to any great extent, they are available and are naturally high producers, because of their rotary motion. The needles in these machines are either of the latch or spring beard needle type, usually the latter, and are individually movable or operate en masse, usually the latter.

Circular Body Machines.— Circular weft looped fabrics, used for the cut-up garment trade, are produced on circular machines which range from the smallest to 8oin. in diameter, usually from 12in. to 36 inches. The machines used are of the individually and successively movable latch or spring beard needle type, depending upon the quality of fabric that is required. If the best quality of plain fabric is desired, spring beard needles should be used, but if anything but very simple fancy fabric is wanted, latch needles should be used. These machines are known as circular body machines, a well-known type being shown in fig. 13. They are either of the revolving or stationary needle cylinder type.

Sinker Wheel Machines.— Another method of producing tubular fabrics is with sinker wheel circular machines in which spring beard needles are used, mounted rigidly in a vertical ring or horizontal disc. These machines use various types of bladed wheels, fixed at an angle to act between the needles to kink the yarn, press the needle beards and slide the loops as they are formed up and down on the needle shanks as is required. A diagrammatic view with vertical needles shows these loop element forming parts in fig. 14, fig. 15 showing a partial view of a circular fixed needle machine, in which the needles are horizontal. These machines have also been fitted with warp yarn feeding implements, so that combination warp and weft fabrics can be produced. They can also produce many types of designs, including lace fabrics, the latter through the use of notched wheels, which bring two or more needles together and so permit loops to be shifted from one needle to the other or spread same over more than one needle.



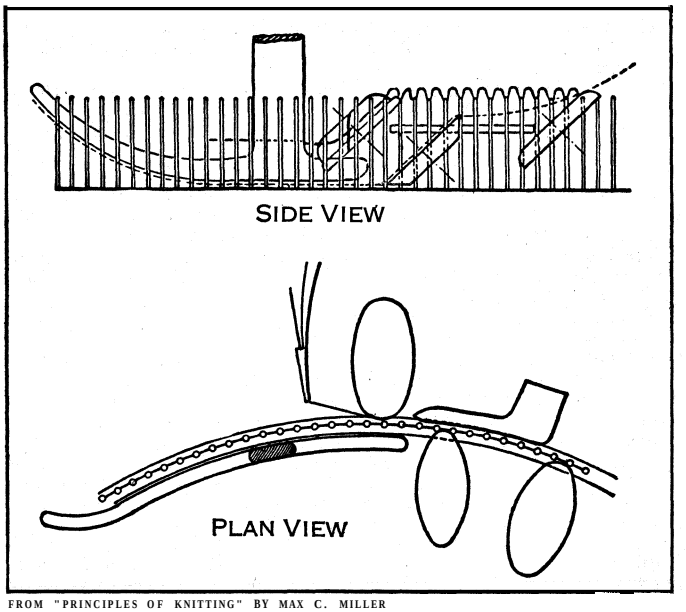
BY COURTESY OF WILDMAN MFG. CO., NORRISTOWN, PA.

FIG. 13.— CIRCULAR BODY MACHINE

Lace Fabrics.— Spring beard needles can readily be adapted to producing lace and spread-loop fabrics, the former being shown in fig. 16 and the latter in fig. 17, and while implements have been added to sinker-wheel circular spring beard needle machines to make these patterns. they are produced in the simplest manner on flat machines by means of grooved pointed loop-lifting implements known as lace points. These are caused to engage with the needle eyes and either take loops completely from the needles and transfer them to adjacent needles, or spread loops over more than one needle. Cotton's system full-fashioned knitting machines have been especially adapted to make such fancy fabrics, either in a simple repeated pattern or by controlling the points with Jacquards or pattern tapes.

Links-and-Links Fabric.— Fabric known as links-and-links, shown in fig. 18, can be produced on both circular and flat machines, more usually the latter. Machines of this type use needles with a hook at each' end, more usually latch needles which are caused to slide from one bed of the machine to the other, so that they are individually caused to draw loops through the fabric, first in one direction and then in the other. The stretch of this fabric greatly resembles that of ordinary weft knitted fabric and is usually used for outer garments such as sweaters. If individual needles are selected to slide from one bed to the other, patterns in the loop structure can readily be produced.

Rib Fabric.— Rib fabrics are produced on either circular or flat machines, including Lamb machines, a one-and-one rib fabric being shown in fig. 19. To produce this type of fabric, latch needles are usually used, although spring beard needles have beeh used to a limited extent. Regardless of the type of machine or needles used, alternate wales of this fabric are drawn in opposite directions, so that the needles near their hook end must cross each other and the yarn must be fed simultaneously to both sets of needle hooks. In circular machines, the rib needles are usually mounted in a horizontal dial, with



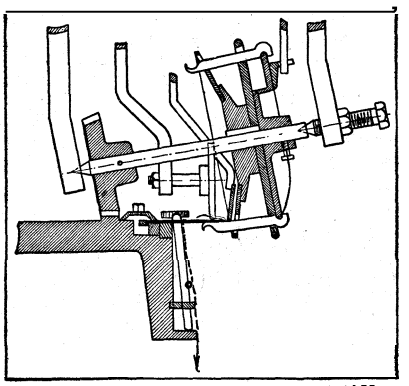
FROM "PRINCIPLES OF KNITTING" BY MAX C. MILLER

FIG. 14.— CIRCULAR MACHINE WITH FIXED VERTICAL NEEDLES

the other needles mounted in a vertical cylinder, all needles being individually and successively movable, although machines are in use in which one, the other, or both sets of needles are mounted in conical cylinders. To produce one-and-one rib fabric, alternate needles draw their loops in opposite directions, but any desired combination of ribbed wales can be produced by causing more of the needles to draw in one direction than in the other. Rib fabric is much more elastic than other knitted fabrics, as the tendency is for the two kinds of wales to draw the fabric together like an accordion. One-and-one rib, therefore, is more elastic than two-and-one, or broad-rib combinations.

Rib fabric formed with latch needles is not as elastic as spring needle rib fabric, for the reason that the yarn, having to open and close the latches during the knitting, permits the needle wales to have much more yarn than the sinker wales, instead of getting the springy effect of both the needle and sinker wale loops, as is the case in spring needle fabric. In rib fabric, only the needle wale loops open and close as the fabric is stretched.

Cotton's system flat machines can also be arranged to produce ribbed fabric by adding a series of horizontally positioned spring beard needles under the sinkers of the plain machine. Beautiful, plain, highly elastic fabric, as well as vertical striped designs of two or more colour effects can then be produced, the latter by feeding and knitting yarn of one colour to one set of needles, floating same over the other needles and then feeding and knitting yarn of another colour to the other needles and floating it over the first set.



PROM "PRINCIPLES OF KNITTING," BY MAX C. MILLER

FIG. 15.— CIRCULAR MACHINE WITH FIXED HORIZONTAL NEEDLES

Patterned Fabrics.— It is possible to produce an endless variety of patterns in knitted fabrics, especially by hand knitting, and a very large range of patterns is possible with the machines hereinbefore described, although each type is best adapted for producing certain patterns and certain machines are better adapted to produce a greater variety of fancy fabrics than others.

Horizontal Stripes.— Horizontal coloured stripes are readily produced on any type of weft knitting machine, as all that is required is a sufficient number of yarn carriers.

To produce such stripes on warp machines is very difficult, but warp machines are readily capable, however, of producing vertical and/or

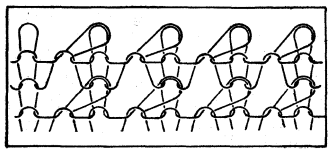


FIG. 16.— LACE FABRIC

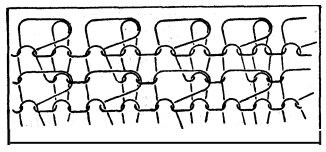


FIG. 17.— SPREAD LOOP FABRIC

diagonal stripes, due to the individual wale construction. Such stripes are with difficulty produced on weft machines, more particularly on fixed needle machines.

Plated Fabrics.— Plated fabrics, in which two or more yarns are simultaneously fed into the machine at one feeding point and a selection is made as to which of these yarns is to appear on the surface, can be produced on any knitting machine, but in other than its simple unpatterned fabric form it is best produced with individually movable latch needles, although simple designs, especially vertical stripes, have been produced on circular and flat fixed spring beard needle machines.

Circular latch needle hosiery machines especially have been developed to produce an endless variety of patterns by the plating and reverse plating method, although the same sort of designs could be made on circular latch needle body machines.

Vertical Stripes.— Vertical striped patterns can best be produced by reverse plating on circular latch needle machines, although spring beard needle machines, both fixed needle, flat, and circular, can produce the simple forms. Float thread vertical striped fabrics can likewise be knitted on all types of machines, but in a simpler manner on latch needle machines by feeding two threads at one point, one of which is selectively fed to the hook side and the other to the back of the needles, the latter thereby producing the floats. This system of striping is often combined in circular machines with reverse plating.

Tucked Fabrics.— In tucked fabrics, the design is produced by not casting off the loops on selected needles for a number of courses, thereby producing a multiple series of loops at the pattern positions. While tucked loops can be formed on any knitting machine, latch needles are best adapted for them, since all that is necessary to produce a latch needle tuck is to prevent the finished loops from moving below the open latch.

Tuck designs are often made in combination with drop-stitch, float, and reverse plated fabrics.

Weft and Warp Patterned Fabrics.— A great variety of patterns can be produced on combination warp and weft machines, the warp threads usually forming the pattern of a different colour from the underlying weft fabric. These machines have in more recent years been known as wrap thread machines and have been developed most thoroughly for the circular seamless hosiery business. Flat and circular spring beard needle machines have also been fitted with thread wrapping implements for design purposes, but the difficulty of properly applying these additional parts has restricted their use. The implements for wrapping the yarns are known as eye-needles and they are similar to those used in any warp fabric machine. These implements are flat, thin blades, with a hole for the individual yarn at the lower end. They are in all instances moved between the needles from the hook side to the back, then shifted one or more needle indexes and again brought through the needles.

Anti-Run Fabrics.— Various looped fabrics and machines for making them have been evolved to mitigate one great fault inherent in weft knitted fabric. This fault is known as a laddering or drop-stitching and results from a broken loop which permits the preceding as well as the following loops of the broken wale or wales to unravel, more particularly the following loops. Some of these loop structures make use of separate tying or locking loops; others make use of the loop-shifting or spread loop idea and others transpose loops to adjacent wales and/or into adjacent courses, and others make use of the weft and warp loop in combination; and while such fabrics do mitigate the laddering difficulty and do meet some of the other requirements of a good fabric, they all, to a greater or lesser extent, give an undesirable pattern effect to the fabric and in many cases increase the cost of material and/or restrict the natural elasticity.

Rib or Links-and-Links Patterned Fabrics.— All the patterns referred to above can be produced in ribbed and links-and-links fabrics, with the additional possibility of producing an embossing effect by

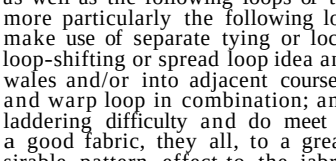


FIG. 18.— LINKS-AND-LINKS FABRIC

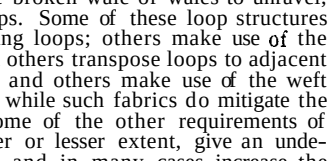


FIG. 19.— RIB FABRIC

forming a pattern of raised and depressed areas by drawing loops to the back or face of the fabric, instead of having each needle always draw its loops in one direction. These machines can also knit rib fabric with selvages, by causing every other needle, or a group of needles alternating with other groups, to remain in one or the other needle bed and draw their loops in consecutive courses in one direction or the other. If a variation in the ribbed wales (for example, when producing fancy ribbed fabrics) is wanted, a Lamb, links-and-links, or double cylinder circular machine may be used and the number of needles—single or in groups—in any one bed are caused to function in the other bed and so draw their loops in the other direction. Circular machines of the two needle cylinder type are often used to produce rib fabric. By changing the relationship of the number of needles in the wales, circular rib fashioned hosiery can be produced.

Spliced and Split Designs.— Still other types of design fabrics can be produced, more readily on flat fixed spring beard needle machines, by splicing. that is, feeding a second thread to selected needles under plating conditions, thereby producing thickened design areas which may be in contrasting colours. Still another effect can be produced by split fabric knitting; again, this is most readily possible on flat fixed spring beard needle machines by using the number of carriers the design calls for and traversing each carrier simultaneously with the other carriers over the restricted number of needles of a pattern and lapping the two yarns at the edge of the pattern by knitting a suture. Circular hosiery machines are also used, in which a part, as for instance the sole of the foot, is split and joined during the knitting to the instep fabric. This makes it possible to form the sole of yarns differing from the yarn used in the instep. Such machines reciprocate when producing split fabric and must be fitted with two feeds.

Machine Speed.— Circular machines, especially those of larger diameter, can be and are usually provided with more than one yarn feeding position. For each revolution, therefore, more than one course of loops can be formed.

As an example, a 24in. machine can readily be rotated at 40 revolutions per minute.

Cotton's system flat machines, having a 14in. needle series, usually form about 72 courses per minute. It would take, consequently, about 8½min. to produce a 12in. piece of 42-gauge fabric having 50 courses per inch. Modern high speed warp machines, which operate up to boo courses per minute, could produce the same fabric in one minute, while a 24in. circular body machine with 12 feeds, at 40 r.p.m. would produce it in a little more than a minute. Modern circular hosiery machines, which are from 2½in. to 4in. in diameter and usually fitted with only one feed, are operated at about 300 r.p.m. and so would produce 600 courses in two minutes. It is to be understood that the production capacity referred to is only average and will necessarily vary with gauge, yarn quality, and as to whether the best or mediocre fabric is to be produced.

BIBLIOGRAPHY.—Max C. Miller, *Principles of Knitting* and *Knitting Full-Fashioned Hosiery*. (M. C. MI.)

HOSIUS or **OSIUS** (*c.* 257–*c.* 359), bishop of Cordova, was born probably at Cordova. He was elected to that see before the end of the 3rd century and narrowly escaped martyrdom in the persecution of Maximian (303–305). In 305 or 306 he attended the council of Illiberis or Elvira, and upheld its severe canons concerning the treatment of the lapsed and clerical marriages. In 313 he appears at the court of Constantine, and 10 years later, as the bearer of Constantine's letter to Bishop Alexander of Alexandria and Arius his deacon, bidding them cease disturbing the peace of the church. He was present at the council of Nicaea in 325, and powerfully influenced the judgment of the emperor in favour of the orthodox party. Hosius presided in 343 at the fruitless synod of Sardica, which showed itself so hostile to Arianism; and afterwards he supported Athanasius in such a way as to bring upon himself a sentence of banishment to Sirmium (355). From his exile he wrote to Constantius II. a letter now his only extant composition. Under pressure, he signed the formula adopted by the second synod of Sirmium in 357, which involved communion with the Arians but not the condemnation of Athanasius. He was then permitted to return to his diocese, where he died in 359.

See S. Tillemont, *Mémoires*, vii. (1700); Hefele, *Conciliengeschichte* (2nd ed., 1873, etc.), vol. i.; H. M. Gwatkin, *Studies of Arianism* (1882, 2nd ed., 1900); A. W. W. Dale, *The Synod of Elvira* (1882); Duchesne, *Histoire ancienne de l'Eglise* (1908), and Herzog-Hauck, *Reatencyktopadie* (3rd ed., 1900).

HOSIUS, STANISLAUS (1504–79), Polish cardinal, was born in Cracow on May 5, 1504. He studied in his native town, in Padua and Bologna, and, entering the church, became in 1549 bishop of Kulm, in 1551 bishop of Ermland, and in 1561 cardinal. Hosius had Jesuit sympathies and actively opposed the Protestant reformation, his *Confessio fidei christiana catholica* being adopted by the synod of Piotrkow in 1557. He was, however, supreme as a diplomatist and administrator. Besides carrying through

many difficult negotiations in Brussels, Prague and Vienna, he founded the lyceum of Braunsberg, which still exists. He died at Capranica near Rome on Aug. j. 1579.

The best edition of his works appeared at Cologne in 1584. Hipler has published separately his letters (1879, fol.) and his sermons (1885). See his *Life* by A. Eichhorn, 2 vol. (1854).

HOSKINS, JOHN (d. 1664/5), English miniaturist, perhaps a pupil of Isaac Oliver, and father of John Hoskins junior. He is believed to have been born in the 1590s; a John Hoskins made a will in 1662 and was buried in St. Paul's, Covent Garden, on Feb. 22, 1664/5, but it is uncertain whether the father or the son made that will and died at that date. Samuel Cooper (d. 1672), the great miniaturist and nephew of Hoskins senior, bequeathed money to his cousin John Hoskins; it is possible that a third John Hoskins, son of John II, is involved. Signed miniatures by the eldest Hoskins date from about 1620; the latest date on a Hoskins miniature, be it by the father, the son, or by both in collaboration, is 1664.

With Nicholas Hilliard. Isaac Oliver and Samuel Cooper, whom he trained, John Hoskins senior is in the front rank of English miniaturists.

His early work is in the Hilliard-Oliver tradition; his later shows the influence of the oil portraiture of Van Dyck, D. Mytens and Cornelius Johnson. He and his son copied subject pictures by old masters.

See Graham Reynolds, English Portrait Miniatures (1952).

(C. H. C. B.)

HOSMER, HARRIET GOODHUE (1830–1908), U.S. sculptor, was one of the leading American women sculptors working in Rome and perhaps the only woman sculptor of the Roman group to win complete financial independence by her work as a sculptor. Born at Watertown, Mass., on Oct. 9, 1830, she early showed an aptitude for modeling, and studied anatomy with her father, a physician, and afterward at the St. Louis medical college. She then studied in Boston until 1852, when she went to Rome with her friend the actress Charlotte Cushman. From 1853 to 1860 she was the pupil of the English sculptor John Gibson. She lived in Rome until a few years before her death.

Among her works were "Puck" (1855), which she copied for the prince of Wales, the duke of Hamilton and others; "Oenone" (1855), in the St. Louis (Mo.) Museum of Fine Arts; "Beatrice Cenci" (1857) for the Mercantile library of St. Louis; a bronze statue of Thomas H. Benton (1868) for Lafayette park. St. Louis; bronze gates for the earl of Brownlow's art gallery at Ashridge hall; and a siren fountain for Lady Marian Alford. She died at Watertown, Mass., on Feb. 21, 1908.

See Albert T. E. Gardner, Yankee *Stonecutters* (1945). (A. T. G.)

HOSMER, JAMES KENDALL (1834–1927), U.S. author and librarian, was born in Northfield, Mass., on Jan. 29, 1834. He graduated from Harvard university in 18jj and continued to study theology for four additional years: after which he took a ministry (1860) at the Unitarian church in Deerfield, Mass. During the American Civil War, he served with the 52nd Massachusetts volunteer infantry from 1862 to 1863.

Hosmer's wartime journal, based on his experiences during that time, was published the following year as *The* Color-Guard and won him wide recognition in the United States and in England.

Although Hosmer returned to Deerfield after his regiment was mustered out, he did not resume his ministry but turned to teaching instead.

He became professor of rhetoric and English literature at Antioch college. Yellow Springs. 0. (1866–72), then taught at the University of Missouri in Columbia (1872–74) and at Washington university in St. Louis (1874–92), where he was professor of English and German literature.

Thereafter he accepted the post of librarian at the Public Library in Minneapolis. Minn. (1892–1904), spending most of the remainder of his life in that city. In 1902 he was president of the American Library association.

Hosmer's literary output was extensive. Apart from numerous articles and short fictional pieces which appeared in newspapers and periodicals, his writings included: A Short History of *German* Literature (1878), The Story of the Jews (Story of the Nation Series [1885]), Samuel Adams (American Statesmen Series [1885]), A Short *History* of Anglo-Saxon Freedom (1890), The History of *the* Louisiana Purchase (1902), *The Appeal* to Arms, *1861–63,* 2 vol. (1907) and *Outcome* of the Civil War, *1863–65* (American Nation Series [1907]).

Hosmer also wrote two novels and, in 1912, a book of reminiscences titled The Lust Leaf.

He died on May 11, 1927.

HOSPICE, the name frequently given to the guesthouses established for the reception of pilgrims and travelers within the precincts or upon the property of religious houses.

It is specially associated with the hospices of the Great and Little St Bernard passes in the Alps; but the word hospitium, as used in the middle ages, had no exclusively religious connotation, and was applied to any kind of lodging or inn, not only to houses of public entertainment, but to the "inns" or mansions of noblemen, prelates and bodies of lawyers in London and on its outskirts.

HOSPITAL, a place where sick and injured persons receive medical care of such nature that some patients are required to utilize a bed during part or all of their stay. A hospital may be contrasted with a "clinic" or "dispensary" for ambulatory patients who return to their homes after each visit; also. with a "home" for aged, infirm or indigent persons in which little or no medical service is provided.

The word hospital is derived from the Latin hospitium, a place where guests (kospes) were received, and the adjective hospitalis. Related forms are hospice, *hôpital,* hotel, *spital* and hostel. Modern English emphasizes the word hospital, with occasional use of hospice or hostel to signify a home.

The word hotel has become synonymous with inn (see INNS AND INNKEEPERS and for early history see HOTEL) as a place for travellers or guests, but in French the term *hôtel-Dieu* indicates a public hospital.

History of Hospitals.— Medical treatment has always been associated with religious service and ceremony. Early priests were also physicians or medicine men, ministering to spirit. mind and body. Pre-Christian religions identified certain of their deities nith healing as early as 4000 B.C. Temples were specially dedicated to Saturn. Aesculapius, or Hygieia, and they served as both medical school for practitioners and resting place for patients under observation or treatment. Historical records indicate the existence of such edifices in Greece, Egypt, Babylonia and India.

The Christian era emphasized the hospital as an asylum for travellers and victims of disaster. By the 4th century AD.. Christian church members in the Roman empire had established hospitals for lepers, cripples, the blind and the sick poor. The Hôtel-Dieu of Lyons. France. mas founded in A.D. 542, and hospitals of the Arabian kingdom existed throughout Spain, north Africa and western Asia.

Religious communities emphasized care of the sick. and sisterhoods and brotherhoods devoted much of their time to nursing, with hospitals constructed adjacent to the monasteries. The first solely nursing order is considered to be the St. Augustine nuns, organized about 11j5.

The work of physicians and surgeons was separate from hospitals during the mediaeval period. Even by the time St. Bartholomew's hospital was established in London in A.D. 1123, the physicians, apothecaries, and blood-letting surgeons practised their professions in home or office. with only hopeless and homeless cases finding their way to hospitals. The Renaissance period emphasized science in the healing arts, and the Reformation saw the beginnings of secular support of hospitals when Henry VIII endoned St Bartholomen's hospital in London European explorers of the 16th and 17th centuries aided religious brotherhoods to create institutions for the homeless and sick poor of the western world.

The Hospital of Jesus of Nazareth, founded in Mexico. 1524, is the oldest institution with continuous service in the Americas. Missionaries. aided by well-to-do citizens in France and

Canada established the Hôtel-Dieu, Quebec, in 1639, and the Hôtel-Dieu, Montreal, 1644.

During the 18th century scientific advances in Europe ultimately were reflected in the treatment of hospital patients, with vaccination against smallpox in England, 1796; and the unshackling of mental patients in France, 1798. The Philadelphia Almshouse in the United States was founded by the Society of Friends (Quakers), 1713. It was later used for insane patients and ultimately became the Philadelphia General hospital. The Pennsylvania hospital, Philadelphia, established 1751, was the first hospital constructed solely for sick and injured persons in the United States. Other early institutions were the New York hospital. 1773; the Massachusetts General hospital, 1816; and the New Haven hospital, 1826.

The 19th century witnessed important developments in the United States. State-owned hospitals were constructed for the insane; local government facilities were opened for the aged, infirm, the sick poor and for victims of contagious disease. These trends also characterized English and continental European institutions. The church hospitals established in the 19th century were primarily for underprivileged persons. Self-supporting patients were treated in private dwellings or "nursing homes" conducted by individual medical practitioners.

Military Hospitals. — Military activity has greatly influenced the history of hospitals and medicine. Hospitals were established along the routes of the crusades in the mediaeval period as resting places for the wounded as well as centres of religious influence. The treatment of wounds provided the opportunity and need for new surgical procedures, and conditions of combat stimulated the grouping of patients in hospitals for treatment by military physicians and their assistants. Military hospitals became frontiers in medical knowledge and skill, as well as nursing and custodial procedures. (See MEDICAL SERVICES, MILITARY.)

During the Crimean War, 1853, Florence Nightingale, a volunteer nurse with the British army, achieved the first effective coordination of scientific medicine and humanitarian care of patients in hospitals. Her theories and principles were rapidly applied throughout the world, and in the United States, her birthday, May 12th, has been celebrated as National Hospital day since 1924. The Red Cross (*q.v.*) since 1856 has conducted hospital service programs for disasters and emergencies, such as fire, flood, famine or military occupation.

World Wars I and II resulted in further contributions to hospital expansion and management. Among the specific advances were: (1) the discovery that good medical care can he provided in improvised facilities, including such varied structures as tents in the theatre of operations, public buildings, private homes, ships, barges, trains, ambulances, aeroplanes and even submarines; (2) development of the "mobile" hospital, with physicians, nurses and supplies following the movement of troops for emergency treatment; (3) the mass movement of convalescent patients for distances and by means previously considered impossible; (4) the control of contagious diseases by large-scale methods later adapted to civilian practice.

Classification of Hospitals. — The two major bases of classification are by type of control and type of service. As to "control," hospitals are: governmental (national, state, provincial or local); nongovernmental, including the proprietary, conducted for private gain and the voluntary conducted on a nonprofit basis by churches, fraternal orders, or independent associations.

Most hospitals throughout the world are under government control, except in the United States. But every country contains a number of small proprietary institutions, usually with a capacity of fewer than 50 beds, owned by one or two physicians for the care of well-to-do patients. In continental Europe they are called "clinics"; in England, "nursing homes." They provide less than 5% of the total bed capacity of the world.

The term voluntary to describe private nonprofit institutions arose in England, where hospitals were administered by religious groups or secular associations, and were supported by voluntary contributions from the general public. Patients also made some voluntary financial contributions, and physicians served without monetary reward. Members of the royal family and aristocracy sponsored drives for funds by specific hospitals. The King Edward's Hospital fund, London, was developed in 1897 for contributors who wished to support voluntary hospitals as a group.

In the United States, the term voluntary is applied to any hospital conducted by a Catholic or Protestant church or religious order, a fraternal society or an independent nonprofit association. Such institutions are available for use by the entire population. The affairs of voluntary hospitals are controlled by trustees who serve without pay in these capacities, and who are responsible for designating the medical staffs, for employment of the administrator, and for the professional and financial policies of the institution. Typically, the medical staff serves free and part-free patients without remuneration, but charges fees to private patients under personal care and supervision in the hospitals.

As to type of service, hospitals may be general or special. A general hospital accepts all types of medical or surgical cases, usually concentrating upon acute illnesses requiring short-term care, including maternity service and the care of children. A special hospital is one which limits service primarily to single classes of patients or types of illnesses, particularly mental and tuberculosis cases and those requiring isolation because of contagious conditions. Special hospitals for short-term cases are less common than formerly, with a tendency for hospitals for children, maternity, cancer, crippled, etc., to become affiliated with general hospitals in order to improve quality of service and economy of administration. Since 1940, special sections for mental, tuberculosis and contagious cases have been established in many general hospitals.

World Distribution of Hospitals. — Statistics of hospitals and their bed-capacity have not been authoritatively assembled for all nations. Such data were particularly unreliable after World War II, but in 1950 the International Hospital federation, London, and the Pan American Sanitary bureau, Washington, D.C., were compiling directories of hospitals, facilities and services. The number of hospitals does not necessarily indicate the adequacy of services in a country, since institutions vary widely in bed-capacity, character of facilities provided, and types of cases accepted. The table signifies, however, the widespread nature of hospital service.

Estimated Number of Hospitals in Certain Countries at Mid-zofth ***Century****

Country	No. of hosp.	Country	No. of hosp.
Algeria	116	Italy	523
Argentina	1,050	Jamaica	31
Australia.	1,727	Japan	3,121
Austria	294	Lebanon	97
Azores	20	Liberia	11
Bahamas.	4	Luxembourg	27
Barbados	5	Madagascar	115
Belgium	455	Madeira Is.	8
Bermuda.	3	Malaya	272
Bolivia	86	Malta	22
Brazil	1,631	Mauritius	49
Br. Guiana	12	Mexico	305
Br. Honduras.	6	Morocco	95
Burma	246	Netherlands	373
Canada	537	Newfoundland	27
Canary Is.	22	New Zealand	445
Ceylon	38	Nicaragua	31
Chile	254	Norway	367
China	268	Oceania	97
Colombia	424	Pakistan	63
Costa Rica	25	Panamá	24
Cuba	139	Paraguay	48
Denmark	296	Peru.	153
Dom. Republic	82	Philippines	126
Dutch Indies	109	Poland	708
Ecuador	81	Portugal.	312
Egypt	311	Port. E. Af.	32
Finland	547	Port. W. Af.	45
Fr. W. Africa.	168	Salvador	30
Great Britain.	1,126	Saudi Arabia	60
Greece	341	Spain	390
Guatemala	49	Sweden	520
Haiti	17	Thailand.	63
Honduras	18	Trinidad	21
Iceland	49	Tunisia	56
Indochina	28	Turkev	184
Iran.	19	United States.	6,335
Iraq.	18	U. of S. Af.	269
Israel	20	Uruguay	113
		Venezuela	206

*These data were obtained from the office of foreign trade, United States department of commerce, except for Canada. Great Britain and the United States, as indicated in the text of this article. Not all countries of the world are included. The figures apply to years 1947 to 1950, depending upon the availability of data in the respective countries.

British Hospital Service. — Hospital care in Great Britain became part of the national social security program, which included

physicians' services, dentistry, drugs and convalescent care. The various voluntary hospitals were originally directed by boards of governors selected from civic, industrial and professional leaders of their communities. Such boards were continued as hospital committees and were co-ordinated under the National Health act, which, July 4, 1948, vested the title of all acceptable voluntary hospitals in the national minister of health. The local committees are no longer responsible for raising funds to finance the hospitals. Their function primarily is to advise with the hospital administrator (house governor or secretary) in budgeting and expenditure of monies received from the national exchequer.

Patients are accepted for care in British hospitals without direct cost to themselves, after consultations with the medical specialists who serve the hospitals on a full-time or part-time salary basis. There is no private medical practice in hospitals under the National Health act, but some well-to-do patients elect to be cared for in nursing homes at which they pay fees for hospital care as well as to the attending physician or surgeon. The services provided under the National Health act are financed in part by equal contributions from each adult person, established in 1948 at four shillings, eightpence weekly. The balance of the costs are met from other forms of national taxation.

At mid-20th century, there were 1,126 general hospitals, bed capacity 110,845. Of this number, 181 hospitals were located in London, 746 were in the English and Welsh provinces, 136 in Scotland and 63 in Northern Ireland. The growth of facilities in the city of London may be indicated by the following data: in 1913 there were 106 general hospitals with 9,171 beds; in 1924 there were 118 hospitals with 13,460 beds; by 1948 there were 181 hospitals with 23,680 beds.

Hospitals in the United States. — In 1948 there were 6,335 registered hospitals with 1,423,520 beds, an average of 9.8 per 1,000 population. In 1872 the ratio of beds per 1,000 persons was 1.9; by 1928 it had risen to 7.4..

Government hospitals comprise 30% of the institutions and 70% of the beds, but they account for only 26% of the annual admissions. They include nearly all the bed facilities for mental and tuberculosis cases, the former group remaining in the hospital approximately three years on the average, the latter about ten months. In sharp contrast, the nongovernmental hospitals dominate hospital service for general medical and surgical cases, including maternity. The nongovernmental general hospitals contain 24% of all beds, but receive 70% of all in-patients annually. The average length of stay in nongovernment general hospitals was 8.2 days in 1948.

Many government hospitals are very large. The state mental hospitals and the federal hospitals for veterans usually exceed 2,000 beds, as do certain local government institutions for medical and surgical cases, notably Bellevue hospital, New York city, Philadelphia General hospital, Cook County hospital, Chicago, St. Louis City hospital and Los Angeles County hospital.

The 4,435 nongovernment hospitals, in 1948, included 3,084 voluntary institutions with 403,753 beds, and 1,351 proprietary with capacity of 50,781 beds. The voluntary group comprised 1,068 Catholic and Protestant church hospitals and 2,016 controlled by independent nonprofit associations. The nongovernment hospitals reported 2,336,740 births, as compared with 457,541 for the government hospitals. In the United States 88% of all recorded births occurred in hospitals, with the rate exceeding 98% in some larger cities.

More patients are using hospitals than ever before and their length of stay is briefer, for all types of institutions. The average length of stay in nongovernment hospitals was reduced from 13.2 days in 1934 to 9.3 days in 1948; for government hospitals the periods of stay were 109 and 77 days, respectively.

Advances of medical science permit early ambulation of patients with resulting shorter convalescence. The preventive value of hospital insurance, such as Blue Cross, prompts patients to seek hospital care promptly when care is required. Consequently, hospitals are able to serve more patients with the same plant and equipment. In 1934, the annual admissions per bed in nongovernment hospitals was 15.1; in 1948 the number was 30.1.

Hospital Finance. — The replacement value of hospitals in the United States was approximately $7,500,000,000 or about $50 per inhabitant in 1948. More than 98% of the money had been furnished by public investment, equally divided between governmental taxation and private contributions.

The annual hospital bill for the United States in 1948 exceeded $2,500,000,000 or about $17 per person. There were 939,000 professional and institutional employees with an annual pay roll of $1,163,000,000. General hospitals for short-term cases maintain full-time personnel of approximately 1 6 persons per occupied bed.

Government hospital expenses in 1949, including all services of physicians and surgeons, were approximately $1,200,000,000, paid almost exclusively from taxation. Nongovernment hospitals involved expenses of approximately $1,300,000,000 in 1948 of which 90% was paid by patients, 7% came from governmental agencies for the care of public charges and 3% from current contributions or endowment income. Contrary to popular impression, very few hospitals are heavily endowed. Less than 300 of the 3,084 voluntary hospitals registered in 1948 possessed as much as $100,000 endowment capital, the minimum amount required, at 4%, to finance care continually in one bed in a general hospital treating acute illness.

The annual expenses of nongovernment hospitals quoted above do not include fees to attending physicians, surgeons and obstetricians, who attend private patients, although the patient's hospital bill would ordinarily cover the medical service involved in such procedures as radiology (X-ray), anaesthesia, pathological examinations, physiotherapy and electrocardiography.

An important factor in the finances of voluntary hospitals and patients is the payments by Blue Cross, nonprofit hospital insurance plan, which had enrolled 40,000,000 persons by 1950, at which time there were also 20,000,000 policyholders in commercial and industrial health insurance plans. These plans remove the uncertainty of sickness costs from the potential patients, and stabilize the income of nongovernment hospitals, which might otherwise have been forced to seek government assistance for their maintenance expenses.

Out-Patient Service. — Hospitals do more than serve bedridden patients. The number of out-patient visits greatly exceeds the number of in-patient in urban communities. For the year 1948, the hospitals in the United States received 45,400,000 visits from outpatients who did not occupy bed facilities. In that year a total of 108 hospitals in New York city, with 38,034 beds, reported 793,364 in-patient admissions (plus 116,716 births) and 5,209,884 outpatient visits. In the metropolitan area of Philadelphia, 66 hospitals, with 16,505 beds, admitted 343,854 in-patients (plus 62,225 births) and received 2,090,372 out-patient visits during the year 1949.

In London, 1946, there were 269,510 patients admitted for bed care to 159 general hospitals and 1,879,574 treatments in the outpatient departments. Data for Canada in 1948 listed 537 hospitals of all types with bed capacity of 113,083, and annual inpatient admissions of 1,353,448, and total out-patient visits of 2,122,024.

Co-ordinated Hospital Systems. — Many small hospitals correlate their work with the services of medical specidlists in large institutions, thereby avoiding the necessity of duplicate professional personnel and scientific apparatus and equipment. In 1946, congress encouraged the principle of co-ordinated hospital systems in states and regions through the Hospital Survey and Construction act, which appropriates $150,000,000 annually for surveys and construction of necessary facilities, particularly in rural areas. The states and local communities are required to provide from one-third to one-half the total costs.

The American Hospital association, organized 1899, is the national organization of hospitals. It conducts information and coordination services for the improvement of hospital administration, including institutes or short courses on such subjects as nursing, accounting, personnel, purchasing, laundry management, public relations, etc. Collegiate training for hospital administration has been developed, the first course being offered at the University of Chicago in 1934.

Hospitals are the training centres for medical and nursing education throughout the world. In the United States, medical education in hospitals is supervised by the Council on Medical Education and Hospitals of the American Medical association. (See also MEDICINE.) In 1948, one or more registered hospitals were directly affiliated with each of the 77 recognized medical schools, 795 were used for the training of internes, and 1,187 offered residency training in the various medical specialties. There were also 1,153 accredited schools for the training of professional nurses (see NURSING) in the hospitals of the United States.

The Hospital Council of Philadelphia, established in 1946, exemplifies a trend in large cities toward the co-ordination of hospital service, research in administration, contacts with public bodies, nursing education, joint-purchasing, uniform accounting and relations with the medical profession. Such groups are financed by membership dues from hospitals and contributions from philanthropic sources.

The United Hospital fund of New York city, organized in 1879, conducts annual campaigns on behalf of 86 voluntary hospitals in the area.

Hospital Management and Operation.— The modern hospital is a complex institution engaged in a variety of activities. Design and construction have changed to reflect trends in medical science. Important trends from 1925 to 1950 include the following: (1) patients' rooms contain fewer beds, from four to six beds maximum in new institutions; this permits greater flexibility in use by patients of different age, sex, or medical condition; (2) air conditioning has offset the disadvantages of cold or warm climates, and reduced dangers of infection during treatment or convalescence; (3) buildings are higher, to reduce construction costs, utilize land space, and conserve time of nursing employees (the first hospitals to exceed 15 stories in the United States were St. Luke's, Chicago, 1925; Jefferson, Philadelphia, 1927; Hahnemann, Philadelphia, 1928; Presbyterian, New York city, 1928; New York hospital, 1931; many other "skyscraper" hospitals have been erected since that period); (4) outpatient facilities are expanding in order to utilize effectively the various types of scientific diagnostic apparatus; (5) group medical practice is developing in hospitals, with many part-time or full-time physicians using offices provided by the institutions; (6) schools of nursing are being provided with special facilities and quarters; (7) departments of social service (*q.v.*) are supplementing medical science by emphasis on personal and environmental problems; (8) public health services (*q.v.*), particularly visiting nursing, are providing convalescent home care for hospital patients.

Hospital care involves a high degree of readiness-to-serve costs, inasmuch as certain administrative, professional, and household personnel must be employed regardless of the number of in-patients or out-patients served. Accordingly, great emphasis is now placed upon professional or administrative practices which will achieve a high degree of utilization of the beds and scientific apparatus. One incidental result has been the virtual disappearance of hospital-owned ambulances in large cities, where emergency patients are more promptly transported by private automobiles, police or fire department ambulances, or commercial ambulances owned by taxicab companies.

The hospital of mid-20th century differed widely from the place of custody or isolation in early times, and from the last refuge for the sick poor in 1850. Patients enter a hospital with confidence, knowing that chances of recovery are greater than elsewhere and that every phase of medical knowledge and skill will be devoted to restoring them to health and normal life. The modern hospital became the logical centre for all preventive and curative health services.

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HOSPODAR, a term of Slavonic origin meaning "lord" (Russ. gospodar). It is a derivative of gospod, "lord," and is akin to gosudar, which primarily means "sovereign." In Little Russian the title hospodar is specially applied to the master of a house or the head of a family. The rulers of Walachia and Moldavia were styled hospodars from the 15th century to 1866. At the end of this period, as the title had been held by many vassals of Turkey, its retention was considered inconsistent with the growth of Rumanian independence. It was therefore discarded in favour of domn (dominus, "lord"), which continued to be the official princely title up to the proclamation of a Rumanian kingdom in 1881.

HOST. (1) One who provides another with lodging and entertainment (Lat. *hospes,* a guest or host). In biology, an animal or plant upon which a parasite lives. (2) An army and generally any multitude (Lat. *hostis,* a stranger or enemy). In biblical use the word is applied to the company of angels in heaven or to the sun, moon and stars. (3) The sacrifice of Christ's body and blood in the eucharist, the consecrated wafer used in the service of the mass in the Roman Church (from Lat. hostia, a victim or sacrifice). (See EUCHARIST.)

HOSTA, a genus of popular garden perennials of the family Liliaceae (*q.v.*), comprising ten species, all from China and Japan, as well as several horticultural varieties, grown for ornament under the name of plantain lily or funkia. They have tuberous rhizomes, basal, plantainlike leaves and attractive clusters (racemes) of drooping, funnel-shaped, blue, white or lilac flowers. They are much grown for edging and in borders, and are of the easiest culture, most of them doing well in partial shade. Propagation, which is easy as they are prolific growers, is accomplished by division.

HOSTAGE, in war, a person handed over by one of two belligerents to the other, or seized as security for the carrying out of an agreement or for preventing violation of the law of war. The practice of taking hostages is very ancient and has been used in cases of conquest, surrender and armistice. The Romans often took the sons of tributary princes and educated them at Rome, thus holding a security for the continued loyalty of the conquered nation, and also instilling a possible future ruler with ideas of Roman civilization. The British adopted this practice in the early period of the occupation of India, as did the French in their relations with the Arab states of north Africa. Hostages were detained as prisoners of war until the negotiations or treaty obligations were carried out. In ancient times they were punished or put to death in case of treachery or refusal to fulfill promises. The practice of taking hostages as security for the carrying out of a treaty between civilized states became obsolete in the 18th century. The last occasion was at the treaty of Aix-la-Chapelle in 1748, when two British peers were sent to France as hostages for the restitution of Cape Breton to France.

In modern wars, hostages have been taken as a measure of reprisal to assure observance by the enemy of the law of war in respect to such matters as the treatment of prisoners and the sick and wounded. The Geneva convention of 1949 forbade reprisals against prisoners of war, and persons taken as hostages are entitled to the treatment of prisoners of war. Vicarious punishment of enemy individuals for war crimes committed by other enemy persons is not favoured by the modern law of war. Even more doubtful is the practice of taking hostages to assure observance by the civilian population of regulations imposed in occupied territory for the security of the occupant's forces and communications and for the payment of contributions. This practice was extensively resorted to by the Axis powers during World War II, but war crimes tribunals after the war found the execution of hostages taken for these purposes to be a war crime except, in the opinion of one tribunal, under very exceptional circumstances.

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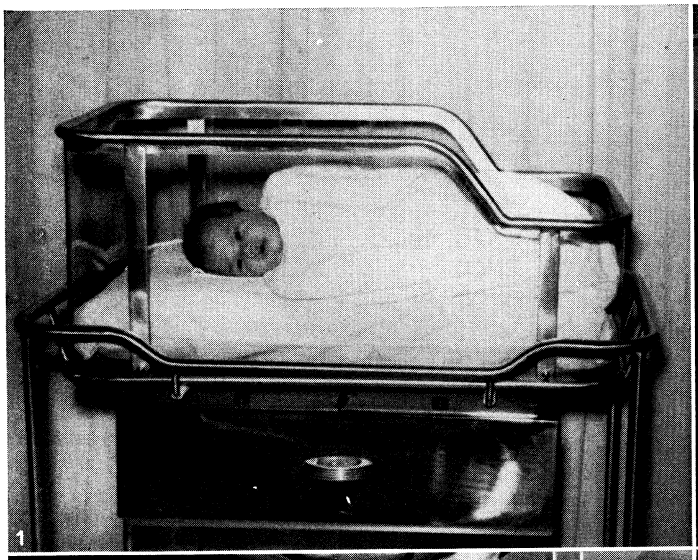
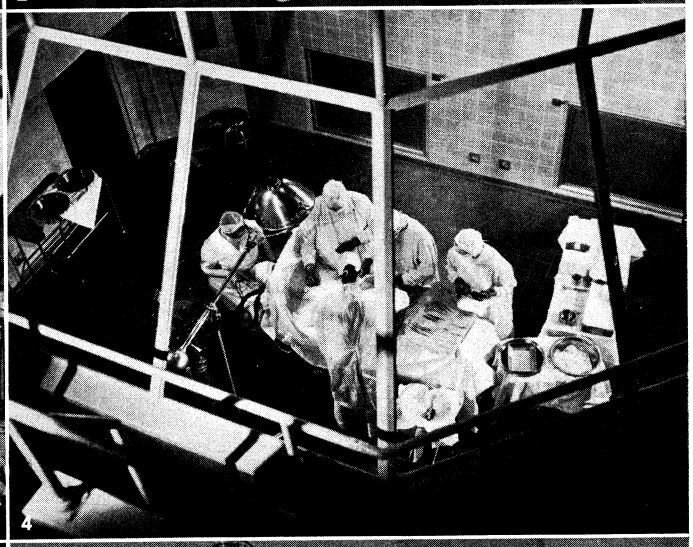
TWO U.S. HOSPITAL CENTRES

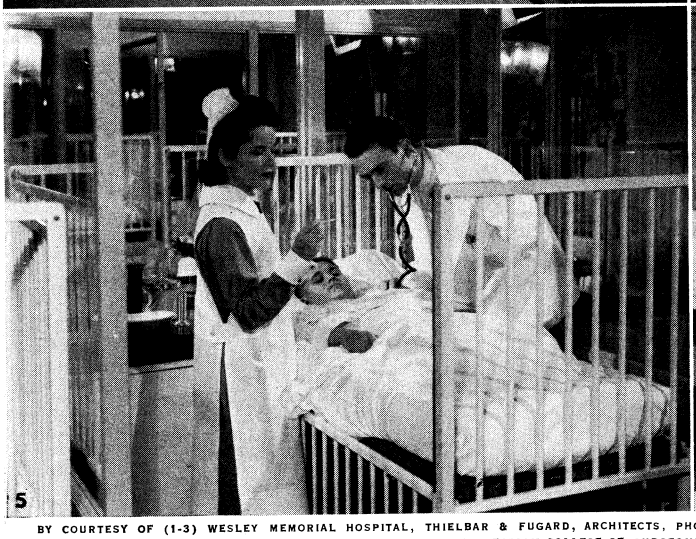
1. The Chicago campus of Northwestern university. At the left is Passavant hospital: in the centre, Wesley Memorial hospital: at the right, surmounted by a tower, is the Montgomery Ward building, which houses the medical and dental schools and the clinics of the university

2. The Columbia Presbyterian Medical Center in New York city. Here are located the medical and dental schools of Columbia university, five units of the Presbyterian hospital group, the Babies Hospital of the City of New York and the Neurological institute

HOSPITAL







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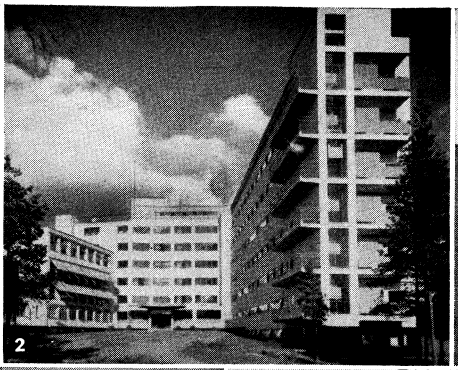
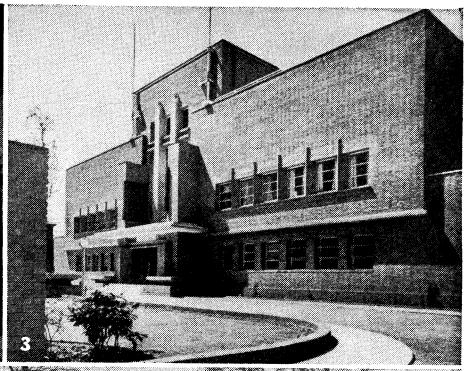
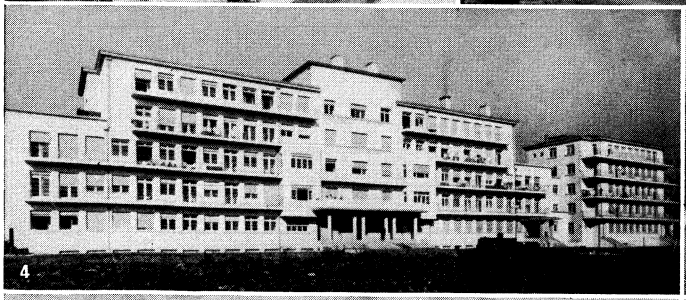
INTERIOR VIEWS OF WESLEY MEMORIAL HOSPITAL, CHICAGO

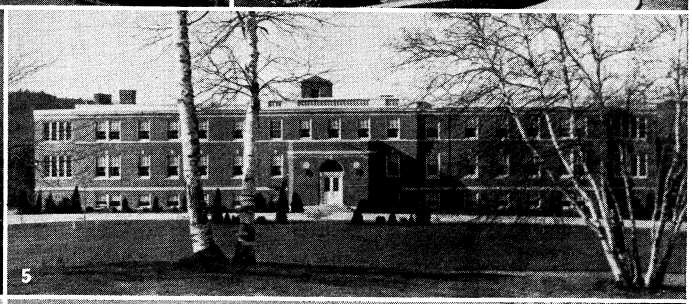
1. Transparent plastic bassinet for infants
2. Pneumatic tube control station which provides rapid communication to all parts of the hospital
3. Emergency storage batteries which can supply current in the operating rooms for 12 hours
4. The operating amphitheatre, with an enclosed balcony for student observation
5. Pediatric pavilion, with glass partitions between beds
6. Emergency room

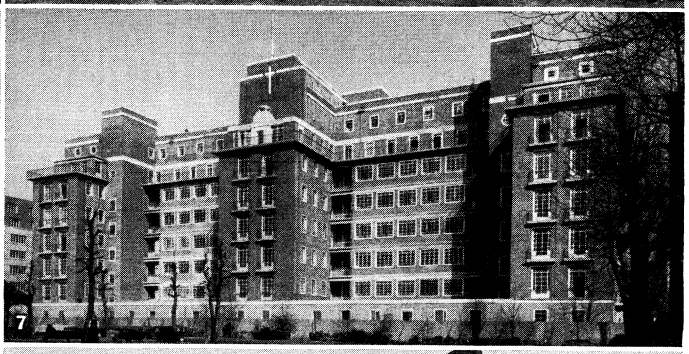
HOSPITAL

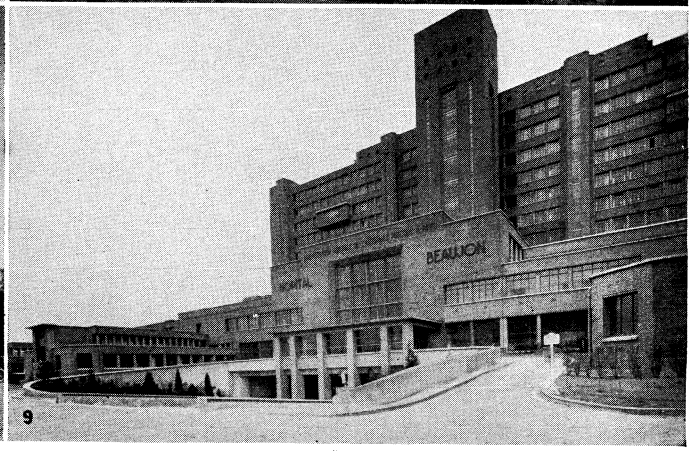












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MODERN HOSPITAL ARCHITECTURE

1. Memorial Hospital for the Treatment of Cancer and Allied Diseases. New York city. James Gamble Rogers, architect
2. Tuberculosis sanatorium, Paimio, Finland. Alvar Aalto, architect
3. Royal Masonic hospital, London, England. Sir John Burnet, Tait & Lorne, architects
4. Hospital Clinico de Niios, Santiago, Chile. Fernando Devilat, architect
5. Franklin County Memorial hospital. Farminoton, Maine. Henry C. Pelton and James G. Rogers, associated architects
6. Toronto Western hospital, Toronto, Canada. Govan, Ferguson & Lindsay. architects
7. Westminster hospital, London, England. Adams, Holden & Pearson, architects
8. White Plains hospital, White Plains, New York. Schultze & Weaver, architects
9. Cité Hospitalière, Beaujon, near Paris, France. Jean Walter, architect

Rules oj Land Warfare, sec. 73, 76h, 358d, 359 (1940); United Nations War Crimes Commission, *History of the United Nations War Crimes Commission,* pp 88, 22j (1948); *Law Reports oj Trials of War Criminals,* vol. viii, pp. viii, 61 ff.; vol. xiv, pp. xi, 135 (1949).

(O. W.)

HOSTE, SIR WILLIAM, BART. (1780–1828), British naval officer, born on Aug. 26, 1780, of a Norfolk family, neighbours to the Nelsons. He joined the "Agamemnon" as Horatio Nelson's follower in 1793 and served with him in four other ships. He was promoted commander after the battle of the Nile and post captain in 1802. Although commanding a frigate under Nelson in 1805, he missed the battle of Trafalgar. All his active service thereafter was in the Adriatic, where he served with distinction until the peace of 1814, after which he saw no further service of note. His most notable achievement took place on March 13, 1811, off Lissa (*q.v.*), when, commanding a squadron of three frigates and a sloop, he engaged three French and three Venetian frigates (with five smaller vessels). The British ships proved more than a match for their inexperienced opponents; two of whose frigates were taken and one destroyed. Hoste was made a baronet in 1814 and a K.C.B. in 1815 He married Lady Harriet Walpole in 1817. He died on Dec. 6, 1828.

See Lady Harriet Hoste, *Memoirs and Letters of Captain Sir William Hoste, Bart.,* 2 vol. (1833).

(C. N. P.)

HOSTEL, the old name for an inn *(see* HOSPITAL, *ad init.);* also employed at Oxford and Cambridge to designate the lodgings which were in ancient times occupied by students of the university. In some of the English public schools the "hostel" system provides the lodging accommodation under separate masterships.

HOSTIUS, Roman epic poet, probably flourished in the 2nd century B.C. He was the author of a *Bellum Histricum* in at least seven books, of which only a few fragments remain. The poem is probably intended to celebrate the victory gained in 129 B.C. by Gaius Sempronius Tuditanus (consul and himself an annalist) over the Illyrian Iapydes (Appian *Illyrica,* 10; Livy, *epit.* 59).

Hostius is supposed by some to be the "doctus avus" alluded to in Propertius (iv, 20, 8); the real name of Propertius' Cynthia, according to Apuleius *(Apologia* x) and the scholiast on Juvenal (vi, 7). being Hostia (perhaps Roscia).

Fragments in E. Bahrens, *Fragmenta poetarum Romanorum* (1884); A. Weichert, *Poetarum Latinorum reliquiae* (1830).

HOSUR, town in Salem district, Madras state, India, 24 mi. S.E. of Bangalore. Pop (1951) 8,712. It contains an old fort, frequently mentioned in the history of the Mysore wars. Close by is a large remount depot.

HOT BLAST. The apparently insignificant idea, introduced by James Neilson in 1828, of sending hot air instead of cold into a blast furnace created a revolution in smelting practice, for it enabled a much greater quantity of ore to be smelted for a given amount of fuel, while furnaces could be made of larger size than hitherto.

The air temperature employed was at first low but later ranged from about 650° F. to 1,500° F. Hot-blast stoves for the heating were originally fired with coal, but later the waste gases from the furnaces were utilized by means of combustion chambers in the stoves. These are of regenerative type, tall structures containing a mass of brick checkerwork.

Stoves vary considerably in regard to the interior arrangement. *(See* IRON AND STEEL.)

HOTCHPOT or HOTCHPOTCH, in common law the name given to a rule of equity whereby a person, interested along with others in a common fund and having already received something in the same interest, is required to surrender what has been so acquired into the common fund, on pain of being excluded from the distribution.

The same principle is to be found in the *collatio bonorum* of the Roman law: emancipated children, in order to share the inheritance of their father with the children unemancipated, were required to bring their property into the common fund. It is also found in the law of Scotland.

HOTEL. The word hotel is of ancient origin (Med. Lat. *hospitale,* Old French *ostelerie*). But its use in English for a house of entertainment for travellers is recent. As late as the 1820s it was regarded as pretentious.

The hostellers of London are, however, mentioned in 1327 and in 1446 they made regulations for the government of their craft. In 1473 they took the name of innholders (the word hostler or ostler having come to mean merely an inn servant). As innholders they were chartered in 1514, their company being recognized as 32nd in order of precedence among the livery companies of the City of London. In this article the word inn (of Anglo-Saxon origin and used in this connection since *c.* 1400) is used for a house of entertainment until the period *c.* 1800, when hotel became fashionable. The Methuen Arms, Corsham, became a "hotel" *c.* 1805; the Acorn, Birmingham, became the Imperial hotel, on rebuilding, as late as 1879.

Early History. — From the earliest days of travel inns of one kind or another must have existed. W. C. Firebaugh *(see* below, *Bibliography)* gives the major classical references. There are also several possible mentions in the Old Testament (Exod. v, 24; Jos. ii, 1; Judges xvi, 2; and Gen. xlii, 27). In the New Testament the outstanding mentions are Luke ii, 7 and x, 34. The biblical inn was however rather a khan or caravanserai than an inn in any modern sense of the word.

There were inns in Britain along the main Roman roads, but the English inn in its present form cannot be traced any farther back than the middle ages. As a rule, when an English inn claims an origin earlier than *c.* 1400 its claims have no substance. There is, however, some substance in the claims to antiquity of the Angel, Grantham (1213), of the Angel, Blyth, and of the George and Dragon, Speldhurst (both 1270), and of the King's Head, Aylesbury (shortly after 1386). The Luttrell psalter, *Piers Plowman,* the *Canterbury Tales* and William Caxton's *The Game and Playe of Chesse* all provide indisputable evidence of the existence of major inns in the later middle ages. Chaucer's Tabard especially has all the essential features of a modern hotel—a sign, a host, a staff of servants, a table-d'hôte meal and a reckoning.

In mediaeval times the inn seems to have developed first in the larger towns, though even there in the earliest inns the wayfarer was expected to supply his own food, fuel and bedding. Elsewhere wayfarers depended largely on the hospitality of manorial lords and of religious houses. In the countryside many inns developed after the dissolution of the monasteries (1536–39). Some English inns flourishing to this day indisputably began as monastic *hospitia:* for instance the New Inn in Gloucester and the Georges at Glastonbury, at Norton St. Philips and at Winchcombe.

The earliest flattering accounts of the English inn date from this period. Thus in 1577 the Rev. William Harrison said in his *Description of England* "Those townes that we call thorowfaires have great and sumptuous innes builded in them · · · verie well furnished with naperie · · · Ech commer is sure to lie in cleane sheets, wherein no man hath beene lodged since they came from the laundresse. . .there is no greater securitie anie where for travellers than in the gretest ins of England." Forty years later, in 1617, Fynes Moryson describes the inn "ordinary," the inn servants who take the guest to his room, kindle his fire and pull off his boots and the host or hostess who waits on him "taking it curtesie to be bid to sit downe." "The World," he says, "affoords not such Innes as England hath."

Probably the development of the inn in late mediaeval and early Tudor times must be related to the improvement in the internal security of the country; it was safe to travel. It was connected also with the growth of the middle classes: the rising *bourgeoisie* were both able and willing to pay for their accommodation when they were away from home, and innkeepers found profit in catering for their needs. Before the middle of the 16th century the inn plan had developed the conventional form which it retained until the coming of the railways. The heart of the premises was an enclosed cobbled courtyard, often with an imposing arched entrance from the main street, with the kitchen and public rooms occupying the main structure. Other rooms were in a galleried structure fronting two sides of the courtyard, with stables and outbuildings along the fourth side. Sometimes in very large

inns the outbuildings surrounded a second subsidiary courtyard opening from the main one. A few such inns survived in part (*e.g.*, the New Inn, Gloucester, and the Golden Cross, Oxford), though usually the gallery was long ago built in. It remained at the Bull, Dartford, the George, Huntingdon, the George, Winchcombe, the White Hart, Chipping Norton, the White Horse, Romsey, etc.

It is in the 16th century that we find the first statutory reference to inns—as apart from mere alehouses, which appear in the laws of Aethelbert of Kent (560–616) and of Ine of Wessex (688–726). The act is 5 and 6 Ed. VI c. 25 (1551–52), which orders that the magistrates are to take sureties from innkeepers, as from alehouse-keepers, for the maintenance of good order in their houses. The act was repealed in 1828, but its basic principles still form part of English law. By 1618 the surety taking had developed into the exacting of elaborate recognizances with specific conditions imposed by the justices in accordance with privy council orders and with the royal proclamation of 1618.

In 1603–04 (1 Jac. I c. 9) the distinction was clearly made between alehouses and inns, since "the ancient and principall True use of Innes and Victuallinge Houses was for the Receipte, Relief and Lodginge of wayfaring people travellinge from place to place." Therefore the innkeeper was given at once duties and privileges such as the mere alehouse-keeper did not possess. Both the duties and the privileges survive in a modified form to this day.

The legal definition of an inn is still unsatisfactory. An inn is said to be a "house where the traveller is furnished with everything he has occasion for while on his way"; or "house the owner of which holds out that he will receive all travellers and sojourners who are willing to pay, and who come in a situation in which they are fit to be received"; or "premises having a full excise licence and containing accommodation for permanent and casual guests." In the mid-1950s there was still no specific inn or hotel licence, the licence granted being one to sell beer (and tobacco) and, in the usual "fully licensed" house, also wines and spirits. It has been said that "English law regards the highest class of hotel as little more than an inn, and little less than a disorderly house."

From the 17th century there are many literary references to individual inns, both in general literary works and in the journals and diaries of travellers in England. Thus Samuel Pepys gives a graphic account of the George, Salisbury, and of the Hart, Marlborough, and a still better one of the house (unnamed) on Salisbury plain, where his party "made merry" on discovering that the beds were lousy. John Taylor, the Water Poet, gives an interesting account of the Rose and Crown at Nether Stowey. Richard Brathwait (Drunken Barnaby), whose amorous alcoholic peregrinations took him four times on horseback from Oxford or London to Kendal in the years c. 1610–30, wrote particularly entertaining accounts of the beer and the hostesses at such inns as the Bull, Rotherham, the Bell, Leicester, and the Cock, Budworth.

The Age of Coaching.— Stagecoaches are first mentioned in 1637, and by the middle years of the 1650s the beginnings of the public stagecoach system had appeared. The system developed throughout the 18th century and lasted until the coming of the railways in the 1840s. For these 200 years the development of road transport had close connections with that of innkeeping. Many coach services were first established by innkeepers, anxious to attract custom to their houses; and to the end of the coaching era coach termini and "stages" were almost invariably at inns. Old inns were now rebuilt (or often refronted), and new inns too were built, especially, of course, on the great trunk roads radiating from London. Thus the Rose and Crown, Saffron Walden, was refronted in 1748; the White Hart, Salisbury, an enormous inn covering nearly an acre, with a very fine classical portico, was completely rebuilt in 1800; and the County, Taunton, was refronted in 1820. The Blue Boar, Maldon, was refronted in sombre gray brick c. 1800, but a wing containing some untouched 15th-century work remained visible from the yard. Some of the greater coaching inns of this period were designed to serve many of the purposes of a modern railway junction station—with booking offices, waiting rooms and through bookings along a whole network of routes centring at the inn. A good example of an inn of this kind, with a total of 23 passenger services centring there, is the Royal, Cheltenham.

Often 18th-century features still survive in inns built or reconstructed in this period. A common one in a town inn is the assembly room—sometimes now partitioned into bedrooms but originally designed as the centre of social activities in the town. The Lion, Shrewsbury, has a very fine Adam assembly room (1777); and the Cups, Colchester, has another, rather later but almost equally beautiful. Sometimes, when the assembly room occupies the first floor front, it has a balcony, which may serve to this day as a rostrum for public speakers (*e.g.*, at the White Hart, Salisbury). One survival of the coaching period is at the George, Stamford, where the 18th-century dining-room doors north and south are still labelled respectively "Edinburgh" and "London." An older custom (not specifically connected with coaching) is that of giving rooms names, not numbers: the original labels "Rose," "Crown," "Star" and "Sun" survive at the Royal Fountain, Sheerness; and the custom was revived (*e.g.*, at the Shakespeare, Stratford).

Roadside Hotels in the 19th and **20th** Centuries.— With the development of the railways in the decades from 1825 onward, through traffic for some time almost vanished from the roads. By the 1840s coach services had virtually disappeared. The railways, however, preserved the sites and sometimes the very signs of the coaching inns that they were superseding, and a few remain to this day as railway district goods and parcel offices; in London the railway office in Aldersgate street preserves the memory of the Elizabethan Castle and Falcon; 65 Gresham street is a vestigial survival of the Swan With Two Necks (recorded from 1556); and the office at 138 Borough High street is the lineal successor to the Catherine Wheel (ante 1534).

The general effect of the advent of railways upon the older, established English hotels was disastrous, as they naturally reduced the time that travellers had to spend on their journeys. Many hotels went out of business or were substantially reduced in size, much of their accommodation being let off in tenements or allowed to go to ruin. Many once-famous inns became for the time little more than mere public houses. Examples include the Bell, Holborn, the Bull's Head, Meriden, the Castle, Marlborough, the Lion, Dunchurch, the Pelican, Speenhamland, and the Swan, Ferrybridge. While a few hotels were built in holiday and show towns and in health resorts, for instance the Randolph, Oxford (1864–66), and the Wellington, Tunbridge Wells (?1870), the Victorian era was in general a time of neglect and even of decay for many hotels of the older kind. (For the railway hotels and the great London hotels, see below).

At the end of the 19th century, however, with the invention of the safety bicycle and still more with the rapid development of the motorcar, traffic came back to the roads. Many old hotels were reopened, to become thereafter more imposing and more prosperous than ever. The renaissance of the English roadside hotel dates from the 1890s.

Four organizations did much to influence it, two representing consuming, two producing interests. In 1878 was founded the Cyclists' Touring club, which long maintained a register of inspected and approved (licensed and other) hotels. The Royal Automobile club (1897) similarly registers and indicates hotels. The effect of this registration and recommendation influenced charges and facilities in hotels generally. Two other institutions which had an influence on hotelkeeping out of proportion to the number of houses that they controlled were the People's Refreshment House association, founded in 1896 by F. F. Jayne, 33rd lord bishop of Chester, and the various county Trust companies, founded from 1904 onward under the inspiration of the fourth Earl Grey and mostly later absorbed into P.R.H.A. or into Trust Houses Ltd. (dating in its present form from 1919). The aim of these associations was the reform of the English public house (the word being used in its widest sense to include hotels, inns, taverns and alehouses). In fact the great majority of their properties are fully licensed hotels. Their policy is centralized control with inspection of local managers, fixed and reasonable prices, no tie for alcoholic refreshments, the encouragement of catering of

all kinds and the provision of residential accommodation. Most of the properties sponsored by these organizations are hotels in the ordinary sense of the word; and these include many of the oldest and most interesting ones in England—the Angel and Royal, Grantham, the Dolphin, Southampton, the King's Head, Aylesbury, etc. Of the remainder, a few are "free houses," not tied to any brewery company. These vary in excellence, the best being very good indeed. Other hotels in Great Britain (apart from a few hundred residential ones in pleasure resorts, spas, seaside towns, etc.) are almost always owned or leased by a brewery company.

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Railway Hotels.—The earliest railway lines ran short distances only so that the return journey could be made on the same day as the excursion. With the opening of the London and Birmingham railway, however, accommodation for long-distance travellers became an obvious necessity. The first major railway hotel, founded at Euston station in 1838 (originally in two parts, the Euston and the Victoria, which were not joined together until 1881) was an object of amazed admiration, being described by R. S. Surtees as constituting two towns or a city. It should be stated, however, that throughout the 19th century the railway companies often encountered considerable opposition to their hotel enterprises on the grounds that the acts of parliament under which they worked did not authorize them to build hotels. At Preston, for example, though we find the North Union company considering the erection of a hotel in 1835, the Park was not opened till 1882.

Of the numerous London terminal hotels built after Euston we may cite the Great Western Royal at Paddington (1854), the Charing Cross (1863) and the St. Pancras (architect Sir George Gilbert Scott, 1865). In the terminal cities outside London, moreover, no less than in London itself. there was often more than one railway hotel, for instance, the St. Enoch and the Central in Glasgow and the North Western (Lime Street, 1871–1933), the Exchange and the Adelphi in Liverpool. All these hotels, however, though magnificent by the standards of the time, were constructed with the utilitarian purpose of accommodating travellers going about their business and so must be distinguished from the later country hotels built by the railway companies, for instance, those at Gleneagles and at Turnberry, which were designed t~ attract holidaymakers, sportsmen and tourists (as was also the case with the Welcombe, at Stratford-on-Avon, as late as 1931).

London Hotels From 1880.—The great period of the railway hotels' predominance may be regarded as conterminous with the early and middle Victorian period. With the 1880s came the rise of the luxury hotels of London, symptomatic of the spirit that was to characterize the Edwardian age. The impresario Richard D'Oyly Carte (1844–1901) opened the Savoy hotel, off the Strand, in 1889, with what was then the distinction of having 70 bathrooms, 6 lifts and electric lighting throughout; and it was he who brought César Ritz (1850–1918) to London. Within ten years the directors of the Savoy had acquired not only Claridge's (reopened 1898) and the Berkeley (originally the Gloucester coffeehouse, terminus of the mail coaches from the west country) in Mayfair, but also the Grand hotel in Rome. Ritz left the Savoy in 1897 to go to the Carlton; his own Ritz hotel was opened in 1906, on the site of the former Walsingham house, in Piccadilly by the Green park.

Contemporaneous with this enterprise was the development of the large but more modest hotels north of Holborn. Harold Walduck first rebuilt the Bedford (where there had been a coffeehouse in 1800) in 1900 and founded the Imperial in 1907; by the middle of the 20th century his company. Imperial London Hotels, Ltd., was controlling nine hotels, including the Tavistock (1951), the first new hotel to be opened in London after World War II.

The Dorchester, the great luxury hotel in Park lane, built on the site of the former U.S. embassy (old Dorchester house) by Sir Robert Macalpine and Sons in association with Gordon Hotels, Ltd., was opened in 1931; Macalpines acquired entire control of it in 1936. (X.)

UNITED STATES

A hotel is generally thought of in the United States as an establishment which provides lodging and usually food for transient or permanent guests.

There is no nationally accepted definition of a hotel, but it is usually characterized by most if not all of the following attributes: it is licensed by the state or recognized by the community as a hotel; its front doors are open and unlocked 24 hours a day; and it provides switchboard, bellboy, maid, watchman and mail and package receiving services, linen service and the laundering of linens, utilities and the upkeep of furniture and fixtures.

Hotels in the United States range in size from 10 or less to 3,000 rooms, but the average hotel has only 96 rooms. Seventy per cent of all hotels have 100 rooms or less, 24% have from 100 to 299, 4% have from 300 to 499, and only 2% have more than 500 rooms.

History.—America's first hotels were seaport inns and converted farmhouses along the stagecoach routes. When railroads succeeded the stagecoaches as the principal means of transportation, the wayside inns gave way to larger hostelries built near the railroad depots. As the cities grew, new hotels arose in the centres of business and theatrical districts. And as the commercial traveller became increasingly important to hotels, he demanded and got more luxurious accommodations. Americans learned to take for granted a standard of hotel comfort and convenience unknown in Europe.

The industry's growth was moderate but continuous until World War I, which put a temporary stop to hotel construction. But the war was followed by a period of prosperity for hotels. This led to an era of overbuilding which resulted in disaster when depression swept the country in 1929. On a national average, four out of every five hotels went bankrupt or passed through some sort of financial reorganization. Widespread rate cutting resulted, so when World War II again raised occupancy levels, the ceiling prices imposed on room rates were geared in most cases to the rates which prevailed during the dog-eat-dog competition of the 1930s.

The shortage of labour and materials that lasted throughout the war forced curtailment of normal maintenance and rehabilitation operations in most hotels. When normal operation again became possible, the industry embarked upon what was expected to be a $1,600,000,000 program of rehabilitation and modernization. By the time this was completed, in late 1952, its cost had mounted to more than $2,500,000,000. Much of this amount was invested in new facilities and services for motor travellers (motels) and travelling family groups.

American travel habits went through a major upheaval after World War II. Development of vast turnpike systems led travellers away from the railroads and out onto the highways. Many of the new turnpikes skirted the cities, so the motor traveller often had to go out of his way to patronize a downtown hotel.

With motels springing up along the highways, many downtown hotels faced a serious loss of business. However, the hotel industry took stock of its collective problems and assets and mapped plans to cope with the new trends.

Types of Hotels.—The three main categories of hotels in the United States are transient, resort and residential. By far the most common are transient hotels, which sell their accommodations on a day-to-day basis and in nhich the average guest's stay is less than three days. Included in this category are working men's (and women's) hotels, which provide relatively modest accommodations at the most economical rates possible; and community hotels. which differ from other transient hotels only in that they are financed largely through the support of organizations and individuals in the communities they serve, in order to fill a

need in the communities.

Resort hotels are designed to serve guests whose principal requirements are pleasure or relaxation and who visit such hotels to enjoy the recreational facilities or the scenery of the surrounding areas. Some resort hotels operate on American plan rates, which include the cost of meals in the charge for the room, while others operate on the European plan, under which the rate covers only the room and the guest makes his own arrangement for meals. Many resort hotels operate only during that portion of each year in which near-by recreational facilities can be enjoyed, but there is a continuing trend toward extension of resort seasons.

Residential hotels accept guests by the month and many serve their guests as permanent homes. Guests often are required to sign leases, and in some cases are allowed to use their own furniture and even prepare their own meals in their premises.

(A. J. P.)

HOTEL DE VILLE, the town hall of a French municipality. The most ancient example, which was still preserved perfectly in modern times, was that at St. Antonin (Tarn-et-Garonne) dating from the middle of the 12th century.

Other fine town halls are those of Compiègne, Orléans, Saumur, Beaugency and St. Quentin. The Hôtel de Ville in Paris, built in the 16th century, burned by the Commune in 1871, has since been rebuilt on an extended site, the central portion of the main front being a reproduction of the old design. There is only one town hall in a French town, those erected for the mayors of the different *arrondissements* in Paris being called *mairies.* (See GOVERNMENTAL ARCHITECTURE.)

HOTEL DIEU, the term applied in France to any hospital in the middle ages, now reserved to those whose history goes back to mediaeval times. Many examples from the Gothic period still remain, notably that of Angers (1153–84), the so-called *salle* des morts at Ourscamps (early 13th century) and that of Tonnerre (*c.* 1300).

In all of these, the most important feature is a vast hall in which were placed the beds for the sick. In the two earliest the hall is divided into three aisles by pillars and vaulted so that four rows of beds on either side of the pillars were possible. At Tonnerre the great hall, nearly 60 ft. wide and 300 ft. long, was roofed with wooden trusses and had a wooden barrel vault ceiling. The beds were in little chambers along the sides, open to supervision from a gallery that ran continuously around the side walls immediately below the window sills.

At Beaune the *Hôtel Dieu,* founded in 1443, is of quite different character, occupying three sides of a courtyard, in two stories. In addition to the halls for the sick, various other rooms for the use of the nuns were furnished. The whole is a picturesque Gothic timber construction.

HOTHAM, WILLIAM HOTHAM, 1ST BARON (1736–1813), British admiral born on April 8, 1736, the third son of Sir Beaumont Hotham (7th baronet), entered the navy in 1751 and was commissioned while serving under Sir Edward Hawke in 1755. He was promoted captain in 1757. In the "Melampe" (36 guns) he took the French frigate "Danae" in 1759. With this brilliant beginning and with the influence that found employment for him in the years of peace following the Seven Years' War, his future distinction seemed assured. In the War of American Independence, however, after good service under Lord Howe, he failed to save from the French a large convoy that he was escorting from St. Eustatius to England in 1780. He was promoted to flag rank in 1787 and made vice-admiral in 1790. With the beginning of the French Revolutionary Wars, he went to the Mediterranean as second-in-command to Lord Hood. Hood unexpectedly relinquished command and Hotham was left to command a fleet, having never hitherto commanded even a squadron. He fought an indecisive action against the French fleet in March 1794 and was content with two prizes and a nominal victory. Offered an even better opportunity soon afterward, he again proved unequal to the responsibility of high command. He mas replaced by Sir John Jervis in 179j and never employed again. He was created a baron, however, in 1797. He died on May 2, 1813. (C. N. P.)

HOTHO, HEINRICH GUSTAV (1802–1873), German historian of art, born in Berlin in 1802, was affected for two years during his boyhood with blindness, but he recovered his sight and took his degree at Berlin in 1826. After a year of travel spent in visiting Paris, London and the Low Countries, he studied for a higher examination and passed as docent in aesthetics and art history.

In 1829 he was made professor at Berlin university. In 1833 he became an assistant in the museum of the Prussian capital and in 1858 the director of the print room.

Hotho divided his time between official duties and literature, his published works being generally confined to the history of the schools of Germany and the Netherlands. In 1842–43 appeared his account of German and Flemish painting. From 1853 to 1858 he revised and published anew a part of that work, which he called "The School of Hubert van Eyck, With His German Precursors and Contemporaries.!'

He died in Berlin on Dec. 25, 1873.

Hotho's development of Hegel's theories was his important contribution to the history of aesthetics. He was deficient, however, in knowledge of Italian painting.

HOTHOUSE: see GREENHOUSE.

HOTIN or KHOTIN, a town of Ukrainian Soviet Socialist Republic, U.S.S.R., in Bessarabia on the right bank of the Dniester. Hotin manufactures leather, candles, beer, shoes and bricks and does an export trade in local products. but its main importance has always been as a military post defending a much-frequented crossing of the Dniester.

The town was a medieval Genoese colony; it has been held by Moldavians, Poles. Austrians. Russians. Turks and Rumanians. The population of Hotin is mainly Ukrainian. Rumania ceded the town to the U.S.S.R. in June 1940 but regained it in 1941 during the invasion of the Soviet Union. In 1944 it was returned to the U.S.S.R.

HOTMAN, FRANÇOIS, SIEUR DE VILLIERS SAINT-PAUL (latinized as FRANCISCUS HOTOMANUS) (1524–1590), French jurist and one of the most learned of humanist scholars who took a leading part in the legal, political and religious controversies of his time, was born on Aug. 23. 1524 in Paris of a family of Silesian origin. He took his doctorate in law at Orléans and practised law in Paris where, in 1546, he became professor of Roman lam. In 1547 he was converted to the Reformed Church and went to teach law successively at Lyons. Geneva. Lausanne and Strasbourg where John Calvin went to hear him. In 1563 he returned to France and taught at Valence and, after 1567, at Bourges, then the foremost law school in Europe, where he succeeded Jacques Cujas. In 1572, after the massacre of St. Bartholomew, he fled to Geneva and taught again there, and later at Basle, where he died on Feb. 12. 1590.

Hotman made important contributions to the work of the French school of Romanists who, in opposition to the Italian commentators, sought to restore the tests of classical Roman law. In his *Anti-Tribonian* (1567) he combined an attack on the compilators employed by Justinian with a plea for codification of French law on the basis of native custom and experience and without borrowing excessively from Roman law. In *Franco-Gallia* (1573), which became his most influential work, Hotman showed that there was no historical foundation, other than the absolutist tendency of Roman lawyers, for the growth of royal absolutism in France which was used to prevent religious reform. In these and numerous other writings, published collectively by J. Lectius (1599–1601). Hotman sought to advance the cause of humanist learning, of religious freedom and of government by consent.

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HOT SPRINGS NATIONAL PARK, a city, spa and tourist resort of central Arkansas, U.S., and seat of Garland county, is located at the eastern gateway to the scenic Ouachita mountains (*q.v.*), 52 mi. S.W. of Little Rock. The springs, probably visited by Hernando de Soto in 1541, were explored in the 1600s, frequented by Spanish and French health seekers in the 1700s, analyzed, routed and mapped in 1804 by the William Dunbar-George Hunter expedition under orders of Pres. Thomas Jefferson.

Warring Indian braves regarded the valley as neutral ground and bathed there together to strengthen their belief that the waters were a therapeutic boon of the "Great Spirit" to all his children. Permanent settlement dates from 1807; the town was incorporated in 1876, and in 1921 was renamed Hot Springs National Park to correspond with the change in nomenclature when Hot Springs reservation was established as a national park. However, the city operates under its own municipal and state laws and is independent of the federal government.

The roadnays, hiking trails, bridle paths and picnic areas of the park are easily accessible from the city's main thoroughfare, The park (about 1,000 ac.), including the 47 thermal springs, denied to private ownership in 1832, was one of the first areas set aside for national conservation. There are 20 hydrotherapeutic institutions (a number on Bathhouse row and the rest in hotels and hospitals) and the Physical Medicine centre, all under federal regulation. Accommodations range from luxury hotels to trailer parks. The climate is mild and nearby lakes with about 1,300 mi. of shore line afford year-round water sports and fishing. The annual schedule of events includes a 31-day horse-race meet. Adjacent Ouachita National forest offers camping, swimming and hunting in season. For comparative population figures see table in ARKANSAS : *Population.* (M. D. Hu.)

HOTTENTOT, a generic term embracing culturally differentiable divisions of peoples known as the Hottentots, the Korana and the Nama located in South-West Africa, living either in European settlements or on official reserves. Most Hottentots (numbering about 24,000 in the latter 1950s) are either Nama or "Orlams," the latter term denoting remnants of the Cape Hottentots together with many of hybrid descent. The main Nama concentrations are the Bondelswarts, Rooinasie, Swartboois and Topnaars; the Orlams groups are the Witbooi, Amraal, Berseba and Bethanie. Physically, true Hottentots closely resemble the Bushmen. the Hottentots' slightly taller stature and decidedly longer and narrower head form being the only marked differences. (See BUSHMAN.)

Traditional Hottentot economy and social organization (see I. Schapera, *Khoisan* Peoples of South Africa (1952) has changed drastically. Formerly, they practised a herding, hunting and gathering economy. While some independent families still lead a nomadic pastoral life, the majority have settled and live by selling their labour, adopting the material equipment, dress, language and general mode of living of their Europeanized rural environment. It is claimed that most Hottentots have become Christian. The former nomadic unit, the patriarchally organized group of related families, now finds expression as the ward of a village. The clan tribes to which persons were affiliated by descent and within which interclan affairs were administered by a council of clan heads, have given way to reserve groups, which are administered as political units by chiefs and headmen, loyalty to whom defines tribal membership.

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LANGUAGE

Hottentot is the European name for the Nama, !Kora and other languages comprising 14 or 15 subdivisions of the main Hottentot speech Of these, the Nama is the most important and will be used for illustration. See also BUSHMAN LANGUAGES.

The Hottentot tongue has the five vowels a, e, *i,* o, u. They are long or short and appear also in reduced form. The consonants are *p,* t, k, *ɜ, s, x, h,* r, m, *n, t', k'.* Nasalized vowels are marked by ~ uritten above them. The outstanding characteristics of the Hottentot language are: (1) the presence of clicks (q v.); (2) the partly monosyllabic nature of the vocabulary; and (3) the presence of tones. The clicks are dental, palatal, cerebral and lateral. These clicks are initial and begin a large percentage of the Hottentot words. The languages are remarkably regular. Word building is simple and regular; gender is marked by suffixes or sex determinatives. Nouns have singular, dual and plural forms; they undergo declension for objective and vocative cases only. Adjectives are not inflected and can be formed from nouns.

Numeration is decimal; the form disi for ten is not I.Eu. **dékm̥* "ten," except in outward appearance and by mere coincidence.

The languages are rich in pronouns and have suffixed forms in singular, dual and plural, in masculine, feminine and common genders. The verb is simple and has present, past, perfect, pluperfect, future and future perfect tenses; subjunctive and optative moods; emphatic and inverted forms (verb first). Derivation of nouns from verbs, of verbs from nouns and of secondary verbal forms (iterative. causative; passive) is wide spread.

Adverbs, prepositions, conjunctives and interjections are not declined. Adverbs of manner are largely derived from adjectives.

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HOTTINGER, JOHANN HEINRICH (1620–1667), Swiss philologist and theologian, was born at Zurich on March 10, 1620. He studied at Geneva, Groningen and Leiden. In 1642, after visiting France and England, he was appointed professor of church history in his native town. The chair of Hebrew at the Carolinum was added in 1643, and in 1653 Hottinger was appointed professor ordinarius of logic, rhetoric and theology. He gained such a high reputation as an oriental scholar that the elector palatine in 1655 appointed him professor of oriental languages and biblical criticism at Heidelberg.

In 1661, however, Hottinger returned to Zurich, where in 1662 he was chosen principal of the university. In 1667 he accepted an invitation to succeed Johann Hoornbeck (1617–66) as professor in the University of Leiden, but was drowned, with three of his children, when their boat upset while crossing the Limmat river on June 5, 1667. His chief works are *Historia ecclesiastica Nov.* Test (1651–67); *Thesaurus* philologicus *sive clavis scrip*turae (1649; 3rd ed., 1696) ; Etymologicon *orientale,* sive lexicon *harmonicum* heptaglotton (1661). He also wrote a Hebrew and an Aramaic grammar.

HOUBRAKEN, JAKOB (1698–1780), Dutch portrait engraver, was born at Dort on Dec. 25, 1698. In 1707 he settled in Amsterdam. He commenced the art of engraving by studying the works of Cornelis Cort, Suyderhoef, Gerard Edelinck and the Visschers. Among his best works are scenes from the comedy of De Ontdekte Schijndeugd, executed in his 80th year, after Cornelis Troost, who was called by his countrymen the Dutch Hogarth. He died on Nov. 14, 1780.

HOUDENC or HOUDAN, **RAOUL DE,** 12th-century French *trouvère,* takes his name from his native place, generally identified with Houdain (Artois), though there are other places bearing the name in one or other of its variants. It seems probable that he followed the trade of jongleur and recited his chansons in the houses of the great. He seems to have spent a great part of his life in Paris. His undoubted works are *Le* Songe d'enfer, La *Voie* de *paradis,* Le Roman des eles (printed by A. Scheler in *Trouvères belges,* new series, 1897) and the romance of *Méraugis* de *Portlesguez,* edited by M. Michelant (1869) and by M. Friedwagner (Halle, 1897). Houdenc was an imitator of Chrétien de Troyes; and Huon de Méri, in his *Tournoi* de *l'antéchrist* (1226), praises him with Chrétien in words that seem to imply that both were dead.

BIBLIOGRAPHY.—Gaston Paris in *Hist. litt.* de *la* France, vol. xxx, pp. 220–237; W. Zingerlé, *Über* Raoul de Houdenc und seine *Werke* (Erlangen, 1880) ; and O. Boerner, Raoul de Houdenc. Eine stilistische Untersuchung (1885).

HOUDETOT, a French noble family, taking its name from the lordship of Houdetot, between Arques and St. Valéry. Louis de Houdetot went with Robert, duke of Normandy, to Palestine in 1034, and the various branches of the family trace descent from Richard I de Houdetot (*fl.* 1229) who married Marie de Montfort.

Charles Louis de Houdetot received a marquisate in 1722, and on his son Claude Constance César, lieutenant general in the French army, was conferred the hereditary title of count in 1753.

His wife *(see* below) was the Madame de Houdetot of J. J. Rousseau's *Confessions.*

Their son Cesar Louis Marie François Ange, comte de Houdetot (1749–1825), was governor of Martinique (1803–09) and lieutenant general (1814) under the empire. His son Frederic Christophe, comte de Houdetot (1778–1859), was director-general of indirect imposts in Prussia after Jena and prefect of Brussels in 1813. He acquiesced in the Restoration but had to resign from the service after the Hundred Days. He became a peer of France in 1819, and under the Second Empire he was returned by the department of Calvados to the *corps législatif.*

HOUDETOT, ELISABETH FRANÇOISE SOPHIE DE LA LIVE DE BELLEGARDE, COMTESSE DE (1730–1813), married the comte de Houdetot *(see* above) in 1748. In 1753 she formed with the marquis de Saint Lambert (*q.v.*) a connection which lasted till his death. Mme. de Houdetot has been made famous by the chapter in J. J. Rousseau's *Confessions* in which he describes his unreciprocated passion for her. When questioned on the subject, she replied that he had much exaggerated.

A view differing considerably from Rousseau's is to be found in the *Mémoires* of Mme. d'Épinay, Mme. de Houdetot's sister-in-law.

See Bussenoir, *La Comtesse d'Houdetot* (1901).

HOUDINI, HARRY (1874–1926), U.S. magician who was famous for his sensational escapes, was born in Appleton, Wis., on April 6, 1874. The son of a rabbi who had emigrated from Hungary, Houdini, whose real name was Ehrich Weiss, became a trapeze performer at an early age. In 1894 he was married to Wilhelmina Rahner, who thereaiter as Beatrice Houdini served as his stage assistant.

By the early 1900s Houdini earned an international reputation for his theatrical tricks and daring feats of extrication from shackles, ropes and handcuffs and various locked containers.

In his article on conjuring in the 13th edition of *Encyclopædia Bvitannica* (1926), Houdini attributed his success partly to his "great physical strength and the fact that he is slightly bow-legged."

In a typical act he was shackled with irons and placed in a box which was locked, roped and weighted. The box was submerged from a boat, to which he returned after freeing himself under water. In another outdoor exhibition he allowed himself to be suspended, head down, about 75 it. above the ground, in which position he freed himself from a strait jacket.

Houdini campaigned against mind readers, mediums and others who claimed supernatural powers. He argued that they were charlatans who produced all of their effects through natural means and various tricks. His *Miracle Mongers and Their Methods* was published in 1920 and *A Magician Among the Spirits* four years later.

Houdini and his wife; however, agreed to conduct an experiment in spiritualism: the first to die was to communicate with the survivor. Houdini died in Detroit, Mich., on Oct. 31. 1926; his widow declared the experiment a failure before her death in 1943.

Houdini. who named himself after the French magician Robert-Houdin (Jean Eugène Robert, 1805–71), published *The Unmasking of Robert-Houdin* in 1908.

See Harold Kellock, *Houdini: His Life Story* (1928); Beryl Williams and Samuel Epstein, *The* Great *Houdini* (1950); Walter B. Gibson and Morris N. Young (eds.), *Houdini on Magic* (1953).

HOUDON, JEAN ANTOINE (1741–1828), French sculptor, achieved such pre-eminence in portraiture that the list of his portraits is a roster of great names of the late 18th century. Not the importance of his sitters, however, but the vividness with which he expressed physiognomy and personality has sustained his reputation as one of the great portrait sculptors of all times.

Houdon was born on March 20, 1741, at Versailles where his father was in domestic service. He underwent the long training prescribed by the Académie Royale, and climaxed it by winning the Prix de Rome in 1761. At the French Academy in Rome. from 1764 to 1768, Houdon established his reputation by a large marble statue of St. Bruno (S. Maria degli Angeli, Rome) and an *écorché,* an anatomical study of a standing man, which served later as the basis for replicas widely used for instruction.

In avoiding the extremes of the decorative emphasis of the preceding generation and the new passion for all that ancient Roman sculpture seemed to stand for, Houdon was following his inclination toward first-hand study of nature. In 1770, two years after his return to Paris, he presented a reclining figure, "Morpheus," as his reception piece for membership in the Academie Royale (marble version. 1777, Louvre).

GIRAUDON

VOLTAIRE BY JEAN ANTIONE HOUDON AT THE COMÉDIE FRANÇAISE, PARIS

Houdon exhibited in almost all the biennial Salons from 1771 to 1814. Among the early portraits shown were: Diderot. 1771; Duke Ernst II von Sachsen-Gotha (nhose extensive patronage of Houdon accounts for the important collection of the sculptor's works in the Gotha museum), 1773; Catherine II of Russia (not from life), 1773; the marquis de Miromesnil, the composer Gluck and the singer Mlle. Arnould as Iphigenia, 1775.

Houdon created four different busts of Voltaire besides the renowned seated figure at the Comédie Française, for which he made first studies shortly after the death of the aged philosopher in May 1778. Five weeks later. on hearing of the death of Jean Jacques Rousseau, Houdon hastened to Ermenonville and took a cast of the dead man's face. From this he developed the bronze bust in the Louvre. In 1785, at the instance of Thomas Jefferson and in company with Benjamin Franklin. Houdon crossed the .Atlantic to carry out a commission for a statue of George Washington. Several weeks at Washington's home at Mount Vernon sufficed for his studies, which he took back to France. The marble statue, signed and dated 1788, was set up in the Virginia state capitol at Richmond in 1796.

Houdon modeled his sculpture in clay; subsequent versions might be of marble, bronze, plaster or clay. A skilled technician in all of these mediums. Houdon either took full charge of repetitions or limited himself to finishing touches upon his assistants' work. He avoided a high finish that would conceal toolmarks; the sense of freshness in execution accorded with his concern for a characteristic pose and for the effect of a direct and vivid glance.

The most celebrated of Houdon's mythological works is the "Diana." first shown in 1777, although not at the Salon (possibly to avoid questions of propriety regarding the artist's frank treatment of the liie-size undraped figurej. The goddess steps forward on her left foot with head erect and turned to her right. a bow in her left hand and an arrow in her right. Versions of this supple, elegant work are in the museums of Tours and Gotha, the Louvre, the Hermitage (Leningrad) and the Huntington Library and Art gallery (San Marino, Calif.).

At the Salon of 1791 Houdon exhibited busts of La Fayette, Franklin. Bailly, Necker and Mirabeau. The turbulence of the Revolution did not prevent him from working. and several charming portraits of his young daughters come from this period. His prestige continued during the Napoleonic era when he portrayed the emperor and received the legion of honour.

He was a professor at the Ecole des Beaux-Arts and a member of the Institute. In 1814 a portrait of Alexander I was his final Salon exhibit. He survived, a figure of the past, until July 1j, 1828.

See G. Giacometti, *La vie et l'oeuvre du sculpteur J.-A. Houdon* (1929). (Js. W. F.)

HOUFFALIZE, a small town nearly 1.100 ft. above sea level in the extreme southeast of the province of Luxembourg, Belg. It is a summer resort with fine bracing air. There are the ruins of an old castle. and some remains of the still older abbey ot Val des Ecoliers.

The parish church dates from the 13th or 14th century. Houffalize is on the eastern Ourthe and is connected by tramway with Bourcy on the line of Libramont to Bastogne, Spa and Liège. Pop. (1955 est.) 1,272.

HOUGHTON, ALANSON BIGELOW (1863–1941), U.S. diplomat, was born at Cambridge, Mass., on Oct. 10, 1863. He was educated at Harvard (B.A., 1886), subsequently studying at Gottingen and Berlin, Ger., and Paris, Fr. He associated himself with the Corning Glass works, N.Y., in 1889 becoming successively vice-president and president and, in 1918, chairman of the board of directors. He was elected a member of congress in 1919 and re-elected in 1921, resigning in 1922 on his appointment by Pres. Warren G. Harding as U.S. ambassador to Germany, a position which he held until 1925. From 1925 to 1929 he was ambassador to Great Britain in succession to F. B. Kellogg. In 1928 he was nominated Republican candidate for senator of the state of New York. He died Sept. 16, 1941.

HOUGHTON, ARTHUR BOYD (1836–1875), English illustrator and engraver, was the leader of a group of artists who drew their inspiration from the pre-Raphaelite movement in its second period. The bulk of his work is in black and white, although he also painted. He was the son of Capt. M. Houghton.

He is among the first British artists to give a vivid and colourful interpretation of the mystery and poetry of the east. His line is delicate, direct and sure and his illustrations full of dramatic power and imagination. From boyhood he had the sight of one eye only, and he suffered considerably from the weakness of the other. In spite of this disability he was a quick and tireless worker, drawing invariably straight upon the wood with a wonderful knowledge of the engraver's technique. The British Museum and the Art gallery of Melbourne each possess one engraved wood block.

The Victoria and Albert museum contains one oil picture, "Don Quixote," and two water colours, "An Oriental with Performing Monkeys" and "The Transformation of King Beder"; also a number of drawings. The Tate gallery has an oil picture, "Punch and Judy."

See *Arthur Boyd Houghton, A Selection from* His *Work in Black and White,* with introduction *by* Laurence Housman (1896).

HOUGHTON, RICHARD MONCKTON MILNES, 1ST BARON (1809–1885), English poet and man of letters, son of Robert Pemberton Milnes of Fryston hall, Yorkshire, and the Hon. Henrietta Monckton, daughter of the 4th Lord Galway, was born in London and educated privately and at Trinity college, Cambridge. There he became a member of the famous "Apostles" club, which then included Alfred, Lord Tennyson, Arthur Henry Hallam, Richard Trench and others. After taking his degree, Milnes travelled in Germany, Italy and Greece. He returned to London in 1837 and was in that year elected M.P. for Pontefract. In the house he interested himself particularly in the question of copyright and the conditions of reformatory schools. He left Sir Robert Peel's party over the corn law controversy and joined Palmerston. at whose instance he nas made a peer in 1863. His chief title to remembrance rests on the part he played in moulding public opinion on literary matters and on the assistance he gave to young writers. He secured a pension for Tennyson, helped to make Ralph Waldo Emerson known in Great Britain and was one of the earliest champions or' Algernon Charles Swinburne. He helped David Gray and wrote a preface for The *Luggie.* Milnes married in 1851 the Hon. Annabel Crewe (d. 1874). He died at Vichy, Fr.. on Aug. 11, 1885. His son, the 2nd Baron Houghton, was created earl of Crewe (*q.v.*) in 1895.

See Sir T. Wemyss Reid, *The Life, Letters and Friendships* of *Richard Monckton Milnes, First Lord Houghton* (1890).

HOUGHTON, WILLIAM STANLEY (1881–1913), English playivright. nas born at Ashton-upon-Mersey, Cheshire, on Feb. 22, 1881, and was educated privately and at the Manchester grammar school.. He became a cotton broker, employing his leisure in dramatic criticism for the *Manchester Guardian* and in writing plays, *The Dear Departed* was played in Manchester on Nov. 2, 1908, and afterward in London. In 1912, with the success of *Hindle Wakes,* which had a long run in London, he leit his business career and went to London, settling in Paris in the following year. His other plays include *The Younger Generation* (1910), *The Master oj the House* (1910), *Trust the People* (1911), *Fancy-Free* (1911). Houghton died in Manchester, Dec. 11, 1913. His work belongs to the realistic: Ibsen tradition.

HOUGHTON-LE-SPRING, a market town and urban district in the Houghton-le-Spring parliamentary division of Durham, Eng., 6½ mi. N.N.E. of the city of Durham. Pop. (1951) 30,676. Area 7.9 sq.mi. It lies below limestone hills at the head of a tributary of the Wear, and the main road from Durham to Sunderland passes through a cutting in the limestone 80 ft. deep. St. Michael's church is an Early English and Decorated building. with a rectory embattled in the 15th century. Bernard Gilpin (*q.v.*) was rector from 1558 to 1583 and founded the grammar school in 1574; it ceased to be used in 1922. Houghton hall, of the late 16th century, is now a social club.

The population is mainly dependent on the neighbouring collieries and on agriculture.

HOULTON, a township and port of entry in northeastern Maine, U.S., about 2 mi. W. of the Canadian border at New Brunswick; the seat of Aroostook county. It is a shipping centre for a large potato-raising region.

The town was settled in 1805 by a group of men from New Salem, Mass., and was named for one of them, Joseph Houlton. It was incorporated in 1831 and was from 1828 to 1847 the site of a U.S. government military station that was nationally prominent for a brief time in 1838-39 during a disturbance over the border between New Brunswick and Maine. A truce was arranged and the border dispute, known as the Aroostook War, was settled by the Webster-Ashburton treaty of 1842. In 1939 Houlton adopted a council-manager form of government, Houlton is the seat of Ricker college (1848).

For comparative population figures *see* table in MAINE: *Population.*

HOUMA, a city of southeastern Louisiana, U.S., on Bayou Terrebonne and the Gulf Intracoastal waterway, about 50 mi. S.W. of New Orleans; the seat of Terrebonne parish. Industries include oil and natural-gas production from the fields which surround the city; commercial fisheries, including oysters, shrimp and shellfish; and the processing of fish and seafood. Houma is also an agricultural centre, with sugar cane and potato crops predominating. Founded about 1810, Houma was incorporated in 1848 and became a city in 1911. The name comes from the Houma Indians, who formerly lived there, and means "red." For comparative population figures see table in LOUISIANA: *Population.*

HOUND, a dog; now used only of dogs of the chase, and especially of foxhounds. Other breeds have a defining word prefixed; *e.g.,* boarhound, staghound, etc. (*See* DOG.)

HOUND'S-TONGUE (*Cynoglossum*), a widely distributed genus of the family Boraginaceae, including several species native to North America and Great Britain. The common hound's-tongue or gypsy flower (*C. officinale*), a native of Europe and Asia and found in waste grounds in the British Isles, is widely naturalized as a weed in eastern North America. It is an erect biennial, 1½ ft. to 3 ft. high, with large, oblong, pointed leaves, purplish-red flowers, ¼ in. across, and a conspicuous burlike fruit which splits into four prickly nutlets. The wild comfrey (*C. virginianum*) or dog bur, native to woods in the southeastern U.S., is a similar but more slender plant with blue flowers. The western hound's-tongue (*C. grande*), a perennial with blue flowers, grows in woods from California northward to Washington. (*See* BORAGINACEAE; FLOWER.)

HOUNSLOW, a town in the borough of Heston and Isleworth (*q.v.*), Middlesex, Eng., 10 mi. W.S.W. of Hyde Park corner, London, by road. It is a residential suburb of London at the junction of two great roads to the west and was an important coaching station, the manure from the stables being used to convert the borders of the heath into market gardens. A priory of the Brethren of the Holy 'Trinity for the Redemption. of Captives was founded at Hounslow in the 13th century; the present parish church stands where the chapel stood. Hounslow heath had an

area of 6.7 sq.mi. in 1546, but only a small portion survives near the Crane. Prehistoric and Roman remains have been found there, and up till the 19th century it was a resort of highwaymen and there were many gibbets on it. In 1784 the base line of the first trigonometrical survey in England was laid down on the heath.

HOUR, the 24th part of a civil day, a space of time of 60 minutes' duration. The word is derived through the O.F. *ure,* from Lat. hora, Gr. ὥρα, season (see CALENDAR).

HOUR ANGLE, the angular distance of a heavenly body from the meridian, as measured around the celestial pole. It is equal to the angle at the pole between the hour circle through the body and the meridian, but is usually expressed in time.

HOURGLASS, a device for measuring intervals of time, also known as sandglass, and as log glass when used in conjunction with the common log for ascertaining the speed of a ship. It consists of two pear-shaped bulbs of glass, united at their apexes and having a minute passage formed between them. A quantity of sand (or occasionally of mercury) is enclosed in the bulbs, and the size of the passage is so proportioned that this sand will completely run through from one bulb to another in the time it is desired to measure; *e.g.*, an hour or a minute. Instruments of this kind, which have no great pretensions to accuracy, were formerly common in churches. In the British house of commons, as a preliminary to a division, a two-minute sandglass is still turned, and while the sand is running the "division bells" are set in motion in every part of the building, to give members notice that a division is at hand.

HOURI, the term for a beautiful virgin who awaits the devout Mohammedan in paradise. The word is the French representative of the Pers. *huri,* Arab. *hawra,* a black-eyed virgin, from *hawira,* to be black-eyed, like a gazelle.

HOURS, CANONICAL, certain portions of the day set apart by rule (canon) of the church for prayer and devotion. The Jewish custom of praying three times a day, *i.e.*, at the third, sixth and ninth hours, was perpetuated in the early Christian church (Acts ii. 15; iii, 1; x, 9), and to these were added midnight (when Paul and Silas sang in prison) and the beginning of day and of night. Ambrose, Augustine and Hilary commended the example of the psalmist who gave praise "seven times a day" (Ps. cxix, 164). The seventh (Compline, Completorium) was added by Benedict. These hours were adopted especially in the monasteries as a part of the canonical life, and spread thence to the cathedral and collegiate chapters. Since the 6th century the number and order of the hours have been fixed thus: matins, lauds, prime, terce, sext, none, vespers, compline. See BREVIARY.

HOURS OF LABOUR. Although precise distinction is not always easy, it is both conventional and convenient to divide a person's day, week or lifetime into so many hours of work or labour and so many of leisure. There is no general presumption that a person is more active physically while at work than when at leisure; for office workers whose recreation is athletic activity such presumption would be obviously false, and for others its accuracy depends upon circumstances. Statistics referring to the number of hours of work usually refer to the number of hours the person is presumed to spend at his job, irrespective of how much work he actually performs. The remainder of his time is considered leisure, though the time consumed in traveling to and from work might merit some other designation.

In most discussions of hours of labour it is daily or weekly hours that are considered. But it is also necessary to consider annual and even lifetime hours of work. The increase in years spent at school, with the attendant delay of entry into the labour force, involves a reduction in hours worked over a person's lifetime. Advancing the age of retirement also reduces lifetime hours, and increasing the number of holidays reduces hours worked per year. Because the fraction of life spent outside the labour force—either at school or in retirement—has tended to rise since 1900, the statistics of the decline in average weekly hours worked tend to understate the rise in lifetime hours of leisure relative to lifetime hours spent at work.

Economic Cost of Leisure.—In general, the more work performed by an individual or a community, the greater the resulting production and real income. Therefore, reducing the daily or weekly hours of labour involves risk of sacrificing real income produced per worker. However, economic progress tends to raise the hourly productivity of workers, creating the possibility of getting either more output (per worker) per day, or the same output with fewer working hours, or some combination of both. In most countries of the western world, the economic progress since the mid-19th century has been used partly to increase real output per worker per year and partly to reduce the average work week. However, the question of how to divide the fruits of progress between work and leisure has been a subject of bitter dispute.

In the late 1950s the average length of the work week in the United States was about 40 hours; in Great Britain and on the continent of Europe it was between 45 and 50 hours. These figures represented a very substantial decline from the levels of a century earlier.

A shorter working day was a major demand of trade unions in most countries during the latter part of the 19th century and throughout the first half of the 20th. In a number of countries legislation was enacted requiring or at least encouraging the adoption of fewer weekly hours.

Despite this pressure, the length of the work week declined only slowly prior to 1920, partly because of employer resistance. The economic reason for such resistance is not hard to discover. In the 19th century, capital equipment was scarce and expensive relative to labour. Competition was keen and, save for occasional depressions, employers used their equipment as intensively as possible. This practice meant running it to the limit of its physical capacity; that is, running it whenever there was a market for the product and the machines did not require repair. Competitive pressure in product markets kept selling prices and wage rates down and, because hourly wages were low, workers needed to work long hours to make enough for subsistence. Put differently, wages were so low that leisure for any purpose other than sleeping and eating was a luxury workers could not afford.

Conditions in the early 19th-century factories were extremely unhealthful, especially for women and children, and those in mines were even worse. It is doubtful that long hours and bad working conditions were conducive to profits; the larger and more successful employers. of whom Robert Owen (*q.v.*) was an outstanding example in Great Britain, generally offered better wages and working conditions than the average. (However, the best of conditions in 19th-century factories would be judged intolerable by 20th-century standards.) But many small employers simply could not afford the modest capital outlay necessary to provide tolerable working conditions, and there was a wide though not universal failure to appreciate the adverse effect of long hours and bad conditions upon worker productivity.

Basically, however, working conditions were poorer and hours longer in the 19th century, as compared with the 20th, because labour was cheaper relative to capital and was therefore used more carelessly. After the turn of the century, as an hour of labour became increasingly more valuable, pressure was placed on employers to use it more effectively. This pressure was reflected in the trend toward "scientific management." which, although it centred in the United States, affected management practice in all developed economies. One of the early findings of the "scientific managers" was that comfortable surroundings enhance worker productivity and that excessively long hours tend to reduce it. These views secured increasingly wide acceptance in the years after World War I, partly because of empirical findings that hourly productivity was severely reduced by unduly long work periods. For example, one investigator found that reducing a longer working day to ten hours would so increase a worker's hourly production as to lead usually to an increase in his daily output as well. This investigator also found that reducing daily hours from ten to eight sufficiently increased hourly output to leave daily production unaffected.

Later studies emphasized that the relation between worker productivity per hour and the number of hours worked per day or per week is not simple. For example, it is possible to increase sharply the number of weekly hours without adversely affecting hourly

productivity, provided that the longer hours are worked for only a few weeks. It is now agreed also that hourly output varies considerably with workers' interest in their jobs, with the pace of work and with the age and health of the workers as well as with daily and weekly hours. However, despite these complications, it is generally accepted that in manual occupations weekly hours in excess of 48 (and in some cases even in excess of 40–42), if long continued. seriously reduce hourly productivity. It also seems clear that there is some work week of probably no more than 60 hours (and possibly less) at which weekly output reaches an upper limit.

The spread of beliefs such as these lessened employer resistance to appeals for a shorter work week, and in many cases, especially in the United States, it led employers voluntarily to reduce weekly hours during the 1920s.

Work Week and Unemployment. — The only valid economic reason for opposing a shorter work week was the fear that it would imply a sacrifice of production. Empirical studies have shown that this fear was greatly exaggerated, if not completely groundless. when the work week was over 50 hours. However, the same studies also have shown that when the work week is less than 48 hours reductions tend to lower weekly output even though hourly productivity may rise somewhat. This means that reducing the work week below six eight-hour days is likely to involve a sacrifice of potential output. This has not in any way lessened the demand for reducing the work week to 40 and even fewer hours. The proponents of a shorter work meek have never rested their case upon the contention that it would not lower potential output; they have argued that the increases in potential annual output per worker are sufficiently large that part of them should be diverted to provide leisure for workers. This argument has appealed to economists and humanitarian reformers.

It is not, however, the only argument offered by trade unionists (and their sympathizers) in support of shorter hours. They have argued also that shorter hours would spread available employment opportunities among a larger number of workers and thereby reduce unemployment. This argument, before the 1930s, was rejected by a great majority of economists, who denied the implication that there was usually a shortage of employment opportunities. But the great depression of the 1930s brought an overwhelming demand from almost all quarters that scarce opportunities for gainful employment be shared. As a result, the trade-union view of the relations between working hours and employment opportunities became the view of virtually the whole of society. Further, the developments in economic theory that culminated in the publication in 1936 of Lord Keynes's *General Theory of Employment, Interest and Money* swung a large body of economists to the view that a shorter work week served to convert full-time unemployment for some workers into a combination of jobs and leisure for a larger number.

This attitude was partly responsible for the decline in the work week in the United States during the 1930s. To a considerable extent the decline resulted from the voluntary action of employers, trying to ration and distribute more or less equally a diminished amount of work. But there was also considerable pressure in the same direction from trade unions. and in some countries, notably the United States and France. there was legislation to limit the weekly hours of labour.

Choice Between Work **and** Leisure After 1940. — Scarcity of employment opportunities ended with World War II, and in advanced countries widespread unemployment had not reappeared on a large scale by the late 1950s. This caused no appreciable lengthening of the work week. though neither was there any material reduction. In all belligerent countries during the war years the average work week rose appreciably, but the additional hours were usually paid at overtime (premium) wage rates. This continued to be the case after 1945, and in some occupations workers came to count upon overtime pay as part of their regular meekly earnings.

In the mid-1950s the attitude of workers toward shorter hours varied from one country to another. In all countries workers presumably would like shorter hours if obtaining them involved no sacrifice of either actual or potential weekly earnings. However, such a sacrifice is required, and the willingness to bear it differs from one country to another and among different groups of workers within a given country.

In the United States a number of unions in the mid-1950s called for reductions in the length of the scheduled work week from 40 to 35 hours. This mas prompted. in good part, by fear that technical progress would soon create a shortage of employment opportunities in the industries affected.

However, the appeal for a shorter work week was opposed by the leaders of a number of other unions who claimed that their members wanted more income rather than less work. It was also pointed out that in most unions workers fight for their share of overtime work rather than avoid such work. Furthermore, by the mid-1950s many workers were taking advantage of the short work week to take extra jobs.

In western Europe, including Great Britain. the scheduled work week after 1945 tended to average between 45 and 50 hours, with overtime being fairly common. The labour movements of a number of countries urged the desirability of a shorter work week, but the need for income seemed to outweigh the desire for added leisure.

The average work week of a country tends to vary roughly with its level of development or its per capita income. Poorer countries, such as Japan, China, Latin-American countries. etc., tend to have relatively long work weeks, and economically more advanced countries to have shorter ones, as may be seen from Table

TABLE I.—Average Weekly Hours Worked in Manufacturing in Selected Countries in 1954

Country	Hours	Country	Hours
United States	39.7	France	44.5
Canada	40.6	Federal Republic of Germany	48.6
Ceylon	48.0	Italy	48.7
Formosa	50.5*	Netherlands	48.8
India	48.0†	United Kingdom	46.3
Japan	49.8		

*For males only, 1953. †Figure assumed because (in 1953) 85.1% of all workers worked between 4 j and 48 hours per week.
Adapted from International Labour Office, *Yearbook of Labour Statistics, 1955*, Table 13, pp. 124–125 (Geneva, 1955).

TABLE II.—Average Weekly Working Hours in the United States, 1850–1953

Year	Weighted average	Nonagriculture	Agriculture
1850	69.8	65.7	72.0
1860	68.0	63.3	71.0
1870	65.4	60.0	70.0
1880	64.0	58.8	69.0
1890	61.9	57.1	68.0
1900	60.2	55.9	67.0
1910	55.1	50.3	65.0
1920	49.7	45.5	60.0
1930	45.9	43.2	55.0
1940	44.0	41.1	54.6
1945	46.4	44.6	54.4
1950	40.0	38.8	47.2
1953	40.1	39.2	48.0

Source: J. Frederic Dewhurst and associates, *America's Seeds and Resources: A New Survey*, Appendix 20–4, p. 1073 (New York, 1955).

I. Table II shows that in the United States the average work week has declined with the growth of per capita income, a fact that supports the preceding statement, and a similar trend has occurred in other advanced countries. There are, however, important qualifications to these statements. In the mid-20th century underdeveloped countries aimed to achieve the working hours and conditions of more advanced countries as quickly as possible. Consequently they did not tolerate the very long work weeks characteristic of 19th-century Europe and America, and the intercountry differences in work weeks were proportionately less than the differences in per capita income.

Economic progress has tended to narrow the intracountry differences in income, and especially in hours, among occupations. Thus in the late 1950s in advanced countries there was little difference between the work weeks of white-collar and factory workers. Such differences are much more likely to exist in backward areas, where skilled workers of all kinds are scarce and enjoy relatively greater advantages in working conditions (as well as greater wage premiums) than are usually found in more advanced countries. The differences in hours and working conditions among

occupations tend to be especially great when occupational boundaries coincide with racial or caste distinctions.

The differences between socialist and capitalist economies have not affected the work week so much as might be thought. In the Soviet Union, in 1934–35, the average work week in manufacturing and mining was 35.7 hours, less than in other European countries. In the following years, however, the work week was lengthened substantially. and by 1940 it was 48 hours in Russian manufacturing. This was still the standard week in 1950, though overtime work was less common than it had been during the nar.

Meaning of Work and Leisure.— Some workers clearly want overtime work; others would rather have leisure. There are individual and occupational differences, but in general it is the workers over 50 years of age who prefer leisure, and younger men with family responsibilities who prefer extra income and work.

In interpreting workers' attitudes toward reduced hours of labour it is important to bear in mind that in economically advanced countries the normal working day no longer is so long as to be physically burdensome to a man in the prime of life and in good health. An additional daily hour of leisure is of questionable utility to him, and he might well prefer extra holidays with pay or longer paid vacations or sick leave to a further shortening of the uorking day. After World War II there was a trend toward more generous provision for paid holidays and vacations. observed in a number of countries but especially marked in the Cnited States. As a result, annual hours worked tended to decline more than weekly hours.

Table I indicates that the United States worker has a shorter work week than any of his European counterparts, but it is widely believed that Americans work harder than Europeans. Whether this opinion is valid is not important here; it serves to indicate that there is more than one dimension — number of hours — to the quantity of work performed.

Economic progress has accompanied a reduction in weekly, annual and lifetime hours of work; it has also involved a reduction in the amount of muscle power that the "typical" worker must exert to perform his task. But these blessings may have been offset, in part. by an increase in the intensity with which the worker must tend his increasingly expensive and complicated machine.

If this is true then it may be that the shorter hours of U.S. workers are partly an offset to the faster pace at which they work. Though this subject has been much speculated about, there is little reliable information upon it.

The idea that leisure may be had at the place of work as well as elsewhere should be borne in mind in interpreting statistics on the hours worked by farmers as compared with those in industry (see Table II). Agricultural hours are always longer, a fact that sometimes causes farmers (and others) to comment adversely upon the easy life of the factory worker. In agriculture, however, the worker has far more opportunity to set his own pace, take a rest when he is tired, etc., than is the case in industry. In other words, intensity of factory work is usually greater than that on farms,

Defining the length of the work week involves difficult problems of separating gainful employment from leisure. For example, there is the time necessary for donning uniforms, for cleaning up, for traveling to and from work, etc. In one sense, classifying the time spent on such activities as work or leisure is merely a verbal matter. However, in collective bargaining negotiations, unions sometimes give up wage increases or other benefits in order to get employers to include, in working time paid for, time spent on such activities. This has the effect of disguising actual declines in the work week; because of this, the work week in the United States probably declined more after 1945 than the figures show.

Higher Wages and Shorter Hours.—*Labour's* Share.— Advocates of shorter hours have usually had mixed motives. Shorter hours have been wanted not only as a means to leisure but also as a method of raising wages. As a 19th-century American rhyme put it,

> Whether you work by the piece
> Or work by the day,
> Decreasing the hours
> Increases the pay.

Other things equal, reducing daily hours per worker reduces total labour supply and therefore tends to raise hourly wage rates. There might well be a reduction in weekly wages, however, despite the rise in hourly pay, for once daily or weekly hours fall below certain maximums further reductions cause output to fall below what otherwise would be obtainable. This has the effect of reducing the community's income of which wages is one share, and thus militates against any increase in labour income. It is sometimes argued that, despite the decrease in total income, reducing the hours of labour will so increase the share of wages in the total as to raise the weekly income of the workers involved. The significance of this argument lies in its implication that reducing hours of work increases the weekly (or yearly) wage incomes of the workers concerned. Where this applies, the fruits of "labour monopoly" are a combination of greater leisure and higher incomes for those benefiting.

The validity of this contention, however, depends upon the group of workers and the time period considered. If the workers whose weekly hours have been reduced can be replaced only with great difficulty; if their wages are only a small part of the total cost of production; and if the demand for the product is very inelastic, then the decline in output resulting from a reduction in hours will lead to a marked rise in product price and a consequent rise in wage rates sufficient to increase weekly earnings despite fewer hours. However, these conditions are far from being satisfied everywhere. In general, they are more likely to be satisfied for short periods than for longer intervals in which employers can find ways of replacing high-priced workers.

For the economy as a whole, it is very difficult to judge whether reducing weekly hours will increase labour's share of the national income. Most economists would deny that there is sufficient knowledge upon which to make a sound judgment.

Significance of Overtime Payment.— In most countries provision is made for permitting work in excess of the prescribed number of hours. Such overtime work must usually be compensated at premium hourly rates, or overtime rates. The significance of requiring premium rates for overtime varies with the state of the labour market. When there is a great deal of unemployment, premium rates penalize employers for employing any one worker more than the standard week and thereby encourage sharing of available work. But when labour becomes scarce and overtime hours must be hired, the effect of premium rates is to provide an automatic device for raising weekly earnings.

The different effects of overtime pay in periods of unemployment and of labour scarcity caused the United States Fair Labor Standards act of 1938 to have quite unanticipated consequences. This law provides that 1½ times the standard rate of hourly wages shall be paid for all weekly hours in excess of 40. This was frankly intended to discourage the employment of any one person for more than 40 hours per week, in order to create additional jobs. Soon after the law took effect, however, the labour shortage of World War II replaced the unemployment of the 1930s. As a result, the overtime provisions brought substantial increases in weekly wages to workers during the war years, and to a lesser — though still appreciable — extent after 1945. This outcome had not been envisaged by either the advocates or the opponents of the law.

Why Employers Have Resisted Shorter Hours.— At the present time, in economically advanced countries workers, through their unions, have substantial control over the length of their work week. It is not that employers are powerless to resist, but that to a considerable extent they are indifferent as to how long workers choose to work, provided they do not work so long as to undermine their efficiency. This partial indifference to the length of the working day results from the fact that the employer if he wishes usually can compensate for an inconveniently short day by having his employees work overtime, use extra shifts, or both. Of course, overtime work and multiple shifts involve extra costs, and employers take them fully into account in bargaining with unions. A union that genuinely wants a reduction in the standard work week, however, usually can obtain it by sacrificing potential wage increases or other benefits.

This is not to suggest that employers can alter technological processes to suit workers' leisure preferences. Often, these processes require continuous work. The number of shifts used to operate a process, however, usually can be varied within very wide limits, though at some cost.

In the 19th century employers were generally far less pliable about the length of the working day than they became in the middle years of the 20th.

There are a number of possible explanations for this change in attitude, but the most important is the fact that in the 19th century long hours were a method of cutting hourly wages, when daily wages were close to a subsistence minimum and could scarcely be reduced further. That is, the employers' resistance to shorter hours was primarily resistance to the accompanying demand for no reduction in daily pay.

History of the Shorter Hours Movement.—Before *1860.*—The "shorter hours" movement began almost with the formation of unions. In the United States in 1791 the carpenters of Philadelphia resolved that a day's work should not exceed 12 hours. In the decade 1825–35, especially in 1835, there were numerous ten-hour-day strikes in the seaboard cities, some of which succeeded. These strikes involved primarily building tradesmen, though others were also involved. Despite some temporary success, this embryonic trade-union movement was destroyed in the depression of 1837. Its only permanent legacy was the ten-hour day in federal government work, which was achieved in 1840 after prolonged agitation.

These early unions were organizations of artisans. Etiective unionism in the factories of New England did not arise until much later. By the 1840s hours and working conditions in the New England textile mills had become so bad as to cause a demand that hours be regulated by law, and in the decade following 1847 eight states enacted maximum hour legislation for women. These lams, however, were mere declarations of public policy, unenforceable and unenforced.

During the first half of the 19th century the movement for shorter hours in Great Britain was concerned primarily with factory employment, especially in textile mills. The development of the factory system in the first quarter of the century had led to the employment of women and children for more than 12 hours per day, under unhealthful conditions. As a response to this, a series of Factory acts was passed regulating various hours and working conditions of women and children. The first of these acts, passed in 1802, merely limited the hours of apprentices to 12 per day. Subsequent acts imposed increasingly severe restraints upon the hours of women and children. Legislation had to be enacted over a determined laissez-faire opposition, however, and it was not until 1847 that an effective limit of ten hours per day was placed upon factory employment of women and children.

Confining legislation to women and children was a concession to laissez-faire sentiment, which objected to impairing the freedom of contract of adult males. However, it was generally understood that regulating the hours of children would effectively control the hours of the men whom they assisted.

1850–90.—Massachusetts, although it was the most important manufacturing state in the United States prior to 1880, did not limit hours of work until 1874. Its maximum-hour law mas the first one to be genuinely enforceable, but its example was not rapidly followed; though in the 1880s and 1890s a number of states enacted maximum-hour statutes, only three of these contained provision for enforcement.

During this period the eight-hour day became a union battle cry. Agitation began in the 1860s, and by the 1880s the eight-hour day had become a characteristic demand of labour unions. In 1884 the Federation of Organized Trades and Labor Unions, forerunner of the American Federation of Labor, made it one of its dominant issues. It mas resolved that after May 1. 1886. workers should refuse to work more than eight hours per day. Although the full implications of this were not explained, the resolution suggested to many that a general strike for the eight-hour day be called on May 1, 1886. Though a general strike was impractical, about 300.000 men demonstrated and 190,000 actually did strike on that day; of these, perhaps 42,000 obtained shorter hours. Another 150,000 obtained some reduction in the working day without resorting to strike action. Most of these gains were soon lost through employer counterattack or offset by wage cuts.

The American Federation of Labor did not abandon the drive for the eight-hour day but changed its approach to supporting individual unions in rotation. On May 1. 1890, the Carpenters' union struck for the eight-hour day and over 23,000 carpenters obtained it; 32,000 more gained a nine-hour day.

In the years following, the various unions chosen to head the drive were too weak for the task, though the Typographical union persisted in its campaign and eventually, in 1906, achieved substantial success. Despite the great union agitation. however, there was no substantial reduction of the work week during this period.

In Great Britain, the factory legislation that had been enacted in the first half of the century was extended in the 1860s and 1870s to a wide variety of industries and also to workshops. Furthermore, in 1874, a (maximum) nine-hour-day law was enacted. As a result of this, by the mid-1870s, working hours for adults had been reduced to an average of about 55 per week. Save for improvements in the hours of the sweated trades, they remained at roughly this level (when work was available) until the end of World War I. This contrasts very favourably with the development in the United States, where weekly hours (outside agriculture) did not fall to 56 hours until 1900.

The slower decline in weekly hours in the United States reflected, among other things, the less effective and extensive regulation of hours by the government, and also the comparative weakness of the American unions.

A few London craft unions achieved the ten-hour day before 1830, but it was not until the 1850s that the "new model" trade unions (especially the Amalgamated Society of Engineers and the builders' unions) began to push for shorter hours. After many vicissitudes in the '50s and '60s, by the early '70s the nine-hour day had been established in a large number of trades. The nine-hour law of 1874 was primarily a means of enabling the textile operatives to catch up with what the other skilled trades had already achieved.

During the 19th century Australia was well ahead of Great Britain and the United States in achieving the eight-hour day. Because of the general labour shortage unions were very successful, and the eight-hour day was established in the skilled trades by the 1850s. In 1874 in the colony of Victoria the eight-hour day was made mandatory for women employed in factories; a few years later a law to the same effect was applied to both men and women working in mines. These laws were later developed and extended, and by the end of the century the 48-hour week had become nearly universal in Australia.

On the continent of Europe there was strong eight-hour-day sentiment, but the unions were generally too weak to limit the working day and the little that was accomplished came through legislation. The French revolutionary government of 1848 decreed 10 hours per day to be the legal maximum in Paris, for both men and women. and 11 hours elsewhere. Later the same year, the law was amended to permit no more than 12 hours of work per day. This law remained formally in effect throughout the second empire, but it became largely inoperative through poor enforcement and numerous exemptions. After 1880 the French Socialist parties began to agitate for the eight-hour day. and in 1890 there were a number of unsuccessful eight-hour-day strikes.

In Germany there was some legislation in the '70s and '80s restricting the working hours of women and children, but the laws were poorly enforced. It was not until the end of the 1880s that unionized artisans and miners began to make some headway in limiting the working day.

1890–1918.—The era from the turn of the century to the beginning of World War I saw a marked extension of hours legislation in the United States. Between 1856 and 1917, 27 states passed laws imposing maximum hours on women's work, and most of these were enforced. The lams themselves tended to broaden in coverage as time went on. At the beginning of the period they usually imposed only ten-hour maximums, but toward the end they often

prescribed eight-hour days. There was also a strong tendency to restrict or forbid night work. The restriction on women's hours was paralleled by a movement to limit child labour or abolish it outright. During 1909–14, when this wave of legislation was at its height, the percentage of manufacturing workers with full-time weeks in excess of jj hours fell from 69% to 49%. It is likely that the aforementioned legislation made a sizable contribution to this result.

In addition to passing laws governing women's hours, a number of states made declarations of public policy regarding men's hours on public works. These laws, which also applied to government contractors, usually limited the working day to eight hours.

Apart from legislative activity, the decline of the work week moved slowly prior to 1914. The American Federation of Labor's eight-hour drive, which had bogged down in the 1890s, was never started again on a large scale. The general failure of unions to invade the manufacturing industries greatly limited union influence.

In the relatively few unionized manufacturing industries, the average standard work week declined from 54 hours in 1890 to fewer than 49 in 191j, a drop of about 10%, compared with a 6% decline in the hours of nonunionized manufacturing workers (from 62 to 58). From 1890 to 1915 the building trades, where unionism was strong, cut standard weekly hours from 51 to fewer than 45 (about 13%), but "all industry" workers' scheduled weekly hours dropped only 5 hours (from 58.4 to 53.5). or 9%. Though causal relations are obscure, the association of unionism with shorter hours in the period 1890–1915 is clear.

In the period 1915–20 the reverse was the case. Under the pressure of the wartime labour shortage, unionized and nonunionized industries alike were compelled to reduce weekly hours in order to retain their workers. In this period. the eight-hour day was a demand for which higher wages were not an adequate substitute. As a result, labour market competition compelled nonunion manufacturers to reduce average weekly hours more than unionized manufacturers did. Furthermore, the building tradesmen, whose weekly hours had been fewer than 45 in 1915, reduced them during this period by an average of only about one hour, or roughly one-quarter of the decline in the hours of nonunion factory uorkers.

World War I was the period when the eight-hour day, six-day week became standard in U.S. factories. In 1914 only 11 8% of all factory workers worked a standard week of 48 hours or less; by 1919, 48.776 worked 48 hours per week or less, and by 1921 this was true of 51.7%. The coal miners also achieved a 48-hour week during this period. and in 1916 the federal government passed the Adamson act establishing a basic eight-hour day. with compensation for overtime. on railroads. This law was the culmination of a prolonged campaign by the railway unions and was enacted to forestall an imminent major rail strike.

In Great Britain hours of work were not greatly altered between the mid-1870s and 1918, despite a campaign for the eight-hour day that began in the 1880s. In 1909 parliament passed an eight-hour-day law for coal mines, but otherwise little change was made until the beginning of 1919. At that time the engineering and shipbuilding trades renewed their prewar demands for a shorter work week and succeeded in reducing it to about 47 hours. The cotton operatives, iron and steel workers and most other unionized workers also obtained approximately a 48-hour week during the first half of 1919.

Although the 48-hour week had become practically universal in Australia by the end of the 19th century, the unions continued to push for still further reductions in hours. In 1913 the building tradesmen were awarded, through arbitration, a 44-hour week. This opened the way for a general drive toward the 44-hour week, which continued through the war and after. During the 1920s there was slow but steady progress toward a general 44-hour week, with both state legislation and awards of the Federal Arbitration tribunal playing major roles. It is worth noting, hoaever, that in the '20s and '30s Australian workers lost the very substantial advantage over others, with respect to hours, that they had enjoyed at the turn of the century.

1921–29.—The 1920s saw only moderate changes in weekly hours in the United States and none at all in Great Britain. In the depression of 1920–21, U.S. unions lost many members, and some employers tried to withdraw the newly achieved 44- or 48-hour week. While the more strongly unionized trades successfully resisted this campaign, the work week of many manufacturing workers was lengthened during the decade of the 1920s. Between 1921 and 1929 the percentage of manufacturing workers having a standard work week of 48 hours or fewer decreased from 51.5% to 45.5%. There were cross-currents, however; for the more fortunate workers, notably in the building trades, the five-day week had become common by the end of the 1920s, and very long weeks of 60 hours and over diminished. The outstanding case of the latter was the abandonment by the steel industry in 1923 of the 12-hour day and the "13 out of 14 days" work schedule; this was replaced by the basic eight-hour day, with payment for overtime.

During the 1920s most European countries made substantial gain toward achieving the 48-hour week. Prior to 1914 the 60-hour week or longer was common on the continent. In the social upheavals that followed World War I, most of the newly created countries, as well as France and Germany, adopted eight-hour-day laws in 1919.

Many of these countries also signed the international convention, sponsored by the newly formed International Labour organization, which declared the eight-hour day or 48-hour week to be a standard at which to aim. (In 1935 the International Labour organization adopted a convention embodying the principle of the 40-hour week, but as this convention was ratified only by New Zealand it never went into force.) Enforcement of the eight-hour lans in Europe was poor, and the exceptions permitted were numerous. It was not till the end of the 1920s that the 48-hour week became widespread, and in 1930 many exceptions still existed, especially in France.

1930–39.—The depression that began in 1929 caused a drastic decline in the weekly hours worked in all countries. This did not have any major effect upon full-time hours in Great Britain or Germany. but it caused a drastic and permanent reduction in the standard work week in the United States. During the early 1930s the advocates of shorter hours encountered little opposition to their argument that technological progress had destroyed millions of jobs and that it was necessary to "share the work." This philosophy was found in the various codes of "fair competition" adopted under the National Industrial Recovery act of 1933, codes typically requiring a 40-hour, five-day week. Although the law was declared unconstitutional in 1935, its hours' provisions remained a part of standard U.S. labour practice. In part, this was attributable to the fact that in the years 1935–39 employers had no strong incentive to lengthen the work week; labour was plentiful.

Another factor was the growth of unions in the manufacturing industries in 1936–38; had employers attempted to lengthen the work week during those years, it mould only have helped the unions' organizing campaigns. Still another, though minor, reason was the existence of a 40-hour requirement for government suppliers imposed by the Walsh-Healey act of 1936.

Whatever employers might have done eventually to lengthen the work week was effectively blocked by the Fair Labor Standards act (FLSA) of 1938, which replaced the invalidated National Industrial Recovery act. Among other things it virtually prohibited child labour, established minimum wage rates, and required that all hours in excess of 40 per week should be compensated at 1½ times the standard rate. The law applies to the major part of the economy, though such important sectors as retail trade and agriculture remain practically uncovered.

The Fair Labor Standards act does not establish a maximum work week of 40 hours; it merely imposes a financial penalty upon employers who hire workers for more than 40 hours, which has the effectof deterring the use of overtime without prohibiting it. Because of the overtime pay requirement, some workers who would wish to work more than 40 hours per week at straight-time rates are prevented from doing so on their "main" job, but after 1940 it was usually possible for such persons to get extra jobs to earn extra income.

In France the popular front government of 1936 enacted a law establishing the 40-hour week with no change in weekly wages. As a result of this law the government by decree set wage levels and the 40-hour week for individual industries. One result of the law was to make 40 hours the effective work week in France; its further repercussions cannot be considered here.

Conclusion. — The long-run trend in the hours of labour has been downward. Despite the spectacular developments connected with legislation and union activity, the prolonged growth of per capita real income has been the major force behind this trend. That is, as workers' incomes have risen they have come to want more leisure in which to enjoy it.

The demands of unions, sometimes for higher wages, sometimes for shorter hours, and the related pressure exerted upon legislatures to limit daily or weekly hours, ultimately reflect the choices of individuals within and without unions, and are not separate forces. Union bargaining power and legislative enactment at times accelerated the decline of weekly hours, but it is unlikely that over a period of a half-century their influence has been predominant.

See also various articles on labour, employment, the factory system, etc.

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HOUSE, EDWARD MANDELL (1858–1938), American statesman and diplomat. was born at Houston, Tex., July 26, 1858, the seventh son of Thomas William House and Mary Elizabeth Shearn. His father, who had left England as a boy, came to Texas when it formed part of Mexico, joined the revolution, helped to free it and bring it into the Union. The younger House was educated at the Hopkins grammar school and Cornell university, and returned to Texas in 1880, where he lived for more than 30 years as planter. His chief interest, however, was public affairs. He took an influential part in the successful campaigns of Governors Hogg, Culberson, Sayers and Lanham, and during the period 1894–1904 his political influence in Texas was regarded as decisive.

He refused invariably to become a candidate for office himself, but acted as the intimate adviser of the several governors named. Although frequently urged to participate in national politics he remained aloof from the disastrous Democratic campaigns that followed the Bryan candidacy of 1896; but in 1912 he played a major rôle in securing the nomination of Woodrow Wilson, and at the time of the election Wilson had come to put full trust in him, offering him a choice of cabinet positions. Following his custom, House refused any office, but politically as well as personally he remained closer to the President than any member of the official family. It was upon his recommendation that Wilson chose a number of his cabinet; after the inauguration both President and cabinet utilized his wide knowledge of men and his shrewd estimate of political effects to help them in meeting legislative and administrative problems; he exercised a great influence in the framing of the Federal Reserve Act and also played an important part in the organization of the original Federal Reserve Board. Wilson spoke of him as his "independent self."

House's chief interest lay in foreign affairs, and through close contact with American ambassadors abroad and his intimacy with European statesmen, as well as the confidence of the President, he was able to influence the course of American foreign policy. In 1913 he helped to tide over the crisis in relations with Great Britain over the Panama tolls exemption until Wilson secured the repeal of the exemption. In 1914 he undertook informal negotiations with the diplomatic representatives of Argentina, Brazil and Chile, which led to the drafting of a pan-American pact designed to guarantee peace in the Western Hemisphere. In the spring of 1914, House, apprehensive lest war should break out in Europe, sailed for Germany to offer the assistance of the United States in reaching some arrangement between England and Germany which might avoid war. He talked with high officials of the civil Government, the army and navy, and had a conference with the Kaiser, in which he received some encouragement. William II. later said:—"The visit of Colonel House to Berlin and London in the spring of 1914 almost prevented the World War." At London he found Sir Edward Grey ready to entertain any feasible plan to preserve peace. This, House wrote to the Kaiser on July 7, 1914. The murder of the Archduke Francis Ferdinand, however, precipitated war before the plan could be developed.

Returning to the United States, House maintained close intimacy with the British and German ambassadors and thus helped to smooth American relations with the belligerents. In Jan. 1915 Wilson sent him abroad to study the possibility of American mediation. He suggested the principle of the "Freedom of the Seas," after visits to London, Berlin and Paris, as a possible step towards a compromise; but the sinking of the "Lusitania" ruined all chances of success. In the autumn, House proposed that Wilson suggest to the Allies that a peace conference should be summoned; if Germany refused the conference or rejected terms calculated to ensure a just settlement, the United States would enter the war on the side of the Allies to enforce such terms. House left for Europe again in Dec. 1915, visited England, Germany and France, and finally made the aforesaid offer to the British, the substance of which was incorporated in a memorandum drafted by Grey and himself. The Allies, however, refused to take advantage of it.

In the summer and autumn of 1916 House took an influential part in the campaign which led to Wilson's re-election. After the United States entered the war, he kept in close touch with the chiefs of the war-making agencies, and was in consultation with the special envoys of the Allies: Balfour, Northcliffe, Tardieu, Reading. In the autumn of 1917 Wilson named him chief of the special American mission designed to co-ordinate Allied war needs, especially the problems of finance, supply, tonnage and man-power. The conferences in London and Paris which he attended proved to be the turn of the tide. After his return he was intimately concerned in Wilson's drafting of the Fourteen Points, and at the request of the President he drafted a tentative covenant for a League of Nations, which formed the basis of Wilson's later plan. In Oct. 1918 Wilson sent him to Paris to represent the United States at the Allied Council, which granted an armistice to Germany.

After some difficulty, House succeeded in pledging the Allies to Wilson's Fourteen Points as a programme for peace. He had previously organized "the Inquiry," a body of experts for collecting authentic data for the use of the Peace Conference. House was one of the U.S. peace commissioners signing the Treaty of Versailles, and although ill at the opening of the conference he played an important rôle by reason of his intimacy with European statesmen. He was a member of the commission that drafted the League of Nations' Covenant, and ultimately most of the details connected with the formation of the League were settled with his co-operation. In July and Aug. 1919 he represented the United States in the organization of the Mandates system. After his return to the United States he urged President Wilson, by letter, to compromise with the Senate so as to secure ratification of the Versailles Treaty and the entrance of the United States into the League. A serious illness, coming at the same time as the physical breakdown of Wilson, combined with other factors to interrupt the close relations between the two men which had persisted since 1911.

Col. House had won a reputation for such sagacity and disinterestedness that his advice was continually sought by political leaders even after the overthrow of the Democratic Party in

1920. He continued his interest in international questions and maintained close relations with the chief statesmen of Europe.

In 1912 House published, anonymously, a political romance, *Philip* Dru; in 1921 he edited (with Charles Seymour) *What Really Happened at Paris*, a series of essays on the peace conference written by members of the American delegation. He also wrote, after 1920, a number of articles upon contemporary politics and political leaders for the *Philadelphia Public Ledger, Foreign Affairs, Harper's* and *Encyclopedia Britannica.*

See *The Real Colonel House,* by *A D.* Howden Smith (1918), a brief but accurate biography covering House's career to 1918, and *The Intimate Papers of Colonel House,* arranged as a narrative by Charles Seymour (1926–28). (C SEY.)

HOUSE, HOMER DOLIVER (1878–1949), **C.S.** botanist, was born at Oneida, N.Y., on July 21, 1878. He graduated at Syracuse university in 1902 and pursued further study at Columbia university, from which in 1908 he received the degree of doctor of philosophy. He was professor of botany and bacteriology at Clemson (S.C.) Agricultural college (1906–07) and associate director and dendrologist of the Biltmore (N.C.) Forest school in 1908–13. In 1913 he became assistant state botanist and from 1914 to 1948 was state botanist of New York.

Besides numerous papers, his writings include *Wild Flowers of New York* (1918), illustrated with colour plates; *Annotated List of the Ferns and Flowering Plants of New York State* (1924); and *Wild Flowers* (1934).

House died on Dec. 21, 1949, at Loudonville. N.Y.

HOUSE, in this article, refers to a human habitation; its origins can only be surmised. It is obvious that Stone Age man, at least in the temperate climates, dwelt frequently in natural caves. There are evidences, also, that forest-dwelling tribes and those in tropical countries early developed some sort of hut construction, probably by planting sticks in the ground in a circle, binding their tops together to form a cone and covering the framework with thatch or leaves. At some ancient time the primitive cave dweller discovered that his cave could be enlarged and strengthened by constructing in front of it a wall of piled rocks, and roofing the space between the cave and the wall with logs or skins. Growing skill in this type of construction led to the development of elaborate cave dwellings such as those found on certain river banks in the southnest of the United States. Viollet-le-Duc (*Histoire de l'habitation humaine* [1875]) hypothecated similar combinations of cave and masonry dwellings as one of the universal primitive forms of Aryan houses. Thus the hut is the parent form of all timber houses, and the cave dwelling of those of masonry. Most of these houses nere of one room but, with the development of a more complex civilization, subdivision became necessary and the plan was articulated. At first this seems to have been accomplished by merely combining several hut units within a single enclosure.

Many remains of floors and foundations of such groups of round huts, probably of straw in some cases and of unbaked brick in others, dating from the Neolithic Age, have been found throughout the Aegean world. Later, elliptical forms with subdividing partitions appeared about 2000 B.C.

Another form of development characterized late Stone and Bronze Age villages of northern and central Europe — the so-called lake dwelling, in which many rectangular houses, some of two or more rooms, were built upon a pile-supported platform over a lake. In European lake dwellings, not only did primitive frame construction, a development of the hut type, appear, but also the use of crossed logs overlapping at the corners — the typical log cabin construction. (*See* DWELLINGS, PRIMITIVE.)

Egypt and Western Asia. — In the vicinity of the Aegean, two types of house plan made their appearance. The first was the block house, with all of the rooms under one roof and in a compact block; the second was the house with a court, in which the rooms opened onto a court with or without a colonnade or open corridor. Egyptian models of houses dating back to the early empire show both types, but in Egypt the court type seems never to have been developed as it was in Europe and China; and the court appeared most frequently as a garden or stable yard enclosed by walls on two or more sides, with the house proper often forming an L-shaped mass on the other two sides. Often, outside stairs led to a flat roof, and houses of two or more stories were common in the cities. In the larger houses of the country-dnelling aristocracy, a central residential block, with or without a colonnaded court, was surrounded by a formal garden, around whose enclosing walls were built the stables and storehouses. There was much use of large windows, columns, awnings and a great luxuriance of decoration; the construction seems to have been largely of clay or unburned brick reinforced with a framework of timber or reeds.

In the Aegean culture, both court houses and those in a single block are found. The great palaces had a court as their most important feature. but the plan of the town of Gournia was simply a maze of crowded, close-built rooms. Moreover, many paintings and terra-cotta plaques show Cretan houses as cubicle blocks, often in two stories, with flat roofs and many windows.

The early Mesopotamian house, which remained fairly constant in form over at least 2,000 years, was of three types. The first was a development of the conical hut, constructed, apparently, in unburned brick, and consisted of a tall, narrow, dome form, sometimes set on a small square base. The second, probably a country residence, was a rectangular building or group of buildings with flat roofs, battlemented parapets, arched doorways and many long, low windows close to the roof, subdivided by colonnettes. The third type, the city house, consisted of an assemblage of long narrow rooms. with walls of immense thickness arranged around one or more courts. Some of these rooms may have been barrel-vaulted in brick. Architectural decoration was of the simplest. What richness they possessed must have been produced by a lavish use of textiles.

The most complete idea of early Semitic houses is given in the description of Solomon's palace in the Bible (I Kings, vii). Timber was much used. Flat roofs were universal, and in the larger chambers they were supported by rows of wooden columns. Decoration was by means of *repoussé* metal work applied to the wooden surfaces.

Classical. — In both classic Greece and Rome, the court type of house was brought to its highest point of development. The house consisted of a group of rooms around a central colonnaded court or peristyle. In some there was an upper story. In the larger houses there was frequently a gallery across the front. There are only few evidences of the division between the men's and women's quarters; either the women's apartments were on the second floor, or else the division was only architecturally expressed in the largest houses through the existence of two or more courts. The most important position, at the end of the court opposite the entrance. was reserved for the reception room and the chief bedroom or the *thalamos*, the official centre of the house life.

In the Roman house the court idea was superimposed upon an earlier tradition of a single room dwelling with a hole in the centre of the roof for the emission of smoke — the primitive atrium (*q.v.*). In the historic period, the atrium had already become primarily a court, with the living rooms around it; and the excavations at Pompeii have proved that by the 2nd century B.C., at least in southern Italy, the typical Roman house comprised a colonnaded court as well.

In the imperial period, the atrium, with its surrounding rooms, was reserved for business and official functions. Family life centred in the peristyle.

Variant types of Roman houses were the great country houses or villas. Remains of such buildings are found frequently throughout the Roman empire. Another type was the farmhouse, such as that at Boscoreale, in which barns, oil and wine presses, storage rooms and the house proper were in one building around one main court. A vast provincial farm establishment in north Africa, that of the Laberii at Uthina (dating from various periods from the 1st to the 4th centuries), was a palatial central residence with many wings to take advantage of the view and prevailing minds, and separate small buildings for the farm. Another variant form was the great apartment house of several storys which was the

usual residence of the poorer free classes, not only in Rome, but in many of the more crowded centres. Indications on the marble plan of Rome which was prepared under Septimius Severus suggest that these structures frequently surrounded a court in nhich was placed the stair tower that gave communication to the various storys. The fronts of these buildings were surprisingly modern in appearance; usually there were shops on the ground floor and rows of simple windows, often with projecting balconies above. The whole was usually faced with brick, unstuccoed, with the mouldings, etc., worked on the face of the brick itself. Other interesting provincial derivations from the Roman stem were the stone houses of Syria, vast numbers of which exist, dating from the 3rd to the 7th centuries, nhen the villages and towns seem to have been suddenly abandoned at the time of the Moslem conquest. These Syrian houses were sometimes roofed in stone, and all of them were remarkable in the extent to which stone was used, not only for walls, but for doors. railings, screens. etc. There was generally an enclosing wall around a forecourt, with the house in a block at the rear. fronted with a colonnaded gallery.

Medieval. — In Europe the growth of towns and villages during the 11th and 12th centuries produced a new development of house planning. Country-house design, on the other hand, outside of feudal castles and manors (see CASTLE), remained almost stagnant; as far as is known, the serfs' dnellings were mere huts with low walls, perhaps of masonry or banked with earth and sods, and with the roughest kind of thatched roofs. This type, evidently once common, persisted into the 19th century in the huts of transient workers (like charcoal burners or bark peelers) in England. and in the sod house or dugout of the western plains of the U.S. By the 13th century this condition was beginning to change, at least in France, and the hut was replaced by stone farmhouses and cottages. often divided into two or more rooms. with chimneys and fireplaces. and with roofs sometimes of slate and sometimes of thatch. The further feudalism retreated, the more the country house developed; by the late Gothic period. all over north Europe, the wealthier peasants lived in highly developed farms, usually taking the form of a rectangular enclosure. entered by a gateway and bordered by barns, storage sheds and the house proper, which was often in two storys and well finished with windows and chimneys. In France such buildings were usually of stone, but in Switzerland, Germany and Scandinavia wood was the common material, either in half-timber work (*q.v.*) or in "log cabin" or chalet (*q.v.*) construction. In towns the smallness of the lots forced an early development of compact planning in several storys.

In general standard of comfort, the houses of the 12th and early 13th centuries compare well with any built during the next 500 years. and it is noteworthy that the development during the 13th, 14th and 15th centuries was merely one of increased size and greater elaboration of the facade.

In Italy, where cities were more highly developed, town houses were even further advanced, and it was during this period that the typical north Italian city palace, built around an arcaded court, with enormously high storys and many small coupled windows, and frequently with a projecting battleinented parapet, took form. In all Italian examples, and in most of those in France, the main living floor was one story above the entrance, and the ground floor was reserved for shops and service rooms. In north Europe, in the 14th and 15th centuries, more and more houses, both city and country, were being built of half timber, so that although stone or brick seemed to predominate in the 13th-century town, it nas half timber which predominated in the 15th-century town, as may be seen in portions of Rouen, Beauvais, Strasbourg, Hildesheim and Chester. The same period, moreover, saw the origin of the great burgher or wealthy free peasant's house, and the development of types for the nobility which were no longer mere castles or châteaux but, like the English manor houses, designed primarily for comfort. In these there was a growing subdivision of the areas to give greater privacy and to separate the various functions of eating, sleeping and social life. The planning was still, however, embryonic, with no grasp of corridor circulation and many stairs.

The same subdivision and the same struggle for convenience and privacy characterizes the entire history of the English house from 1400 to 1700. At first merely a great hall (*q* v.) with service rooms at one end and private rooms at the other, the house rapidly developed into a plan which in all main respects was modern, with parlours, dining rooms, sleeping rooms, etc., all carefully differentiated The beautiful manor of Compton Winyates (c. 1520) shons the type; Kirby hall, by John Thorpe (begun 1570), and Hardwick hall, Derbyshire (early 17th century, John Smithson architect), show the complexity and growing symmetry of the English plan as well as the introduction of Renaissance ideas; and Speke hall. near Liverpool (17th century). shows the similar type treated in half timber. In all of these. lavishness of interior finish, by means of plaster and wood paneling, is a noteworthy feature.

The Renaissance. — The Renaissance house throughout Europe was a compromise between two conflicting influences: the traditional development of convenient plan ideas and the desire for classic symmetry. In Italy, where the medieval large house had always been designed on monumental lines, the conflict was not strong, but in north Europe late Gothic plans were definitely asymmetrical, and the conflict was bound to lead to compromise. The best of the compromises was that achieved by the English during the late 17th and 18th centuries under the influence of Inigo Jones. In France, through the craze for classicism and the influence of the court, convenience markedly suffered, so that there the average large 14th- or 15th-century house had infinitely more real comfort than that of the 17th or 18th century. There mas, however, a corresponding gain in elegance; and individual staircases and rooms reached a rare standard of excellence. There was also an enormous ingenuity in planning; a groning elimination of waste space; and a remarkable integration of interior arrangement and exterior effect.

The greater number of these large houses, or *hôtels,* which give character to so many French tonns, were built between the street and a large garden, nith an impressive gateway leading to a courtyard and the house rooms beyond.

In America, different conditions were developing from English precedent a slightly different type of house, more compact and usually less monumental. In the north, the house of a single block, with two or four rooms to the floor and a central chimney, or the larger houses with end chimneys became the accepted type. In the south, where social conditions were more like those in England, the houses more closely resembled those of the mother country. Thus, Mt. Airy, Va. (1758), of cut stone, and Westover, Va. (*c* 1730), could be almost duplicated in many English counties, and George Washington's home at Mt. Vernon, Va., with its multitude of service outbuildings. slave quarters, etc., was but a version in wood of a common English type. Close contact with France during and after the American Revolution, French architects working in America (*e.g.,* Pierre l'Enfant), and the fact that many early U S. architects traveled widely in France (*e.g.,* Charles Bulfinch) led to the development in America of the French monumental house plan.

Modern. — The industrial revolution produced a synchronous revolution in house design all over the western world, especially in towns and cities. The influences at work were confused— increased land values because of sudden city growth; congestion of population; and a generally rising standard of comfort, with the additional facilities provided by the coincident development of plumbing, lighting systems, etc. Up to the middle years of the 19th century the house of western civilization had been but a development in a direct line going back to the 12th century. After the industrial revolution ideals and aims were totally different. In general, the area for each family diminished, while the number and differentiation of rooms increased. An inevitable result was the complete alteration of the appearance of modern cities because apartment or tenement dwellings, to a large extent, replaced the individual house. Equally significant was the development of suburbs.

In the design of houses, as well as in the industrial housing surrounding many factories and in the larger country houses of the more well-to-do, there was a general advance. Waste spaces were reduced, and the problem of furnishing adequate communi-

cation uhile at the same time preserving privacy was to a great extent solved. Moreover, the service arrangements were simplified and perfected so that every possible waste of time might be avoided in serving meals or caring for the house. The lack of an inhibiting tradition in much of the United States remarkably aided this development; and, more and more, such originally U.S. ideas as a multiplicity of bathrooms, the use of a central heating system and the evolution of space-saving kitchens and kitchenettes appeared in newer houses in all parts of the world. In the absence of any standardization of architectural treatment, however, a chaos of varying styles was evidenced.

See also APARTMENT HOUSE: ARCHITECTURE; ATRIUM; DWELLINGS. PRIMITIVE; HALL; HOUSE DESIGN; RESIDENTIAL ARCHITECTURE; and the various articles on the history of architecture, described under the heading ARCHITECTURE (ARTICLES ON).

(T. F. H.; X.)

HOUSEBOAT. In its simplest form a houseboat consists of a cabin of one or two rooms built on a flat-bottomed scow, drawing only from 12 to 24 in. of water and usually with a platform or porch at either end. In the eastern hemisphere, the houseboat is an established institution as the residence for a number of inhabitants, because of overcrowding. In the west such boats are found in great numbers on small rivers or streams, especially where there is good fishing and shooting, on the shallow waters of inland lakes and on the numerous harbours along the coasts. When used as summer homes, houseboats have been developed into quite elaborate craft, having four or more rooms, with a broad porch or veranda on top protected by awnings, the hull construction still retaining the characteristics of a flat-bottomed scow, having great stability. In this form the boats have no motive power and have to be towed from place to place when it is desired to change their position.

With the introduction of the internal-combustion engine, power houseboats were developed and became popular because they could be moved from place to place easily and combined the 'roominess and comfort of the houseboat with the convenience of the power cruiser.

They are for the most part screw-driven and range in length from 45 ft. to 100 ft. or more. Being of shallow draft, they have living quarters in the superstructure, with large windows giving plenty of light and ventilation; they also have broad decks, making ideal summer homes.

In the United States many of these power houseboats are used in northern waters during the summer months and taken south under their own power, to be used in Florida or along the Gulf coast during the winter months. (H. L. ST.)

HOUSE DESIGN, in this article, refers to the process through which a single-family dwelling is planned and built. Information about the fundamental principles of building will be found in ARCHITECTCRE. The reader will also find relevant information in INTERIOR DECORATION and LANDSCAPE ARCHITECTURE.

GENERAL CONSIDERATIONS

The Site.—A house must be attached to a piece of land, and the decision as to which piece of land is as important as the design of the house itself. The design of the house can only determine the environment within the house walls: the environment outside the walls is determined by the neighbourhood. A family about to build or buy a house will want to evaluate both the present and the future character of the neighbourhood. The relation of the neighbourhood to other parts of the city is an important consideration. The orderly and controlled development of residential building may be greatly influenced by zoning and planning regulations; their absence should be regarded as a danger signal. Regulations will have a great effect on the surrounding neighbourhood, as well as on the particular house to be built. Schools, churches, paved roads and highways are obviously of fundamental importance. Water, electricity and sewage disposal should be available at the house site; long connections may be subject to future assessments. Local government and fire and police protection affect the value of property. Taxes should be examined and the probable annual tax bill estimated.

In evaluating the particular piece of land to be built on, soil conditions are important. Building lots with rock or water below grade can cause additional expense and hardship in a building operation. Subsurface conditions can be determined by investigating neighbouring building operations. If there is a water problem, the possibility of economical drainage by gravity should be considered. Clay- and water-bearing shale which hold water instead of carrying it off are potential hazards. If there is rock below grade, money may be saved by shifting the position of the house on the site or by reducing the size of a cellar. Soil conditions must be known before the house is designed to avoid unexpected expenses. If there is any question about subsurface conditions, test pits should be dug or borings made; their cost is not great and may be recovered many times over.

The character of the site will in part determine whether a cellar should be built. Cellars have been prevalent in northern climates and were virtually a necessity when gravity heating was used. However, the storage space in a cellar can usually be more advantageously placed above grade. There is little reason for building a cellar today, unless the site makes it easy.

An accurate survey of the property is essential for legal purposes, for the design and for construction operations. The survey forms an important adjunct to the deed. It should be made by a legally recognized surveyor. If there is any easement (*q.v.*) on the property it should be noted. For example, an easement may have been granted to an electric light company to string power lines over the property, and a house would have to be built so as not to interfere with them. Another example is that known as ancient lights (*q.v.*) in England, involving rights to natural light. Some New England farms have easements for roads over which wood from back lots was carried.

If the house site is at all irregular in surface the survey should indicate the differences in level. Levels are measured at regularly spaced points over the property; the points are plotted and those of identical height are connected with contour lines. Differences in ground level can be deceptive to the eye. On simple sites a few readings with an eye level will suffice, but it is important to know exactly what slopes there are on the property. A well-designed house will belong to the land; by working with natural contours the architect can build a house of character and distinction. An irregular site can insure an interesting design; changing the particular characteristics of a site often results in banality and stiffness. Economy is another welcome result of taking advantage of the inherent possibilities of the site.

The Program.—Before the site is selected, and certainly before any active design work proceeds, a program should be drawn up of the particular requirements and tastes of the family who will occupy the house. Even within one locale there are wide differences of income, family size and way of life. A designer must understand the needs and preferences of a family before he can explore ways of satisfying them.

The program starts with a statement of space needed and funds available. These two factors often conflict, but they should be clearly stated. The space needed, especially the number of bedrooms, will relate directly to the number of members of the family, but, in large part, size will be determined by amenities. Therefore, the way of life should be analyzed and set down; it may have been largely unconscious until the writing of the program.

The program should state the members of the family, how they live, and how they expect to live. Children grow up and parents develop new interests, but houses are made of rather unyielding materials. Families differ in the degree of formality with which they live; tastes vary widely. These should be stated. The program for the house will almost invariably need disciplining, a necessary step when ideas are translated into bricks and mortar. But it is well in writing a program to start with ideal objectives; some are bound to come through and add distinction to the final results. The program will have to state whether the living room is to include dining space; the kitchen must be characterized and needed equipment listed. Number and sizes of bedrooms, closets, baths, storage spaces, and special spaces for family vocations and avoca-

tions should be listed.

There will be elements in the program which will not have to be listed since they are common to well-designed houses in a particular area. Local climatic conditions have considerable influence on design, as do availability of materials and craftsmen. These are important parts of the program, though they do not have to be spelled out in each case. A well-thought-out program will help produce satisfactory results as much as the careful selection of the site. Both are necessary before the house can be planned.

Planning. — It is well to work with floor plans before turning to such photogenic architectural details as doorways. porches and fireplaces. A well-organized plan can result in satisfactory appearance as well as efficient use. Although there are many books and magazines full of house plans, there never has been a perfect one. But good plans result from careful study of various solutions to a clear program; with study, the preferred solution emerges.

The great change that has taken place in house planning during the 20th century is in the openness of the plan. Small northern European or New England houses of traditional style were compact; they had an inward look and the rooms were distinctly separate. The contemporary house throughout the world is more loosely articulated; interior spaces open into one another. A distinct outward look is obtained through the use of larger areas of glass between indoor and outdoor living spaces. With houses of modest size simple, economical forms such as rectangles are still used. But however small the units. the contemporary trend is expressed by joining the living and dining areas into a single space or by relating the kitchen and dining areas.

There are two important factors in considering the size of interior spaces. A space has to be large enough for use; a well-designed room will take furniture well and allow for movement. If linear dimensions of walls are kept to multiples of four-foot units. there are some savings on construction where modular building materials are used. Experience and ingenuity in planning are required if floor areas are to be kept within reason; the interior of a trailer is perhaps the ultimate in space planning. The second requirement of living spaces is that they be visually satisfying. It has become increasingly important as rooms have become smaller that they appear as spacious as possible. Economic pressures, the trend toward built-in iurniture and the transposition of many activities from the home to automobiles or public places have contributed to the reduction in room size. Living rooms, for example, on utilitarian grounds now need to be only a fraction of the size that was considered a decent minimum at the beginning of the 20th century. But contents that are adequate for use can leave our visual needs unsatisfied. Screen walls that let the surfaces of ceiling and floor run visually uninterrupted do much to capture within limited volume the satisfaction of adequate space. Interior spaces. though densely planned and compact. are further enhanced visually by running the line of vision through glass-wall areas, reaching from floor to ceiling into the garden. Rooms should be both efficient and visually satisfying; the openness of contemporary planning is a tool for the accomplishment of both.

Kitchen planning has received much attention in the U.S. The kitchen has changed from an ample ice box inconveniently disposed. to a streamlined galaxy of gadgetry; the housewife has been studied thoroughly, and every conceivable labour-saving device has been offered her. There is little to do in planning this portion of the house except to evaluate what is offered and decide how much is wanted.

Templates of furniture, cut to scale and manipulated on proposed floor plans. are very useful. Beds should be free of windows and doors, and with room around three sides for the daily round of bed making. The extent of built-in cabinets must be determined. Drawers and shelves can oiten be concealed behind walls, freeing valuable floor space. Circulation spaces such as halls, vestibules and corridors can be kept at a minimum through a careful study of relationships. Living and circulation space should be distinctly separated. The area around a fireplace should be kept clear of passageways; doors should be located so as not to encourage traffic through spaces furnished for sitting, conversation or quiet.

The site must be studied and determined in conjunction with the planning of the house proper. Topography, garden location, outlook from windows and the points of the compass are important factors in the design of the house. Zoning regulations may limit the percentage of the lot to be built on and may state minimum setbacks from property lines.

Throughout the planning process, projection of floor plans into the third dimension will be desirable. Often a simple model will be of value, built of cardboard or plasticine. The design process consists of continual adjustments made during the various stages.

Finally, it is important that the best professional advice be sought in the design and construction of the house. The cost of such service. when competently given, can be recovered several times over in reduced construction costs, and greater satisfaction results from the use of a well-designed house.

Appearance. — Most people start thinking about a house with a definite picture in mind, and the purpose of the design process is to arrive at a house that properly reflects the dweller's likes and dislikes. Houses in a specific historical style such as Georgian or Tudor are seldom designed today. The character of the present time is achieved by using the past for inspiration rather than imitation.

Proportion. material and colour are the fundamental factors in appearance, good or bad. The over-all proportions of the house are naturally related to room dimensions and ceiling heights. There are no universally accepted formulas for these relationships. Dimensions for projected rooms should be compared with existing rooms whose measurements are known and whose visual impact can be observed. Interiors are most satisfactory when spaces are clear and simple. Too many corners indicate bad planning and result in visual confusion and increased cost. There is a constant relationship between a clear program, clean planning. aesthetic satisfaction and financial economy.

Small rooms can be made to appear larger by a number of devices. Properly scaled furniture and not too much of it. placed in a room designed with the furniture in mind, is the best way of achieving this effect. With open planning and the use of screen walls. rather than solid walls with doors. the eye can look beyond the limits of the immediate room; visual awareness of adjoining spaces gives a feeling of increased space.

Colour selection is important, not only for its own effect. but also for its effect on space. Colour is greatly affected by both form and lighting. The same pigment will look different on a wall opposite a strong light such as comes from a large window, than on a wall in shade. Colour has an important effect on apparent size. In general we can say that light, cool colours enhance apparent size, and strong, warm colours reduce it.

If the earlier planning stages in house design have been logically and carefully undertaken, the house will tend naturally and easily toward good appearance. Unfortunately, this tendency is not quite automatic and there is a constant need for modification until satisfactory appearance is attained. The mass of the house and its component spaces should be pleasing. The over-all impression is greatly affected by the relationship of the heights of walls to each other and to their lengths. Also rooi pitches and projections. such as porches or sun shades, greatly affect the appearance of the mass.

The placing and sizing of openings is another critical consideration. The windows and doors must look well from the interior as well as irom the exterior. Satisfactory functioning is also involved; windows must be sized and located for the best possible lighting and ventilation, and to provide good wall space for furniture. The pattern of light and shade created on the interior is of obvious importance. Size, shape and character are dependent on climate, orientation and structure.

In a world where news flashes almost instantly around the world, we are quickly aware of what is being built everywhere, and there is a constant urge to copy what we like, too often without understanding it. The special qualities that are indigenous to particular regions are lost in this way. Local materials, local customs and local climates are factors that add distinction to houses. Indigenous materials such as stone or lumber that are quarried or cut in the vicinity add a special quality, particularly when they have had the

refining influence of long tradition. The architectural expression of a way of life in California or New Mexico properly characterized as a ranch house is anomalous when built in a New England village nhich has its own tradition. Climates vary enormously throughout Europe and throughout the United States; a large glass area that is reasonable in the northern latitudes will tend to turn a house into an oven if used on the west side of a house in a southern area.

Details should be consistent in scale. Too many materials on one house should be avoided: this admonition applies also to colours. Simplicity is important: emphasis of detail should be concentrated. Chimneys usually are made larger for visual reasons than they need be. In the last analysis, appearance is a product of taste. In building, good appearance comes from good taste that is trained and disciplined.

Estimating — Unlessthere is a constant and clear understanding of what designs under consideration may cost, a great deal of time and study can be wasted. It is important that there be an early and continuing consideration of this factor.

As a rule of thumb. a unit cost per cubic foot can be assumed and then multiplied by the cubic contents of the projected house in its various design stages. Such unit costs are available as a result of local experience. With the tendency to reduce or eliminate cellars and attics, it can be understood that a cubic figure unit becomes less valid. By changing from a pitched to a flat roof and thereby eliminating a large attic. the cubic contents of a house would be materially reduced. while the cost of the house, which would still have the same amount of living space, would not be proportionately changed.

A better method is to estimate on the basis of floor space. with a unit price per square foot. This method probably comes closer to reality. since floor space is what has most value. A price per square foot will vary with quality of construction. type of design and locale, but it is generally available as a yardstick in most communities where building goes on. It may be well to use it for the house proper and to add lump sums for elements such as garages and porches. As the design becomes more precise, so can estimates; a firm price or controlling estimate may be secured before construction.

To the estimated cost of construction of the house, allowances are added for cost of land, utilities. legal fees, cost of financing and architect's fee. Landscaping and finished grading have to be provided for as do any other special requirements.

Financing. — A house usually represents the greatest capital expenditure that a family ever makes and it is customarily paid for in major part through mortgage loans. A useful and comparatively simple home mortgage finance structure has been established in the U.S., largely through the operations of the Federal Housing administration. The FHA was established as an agency of the federal government to insure mortgage loans made by lending institutions such as banks. insurance companies, and building and loan associations. It also establishes standards and supervises the quality, location and marketability of houses on which insured loans are made.

The general practice on mortgage loans, whether FHA insured or not, is to limit financing to a single loan, not exceeding a maximum percentage of the value of property. Monthly payments. within the capacity of the family's income, are mandatory regularly over a period of years. The provisions are sound for the borrower as well as the lender. In order to equalize the payments over the time of the mortgage, the amount of each payment for the repayment of the loan is less during the earlier stages while interest is high, but it becomes greater as interest payments decrease on the diminishing balance.

The cost of the house during the amortization period, sometimes called a rental equivalent, includes interest and amortization of the mortgage. taxes, insurance, maintenance and repairs. It is generally accepted as sound principle that the total of these charges should not exceed one quarter, or preferably one fifth. of the family income. Another rule of thumb for use in preliminary budgeting is that the cost of the house, including land and all other capital charges, should not exceed much more than twice the annual income of the family. This is a flexible rule, due to variations in interest rates, amortization periods and construction costs.

The development of house design has been discussed primarily from the point of view of a family building its own house, but the statements also apply to the development builder who is designing houses to sell or to rent. It is not always wise or expedient for a family to build or to own a house, and in many instances rental will be preferable. Furthermore. there are desirable types of housing other than single-family residences, such as attached row houses. garden apartments and multistory apartment buildings, Similar principles of good design procedure apply to all these.

Professional Services. — The design and construction of houses is an intricate process requiring competent professional advice. Most countries and all the states in the United States have laws licensing and regulating the practice of architecture. It is often very difficult to apply the professional services of the architect to a single small house. This can be indirectly done through the development builder who is able to portion the time and cost of architectural services to a number of houses which are sold or rented individually. Often the services of an architect can be made available for the builder of a single small house on a limited basis. But whatever the procedure. the design of a house is a science and an art. It requires practical experience, technological understanding and visual sensibility.

STRUCTURAL ELEMENTS

Materials. — Technology has produced a multitude of building materials that were unknonn only a few decades ago. The home builder is deluged with a wealth of choices for almost every element of the building.

The structure of the house is not a complicated engineering problem. Loads are modest, spans are seldom great and two or three stories is the limit for height except for apartments. Bearing walls of masonry. such as brick, stone or concrete block, and framed walls of studs. usually of lumber but sometimes of steel, are the two basic alternatives.

Masonry walls are economical where the materials are indigenous. since they are too heavy to ship long distances. In northern or wet climates they should be furred between masonry wall and interior finish to prevent passage of dampness. Stone requires the greatest amount of labour. Brick can look well painted; concrete block needs to be well made and carefully laid. Masonry bearing walls are the almost universal method in Europe and Latin America and are widely used in the U.S.

The development in the U.S. of the balloon and platform type of lumber frames followed the earlier post and lintel construction used by the settlers. Frame construction is remarkably strong. Lumber of a nominal two-inch thickness (actually finished to one and five-eighths inches) and a nominal width of four inches is usually used for studs, and a depth from six to twelve inches for floor joists and roof rafters. The basic module for spacing is usually sixteen inches. At all framing points it is important to have an equal depth of wood at right angles to the grain. since wood does shrink in that direction and shrinkage can cause uneven settlement, cracks in walls and bumps in floors. The frame was traditionally sheathed on the outside with one-inch boards and plastered on the inside. There are now various sheet materials to take the place of sheathing and plaster. (See CARPENTRY.)

Gypsum, which is used in plaster. is made into paper-faced sheets of gypsum board. usually four feet wide and at least eight feet long. By masking the recessed joints with tape and filler, a dry wall interior finish that is economical and satisfactory is obtained. The elimination of the great quantities of water needed for plaster, together with the saving of labour and time: has led to wide use of this and other dry sheet materials such as plywood for interior finish.

Plywood (*q.v.*), made from wood veneers glued together with the grain alternately at right angles, is strong and durable. Considerable structural strength in relation to weight is characteristic of plywood made from Douglas fir, and considerable beauty can be obtained with the use of a variety of woods. Plywood finishes in-

clude exotic grains from the far east, hardwoods such as oak and walnut from Europe and the Appalachian regions in the U.S. and mahogany from Central America.

Gypsum board can be waterproofed and used for exterior sheathing. as can plywood. Plywood for exterior finish is made with waterproof glues. Boards of cellular fibres pressed into rigid sheets have structural value for wall sheathing and interior finish, as well as insulation value against heat transmission.

Wood flooring is available in oak and other traditional hardwoods, in addition to composition floor materials, including rubber tile, asphalt tile. cork composition and linoleum. Ceramic tile is available for floors and walls. Sheets of synthetic resins (plastics), having various properties, are available for floors and walls, as well as for counter tops and trim.

For exterior finish, brick veneer over wood framing is highly satisfactory, sometimes giving better insulating value and weather protection than solid brick masonry. Wood clapboards and shingles, flush boarding and asbestos siding are other possibilities. Asbestos siding is made of lapped strips of asbestos cement board, which is also available in large sheets. This fire resistant material is made of portland cement reinforced with asbestos fibres. There is also a process by which wood is ground and pressed into a hard board of good finish and strength. A variety of sheet materials of good properties have been made from waste wood products.

Roofing materials include the traditional wood shingles, slate and tile, as well as the newer asphalt and asbestos shingles. Asphalt shingles are made of asphalt impregnated felt, surfaced with slate or ceramic granules to give colour and protection. Aluminum, copper, stainless steel and galvanized steel are available for roofs as well as for leaders, gutters and flashings. For roofs that are flat, or practically so, built-up layers of felt in asphalt or tar, surfaced with gravel, are the standard. Walking surfaces of tile are available.

The trend in building materials is toward larger, lighter and stronger building units which can be efficiently assembled at the job site. Building units the size of bricks are being supplanted by building units the size of wall board.

Factory Fabrication. — The building industry was traditionally one of handicraft operations. Technological change has not been swift in comparison with many manufacturing industries, but it has been steady. Craft operations at the building site are being replaced by mechanized operations at the factory. and houses are increasingly becoming assemblages of factory-made elements. Windows and doors, once made and fitted by carpenters at the site, now arrive from a factory, fitted and finished with hardware and glass, ready to be set in place.

Modular design (*i.e.*, design in which the elements are dimensioned in combinations of a fixed unit) has led to standardization of elements, interchangeability of parts and increased possibilities for mass production, with resultant economies. A wide variety of mass-produced elements from which substantial portions of the house can be assembled are now available. Examples are kitchen cabinets and mechanical equipment and window and door units. Entire house assemblages are available from manufacturers and are being used to an increasing extent.

Doors and Windows. — Flush doors of plywood veneers are gradually replacing the older paneled doors. A sliding door eliminates the floor area necessary for the swing of a hinged door. Glazed double doors can be used effectively for wide exterior openings; glazed sliding or folding exterior doors are often desirable in joining interior to exterior living space. Since correlation with hardware is important for smooth operation, these units are usually factory assembled. (See DOOR.)

The traditional types of window are double hung and casement. Originally made in wood, they are now also in various metals. The double-hung window is economical, easy to operate and excellent for use in wood-framed houses, since it adjusts itself to shifts in the house due to lumber shrinkage. To insure easy raising and lowering of sash, good hardware is important. Double-hung windows are easily screened.

The casement sash has the advantage of providing a complete opening, but it is more likely to warp if made of wood. Therefore it is usually made of metals which do not warp if properly treated. Steel sashes finished for long life without painting. and aluminum alloy sashes are widely used. Casement sashes are more easily made weathertight if they swing outward, but this requires inside screening, with under-screen operators.

In addition to double-hung and casement windows, there are top-pivoted sash windows, which have the advantage of shedding the rain when open. They are made in groups with a common operator. Sashes that are centrally pivoted, either horizontally or vertically, are available, but offer screening problems. Sliding sash windows are simple to operate, particularly when made in metal. *(See* WINDOW.)

Window screens are made of copper, aluminum, stainless steel, plastics and galvanized steel. They can be replaced during the winter with prefitted storm sash.

It is well to watch thickness of glass in relation to size when installing large areas of fixed glass. Various types of double glazing with an air space between help to reduce heat losses. Consideration should be given to both outlook and to orientation. The picture window is of doubtful visual value when facing the neighbour's clothesline, and it can act as a heat trap in summer if placed, for example, on a west wall.

Considerable information is available about the relationship of house design to climate. Houses are, in one sense, filters between human beings and climate. The design of a house should be such as to take advantage of some climatic impacts such as the heat of the sun on a cold day or a prevailing breeze in hot weather. On the other hand, during hot weather it is desirable to keep the sun off glass areas. This can be accomplished by orienting the house properly in relation to latitude, by placing glass areas on walls which the sun does not reach until low, and by using various shading devices. A canvas awning is an obvious shading device, but projections can be built as projecting cornices or porch roofs.

Since the angle of the sun's rays to the earth is greater in summer than in winter, houses can be designed to shade glass areas when the sun is high in warm weather and to let in the lower winter sun. The maximum benefit from sun and wind can be derived from proper design. The design of a house in Massachusetts will, of course, be quite different from that in Florida, in shape and orientation and in the size and location of openings. Working with natural forces substantially reduces heating bills in the north and the cost of air conditioning in the south. *See* ORIENTATION.

Heating and Air Conditioning. — Man is usually most comfortable when the air about him has a temperature of 70° F. and a relative humidity of 50%. To obtain this condition within a house is the purpose of heating equipment in cold weather and air-conditioning equipment in hot weather. A source of heat has to be provided, generally in the form of a furnace which burns either coal, oil or gas. It should be centrally located to minimize circulation runs. To distribute the heat from the furnace so as to balance temperatures throughout the house requires ducts or pipes. A simpler heat source is, of course, a stove or fireplace.

In a warm-air system the air is heated by passing over a heat chamber surrounding the burning fuel and carried through ducts to outlets in rooms. Warm air naturally tends to rise and if the furnace is below the outlets or registers, the circulation of air can work by gravity, a most dependable source of energy. This requires, however, ducts that are constantly rising and of considerable size. By forcing the air with an electrically driven blower, ducts can be reduced in size and more control gained over the system. Filters are installed in the duct system to eliminate dust, and the air can be humidified. In warm-air systems the heat is transmitted largely by convection.

Radiation is another method of heating. The sun heats by radiation and, in a lesser way, so does any object the sun has heated, such as a stone bench at noon. Hot-water or steam-heating systems utilize this principle; radiators are usually placed under cold glass areas and hot water or steam is piped to them from the furnace. A steam system maintains a temperature high enough to change water into steam. The steam enters the radiators where it cools while giving off heat and returns to the furnace as water to repeat

the cycle. A hot-water system operates at a lower temperature; hence it is an easier, more pleasant heat than steam, but it requires larger radiators. If the water can be pumped, higher temperatures are possible, with quicker response, and pipes may be inclined downward.

Radiators heat by convection as well as radiation, since air passes over the radiators and circulates in a warmer state. Radiators can take the form of continuous elements between walls and floor (baseboard radiation). While radiators usually are made of a heavy, heat-holding material such as cast iron, the steam or hot water may be passed through elements with copper fins, known as convectors. The fins accelerate the emission of heat, largely through the movement of air across them. Convector type radiation equipment can be recessed in the wall in less space than cast iron radiators.

It is widely held that a true radiant heating system is the most satisfactory physiologically, resembling as it does the action of the sun. It is accomplished by circulating hot water through heating pipes embedded in floors, walls or ceilings, thus heating large surfaces to relatively low temperatures. The large surfaces emit heat gently in contrast with the more intensive. concentrated sources of other systems. Radiant heat makes possible a lower air temperature without discomfort.

Radiant heating was used by the Romans in their baths, with warm air in floor cavities as the heating agent. It has been used in England for many years. Its possibilities are now enhanced because low-temperature hot water can be circulated by pumps, making for quicker response to temperature changes. Any one of the automatic heat sources can be used. Piping can be either iron, steel or copper. There are alternatives as to the location of the radiant surface. If the pipes are in the floor, a concrete slab on grade acts as a substantial, heat-holding agent. It is important that the slab be insulated from the ground around the perimeter. An advantage of pipes in the ceiling is that they permit higher temperatures, and therefore quicker responses. Reflective insulation, such as aluminum foil, should be placed over the ceiling pipes. Where there are large glass areas, auxiliary pipes in nalls are sometimes necessary. *(See* HEATING AND VENTILATION.)

The cooling of houses in warm climates can be greatly simplified by proper design. Where mechanical means are used, the choice lies between a central system with ducts and separate wall units. If a warm-air heating system has been installed the ducts can be used for cooling. A central unit can be conveniently installed in an attic. *(See* AIR CONDITIONING.)

Proper insulation of a house adds greatly to comfort and reduces fuel bills. The roof is probably the most important place for insulation. Double glazing of windows, most economically through storm sash, is desirable in cold climates. A warm floor is essential to comfort. Rigid insulation board can serve both as structure and insulation. Loose insulation is formed of rock wool, glass fibres, wood fibres or other porous combinations. It is vital that such insulations have vapor seals on the warm side, since the vapour in warm air condenses when it reaches a cooler point inside the insulation. This renders the insulation ineffective, and the moisture has a detrimental effect on structure and finish. Reflective insulations, such as aluminum foil, are efficient and act as vapour barriers themselves. (See INSULATING MATERIALS.)

Fireplaces. — The fireplace was an important element of early houses that has survived in all forms of modern ,planning. Although inefficient in its heat output, it is a symbol that has a remarkably strong power. It is usually placed along one wall of a room, but it can also be located between two spaces, opening on both sides, or even in the centre of a room. Great care should be given to adequate chimneys since flue sizes should bear a definite relationship to the size of fireplace openings to provide good draft.

Plumbing. — The kitchen and bathroom should be located as close as possible to each other in order to economize on supply and waste lines. Code requirements will set the standards in most communities. If the house is built outside any such jurisdiction it is well to follow the code of a nearby town or city. Venting is important. Care should be taken to avoid back syphonage when a supply faucet contacts waste material in a basin or tub. The service line from the street, of generous size, should be placed below the frost line in cold localities. It is well to know the degree of hardness and acidity of the local water. If unusually hard, allowance should be made for some future constriction from calcium deposits within pipes. Water-softening devices can control this.

Supply lines to and within the house are generally of copper tubing. There may be local conditions which would indicate other materials. Waste lines have generally been made of galvanized steel and iron, with heavier lines of cast iron. Copper is used because it can be shop fabricated and it takes up less room in walls and floors than cast iron, which has projecting hubs and must be caulked and soldered on the job.

Great technological advances have been made in plumbing. There is no valid objection to standardization in the design and arrangement of the three basic bathroom fixtures. Much progress has been made with respect to standardization and production of the elements of kitchen equipment. The same principles are being applied to factory fabrication and assemblage of supply and waste connections. *(See* PLUMBING.)

Electricity. — The electric load of most houses has increased enormously as standards of lighting rose and mechanical and household equipment multiplied. Wiring can soon become obsolete so it is well to provide for future increase of electric load. The power should come into the house at a convenient but inconspicuous point where the meter is installed. From the entry switch and panel box a network of wiring leads to the fixtures and equipment. The wiring is occasionally run in rigid conduit, but more often consists of steel-armoured or plastic-covered cable.

The network of wiring throughout the house is divided into circuits, each of which is connected to the panel box. which in turn is tied to the service line from the power main in the street. The panel box has circuit breakers which shut off power to any line which is overloaded or develops trouble. It is important to provide plenty of convenient outlets throughout the house into which lamps and electric appliances can be plugged. There should not be too many outlets to a circuit, to avoid overloading, but outlets should be available at all wall spaces where they might be needed. A tangle of extension cords is hazardous.

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HOUSEFLY *(Musca domestica)*, a two-winged insect belonging to the family Muscidae of the order Diptera *(q.v.)*, common in dwellings and practically cosmopolitan, being found wherever man has established himself. It is most abundant during the hotter parts of the year, and in Europe and North America attains its greatest numbers from July to September. Its chief breeding place is in accumulations of horse manure, but it also utilizes various kinds of fermenting animal and vegetable matter, including the contents of ash bins, etc., where the eggs are laid and the larval life is passed.

A single female usually lays 600–1,000 eggs in her lifetime. The cycle, from egg to fly, varies in different parts of the world with temperature and other factors.

In cold regions the flies disappear during the winter although a few may survive in heated buildings. The housefly is of extreme importance in human welfare since it may be a carrier of typhoid fever, dysentery, cholera, yaws, anthrax, some forms of conjunctivitis and possibly jaundice. During wars preceding World War I (1914–18), more troops died of fly-borne diseases than from wounds, but proper sanitary practices have greatly reduced the menace.

The reduction in the number of horses in cities and towns and frequent disposal of garbage contribute to the reduction in the number of houseflies, but they remain a menace in rural areas. In manure the larvae can be killed by spraying it occasionally with 1 lb. of hellebore to 20 gal. of water, using 1 gal. per cubic foot, or by dusting powdered borax at the rate of 1 lb. per 16 cu.ft.; but this latter treatment must not be repeated. Garbage should be disposed of at least twice a week. Flies inside buildings may be destroyed by sprays containing rotenone or pyrethrum.

A spray of DDT (2,2-bis[parachlorophenol] 1,1,1-trichloroethane) in oil on walls and screens kills flies for many weeks.

More than 50 species of *Musca* are known from various parts of the world, most of them having habits similar to *M. domestica; M. vicina* is a tropical representative of *domestica,* differing in having the front of the male a little narrower; *M. sorbens* or *nebulo* is common in Africa, the orient and on the Pacific islands; *M. vetustissima* is the commonest Australian species.

The related *Muscina stabulans* is almost cosmopolitan and sometimes enters houses; its larva is found in decaying vegetation, and is probably predaceous; it has been reared from larvae of the American tent caterpillar and may be important in its control.

The related M. *assimilis* is known as the squash root maggot in Europe.

The biting housefly, or stable fly, *Stomoxys calcitrans,* is a serious pest in rural districts and on beaches; it inflicts a very painful bite and is most persistent. It may play a part in the transmission of poliomyelitis.

The larvae live in decaying vegetation, particularly straw and piles of weeds, and in manure in which an abundance of straw is present. It is more robust than the housefly and can be recognized by its long, shining proboscis.

The horn fly: *Haematobia stimulans,* is so named because of its habit of feeding in large numbers near the base of the horns of cattle; it is smaller than the stable fly, and the palpi are elongate.

See C. G. Hewitt, *The House-Fly* (1914); *W.* B. Herms, *Medical Entomology* (1939). (C. H. CN.)

HOUSEHOLD, THE ROYAL, or CURIA REGIS. In all the mediaeval monarchies of western Europe the general system of government sprang from, and centred in, the royal household. The sovereign's domestics were his officers of state, and the leading dignitaries of the palace were the principal administrators of the kingdom. The royal household itself had, in its turn, grown out of an earlier and more primitive institution. It took its rise in the *comitatus* described by Tacitus, the chosen band of *comites,* or companions, who, when the Roman historian wrote, constituted the personal following, in peace as well as in war, of the Teutonic chieftain. In England before the Conquest the *comitatus* had developed or degenerated into the thegnhood, and among the most eminent and powerful of the king's thegns were his dishthegn, his bowerthegn and his horsethegn, or staller. In Normandy at the time of the Conquest a similar arrangement, imitated from the French court, had long been established; and the Norman dukes, like their overlords, the kings of France, had their seneschals, or stewards, their chamberlains and their constables.

After the Conquest the ducal household of Normandy was reproduced in the royal household of England; and since, in obedience to the spirit of feudalism, the great offices of the first had been made hereditary, the great offices of the second were made hereditary also, and were thenceforth held by the grantees and their descendants as grand-serjeanties of the crown. The consequence was that they passed out of immediate relation to the practical conduct of affairs either in both state and court or in one or the other of them.

The steward and chamberlain of England were superseded in their political functions by the justiciar and treasurer of England, and in their domestic functions by the steward and chamberlain of the household. The marshal of England took the place of the constable of England in the royal palace, and was associated with him in the command of the royal armies. In due course, however, the marshalship as well as the constableship became hereditary, and, although the constable and marshal of England retained their military authority until a comparatively late period, the duties they had successively performed about the palace had been long before transferred to the master of the horse.

In these circumstances the holders of the original great offices of state and the household ceased to attend the court except on occasions of extraordinary ceremony, and their representatives either by inheritance or by special appointment have ever since continued to appear at coronations and some other public solemnities, such as the opening of parliament or trials by the house of lords.

The materials available for a history of the English royal household are somewhat scanty and obscure. The earliest record relating to it is of the reign of Henry II and is contained in the *Black Book of the Exchequer.* It enumerates the various inmates of the king's palace and the daily allowances made to them at the period at which it was compiled. Hence, it affords valuable evidence of the antiquity and relative importance of the court offices to which it refers, notwithstanding that it is silent as to the functions and formal subordination of the persons who filled them. In addition to this record we have a series of far later, but for the most part equally meagre, documents bearing more or less directly on the constitution of the royal household, and extending, with long intervals, from the reign of Edward III to the reign of William and Mary. Among them, however, are what are known as the *Black Book of the Household* and the *Statutes of Eltham,* the first compiled in the reign of Edward IV and the second in the reign of Henry VIII, from which a good deal of detailed information may be gathered concerning the arrangements of the court in the 15th and 16th centuries.

The *Statutes of Eltham* were meant for the practical guidance merely of those who were responsible for the good order and the sufficient supply of the sovereign's household at the time they were issued.

But the *Black Book of the Household,* besides being a sort of treatise on princely magnificence generally, professes to be based on the regulations established for the governance of the court by Edward III, who, it affirms, was "the first setter of certeynties among his domesticall meyne, upon a grounded rule" and whose palace it describes as "the house of very policie and flowre of England"; and it may therefore possibly, and even probably, take us back to a period much more remote than that at which it was actually put together. Various orders, returns and accounts of the reigns of Elizabeth, James I, Charles I, Charles II and William and Mary throw considerable light on the organization of particular sections of the royal household in times nearer to our own.

Moreover, there were several parliamentary inquiries into the expenses of the royal household in connection with the settlement or reform of the civil list during the reigns of George III, George IV and William IV.

But they add little or nothing to our knowledge of the subject in what was then its historical, as distinguished from its contemporary, aspects. So much, indeed, is this the case that, on the accession of Queen Victoria, Edward Chamberlayne's *Present State of England,* which contains a catalogue of the officials at the court of Queen Anne, was described by Lord Melbourne, the prime minister, as the "only authority" which the advisers of the crown could find for their assistance in determining the appropriate constitution and dimensions of the domestic establishment of a queen regnant.

The royal household of modem times is a modification of its mediaeval prototype; even Burke's act of 1782 did not destroy continuity.

Two of the three chief departments, the lord chamberlain's and the lord steward's, are direct links with the past. while the third, that of the master of the horse, claims importance from Tudor days and descent from a mediaeval minor office.

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HOUSEHOLD APPLIANCES: *see* HOME EQUIPMENT.

HOUSEHOLD TROOPS: *see* GUARDS AND HOUSEHOLD TROOPS.

HOUSEKEEPING. The care and maintenance of a home includes: (1) providing sufficient and suitable food for all mem-

bers of the household; (2) care and cleaning of the house, its equipment and furnishings; (3) care and cleaning of the clothing of household members; (4) personal care of members of the family, including care of children and invalids; (5) responsibility for heating and lighting the house and sometimes for its repair; (6) control of household expenditures; (7) engaging and supervising household employees; (8) purchasing food. supplies, equipment, furnishings and clothing; (9) maintaining relations with other families and with organizations in the community; (10) taking part in and sponsoring such civic activities of the community as garbage disposal, water supply, good markets inspection street cleaning, smoke and dust elimination or any community housekeeping projects which have bearing on personal housekeeping problems; and (11) making suitable provision ior the comfort of family members and guests.

Housekeeping is one of the most comprehensive occupations that a woman can undertake. Few other careers demand a knowledge of such widely varied subjects. It is work of the highest order to manage a household methodically and efficiently. It takes the same sort of organizing ability and persistent effort which running any successful business does and should command equal respect whether the work is done by the housekeeper herself, with or without a salary, or by helpers whom she directs. Success in this work is important for all the family members and for the community as a whole.

The quality of the nation's housekeeping has great influence on the health, the morale and the general standard of living of all its people.

TIME AND WORK MANAGEMENT

The actual work of running the home should not consume so much of the housewife's time and energy that she has none left for anything else. Housework should be a means to an end, rather than an end in itself. To keep the housework in proper relation to other things, a plan is essential. It need not be a hard and fast schedule, but the housekeeper who gets the most out of the time and energy she puts into her housekeeping is bound to follow a well thought-out plan, one that is individual to her family and her home, its equipment and to her way of working. There is no cut-and-dried plan which will fit any two homes exactly. Just as the families, houses, localities and personal standards differ, so will the housekeeping and the plans for carrying it on. The homemaker must determine what the standards in the home shall be and how to attain them.

How to **Plan** Work.--Make a list of the tasks that must be done every day. Make a second list of the tasks that need doing once a week, noting special days if these are best done on a given day of the week. Make a third list of the tasks which need doing less often. Make out a chart with the days of the week listed across the top and the time or parts of the day listed at the left. Fill in this chart, first, with tasks from the daily list, in the order and at the time most convenient to do them, allowing some time for tasks from the other two lists. Next assign the weekly tasks to the proper day's schedule, and finally place the tasks from the less-often list on the chart. Try this plan out for a week or longer, at least until you have had a chance to become somewhat familiar with the routine. If work doesn't go well, it is then time to check over the schedule and made adjustments. Use the check list below to help find the trouble. It includes common errors in planning:

Too much crowded into one day.
Inefficient, hard-to-use tools such as dull knives, dented and burned pots and pans.
A too-low or too-high sink and work counters.
Unsuitable, inefficient methods of work and equipment.
Badly arranged kitchen.
Poor working light.
Heavy iurniture without casters, hard to move for cleaning.
Standards of housekeeping too high.
Too much time spent on a given job.

Skeleton Housework Schedules.—The tables below show forms for making work schedules for one and for two workers. There should be definite, separate schedules for each person having a part in the housework, covering whatever part of the day she works. It should be based on a careful division of work and responsibilities. Table I shows the method of setting up an entire week's work plan for one worker. Table II shows a form for a day's schedule for two workers. The actual time is not given in either. This will vary with the rising time, other family habits and the speed of the norkers. The order of work is more important than the actual hour, and it is often wiser to begin a work plan by lining up work in the order in which it should be done than by assigning actual time for work. Times can be added as the schedule progresses and the workers become accustomed to it. Chart I shows a concise form for recording a complete 24-hour schedule, with actual time used.

TABLE I.—Week's Schedule for One Worker*

Time	Monday	Tuesday	Wednesday	Thurs-day	Friday	Satur-day (4)
a	rearinga	s i n r e s t				
Forenoon	General pickup. Light clea	ning of rooms—	/	/	/	→
	(1) Washing if done at home; if not, send laundry out	Marketing (2) or iron-ing (3)	Specific jobs such as silver polishing, shopping, sewing or something to be carried on throughout the day	Thor-ough clean-ing of rooms	Thor-ough clean-ing of rooms Mar-keting (2)	Special food prepa-ration for neek end
Noon	Preparing foods for lunch and dinner. Lunch, dishes, cleaning up kitchen					→
Early after-noon (until 2)	Finish wash-ing (1)	Finish iron-ing (3) Put away ironing. Marketing (2) if not done in morning				
Late after-noon	Rest, relaxa-tion, corre-spondence, reading, personal care, etc. — Final din-ner prepara-tion					→
Evening	Washing dishes					→

*Adapted from *America's Housekeeping Book*, published by Charles Scribner's Sons.
(1) Many homemakers still prefer to wash on Monday; others find Tuesday more convenient; and some prefer to stretch the work over the entire week.
(2) The bulk of marketing should be done on a day when local stores offer special prices. Often Friday and Saturday are bargain days.
(3) If washing is done on Tuesday, ironing is put forward to Wednesday.
(4) Careful planning may keep Saturday free for recreation.

TABLE II.—Daily Schedule for Housewife and One Helper*

Monday

Time	Household Helper	Homemaker
8:00– 8:15	Prepares family breakfast.	
8:15– 8:30	Eats own breakfast	
8:30–11:30	Does washing Cleans laundry floor Assembles ironing equip-ment (such as ironer, ironing board) for afternoon use.	Washes breakfast dishes. Checks supplies. Makes beds. Does necessary light cleaning. Makes advance preparations for dinner. Prepares lunch.
11:30–12:00	Assists with lunch.	
12:00– 1:00	Eats own lunch and washes dishes	
1:00– 4:00	Irons clothes.	Answers doorbell and telephone.
4:00– 6:00	Rests and dresses for dinner.	Prepares dinner.
6:00– 6:30	Sets table and finishes with din-ner preparations.	
6:30– 7:45	Serves dinner, eats own dinner and washes dishes.	

*Adapted from: Edith M. Barber's *Speaking of Servants*, published by McGraw-Hill Co., Inc.

Time Required for Housekeeping.—The time housekeeping requires varies in different homes. It is influenced by size of family, ages and health of family members, kind of house and its equipment and furnishings, the climate and seasons, amount of

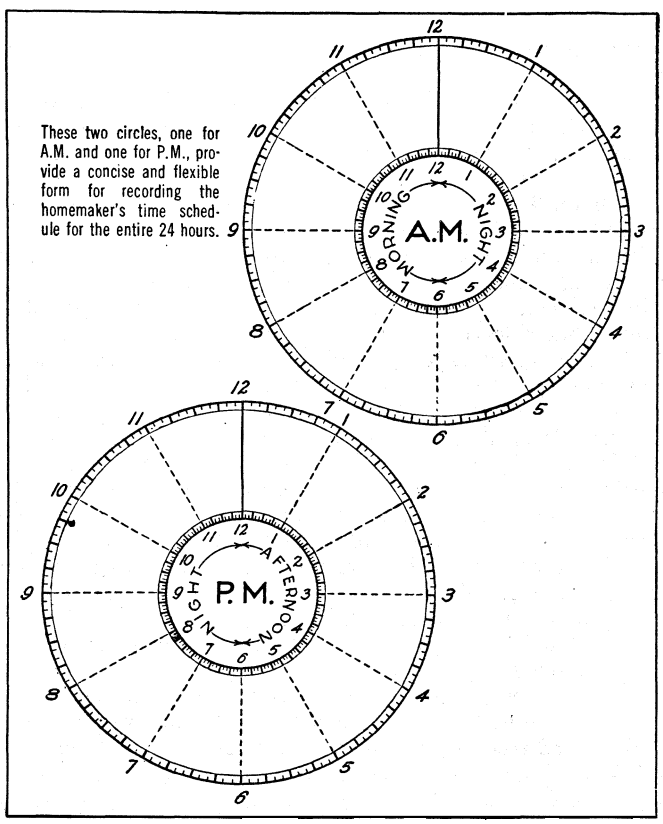
housework done at home, the health and speed of the housewife worker. Studies show that on the whole, farm women spend more time at housework than town and city women and that in homes where there are children under 15 years of age the housewife averages longer hours of work than in families with only older children or adults. According to one report, the average time spent in major housekeeping jobs by farm homemakers was 52 hr. per week[1], divided as follows:

Purchasing and management	2.2 hr.	Care of house	9.6 hr.
Care of family	3.9	Laundering	5.3
Preparing meals	15.2	Mending	1.5
Clearing away meals	7.6	Sewing	4.0
		Other homemaking	2.3

These figures give a general idea of the time required for the average household tasks. Shorter hours are the rule in some homes. Longer work hours are frequently necessary, as when there is a small baby to be cared for—5 to 7 hr. per day is one estimate of the time for this—or when there is illness in the family. At special times total work hours are long, as during harvesting, in canning season or when there are guests for any length of time. At such times some of the routine housework can often be omitted or put off. On the whole, housekeeping though very demanding is very flexible in its time requirements, as compared with most other work.

THE ROUSE

The plan and design of a house, its furnishings and equipment, are important factors in the time and effort required to do the housework in it. Work is easier and living pleasanter in a house planned with such room relationships that people can move about the house without interfering with one another. Space enough so that the house does not seem crowded or cluttered with either furnishings or people is essential to comfort and efficient working conditions. But rooms should not be too spacious if work is to be easy. Ease of passage between rooms is important. To avoid confusion, and to ensure individual privacy and convenience, there should be access from every bedroom to the bathroom and to the house entrance without passing through another room. There should be rooms or space set apart for carrying on the various activities, such as studying, sewing, dining, games, hobbies, etc., which the family members engage in.



ADAPTED PROM FORM DESIGNED BY BUREAU OF HOME ECONOMICS, U.S. DEPARTMENT OP AGRICULTURE

Rooms and furniture which can do double or triple duty or be changed in use entirely as the family activities change help keep a house easy to work in as well as to live in. Individual bedrooms can be used for study, play and entertaining as well as for sleeping. Often the kitchen or dining room can be used for entertaining or for study. The laundry can frequently be used as a hobby room, a sewing room or for other activities if it is dry, warm and well lighted.

When space requirements for living are met, the home is not cluttered and housework can run smoothly. Simple, easily cleaned and handled rugs, draperies and furniture are essential in saving work. Smooth surfaces without decoration save in dusting time. R'oodwork that is smoothly finished catches a minimum of dust. Unnecessary mouldings and cornices and tarnishable metal should be avoided to save uork. Glass, plastic and porcelain fittings are great cleaning time-savers where they are feasible. Strong, comfortable furniture need not be so excessively heavy that moving it for cleaning is a burden. Smoothly finished floors with small rugs, in much used rooms, are more readily kept clean than carpeted ones. Where carpets and heavy rugs are used there should be a vacuum cleaner and allowance should be made in the budget for occasional professional rug cleaning. which is not readily done at home. Washable wall coverings—paint, coated fabric. linoleum, washable wallpaper—are important especially in service and children's rooms.

Washable, color-fast, non-shrinkable materials for curtains and slip covers, and the soil-resisting finishes available in various household accessories, can play a big part in cutting down time required for house care.

But most important of all in saving the housewife's time and energy is labour-saving equipment—a washing machine, vacuum cleaner, ironer, etc.—and a well-planned kitchen and laundry.

The Kitchen.—The average housewife spends more than half her working hours in the kitchen. Today's labour-saving appliances have lessened these hours and made them far easier than they used to be, but without a proper organization and arrangement of equipment and utensils a large part of their value is lost. The best equipment ever invented can become a major menace in a house not planned for its effective use. Before a new appliance is purchased a plan should be made for using it efficiently and for storing it conveniently. In this way labour-saving equipment can speed up the tempo of work without speeding its tension.

Points on *Arrangement*.—The actual time required for work done in the kitchen is directly related to the arrangement of the major pieces of equipment and to the size of the work area. Work time can be cut down one-third to one-half by efficient arrangement of equipment in a work space not over 10 x 12 or 14 ft. in size. Where a room is larger. grouping the equipment in a part of it is often possible. The following points are a brief guide to making an efficient kitchen plan.

1. Work space and storage space should stand beside each piece of equipment ahich needs it.

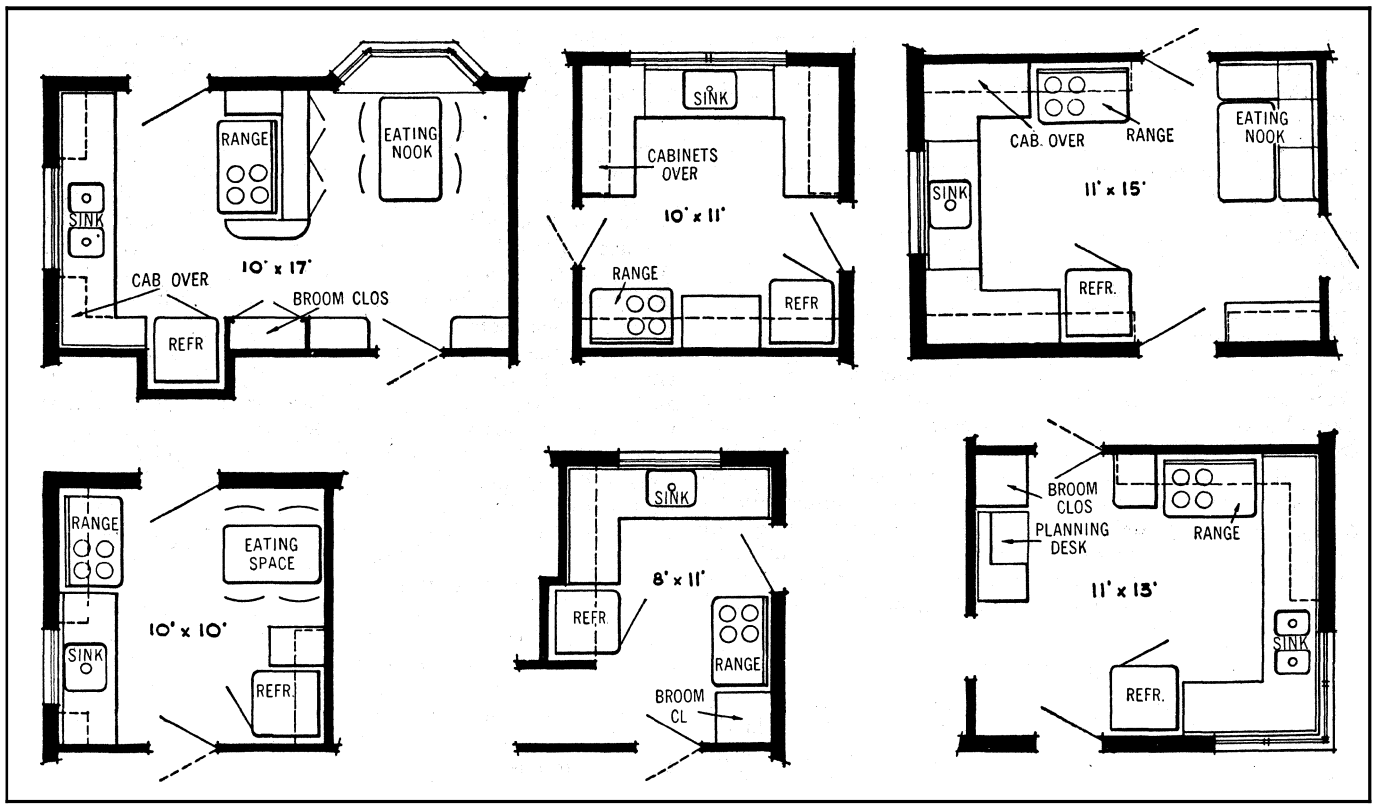
2. The main work cabinet (which must include a work surface) and refrigerator should stand together, with the refrigerator door opening toward the cabinet.

3. The sink is most convenient when it is placed between the range and the refrigerator, or equidistant from both and not more than 4 ft. from either. It should have drainboards on both sides.

4. The space between the kitchen work centres should never be so arranged that the traffic lane through the room cuts across it.

5. A U-shaped arrangement, not over 10 ft. wide, with the sink at the base of the "U," is a very convenient plan for a one-worker kitchen. With good division of work it can easily be used by two workers 4 broken "U" with the passage to a dining space between the sink and the range is also very convenient But this passage must not become a traffic lane through the kitchen

[1]Adapted from data supplied by Hildegarde Kneeland, Economics Division, Bureau of Home Economics, U. S. Department of Agriculture.



BY COURTESY OF THE PEOPLES GAS LIGHT AND COKE COMPANY

ARRANGEMENTS OF KITCHENS OF VARIOUS SIZES. FOR EFFICIENCY OF WORK. CONVENIENCE AND APPEARANCE

or much convenience will be sacrificed.

6. An L-shaped arrangement gives an "open-feeling" room. It is especially good where more than one person usually uses the kitchen and where work other than food preparation is regularly done in the kitchen.

7. The two-wall plan is convenient if the work space is not a passage and if the work areas on either side are not too widely separated *(4* ft. is satisfactory).

8. The one-wall kitchen is likely to require too many steps except in very small apartment-sized kitchens. This type of kitchen is apt to have insufficient work and storage space for preparing average family meals, but supplemented by a sizeable, well-placed table it can be made workable.

Work Space.[1]—Work surfaces should be easy to clean. Linoleum, composition materials, pressed wood, stain-resistant porcelain-enamel, monel metal, stainless steel, plastic material and hard wood such as maple suitably finished to withstand heat and moisture all are satisfactory. The amount of work space needed depends chiefly upon the number of persons for whom work is being done. A good allowance at each work point is the following. The right-hand drainboard of the sink, where soiled dishes are stacked, should be *32* to *36* in. long and *24* in. wide. The left-hand drainboard, which holds the dish drainer, should be at least 20 in. long and *24* in. wide. The working surface at the food preparation centre should be *36* to *60* in. long and 22 to *27* in. wide. and at least 15 in. below any overhanging cabinet. A pull-out pastry board located at this point should be *24* to *30* in. wide. Toe space **3** in. high and 33 to *4* in. deep should be provided at the base of all cabinets built to the floor, before which a worker stands. Clearance space between work centres should be allowed as follows:

Space between two opposite work centres—48 in.

Width of passage past sink, range and preparation centre—36 in.

Space in front of sink—27 in.

Space in front of refrigerator—32 in. (this allows for a 3-in. safety margin when the door is open).

Space in front of range—36 in. (this allows for room to pass when the oven door is open).

Working Heights.--The height of work surfaces is important to save discomfort and energy expenditure. According to one authority it requires $4\frac{1}{2}$ times as much energy to work at a table or sink that is too low as at one of the correct height. Studies have shown that no one height is correct for every woman nor is one height ideal for one person for every kind of work.

For instance, beating a cake is most easily done at a surface *2* to *4* in. lower than one best used for cutting bread. Ideal working conditions would mean having work surfaces placed at three or more levels in every kitchen and their actual heights determined according to the worker using them. Usually such a plan is not practical. The work counter used commonly today, which is continuous throughout the work area, makes this impossible. Fortunately a compromise in height works reasonably well for the majority of women. Electrical appliances have lessened the amount of work done where work heights are most important. Work counters placed at 33 to *34* in. are satisfactory for most work for the majority of women. The bottom of the sink should be lower—32 in. is a suitable average for this unless the sink is more than *4* in. deep, bringing the drainboards over *36* in. in height. The sink should be lowered to *30* inches in such cases. A compromise is always necessary here. Shallow sinks are best from a working height point of view.

Where kitchen work counter height can be fitted to the worker, determine the best average height to use as follows: have the worker stand erect in front of a table, with arms reaching down and forward toward the table surface, elbows straight and palms flat. If the hands rest easily on the table the surface usually will be of satisfactory height for most work. If the hands are above the table, build up a surface to the hands to determine the correct working height. If the elbows bend when the worker's hands rest on the table the surface is too high. Lower the surface, or raise the worker by placing her on books or boards, until the right work counter height is determined, then adjust the height accordingly.

Laundering Space.—The fact that some laundry work is done

[1]Adapted from *America's Housekeeping Book,* published *by* Charles Scribner's Sons.

in almost every home should be recognized, and provision should be made for doing this work conveniently. Space for washing can be arranged in a 4 x 6 area but more space is essential if complete laundry equipment is to be installed and used conveniently, A separate room is desirable uhere any large amount of washing is done at home, but the limited space in many modern houses makes this impossible. Convenient laundry centres can often be arranged in other rooms. The important thing is to group the equipment and have the necessary water and drain connections. When a separate room is available it can often be a combination room to be used for laundry work and also other work or activities such as sewing, canning, flower arranging or hobbies.

The laundry should be light, dry and easily kept clean. When space permits, a first floor laundry is better than a basement location, though a dry, well-lighted basement area can be satisfactory. A well-planned laundry provides space and equipment for sorting clothes and removing stains, for washing, for ironing and for drying. Frequently drying is done out of doors. When laundry work must be done in the kitchen. a washing machine with its own water supply and drain is the ideal. When this is not possible, plan to store the equipment where it can be used with as little moving as possible. Filling and draining the machine with a hose or pump eliminates the hardest part of washing — lifting the water.

Sewing Space. — In some homes a great deal of sewing is done, such as making or remodelling clothes. slip covers for furniture, curtains, draperies, etc., in others very little; but since some sewing, especially mending, is frequently necessary in every home, it is important that supplies and equipment be kept easily and quickly available. If there is no separate room for sewing where it is easy to keep material and equipment handy, some special place should be allotted for this. The minimum essentials require very little space.

Minimum Equipment Needed

Needles, thread, dressmaker pins, thimble, snaps, hooks and eyes, slide fasteners, buttons, etc., scissors, tape measure.

Other Equipment for a Complefe Sewing Outfit

Cutting board or table	Pinking shears
Sewing machine and attachments	Darning "egg"
Dress form	Tracing wheel
Full-length mirror	Patterns and fashion magazines
Ironing board	Materials
Electric iron	Trimmings
Ruler	Bindings
Yardstick	Scrap bag
Hem gauge	Tailor's chalk

Place **for** Children. — It has been estimated that children spend from 50% to 95% of their time in the house. If the children are to be happy, the adults' lives free from confusion and orderly housekeeping possible, there must be space provided and furnished definitely for children and their activities.

If possible, a child should have a room of his own where he keeps his clothing and toys and where he plays much of the time. Furnishings should be simple, easily cleaned and of suitable size. It as important that walls and floors have washable or easily cleaned surfaces. The room should be sunny and cheerful. But a child likes and needs company and some provision should also be made for him to spend part of his time with his playthings in a corner of the family living quarters.

Lighting. — The right lighting is as essential for working efficiency in a home as it is in a shop or other place of business. In addition, light rightly handled adds tremendously to the attractiveness of the home. Three requirements for good lighting are: (1) enough light for clear, easy vision; (2) absence of glare; (3) a practical combination of general lighting and local illumination.

Quality of light is important. It must be free from glare, for glare is very trying to the eyes and the entire nervous system. To eliminate glare, light must be filtered or diffused. It is filtered through fabric, special glass or plastic. It is diffused by being reflected from the ceiling or other reflecting surfaces. Several styles of lamps which provide sufficient light without glare have been made according to Illuminating Engineering society specifications. These bear an identifying I.E.S. tab. Many other lamps can be fitted with adapters to give similar results. General light in a room is essential in addition to light at work and reading centres, to avoid sharp contrasts which tire the eyes. General illumination can be provided by a central fixture, torchieres or by floor or table lamps if these are properly equipped. I.E.S. approved lamps give general as well as locaiized light. Table 111 gives the lighting levels for the home as approved by the I E S. Light is measured in foot candles with a light meter — a special device made for this purpose. Many lighting companies offer a service of checking home lighting adequacy, with this light meter.

TABLE *111.1—Lighting Levelsfor the Home as Approved by the Illuminating* **Engineering Society**

	Foot candles
Reading	
Prolonged periods with fine type	20–50
Ordinary reading	10–20
Sewing	
Fine needlework on dark goods	100 or more
Prolonged average sewing	50–100
Prolonged sewing on light goods	20–50
Ordinary sewing on light goods	10–20
Writing (ordinary)	10–20
Card playing	5–10
Children's study table	20–50
Dining room (when used for ordinary reading or writing)	10–20
Kitchen	
General	5–10
Local at work counters and sink	10–20
Bedroom	
General	2–5
Bed light	10–20
Dresser, vanity and dressing-table mirrors	10–30
Sewing machine	20–50
Bathroom mirror	10–30
Children's playroom	
General	5–10
Local	10–20
Stairways and stair landings	2–5
Workbench	10–30
Ironing machine, ironing board and laundry trays	10–20

House Heating. — The fuel and the type of heating equipment used makes a tremendous difference in the amount of time and energy required for housecleaning. A modern automatic air conditioning system reduces cleaning to a minimum the year round. Unfortunately only a small percentage of houses have this equipment. Nor can most housewives choose fuels or equipment on the basis of cleanliness.

The fuel choice is usually determined by availability of fuel, its costs and the equipment at hand. But whether gas, electricity, coal, wood or oil is used, good management and proper care of the heating and cooking systems will affect greatly their efficiency and effectiveness and the cleanliness of their operation.

It is always important to know exactly how to handle and care for the particular equipment used. The details are available from service departments of local dealers or from manufacturers of heating equipment.

MONEY MANAGEMENT

Like handling time and energy, handling the family income is an important part of home management. A definite basic plan for

[1]Adapted from ***America's*** *Housekeeping* Book, published by Charles Scribner's Sons.

spending is needed to ensure a proper balance in using the income. Each family must have its own individual plan to fit its own particular needs. Spending patterns which give amounts or percentages of income to be spent for certain purposes are useful as a guide in making or checking one's own plan. but they should never be followed literally, for the needs of no two families will be alike nor should the proportion of income spent for any one item be the same at all times in the same family.

Plans must be flexible and be changed as family needs change. As children come along, grow up, are sent to college and leave home, spending plans must be changed. When costs for school are high and income does not increase, those at home often must wear clothes longer, live in houses costing less rent, make other sacrifices. In a year when there is serious illness. adjustments must be made. It will be easier to compensate for an extravagant vacation or an unexpected expense if all the family members know why sacrifices are necessary. The budget or spending plan may be the means of making children understand that money for a football game or music lessons is going to be available only if daily movies or between-meals ice cream and candy are sacrificed. The same principle works with adults. They soon learn that using the street car consistently instead of a taxi, for instance, may make concerts or week-end vacations possible.

How to Make a Spending Plan.--A constructive approach to the spending plan is made by first setting up the family's long range aims and ambitions for such things as study. travel, future security and planning definitely for them. These objectives are a better approach to money control than the negative one of saving for an indefinite "rainy day." the common approach of early budget-makers. Such definite aims and ambitions will help to encourage careful spending and an understanding attitude toward economies. Without a goal ahead much money is apt to be spent in small ways that bring comparatively little real satisfaction.

How many of these long range ambitions can be met depends upon the money available after essential living costs have been met. Listing these in detail is an important step in budget-making. Start with the "fixed expenses"—those which can't be altered quickly—like rent—(interest on mortgage and taxes and insurance to the home owner)—commutation to business, payments on indebtedness, contributions toward support of relatives. church pledges, dues, etc. Many of these will be yearly payments. so total them for a year and divide this amount into monthly or weekly amounts. Next list the more flexible expenses—food. clothing, expenses of running the house, papers and magazines, doctor and dentist, amusements. personal allowances. If these amounts are not known. make a careful estimate of them or keep an accurate account of money spent for a week or longer before going further with the spending plan.

This estimate of expenses plus the amount to be saved toward the family's ambitions must of course come within the income available. If it does not, each expense item must be studied carefully to see where to cut. Perhaps the amount for "ambitions" must be revised. Families on the lower incomes must spend a disproportionate amount for food. An adequate diet[1], not a percentage of income, should be the guide in food buying. As incomes rise, the proportion needed for food will grow less.

Rents in some areas are excessively high if children are to have sunshine, fresh air. suitable schools and play areas. Clothing is more important in some families than in others. Climate as well as living standards and social obligations influence many expenses. The budget must steer a sane course between all these demands, picking out spots where spending must be high in proportion and where it can wisely be cut.

Suggested spending percentages[2] recommended by budget authorities are given below as a guide only:

Rent (if heat is included)	25% of income
Rent (if heat must be supplied by tenant)	20% of income

(If you are buying a home or already own it. "rent" is the total of interest on mortgage, taxes, insurance, upkeep and repairs, which should not ordinarily exceed 1/8 to 1/10 of income, if payments on principal are included.)

Clothes	15% of income
Operating expenses	10 to 15% of income
Food	20 to 35% of income
Advancement	15 to 20% of income
Savings other than life insurance	10% of income
Life insurance—face of policies should amount to 2 or more years' income.	

Keeping Accounts.—Records of expenses must be kept to be sure the spending plan is being followed. Suggestions on how to handle the details of these can be obtained from numerous sources—the bureau of home economics in Washington, D.C., the Home Economics Extension services in each state, insurance companies and savings banks.

Household account books may be purchased in stationery stores, department stores and in j and 10 cent stores. Adequate account books can be ruled up in the simplest notebook. Often these will fit individual needs better than ready-made books. But a record book should be used. Records on odd bits of paper should not be depended on. Whether the homemaker or the man of the house keeps these records should depend upon which one can do it most easily and which one has most time for it.

The homemaker does most of the buying as a rule. She must take responsibility for many of the choices involved and must know the details of the spending plan. In many cases she is the logical one to carry the details of account-keeping. An important part of account-keeping is making the monthly and yearly summaries. These must be checked against the spending plan. It is from study of these two that the spending plan can be changed from time to time to provide advantageously for the family needs. Not only should this study of expenses be made regularly but it should be done at a family council if possible so that all members of the family share in plans.

Buying **for** the Home.—The housewife, who according to statistics spends over 85% of the nation's income, has a great responsibility for her family's standard of living. Her skill and judgment as a buyer are most important factors in how well-fed, well-clothed and well-housed her family will be. This is especially true in low-income families. She must know a great variety of goods well enough to choose good value for money spent—the qualities and quantities which will serve her needs best. Qualities in many goods are not as easily judged as they used to be. New materials are constantly appearing, new uses are being made of old materials, so that values in many goods are not easily detected.

Hidden to the average purchaser, these values can only be determined by laboratory tests not practical for the housewife to make. Hence she must depend upon brand names, labels, statements made by stores, the data from independent testing agencies and the reliability of the manufacturer and dealer. She musb be able to interpret the information given on labels in terms of her needs. The facts she needs are far too numerous to keep in mind. Records of past purchases and knowledge of where to find other facts are both essential aids to her buying. There are many sources of information for the housewife who wishes to keep herself informed as a purchasing agent on the wide variety of goods she buys. There are local home demonstration agents sponsored by the extension services of each state college or university, and there are occasionally good consumer centres where much may be learned. Books and pamphlets supplied by government and state agencies and by schools and colleges give valuable information on the quality of goods. Magazines, advertising, the daily papers, provide particularly up-to-date facts.

[1]Minimum standards for good nutrition for a low-cost diet high in calories have been set up by a national committee on nutrition as follows:

Approximate number of servings of different foods needed per person for a day or week are: milk, 3 to 4 cups daily for each child; 2 to 3 cups for adults. Potatoes or sweet potatoes twice daily. Dry beans or peas or nuts 4 times a week. Tomatoes, citrus fruit or other vitamin C-rich food, 5 servings a week. Leafy, green and yellow vegetables, 6 servings a week. Other vegetables and fruit, 6 servings a week. Eggs, 3 or 4 a week. Lean meat, fish and poultry, j to 6 small servings a week. Other foods: cereal once a day, bread in some form at every meal. Dessert about once a day if desired.

[2]Adapted from *America's Housekeeping Book*, published by Charles Scribner's Sons.

HOME SAFETY

It is an appalling fact to consider that approximately one-third of all fatal accidents occur in the home. In addition, a tremendous number which are nonfatal occur there. Analysis by the National Safety council has shown that most accidents are the result of carelessness, indifference to risk or ignorance of danger, and that most could be prevented. Housewives are by and large responsible for most of the conditions which cause these accidents. Greater efficiency in home management would prevent them.

Proper care of rubbish, care in use and storing of matches, gasoline and kerosene, immediate attention to defective heating equipment or electrical connections, avoiding slippery floors. scatter rugs at the top and bottom of stairs. makeshift arrangements for reaching high shelves. are examples of points where the homemaker's care and attention can prevent many home accidents.

HOUSEHOLD EMPLOYMENT SITUATION[1]

In the majority of homes in America the housewives do all their own work except possibly laundering. which is sometimes or regularly sent out. A statement has been made that as many as 95% of the housewives in the United States do ali their own work. In some homes there is help part of the time—a few hours a week or part days. In comparatively few is there a full-time worker or more than one In spite of this fact the market for household employees remained tremendous. The number of U.S. domestic workers totalled 2,240,000 in 1940 and 1,923,000 in 1950. There was a further decline, the total being 1,786,000 in April 1952; 98% of these workers were women.

Household labour is largely unorganized, unstandardized and has an extremely high turnover. This is wasteful for employer and employee and society as a whole. It is a condition for which homemakers themselves must take a large share of the blame. The four chief causes are: overwork, underpay, poor living conditions, social stigma. Working hours for domestic workers who "live in" may range as high as 70 to 80 a week. According to reports to the U.S. bureau of old-age and surtivors insurance, wages of covered household workers averaged about $80 a month during 1951. The median annual earnings of private household workers totalled $296 in 1939 and $448 in 1950. Many household employees were employed at irregular intervals and some received in addition meals. payment for transportation to work, if necessary, or were provided with living quarters.

Generally speaking, state wage and hour laws do not apply to domestic employees. In 1950 the Social Security act. however, amended to cover various categories of workers, included regularly employed domestic workers.

It has been recognized for some time by a rapidly expanding number of persons throughout the Gnited States that many conditions and attitudes must be changed if household employment is to become an attractive and dignified occupation.

In 1928 the women's bureau of the United States department of agriculture, the national board of the Young Women's Christian association and certain private organizations called a conference in Washington to discuss how household employment could be improved as an occupation for women. Out of this conference there developed the National Council on Household Employment (disbanded in 1942), which drew up proposals for a voluntary agreement in household employment, given here in part:

Working Agreement.—A definite written agreement between employer and employee should be made at the time of employment. It may be signed or unsigned and should be subject to periodic review to meet changing conditions. Such an agreement is based on the following considerations.

Duties.—Regular duties shall be clearly defined, based on an analysis of the job to be done within the hour limit agreed upon. A high standard of work snall be expected in return for good wages and satisfactory working conditions.

Hours.—1. Actual working hours shall be defined as hours of duty during which the employee is not free to follow her own pursuits.

2. Total actual working hours shall not exceed 60 hours within the week A schedule of less than 60 hours is desirable.

3. Time on call is that time when the employee is not free to leave the house but may rest or follow her own pursuits and is available for emergencies. Two hours on call shall be equivalent to one hour of working time. Overtime may be adjusted by extra time off or extra payment on a per hour basis. Frequent overtime should be avoided.

4. Time off shall include two part-time days each week beginning not later than 2 P.M. on week-days and immediately after the midday meal on Sundays or one uhole day each week, or its equivalent. In the 60-hr. week some evenings will be free. Four out of eight holidays shall be given during the year and some adjustment made for church attendance. Free time shall be defined as hours when the employee is free from all responsibility to the employer. Mealtime cannot be considered an employee's free time if the telephone must be answered.

Vacation.—One week with pay shall be given after one year of service. two weeks with pay after the second year.

Termination of Services.—Notice of one week or one week's pay shall be given on termination of service by the employer—one neek's notice by the employee.

Wages.—For full-time employment the scale of wages will be the minimum for the unskilled worker, with a rising scale for increasing skill and experience on a wage scale comparable to that paid in the local industries. Payment should be made weekly or biweekly on the day due. If the employee wishes a monthly wage, 4 and $\frac{1}{3}$ weeks should be calculated as one month.

Living conditions.—Comfortable living conditions include: (1) adequate food; (2) private room or one shared by another employee, if necessary; (3) access to bath; (4) adequate heat and light; (5) a place to entertain friends. The national council also urges that local councils on household employment shall be organized and that these councils experiment with and include in their community-wide agreement the following:

1. Health certificates for employees in line with state laws for workers handling food.
2. Benefits of accident compensation to employee and employer and the relation of accident insurance to the state system of industrial accident compensation.
3. Sick leave.
4. Good equipment chosen in relation to skill of workers.

As a result of these recommendations made by the National Council on Household Employment and other developments, local community councils are developing rapidly in many communities throughout the United States and all wide-awake women are affiliating with these groups and helping in this nation-wide movement to improve this important industry. These groups are developing along at least four different lines:

1. A training school for domestic employees.
2. A placement service for graduates.
3. A consultation service for employers, covering all types of household problems.
4. Discussion groups for members.

Briefly, the responsibilities of employers in establishing better conditions in this particular labour market are:

1. To raise the status of a domestic employee to a position of dignity through decent wages, shorter hours and better working and living conditions.
2. To establish a better relationship between employer and employee by raising the employee's morale through sympathetic guidance, appreciation of work well done and dignified and courteous treatment at all times.
3. To maintain a smoothly run household through careful planning and explanation of work to be done.

On the other hand, the employer has the right to expect a good return on her investment, and she should have a clear picture of what is to be expected from the superior employee.

HOUSEKEEPING IN EUROPE

The details of housekeeping differ in different countries because

[1]Adapted from ***America's Housekeeping Book***, **published** *by* Charles Scribner's Sons.

of climate, tradition, social customs. economic and industrial conditions. One of the greatest differences between housekeeping in America and that elsewhere is in the number of servants employed in the home.

The average American housewife does all or most of her own work. The European woman in a similar status in normal times has help. Families on the same economic level as those employing one paid helper in America would employ two or more in Europe. Household help is plentiful and cheap in nonindustrialized countries. In these less industrialized countries. housework is harder work physically, because of the lack of labour-saving devices and because many houses are without the conveniences which are common in America. Hence it takes more hands to carry on a home satisfactorily. As countries become industrialized and factory work becomes available to women and girls, they are less interested in housework, and housewives must do more of the work themselves, as has been the case in the United States.

From colonial times the problem of paid help in the household has been greater in the Cnited States than in older countries since opportunities for work other than domestic have been more numerous. In older countries with their more plentiful household help the urge has not been so strong for labour-saving appliances and houses easy to care for as it has been in the United States. But changes similar to those in the United States were gradually taking place in many countries before World War II put a stop to all such progress.

HOUSEHOLD TECHNIQUES]

Housekeeping requires the repeated performance of a great variety of tasks. Knowing exactly how to do them well and quickly is an important part of every housekeeper's job whether she does them herself or directs others in this work. The following suggestions contain some of the facts housewives need to refer to frequently.

How to Avoid Moths.—Moth damage is done by the moth larva, not by the moth which flies about. The moth lays eggs on woolen materials, preferring dark places and soiled materials. These produce the larvae, sometimes in four to eight days in warm weather. These feed upon wool, feathers, felt, fur or hair. Garments which have no moth eggs or larvae on them and which are kept away from the moths are safe. Dry cleaning, washing, sunning and brushing, if thorough, will rid garments of both eggs and larvae.

If stored in a sealed package clean garments will be safe. The point is to be sure of the thoroughness of the cleaning and completeness of the seal of the packages. Such substances as paradichlorobenzene or naphthalene flakes will kill moth larvae if used in sufficient concentration. Place the garments to be stored in a tight closet or box, tightly sealed. Add the chemicals. Any moth larvae inside will be killed. Use 1 lb. to each trunk to ensure protection—less will do under some conditions.

What to Use on Common Stains.—Stains on nonwashable materials are best taken to a good dry cleaner. For home treatment try carbon tetrachloride It will be effective on most. Precaution: On washable materials try the following, remembering that a bleach can be used only on white cotton or linen materials —never on silk or wool.

Fruit stains.—Pour boiling water from 2 or 3 ft. above the material (note bleaching precaution above).

Blood.—Soak in cold water, wash or sponge in warm suds. Rinse well.

Candle wax.—Scrape off excess with a dull knife. Put stained area between white blotters and press with warm iron. If stain remains, sponge with carbon tetrachloride.

Chewing gum.—Scrape off excess. Sponge with carbon tetrachloride.

Coffee.—Pour boiling water through the stain from 2 or 3 ft. above. Launder. Old stains, use chlorine bleach (note bleaching precaution above).

Grass.—Rub with heavy suds. If stain remains, use chlorine bleach (note bleaching precaution above).

Greasy foods.—Scrape off excess. Sponge with carbon tetrachloride.

Automobile grease.—Rub lard into the spot. Scrape off and launder.

Lipstick.—Sponge with carbon tetrachloride. If stain remains use chlorine bleach (note bleaching precaution above).

Iodine.—Fresh stains will usually wash out. Old stains, sponge with alcohol or diluted ammonia.

SPECIAL LAUNDERING PROBLEMS

Bluing.—1. Bluing does not whiten clothes. It merely corrects the yellow tinge nhich white articles sometimes acquire through age or poor laundering. Therefore bluing is unnecessary unless the articles are yellowed, and it may even impart a grayish tinge if used too often.

2. Never use bluing that contains Prussian blue, or rust spots may appear on the clothes if all the soap has not been rinsed out. Ultramarine and aniline blue do not cause this trouble.

3 Bluing is manufactured in many forms, liquids, solid balls, cubes, powder and in combination with soap flakes. Bluing-soap flakes are used in the wash water; all others are added to the final rinse water. Follow package directions for the kind you choose, and mix it thoroughly with the water, to prevent streaking.

Bleaching.—White cottons and linens may need to be bleached occasionally. Cse a bottled chlorine bleach and follow directions carefully as to the quantity.

1. Mix the bleach thoroughly with the first rinse water.
2. Rinse at least twice after the bleach is used. If any bleach is left in the fabric it may weaken it seriously.
3. Be careful not to spatter the undiluted bleach on other clothes: it will remove color and weaken fibres.
4. Sunshine is a natural bleach and clothes always dried out-of-doors in the sun may need nothing more. Extra moisture left in the clothes after the final rinsing increases the bleaching action of sunshine.

White silks or delicate cottons and linens that have yellowed may be whitened with one of the "stripping compounds" sold by dye manufacturers for removing color from silks. Follow directions on the package.

Stripping compounds will not injure any fabric that is not harmed by boiling water. Never use a chlorine bleach on silk or wool.

Starching.—The use of the correct amount of starch improves the appearance and finish of many articles. Starched pieces also shed soil more rapidly. Accurate measuring, careful cooking and the right method all are essential to successful making of starch.

General Directions.—I. Hard water should never be used in making starch. Use borax to soften water that is naturally hard. Never use washing soda, because it tends to make the starch yellow.

2. Read the manufacturer's directions carefully and follow specific directions for specific purposes.
3. Wring rinsed clothes as dry as possible. Shake out each garment thoroughly and turn it inside out before immersing in starch mixture.
4. Use enough starch mixture to cover garments.
5. Dipping is not enough; immerse garment and press between hands to force starch through.
6. If a fine finish is desirable, rub and pat the starch mixture evenly into the fabric.
7. Remove excess starch by wringing. If wringing is done by machine, use thicker starch, since more is removed than when clothes are wrung by hand.
8. Hang starched clothes to dry immediately to prevent mould.
9. When garments are thoroughly dry, turn right side out and sprinkle, unless garments are to be ironed on the wrong side.
10. Iron starched dark-colored garments on the wrong side.

[1]Adapted from ***America's Housekeeping Book,*** published Charles Scribner's Suns.

Many factors affect the stiffening quality of starch, and it is almost impossible to give exact proportions for various fabrics. Personal preferences vary, also. However, the following basic starch recipe will serve as a guide:

Basic Starch

½ cup starch or 14 starch cubes
½ cup cold water 2½ quarts boiling water

Mix starch and cold water to a smooth paste. Add boiling water gradually, stirring constantly. Cook over low heat, stirring constantly, until clear (about 5 min.) or cook over hot water, stirring frequently, until clear (about 15–20 min.). Strain through very fine strainer or cheesecloth.

Troubles and Remedies

Sticking

1. Insufficient cooking.
2. Careless straining.
3. Allowing "skin" to form on starch after cooking (keep starch closely covered to prevent skin from forming).
4. Iron not hot enough.
5. Excess starch on surface of garment.

Limpness

1. Garment not wrung dry before starching.
2. Drying in moderate or strong wind.
3. Freezing on clothesline.
4. Drying in damp atmosphere.

General Rules for Washing Woollens, Rayons, Silks.—DO not soak material, and use lukewarm, never hot, water. Use mild soap only and be sure it is completely dissolved. Squeeze; don't rub or twist. Rinse gently and thoroughly. Squeeze dry—do not twist. Roll in a heavy turkish towel and press out moisture with the hands. Wool garments should be dried on forms or pinned into shape. Dry quickly in a warm place but not near stove or radiator.

CLEANING EQUIPMENT

A place to store cleaning equipment is lacking in many houses. It will be time well spent to fit up a closet or wall space to take care of these tools. To arrange this area, collect all the cleaning tools and materials at the location to be used. With the help of a second person and a piece of chalk work out a plan for placing them.

First set the tools requiring floor space in position—the vacuum cleaner. carpet sweeper, mop pail. Next have the helper hold in position the tools that are to be clipped to the wall. while they are outlined in chalk—which can be erased if a better position is found. Place the tools used most often in the most accessible positions. After every tool has been assigned a place, put the necessary holders or hooks in place. Always return equipment to the right places after each use.

*Essential Cleaning **Equipment** and **Supplies***

Vacuum cleaner and attachments
Carpet sweeper
1 corn or fibre broom
1 dust mop
1 wet mop (string, sponge rubber or cellulose sponge) and 2-compartment pail
1 scrub brush (long handle preferred)
1 dust pan (long handle preferred)
Toilet bowl brush
Radiator brush (if not included with vacuum cleaner attachments)
Whisk broom or upholstery brush
2–4 treated dustcloths
6 cheesecloth squares (24" x 24")
2 flannel polishing cloths
3 cellulose sponges (for kitchen, bathroom and cleaning basket)
2 floor cloths (for kitchen and bathroom)
Wax (paste. liquid or self-polishing)
Metal polish
Silver polish
Turpentine (flammable)
Lemon oil
Mild scouring powder or whiting
Ammonia (household)
Toilet bowl cleaner
Fuller's earth or other absorbent
Rottenstone
Carbon tetrachloride
Household disinfectant
Mild soap (chips. flakes, beads, grains)
Paint cleaner (commercial or homemade)
Art gum eraser.

How to Clean Painted Surfaces.—Dust frequently to avoid washing. When washing is necessary wash a small inconspicuous area first to see the effect on the paint. Mild soap and water will clean lightly soiled surfaces. Always avoid strong soaps, harsh scouring powders and powerful cleansing solutions. If painted surface is heavily soiled, try one of the following solutions:

1. ½ oz. trisodium phosphate to 2 gal. of warm water.
2. 1 tsp. tetraphosphate compound to 1 gal. of warm water.
3. Sodium hexametaphosphate compound used according to manufacturer's directions.
4. ***Whiting** cleaner:* Dissolve 2 tbsp. white soap flakes in 10 tbsp. lukewarm water. Cool until jellied and stir in 1¼ cups of whiting. Apply with a damp cloth or sponge.

Follow this procedure in washing walls:

1. Dust walls thoroughly.
2. Start at the bottom and work up to avoid streaks from water running down.
3. Apply chosen cleaning solution to a small area with a soft cloth or sponge, using a circular motion. On textured surfaces use a stiff brush.
4. Rinse the clean area with clear water.
5. Wipe with soft cloth wrung nearly dry out of clear water, using the up and down stroke.
6. Wash a new area, starting well within the cleaned area.

Liquid Window Cleaners.—These may be purchased in bottles equipped with sprays. They are extremely easy to use. Merely spray the surface and wipe it at once. Then polish with a dry cloth or newspaper. Never work in sunlight. To make a liquid cleaner:

1. 2 tbsp. of household ammonia added to 2 qt. of warm water.
2. ½ cup of denatured alcohol in 2 qt. warm water. Use the latter solution for washing in freezing weather.

Paint or Varnish Spatters on Window Panes.—If possible remove while fresh, using a cloth dampened with turpentine. If old, soften with turpentine or paint remover, then scrape off with a putty knife or razor blade held in a handle. Purchase latter at 5 and 10 cent stores.

Putty Smears on Window Panes.—Remove with household ammonia.

Window Sills and Frames.—These need constant care if they are to be kept from getting grimy. A coat of wax—any variety—makes this task easier and saves the surface beneath the wax.

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(E. DA.; G. L. P.)

HOUSELEEK, common name for *Sempervivum,* a genus of ornamental succulent plants, also called "hen-and-chickens," belonging to the family Crassulaceae. About 50 species are known, some of which are hardy perennial herbs and grow well in dry or rocky situations; the others are evergreen shrubs or undershrubs, fit only for cultivation in the greenhouse or conservatory.

The genus *Sempervivum* is distinguished from the nearly allied *Sedum* by having petals in multiples of six or more, whereas *Sedum* has petals in multiples of six. The common houseleek, S. *tectorum,* is often met with in Great Britain on roofs (where it is sometimes planted to keep slates in position) and wall tops, but is not a native.

Originally Eurasian, it became widely dispersed in Europe, and was introduced into America.

The leaves are thick, fleshy and succulent, and are arranged in the form of a rosette, lying close to the soil. The plant propagates itself by offsets on all sides, so that it forms after a time a dense cushion or aggregation of rosettes. The flowering stalk, which is of rather rare occurrence, is about one foot high, reddish, cylindrical and succulent, and ends in a level-topped cyme, recurved at the circumference, of reddish flowers, which bloom from June to September.

Sedum acre (stonecrop) is styled the little houseleek. S. *arachnoideum,* the cobweb houseleek, is often cultivated for ornament. *S. arboreurn* is employed in Cyprus, the east and northern Africa as an external remedy for malignant ulcers, inflammations and burns.

HOUSE OF ISSUE, an investment banking house which underwrites, advertises and undertakes the sale of an issue of stocks or bonds for a corporation. It is known as the house of issue to distinguish it from other banking houses which may be merely participants in the disposal of the securities.

HOUSE OF REPRESENTATIVES: *see* CONGRESS, UNITED STATES

HOUSE SPARROW *(Passer domesticus),* a bird characterized by its attachment to human habitations; it destroys noxious insects, but in part counterbalances this by its ravages on crops. It breeds in most of Europe and parts of Asia, with allied species in northwest Africa, Italy, etc. It is not a finch but belongs to the weaverbird family, Ploceidae. First introduced in the United States at Brooklyn, N.Y., in 1851, about 200 were released in 1860–66 to combat insect pests in New York (where they were soon called English sparrows), where they established themselves and began to spread.

The house sparrow thereafter found its way to every state and much of Canada. It was introduced by Sir W. Buller to New Zealand to combat a plague of caterpillars. It was also introduced into Australia and has multiplied immensely in both countries. The tree sparrow (P. *montanus),* distinguished by a brown cap, takes the place of the house sparrow in cities in part of Europe and Asia. (G. F. Ss.)

HOUSING. This article is divided into four broad sections dealing with the principal aspects of housing and the development of housing policies and programs in the United States and in Great Britain and western Europe. For additional information *see* POVERTY; PUBLIC HEALTH; SOCIAL SERVICE. Planning and zoning programs are discussed in CITY PLANNING; ZONING; and GARDEN CITY.

Population trends which affect housing needs are treated in the articles BIRTH RATE and POPULATION. The program of the Farmers Home administration is described in the article AGRICULTURAL ECONOMICS: *Agricultural Credit Systems.* For additional information on specific aspects of housing *see* SAVINGS AND LOAN ASSOCIATION; HOUSE.

Following are the main divisions and subdivisions of this article:

I HOUSING: A PERSPECTIVE

In its most general sense housing means shelter, or the means of providing shelter. Increasingly, however, it has come to signify the particular problem of providing an adequate supply of dwellings for human habitation, at suitable price levels, and of a quality to meet acceptable modern standards.

A. HOUSING AND THE FAMILY

Home is the place where people care for most of their bodily needs, rear their children, keep their possessions, seek quiet and privacy, entertain their friends and in general fulfill the basic domestic and personal functions of family life. Physical and mental health, working efficiency, emotional security and social status are all likely to be influenced by housing conditions. Specialization, mass production and the network of communal services make the individual household less self-sufficient, physically and socially, than it was formerly. But many labour-saving devices tend to strengthen its independence, and such inventions as radio and television probably increase the amount of leisure time spent at home. Housing and household equipment are normally a major item of consumer expenditure, often larger than food, and when a family buys a house it is likely to be the biggest single financial commitment it ever makes. A suitable home is vital to the modern family, but the average family cannot produce such a home on its own initiative.

B. Housing and the Community

Housing is also of direct significance to the community and the nation even apart from its importance to the individual family. The largest single use for urban land is for residence, and most of the value of urban real estate is in residential property. Services for home protection and convenience are a major item in the municipal economy. while the neighbourhood social pattern created by housing practice may be a dynamic factor in class and race relations. Moreover, since each dwelling is a base point in the web of urban activity, traffic and transportation are primarily a problem of communication between homes and other facilities Insanitary, obsolete, ugly, overcro ded or inefficiently located residential districts not only affect the lives of the occupants but are also a burden and a threat to the rest of the community.

At the national level. housing is important not only because it affects health and welfare and is closely related to such political principles as "equal opportunity" and "minimum standards," but also because it is a vital factor in the national economy. A large number of workers are dependent on residential construction for employment, directly or indirectly, and housing credit is an important aspect of both the investment market and fiscal policy. Housing problems are continuously created by population movements of all kinds, and the location of housing and industry is a factor in national defense.

C. Emergence of a Problem

Housing emerged as a major problem and public issue because of dissatisfaction with existing conditions. The standard of demand was rising or changing in many respects, and the supply failed to keep up with it. Deficiencies in the home production mechanism were almost universally evidenced in western countries by (1) the enforced occupancy of an enormous number of dwellings seriously substandard by accepted criteria; (2) the rapid spread of physically and economically blighted areas, undermining civic amenity and efficiency; (3) the frequent recurrence of severe housing shortages, causing overcrowding and an inflexible or exploitive housing market; (4) a narrow "effective market" for new dwellings constructed by ordinary private enterprise. often limited to upper income families; (5) the inadequate planning and design of much new housing; and (6) extreme fluctuations in the rate of home production endangering the national economy.

As a result of these deficiencies a strong movement for housing reform gradually took shape, beginning in mid-19th-century England as an offshoot of the public health movement. Specific emphasis varied in different situations, but the over-all trend was remarkably continuous and consistent. The housing movement became international in scope, attacking common problems, and working toward more or less common goals.

There were numerous private efforts to reduce costs and improve quality. A long series of experimental community developments demonstrated new standards of design, often gradually adopted in general practice. Building and loan societies endeavoured to make cheaper capital available on a more responsible basis, primarily for individual home purchase in the United States and England, more particularly for large-scale rental housing on the continent. Co-operative initiative was encouraged to eliminate speculative profits. Technical research sought, via rationalization and prefabrication, to lower costs by increased efficiency. There was a fairly steady trend toward standardized building units and larger-scale operations.

But progress by private initiative alone was inadequate to meet the demand, and housing became an important chapter in the political modification of the laissez-faire system for social ends. The history of the housing movement is primarily the history of expanding public responsibility — restrictive standards applied to new and old construction in the interests of health and welfare; rent control in periods of shortage, financial aid of all kinds to private housing, subject to various conditions; direct public construction of homes; subsidies for the clearance of slums and blighted areas; guidance on the location of new housing; and lans and policies against racial or other types of discrimination. In the United States quite as much as in Europe, home building and ownership became a thoroughly "mixed" enterprise in terms of public and private participation. Throughout Latin America, Asia and Africa, as a result of rapid urbanization and rising social demands after World War II, housing conditions have increasingly become a major issue.

Along with the trend toward large-scale operations and public intervention, the movement for housing reform is inevitably related to the broader land use and social economic problems of cities and regions. In addition to signifying a necessary but troublesome physical commodity, "housing" has come to mean a basic instrument for community planning and civic development and redevelopment. (C. B. Wu.)

II. TRENDS IN WORLD HOUSING

In all countries housing is prominent among the factors affecting the level of living. It plays a multiple role in creating or retarding employment and economic growth, in maintaining health and social stability and in preserving the values of decent family life. Housing constitutes the physical environment in which society's basic unit, the family, develops. The improvement of that physical environment represents a concrete and visible rise in the general level of living.

From the family's perspective, "housing" is not shelter alone but comprises services, facilities and utilities which link the individual and the family to the community. These include such amenities as easy access to schools, medical facilities, shopping, recreation and cultural institutions; and a reasonable time for travel to and from work. Because of the complexity of the problems involved, approaches to housing in the second half of the 20th century emphasize regional and national programs — instead of local housing projects — and comprehensive community planning in order to prevent a further haphazard gronth of cities. Housing standards also are changing, from establishing minimum requirements of habitable area and space, or of materials, to controlling overcronding and promoting better sanitation, greater safety and more privacy. As a rule they provide for high levels of community services. facilities and utilities even in cases where the family's income does not allow for high levels of shelter accommodations. Governments thus promote adequate levels of community activity when for reasons of etonomy shelter standards must be set temporarily at relatively lower levels. High community standards promote in such cases the realization of suitable patterns for the development of urban and rural communities in accordance with anticipated economic and social advances and the improvement of dwellings as family incomes rise.

1. The General **Problem.**—By the second half of the 20th century the world's population had reached 2,500,000,000, increasing at a rate that indicated it might swell to as much as 6,000,000,000 by the end of the century. Progressive industrialization will most probably have to be relied on for the livelihood of most of this added population, expected to be concentrated in urban areas. An explosive growth of cities has been in the past and is expected to be in the future a direct result of the rapid transformation of a fundamentally rural and agricultural mode of life into an essentially urban society.

Technological advances in construction, transportation and utilities have been notable but they have not been applied at a sufficient rate in urban development. Economic imbalances have grown out of this situation. Their outward physical symptoms are poor housing and inadequate community services; choked-up city traffic and excessive travel time to work; and filth, squalor and disease. Gang activity, juvenile delinquency, crime and vice are the more conspicuous social problems of economic disorganization and the physical decay of the city. These conditions affect an evergrowing number of people but primarily they involve newcomers in the lower-income groups who become slum dwellers and squatters in the communities to which they migrate.

The problems of housing and urban reconstruction have grown into major political issues in most countries. Governments have assumed increasing responsibility for the planning and financing of housing and community improvement programs and separate governmental departments or agencies for housing and urban de-

velopment have been established. In order to facilitate the execution of housing and urban development programs separate financial, loan and banking institutions of a public or semiprivate character have also been organized, and great efforts have been made by governments to stimulate private financing of housing. Individual ownership in the United States covers nearly 70% of all households; and in the U.S.S.R. and the other socialist countries more than 50% of all dwellings are built for individual or co-operative use. At the same time maintenance and management of a steadily growing housing stock have become serious problems for public authorities. Special agencies therefore have been established to take care of social aspects of housing, urban redevelopment, slum clearance and squatting.

The share of the family budget spent for housing varies considerably. However, low-income families in most countries find it more and more difficult to obtain adequate accommodations without jeopardizing other essential needs. To overcome the serious gap between the "economic" and the "social" rent (that is, between the cost of construction and maintenance of acceptable housing accommodations and the amount families are able and willing to pay for them) governments directly or indirectly subsidize builders, as well as householders in the lowest-income groups. These measures are sometimes supplemented by rent controls to ensure (1) an adequate security of tenure; (2) rents within a reasonable proportion of the family budget; and (3) the maintenance of existing housing accommodations. While rent controls have tended to disappear in the high income countries there has been a growing interest in this measure in the developing countries.

2. Urbanization. — In most parts of the world more people already live in cities and industrial centres than can be supported by employment opportunities in existing industries. The levels of living of the migrant population are therefore declining both in terms of physical and social environment and from the point of view of family income.

Measures are being instituted in town and country to discourage the transplanting of rural poverty into the urban environment. In this context housing and community services and facilities play a crucial role. However, the progressive concentration of people, a scarcity of resources, the rising cost of building and a growing shortage of suitable land in urban and industrial areas retard improvement. Economic development programs have tended to intensify urban-rural differences, and to stimulate migration when insufficient attention has been paid to a corresponding development of agriculture and the improvement of rural life. Rural residents generally, and large sections of the urban population, have failed to benefit from economic progress; living conditions in the villages continue to deteriorate and growing numbers of people continue to drift into towns. Thus the demand on national resources for housing and urban development has greatly increased at the time when large investments are also required to create the many jobs needed for the employment of new city dwellers.

3. Housing Needs. — In 1950, when every fifth inhabitant of the world already lived in a city with a population of more than 20,000, studies indicated that within 25 years between 280,000,000 and 540,000,000 persons would be added to the populations of such cities in Asia. In Latin America 62 metropolitan cities (with over 100,000 inhabitants each) accounted for some 40% of that continent's population and a group of 11 among them had reached a level of employment in industry comparable to that of New York, Paris and London, namely about 39%. In Africa the population was expected to grow from nearly 200,000,000 to more than 330,000,000 by 1975 with urban population showing the highest rate of increase. The studies showed that 70,000,000 people would be added to North America's population by 1975, practically all of whom would have to live in cities and work in industry, commerce, transport and various services. The same was true for the 177,000,000 people who would swell Europe's population (including that of the U.S.S.R.) during the same period.

Although the second half of the 20th century was characterized by the greatest technological advances in man's history, there was no cocntry without a housing problem. With very few exceptions the supply of housing for the lower-income families was in fact worsening, especially in the less developed countries.

Physical congestion and blight are atiecting many areas, and they are presenting seemingly insoluble problems of reorganization, reconstruction and financing. It has been estimated for India, for instance, that considering only cities with more than 100,000 inhabitants, during the 25 years ending in 1975 housing and site improvement for new dwellers would require 60,000,000,000 to 110,000,000,000 rupees (or U.S. $12,000,000,000 to $22,000,000,000). The Organization of American States estimated that a yearly investment of U.S. $1,400,000,000 was required in Latin America over a period of 30 years to wipe out the housing deficit, to replace obsolescent dwellings and to provide new homes for new households. These examples assume an ominous significance against world-wide needs. According to rough estimates by the United Nations, as many as 150,000,000 families in the less developed countries required more adequate homes in better physical surroundings; and in the industrially advanced countries, there was a deficit of more than 30,000,000 units.

4. National Policies. — In the countries that have legislation controlling rents (eastern Europe for instance) families pay on the average less than 5% of their incomes for rent. In some Asian countries a 10% share of family income is considered to be a reasonable allowance for rent. Among the more highly industrialized countries, between 15% and 20% is regarded as normal (in western European countries), while 25% and more is customary in North America. The interplay of needs, resources, rights and habits has produced a variety of housing policies corresponding to varying conditions. The general trend has been toward establishing national policies for housing and urban development on a comprehensive scale; to enact requisite legislation including the appropriation of necessary public funds to supplement private and co-operative resources; to set up the organizations required at the central, regional and local levels for the planning and execution of these programs; and to institute corresponding research and training activities. The methods applied in different countries to facilitate the financing of housing and urban development programs are influenced by their general economic and social policies. Thev include such measures as tax concessions, state-guaranteed mortgages, granting of loans, capital subsidies. direct subsidies to householders and building of rental housing with public funds. In addition some countries plan and finance with public funds the provision of certain community services and facilities and the acquisition and development of land required for new neighbourhoods or residential communities.

In most countries the housing requirements exceed the capacity of the building industry and the supply of readily available building materials. At the same time rural residents transplanted to urban communities do not usually have facilities to build their own homes as they often did in the country. Furthermore, the qualitative standards of urban dwellings continue to rise so that they have come to include many amenities usually not found in rural homes. Thus the cash cost of urban dwellings rises while the ability of the householder to contribute labour or building materials decreases. The desire to bring the cost of housing within the reach of low-income families underlies the policy of public aid for the development of building and building-materials industries and the growing practice of using the householders' own savings and labour in the financing and execution of urban and rural housing programs.

5. Mobilization of Resources. — The use of the future householder's own labour or of cash and his potential savings represented a way of reducing the burden of financing housing programs from public sources. In most countries the establishment of suitable credit facilities and of savings and loan mechanisms created a sufficient incentive for mobilizing the residents' own financial means for home building. In a number of countries with strong inflationary tendencies a special device was used to attract private savings. In addition to the normal interest rates an "index clause" was introduced which provided for an allowance for any rise in home building costs as reflected in the fluctuations of a specified price index, such as the cost of construction or of some basic building material.

All societies have traditionally used self-help and mutual aid for building family shelters and community facilities. Organized versions of these methods are applied with enthusiasm in villages and small towns throughout the world under the guidance of community development workers: in Scandinavian cities under the *egnahem* (one's own home) arrangement; in squatters' resettlement and slum clearance projects carried out by a number of municipalities; in the newly established industrial communities of the U.S.S.R. under the leadership of labour unions; and in North America by enthusiasts of the do-it-yourself movement. The motivating force may vary, but the general principle is the same: the people concerned contribute their own labour to reduce the required capital outlay for the building of homes and community facilities; or governments use this method to obtain for housing construction labour which may be in short supply in situations of full employment.

In Africa, Asia and Latin America self-help and mutual aid have often been means for improving the physical environment and health and general living conditions in villages and towns through the construction of public works. In these instances efforts to better one aspect of the community environment have often led to improvement in others, as evidenced by pilot projects in Nigeria, Haiti and India; by cultural missions in Mexico which used as their main vehicle a suitable system of education; by fundamental education programs in village reconstruction projects in Egypt; and by rural centre projects in Africa and the Caribbean which demonstrated in a practical way what rural families can do for themselves. In Ceylon, Indonesia, Jamaica and the Philippines self-help projects have been developed in connection with broad programs of rural resettlement; and in Puerto Rico self-help and mutual aid were applied also in urban resettlement and slum-clearance projects. These latter included the transfer of families from slums or squatters' camps to new communities in which they were granted building lots and supplied with basic utilities.

In Greece thousands of homes were cheaply and quickly constructed after World War II, despite a shortage of building materials and skilled labour, through a "materials-in-aid" plan. The new town of Faridabad in India proved that 40,000 ordinary persons could erect homes for themselves, largely with their own labour. It was possible to build the new town in about two years, and the cash outlay per house was at the same time drastically reduced. As many as 500 dwellings a month were produced without elaborate mechanical devices.

Because of the steady influx of immigrants into Israel about 100,000 persons were at one time sheltered in tent colonies. shacks and abandoned army camps. As a solution to the restiveness of the immigrants and to the waste of potentially productive labour the work village. or *maabarot* plan, was developed. Under this plan teams of immigrants built their own permanent homes. In most cases they also built the factory in which they eventually were employed.

In Ghana a self-help program of great promise was developed. Home ownership has such appeal that many people there invest their savings in cement blocks for future building. The government in 1956 also started a program under which persons who had built their homes up to the roof level were provided roofing materials and doors and windows on credit. A similar arrangement was tried out with success in Burma. It involved five-year loans for aluminum roofing for rural dwellings, for structures for agricultural uses and for communal buildings such as schools, community centres and health clinics.

The rehabilitation of areas stricken by disasters such as earthquakes, floods or hurricanes has offered opportunities for effective co-operation. The National Reconstruction board in Lebanon (established in 1956 following an earthquake) is financed by a special tax on imports, an entertainment tax and a postal tax. Some 300 villages affected by earthquake were rebuilt initially through paid labour and ultimately by using self-help and mutual aid methods.

The urban housing program known as *egnahem* is used in Stockholm. Swed. The municipality supplies the building components, provides technical advice and negotiates contracts for skilled jobs such as plumbing and electricity. The neighbourhood is planned as an urban residential unit with all needed facilities and services. House construction is financed by a single government loan at 3½% for 40 years. This scheme combines saving through industrial prefabrication of elements of the house with the savings achieved through self-help labour of the householder, his family and friends. In the Soviet Union another approach was used. Participants were paid full wages by the labour union or other organization sponsoring the project, with the government subsidizing any difference between wages in the factory and wages earned by the householder as temporary construction worker. Industrial communities in the Gorki region built after 1957 about 60% of the state housing plan for that area. Such housing projects are financed through a fund constituting 1% to 6% of anticipated productivity of the industrial community thus created and from savings due to lower production costs. Larger deductions of from 20% to 50% are obtained from production in excess of that anticipated. In large enterprises the assembly-line method is applied and local building materials are used as much as possible, including industrial waste products.

In the United States the future householder's labour (his "sweat equity") has in some instances been accepted in place of the down payment in cash required by law in connection with mortgages guaranteed by the government. The do-it-yourself method is widely employed for improving or finishing one's own home and large industry exists to supply tools and materials. In a number of other countries, from Morocco and Tunisia to the Congo, Indonesia and Poland, self-help and mutual aid have been applied with varied success. Projects combining the contribution of the people's own labour with the technical skills and equipment provided by public or private construction enterprises have proved to be most productive. In France and Sweden savings in cash through contributed labour have been estimated at about 10% and savings in the cost of building materials through bulk purchase accounted for another 20% to 30%. In less developed countries, where construction is generally simpler and more unskilled labour can be used, savings amounting to as high as 60% have been reported.

6. The Building Industry. — The backwardness of the building industry with respect to design, technology and organization has been one of the major causes of the relatively high costs of housing in comparison with other industrial products. The lack of a stable market and the seasonal character of the building industry are partly responsible for the high outlays required for dwellings and for other structures. The major causes remain the lack of integration of the different phases of building and the uneven application of technological improvements and innovations in the factory and on the site. Thus most of the remarkable but isolated improvements in house building in the 20th century have not reached the general consumer in the form of lower rents or lower monthly payments for his home and related services. The building and building-materials industries are consequently under pressure to reorganize. In some countries this is being done with state aid, aiming at a higher output of better structures at lower cost. The first step in this process usually is the assembly (or prefabrication) of structures in shops. However, the costs of transporting the materials to the shop and the prefabricated house or its parts to the site are higher when this method of building is used. Reduction of weight and bulk is, therefore, a prerequisite for factory built housing, which also implies a high degree of standardization of materials, accessories and structural elements as well as modular co-ordination of products and designs. The more interchangeable the structural elements are and the more their dimensions are co-ordinated the greater the economy in their erection and the flexibility in their use.

The modern house is composed of two functionally distinct parts: the shell and partitions enclosing. dividing and connecting the built-in space, and the mechanical equipment (primarily utility systems) controlling and conditioning that space. Rising housing standards are reflected in the ever growing share of mechanical equipment in the total cost of building. Integrated utility systems, however, are "naturals" for prefabrication and can be used

in existing and in new urban and rural homes.

The availability of local materials, wages, transport costs, regional customs and building codes continues to determine the extent to nhich shell elements are prefabricated but, the use of local building materials in combination with elements fabricated on the site or in the factory encourages economies and variety in design.

7. Housing in the National Economy. — Expenditure on residential housing amounts to at least 1% to 2% of the gross national product of most countries; in rapidly developing countries it is 4% or more. Residential construction has constituted at least 12%, and frequently more than 25%, of all capital formation.

Housing competes for investment funds with other fields of development. The comparatively low ratio of returns in the housing field in the high-income countries and the general shortage of capital in the low-income countries heighten this competition. Also. large housing programs have tended to stimulate inflationary pressures when they mere not accompanied by appropriate counteracting measures (for instance. control of credit facilities and allocation of scarce materials and manpower). While it is generally recognized that the financing of housing must come largely from domestic sources, external financing becomes necessary, particularly in the less developed countries, where resource development projects also involve a certain amount of housing, community facilities and utilities. The problem of obtaining foreign exchange to pay for imported materials. equipment and services for such programs is particularly acute in countries in which the building and building-materials industries are insufficiently developed. If it is well planned, external financing is directed toward programs that will develop the country's own building industry.

Housing, together with education and health, belongs to the category of so-called "social overhead" projects which are basic to economic development They can be compared with the "economic overhead" projects such as transport, communications and power, which are also generally considered to be requisite for effective economic development. Overhead projects, whether social or economic, usually provide few if any direct financial returns in the short run. their benefits are derived from the more balanced development of economic activities that they make possible.

Provision of adequate housing and community facilities should accompany, if not precede. resource development in order to avoid serious obstacles to economic activity and high social costs of haphazard urbanization. But there appears to be a considerable area of conflict, in the sphere of national policy formulations in the developing countries, between the "economic" and the "social" approach The housing enthusiast seeks prompt fulfillment of housing needs; the development enthusiast sees the problem of economic development in terms of scarce capital resources which should be diverted to "more productive" tasks. Housing finance therefore involves determining the share of investment funds which a country can and should allot to housing and community improvement programs in the interest of balanced economic growth and stability.

Housing is deeply involved in the process of saving and investment. it is a type of capital formation that both encourages and strengthens long-term patterns of saving. Persons will save for better housing who would not otherwise make their savings available for capital formation. As the shortage of savings is a severe obstacle in the developing countries, this additional mobilization of capital makes an important contribution to their economic and social growth

8. Major Issues. — The principal issue in the developing countries remains the assessment of an appropriate share of national resources that must be devoted to the financing of housing and urban development programs in relation to over-all economic development. In several of the highly industrialized countries. however, part of the problem may be to determine what resources should be invested in housing and urban reconstruction to obtain and maintain full employment; for example, in a situation of reduced armament production or as a consequence of automation and other technological advances in agriculture and industry. At the same time the financing of housing for people in the lower-income groups continues to be a critical problem. New ways of stimulating the flow of private capital and of individual savings into the housing and urban development fields need to be evolved, preferably from sources not previously used.

In the highly developed countries a major issue is the development of a house-building industry that is highly integrated and capable of translating the benefits of higher productivity into lower costs to the consumer. In the less industrialized countries, honever. a two-front attack is needed: large sections of the population nhich are still living in rural areas require assistance in adjusting the use of local materials and building methods to the progress that has been made in engineering, chemistry and technology without undue additional cash outlays. The use of stabilized earth and bamboo preservation are examples of this approach. At the same time, a highly productive building industry must be developed to provide the required volume of house construction in congested urban areas at a cost attainable to lower-income families.

A growing volume of resources will be required merely to maintain the present levels of living in addition to providing new jobs for the 50,000,000 to 75,000,000 people being added every year to the world's urban population. Suitable planning on a regional scale (territorial planning) may help to guide urbanization and internal migration so that they facilitate rather than impede development. Such planning could first of all help to strengthen the economic bases of the existing urban agglomerations (thus fully utilizing the "external economies" present there); and secondly, it could create alternative centres of attraction for the movement of rural people to the cities, the brunt of which has been borne almost entirely by large metropolitan centres. Judicious location of new industries within a region and the development of transport in a more rational and perhaps also a more decentralized pattern could facilitate the creation of these new centres.

The world-wide problems of housing and urbanization represent an area in which the role of the social scientist comes into sharp focus, not only in the realm of theory and planning but especially in the realm of action. In view of the growing concentration of people in urban areas, failure to plan for and guide the growth of cities would inevitably deprive a very substantial part of humanity of the right to a decent living in a decent environment. Three types of research and surveys may be useful in this connection. For the determination of national policies and broad, regional development programs a general but true picture of social and economic trends may suffice. More precise data are necessary for action at the local level in connection with community planning and land use. Finally, a specific project for a residential community or neighbourhood must be based on definite knowledge of a multitude of economic, social. cultural, physical and other facts. By means of suitably designed surveys the social scientist can provide an appropriate basis for a continuing evaluation of the social implications and consequences of various development programs. (ET. W.)

III. HOUSING IN THE UNITED STATES

A. Growth of a Problem

During the first two centuries of building in the United States, houses were erected without being regarded as a public problem. In the atmosphere of an expanding frontier economy, home-financing facilities available to the individual were meagre as more lucrative investment attracted capital into other fields. Investment in land and rental housing located in commercial and later in industrial centres became highly profitable and speculative ventures. Heavy waves of immigration accelerated the growth of housing need.

Throughout the 19th century housing as a problem of urbanization grew in proportion to the expansion of the urban population. Between 1320 and 1840 the urban population trebled. A sanitation report of 1834 called attention to the effects of bad housing conditions on health in New York city. At later dates similar reports for Boston, Mass., Philadelphia, Pa., and Washington, D C., focused attention of sanitation authorities on prevailing bad housing conditions. As population and industry moved westward, in-

land cities had like experiences.

With the spread of industrialization and the corresponding commercial expansion, urban growth brought governmental action to regulate city housing construction in the interest of public health and safety. Through the second half of the 19th century and the first three decades of the 20th century, however, this action was confined almost exclusively to the exercise of police powers in the various states to enforce certain minimum criteria for residential construction. The first action of this type was taken in Sew York city in 1866 and 1867 with the establishment of a board of health and the adoption of the New York city tenement house law.

While the institution of municipal and state building regulations in the latter half of the 19th century prohibited the more flagrant housing practices injurious to public health and safety, it did little or nothing of a positive nature to alleviate the causes of bad housing. However, some private measures had been undertaken to help meet the housing needs of the modest-income, urban industrial population A report made in 1836 on conditions in Lowell, Mass., indicated that New England manufacturers in some instances as a function of management, provided housing accommodations for their labourers. The building association movement, which started in Philadelphia, Pa., in 1831, spread rapidly during the following years to provide a sounder basis for home purchase by moderate-income workers.

By the turn of the century a number of employers had sought to relieve the housing problems of their workers. The Pullman experiment in Chicago, Ill., much discussed during the 1890s, was wrecked on the rock of paternalism. The Boston Cooperative was started in 1871. The Philadelphia Octavia Hill association. uhich repaired and managed old houses, dated from 1896. The Washington Sanitary Improvement company and the New York City and Suburban Homes company, both with voluntarily limited dividends were of the same period. The spreading awareness of housing troubles resulted in wide-scale enactment of state and local housing laws, some of which nent considerably beyond others in requirements as to open space and modern improvements.

The relatively high cost of housing, the inadequacies of credit and the costly and hazardous forms of home mortgage finance used throughout the 19th century had been major obstacles to onnership Of the 10 275.000 nonfarm dwellings occupied in 1900. nearly tno-thirds were rented The increase in ouner-occupied homes which occurred during the subsequent years, from 36% in 1900 to about 60% by the 1960s, reflected the influence of many factors, including increased purchasing power, the greater availability of home mortgage credit and improvements in the form and structure of mortgage debt.

In the boom of 1919 after World War I. the volume of housing increased rapidly, only to fall back the following year in the face of competition from other types of construction for manpower and materials which priced many buyers out of the market; a shortage of mortgage credit further restricted activity. Following the readjustment of prices, however, the volume of new home building rose rapidly. reaching a new annual peak in 1925 of 937,000 nonfarm units started

Except as home-loan amortization was required by savings and loan associations and other scattered institutional lenders, most of the home financing in the 1920s. as before, involved the straight type of mortgage. due in full amount upon maturity. Also, housing loans in general involved a low-ratio first mortgage of but a few years' term with the frequent use of second and third mortgages—the junior lien loans bearing higher interest rates and short terms However, the general rise of prosperity coupled with a long-term upward trend in property values tended to conceal whatever defects there were in the home-financing structure.

B. The Government's Role in Home Financing

1. Beginnings. — At the turn of the 1930s, spreading unemployment and declining incomes abruptly narrowed the market for homes. The volume of housing started fell off rapidly. In the five years 1930 through 1934 home-building volume barely equaled that reached in a single year in the mid-1920s. At the same time the forces of deflation brought on a wave of home mortgage foreclosures.

The Federal Home Loan bank system was created in 1932 to strengthen home-financing institutions of the nonbank type. The system was designed to divorce its membership from complete dependence upon commercial bank credit for their borrowings, through reserve credit functions financed by the sale of Federal Home Loan bank securities on the open market. The system was also intended to assure a better geographic distribution of funds for home-financing purposes. Its establishment marked the beginning of a series of federal programs in housing designed to aid and supplement private enterprise in this field.

Although it was apparent that fundamental long-range approaches were needed, the severity of the crisis demanded emergency action in housing as it did in other fields. The Home Owners' Loan corporation (HOLC) was established as a temporary emergency operation in 1933 to relieve distressed homeowners and increase the solvency of credit institutions By that time the rate of home loan foreclosures had risen to about 1,000 a day. HOLC purchased the loans of more than 1,000.000 homeowners in its three-year period of rescue refinancing and recast these loans on a monthly payment basis with amortization over terms as long as 15 years. Subsequently, in 1939 HOLC was authorized to extend the terms of the loans it held, where necessary, to as long as 25 years. By 1951 HOLC had liquidated its total investment of about $3,500,000,000, with a profit of $14,000,000 to the government

The Home Owners' Loan act also authorized the chartering and supervision of federal savings and loan associations by the Federal Home Loan Bank board (FHLBB) to assure an adequate geographic distribution of housing credit facilities. This latter authorization constituted the second application of federal government powers to meet the long-range requirements of the housing sector of the national economy.

As the nation devoted greater attention to its economic health, special importance was attached to the stimulation of increased private building. particularly private residential construction. The National Housing act of 1934 authorized establishment of the Federal Housing administration (FHA) to undertake a nationwide system of home loan insurance. The same act provided for creation of the Federal Savings and Loan Insurance corporation (FSLIC) to provide protection of savings in insured home-financing institutions of the savings and loan type up to $5.000 per investor. In 1950 the extent of this coverage was increased to $10,000 per investor. These two programs represented the third and fourth long-range positive applications of federal government powers to strengthen the housing industry.

The Federal Housing administration was created to provide a system of mutual mortgage insurance. applicable to mortgage loans financing the purchase of both new and existing one- to four-family structures and to afford protection on repair and modernization loans for housing and on loans financing rural housing and nonhousing construction. Capitalizing on the experience of the past. the FHA system of mortgage insurance provided an economical means of home financing under liberal private credit terms with first mortgage loans as high as 80% of property valuation, the principal amount of the loan being reduced through regular monthly payments including payments for interest. property taxes and insurance. FHA-mortgage insuring authority was extended to afford safe, economical financing methods for large-scale private-rental housing projects. By the latter part of the 1930s there also evolved the application of special mortgage insurance provisions under the mutual provisions of title ii to encourage production of lower-cost housing, particularly for owner occupancy.

Another significant purpose of the FHA program was to establish and promote, through its mortgage insurance requirements. sound minimum standards of construction, design, location and neighbourhood for housing for families of moderate means. Its influence on the improvement of housing standards and subdivision development extended beyond its own operations to the general field of house construction and development and of consumer demand.

From 1935 through 1939 the volume of home building almost

doubled that for the preceding five years. Of the 1.782.000 dwellings constructed in the 1935–39 period, a great majority (96%) were built by private investment

The 1930s ended with limited federal assistance in home building a generally accepted fact, but with the extent and nature of the government's future role in the field under debate.

The FHA-mortgage insurance program, skeptically received by the industry at the outset. developed into a commonly used method of financing, so that by the end of 1939 FHA had insured 497.000 mortgages for the purchase of new and existing homes, in addition to insuring lenders against loss on 2,346,000 home repair and modernization loans. The membership of the Federal Home Loan bank system included 3,920 home-financing institutions, of which 3,870 were savings and loan associations. The HOLC was no longer needed to refinance distress loans and continued only to administer and liquidate its holdings. The federally aided public-housing program (see *Housing Problems and Programs* below) was just getting under way.

2. Wartime and Postwar Programs.— The president declared a national defense emergency on Sept. 8, 1939. By the middle of 1940 rising prices and sharply mounting housing requirements in the defense centres, where workmen and their families were migrating in large numbers, produced problems that could not effectivelybe met through the normal peacetime operations of the industry. The government intervened initially by converting its existing housing aids to defense-housing purposes.

Low-rent public housing under construction or not yet started was diverted to wartime housing uses; the war and navy departments received appropriations to build housing for defense purposes; congress in the Lanham act. authorized federal funds to finance defense housing. This act became the basic measure for construction of federally owned wartime housing.

After the attack on Pearl Harbor on Dec. 7, 1941, housing, along with other major segments of the production economy, was swiftly brought under complete mobilization for war purposes.

The first housing action, in Feb. 1942, was to set up the National Housing agency (NHA) as a war emergency operation and to consolidate in it nearly all the nonfarm housing functions of the government. Price and rent controls were instituted at the end of Jan. 1942. affecting building materials and existing housing. By March the NHA and War Production board (WPB)had worked out the main lines governing new housing production under WPB conservation order L41. The broad outlines of the arrangements were as follows: The WPB issued priorities only in accordance with NHA programing schedules; KHA programed housing only for additional necessary in-migrant war workers who could not be housed in existing housing; new housing was limited to essential in-migrant war workers; the size of new dwellings was limited, the amount of critical materials was reduced and a $6.000 ceiling was put on sales price. New rental housing was covered by rent control.

Through this program, plus the controls on manpower and prices, the government developed effective control over housing construction, private and public, during World War II. Private builders were encouraged to build as much of the new housing as possible. Direct federal financing was used where the housing could not be suitably provided by private industry in time to meet the need.

As war requirements mounted and materials and labour became more scarce, an increasing proportion of the federally financed wartime housing built was of a temporary type. As war production needs shifted, a substantial amount of temporary housing nas moved and re-erected for use in other locations in order to conserve materials and labour. Nevertheless, two-thirds of the wartime housing program was carried out directly through private home builders, thereby employing a substantial core of the industry to serve war needs and maintaining the basis for rapid expansion to meet the tremendous demand for housing that developed at the war's end

The postwar housing problem became a matter of early concern. In June 1944 congress enacted the Servicemen's Readjustment act, including home loan guarantees for veterans up to $4.000, or 50% of the loan, whichever was less; later increased to $7.500 or 60%. As the peak of war housing construction passed, the NHA, to ease the housing situation, gradually expanded the authority to build homes to include hardship needs as well as in-migrant war workers. Following the end of the war WPB on Oct. 15, 1945, lifted its conservation order L41, to release materials for peacetime construction. The heavy backlog of demand for materials for new factories, for deferred commercial, educational and community construction and similar needs quickly outbid home builders for the limited supply of materials. (See *Housing* Supply *and Demand,* below.)

3. Permanent Housing Agency Established.— In 1947 the president issued reorganization plan no. 3, which replaced the temporary grouping of federal housing agencies in the National Housing agency with a permanent organization, the Housing and Home Finance agency (HHFA). The HHFA was created with an office of the administrator and three constituent agencies: the Federal Home Loan Bank board, the Federal Housing administration and the Public Housing administration (PHA). The office of the administrator co-ordinated the activities of the constituent agencies and supervised activities under the Lanham act, which remained in effect. The FHLBB operations were responsible primarily for providing a credit reserve for home building and insurance for savings of investors in home-financing institutions. The FHA administered the home-mortgage insurance programs and underwrote modernization and repair loans. The PHA administered the low-rent public-housing program and remaining wartime housing activities.

In the course of the following decade certain additional functions of the government in relation to housing were recognized and included under the administrative responsibility of the HHFA By the mid-1950s these included the Federal National Mortgage association (FNMA), the Urban Renewal administration and the Community Facilities administration. Meanwhile, in 1955, the Federal Home Loan Bank board was removed from the HHFA and made an independent agency.

4. Government's Changing Role.—Guidelines for the government's role in housing in the 1950s were initially laid donn in the Housing act of 1949: continued support of privately financed housing under FHA-mortgage insurance and Veterans administration (VA) guarantees and a new and expanded role in community assistance both in public housing for low-income families and in community assistance to clear and redevelop slum areas. Other acts added special types of aids, such as direct loans to meet expanded housing needs at colleges and universities and special FHA-mortgage insurance for housing of military personnel at permanent posts in the enlarged post-World War II military establishment. The Korean emergency which arose in 1950 temporarily curtailed development of these programs.

Under the Housing act of 1954, based upon the recommendations of an advisory committee appointed by President Eisenhower to examine housing policies and programs, all existing housing programs were continued except the one for housing research. A number of important modifications in the basic statutes were made and new or broadened programs were introduced.

To meet higher cost levels and to broaden the mass market. FHA-mortgage terms have been continuously liberalized. both for new construction and for existing housing. By the end of 1960 the FHA had insured a total of about $67,400,000,000 in mortgages on more than 5,800,000 homes and 900,000 apartment dwelling units. In addition, the FHA had undernritten a total of $24.000,-000,000 in short-term home-improvement loans. The home-loan guarantee program of the Veterans administration also continued to provide an important source of home financing. From its inception in June 1944 the VA had guaranteed more than 5.000 000 home loans with a total mortgage amount of nearly S50.000.000.-000 Under both FHA and VA programs defaults and foreclosures continued to be low.

Through purchase of mortgages backed by the FHA and VA nearly $7,000,000,000 in government credit had been channeled into the mortgage market by the Federal National Mortgage association: The government continued, moreover, to supply funds to

purchase certain types of special mortgages, such as those for urban renewal, military housing and housing for the elderly. In addition the Voluntary Home Mortgage Credit Extension committee was established in 1954, under private direction but with the government providing administrative costs, to find private mortgage lenders for persons in small towns or for minority groups unable, though otherwise qualified, to get loans from local institutions.

Savings and loan operations, representing about 40% of the nation's home-mortgage financing, continued to expand rapidly with the support of the Federal Home Loan bank system. Other government aid programs that were continued or expanded included FHA-insured co-operative housing; liberalized terms for FHA-insured loans for home repair and modernization; and special FHA-mortgage terms for multifamily housing and home purchases for a new field of special housing needs, that of the elderly.

Housing policies became more closely geared to over-all fiscal and economic conditions. Interest rates varied depending on the supply of and the demand for mortgage money. FHA and VA maximum interest rates were increased in 1953 to 4½% as money costs began to rise. In 1955 limited cutbacks were imposed to restrain the housing boom. In 1961 FHA maximum rates went up to 5½% for home mortgages and 5¼% for most multifamily unit mortgages. The VA rate was increased in 1959 to 5¼%.

5. The Housing Economy. — The construction of more than 1.000.000 dwelling units a year during the 1950s was made possible by the ready availability of funds for mortgage investment and resulted in a tremendous increase in mortgage debt. At the end of 1950 the total estimated mortgage debt on nonfarm dwellings was $53,600,000,000 By the end of 1960 it was $160,500,000.000. Of the total debt the FHA-insured segment was 20%, the VA-guaranteed mortgages constituted 19% and the conventional loan segment 61%--mortgages held by savings and loan associations, mutual savings banks, life insurance companies, commercial banks and others.

C. Housing Problems and Programs

1. Slums and Slum Clearance. — Slums are residential areas that are physically and socially deteriorated and in which satisfactory family life is impossible. Bad housing is a major index of slum conditions. By bad housing is meant dwellings that are lacking in light and air, without adequate toilet and bathing facilities; that are in bad repair, damp and improperly heated; that do not afford opportunity for privacy in family living; that are subject to fire hazard: and that are overcrowded on the land, leaving no space for recreational use. Such in varying combinations are the characteristics of slum housing. To these one may add other indexes of slum conditions. They are to be found in congestion of population, both on land and in dwellings, high death and morbidity rates from contagious and chronic diseases, high infant mortality, a general prevalence of destitution, deteriorated or even degenerating neighbourhood conditions, the lack of adequate municipal or social services and a high incidence of dependency, child delinquency and crime. It should always be noted that slums involve people as well as buildings.

The growth of slums became an acute problem in cities of the eastern seaboard of the United States, especially in New York city, with the heavy immigration that began with the Irish about the middle of the 19th century. The problem spread westward as successive waves of immigrants colonized in urban areas, taking over housing accommodations that had been abandoned by former residents, that were already deteriorated, and which quickly became slums.

Besides immigration, other factors contributing to the development of slums may be cited as follows: low wages and poverty, preventing people from paying for decent dwellings; the invasion of business and commerce into residential areas, leading to the neglect and abandonment of dwellings; the haphazard, uncontrolled growth of cities; leniency toward the owners of dilapidated property in the matter of tax assessments. and in the toleration of low standards in the remodeling of old dwellings; racial or other restrictions limiting the location or quality of housing available to certain groups; and municipal government that neglects the adoption and enforcement of regulations with respect to sanitation and safety. Finally should be mentioned a general apathy regarding the menace of slums.

Initial efforts in the late 19th century and the first three decades of the 20th century to halt the growth of slums and improve housing standards sought unsuccessfully to correct conditions through the exercise of the police powers of the states (see *Growth* of a *Problem,* above).

2. Early Federal Programs. — Much that was undertaken in housing in the 1930s was motivated at least in part by the desire to stimulate private business and employment or to provide work relief. In 1932 the ne ly created Reconstruction Finance corporation (RFC) was authorized to finance low-rent housing and slum reclamation operations undertaken by limited-dividend corporations. Only two projects, however, were financed under this authority.

The inauguration of federal work relief programs in 1933 brought with it the direct application of federal funds to the construction of housing. Under the program of the Public Works administration (PWA), 21,600 dwellings in 50 public low-rent housing projects were built in 37 cities. In addition 15.000 dwelling units were built with relief funds as subsistence homesteads for rural and suburban nonfarm workers, rural farm-resettlement projects and in three green belt towns, built as models in land planning and suburban development for salaried workers. Also, direct loans from relief funds were made to seven limited-dividend corporations for the construction of 3,065 dwellings.

The development of these programs of federal assistance brought to light the meagerness of knowledge in the housing field. As a remedy to this situation a real-property inventory was undertaken in the last half of the 1930s in more than 200 areas, mainly by local authorities working in co-operation with state and federal works projects administrations, and mas financed through emergency relief funds. One of the most important contributions of the real-property inventory was the documented substantiation of the need for effective measures to improve the housing conditions of low-income families.

3. Local Responsibility. — Experience indicated that direct federal building of low-rent housing, although it served a housing purpose, did not contain the best approach to the housing of low-income families, largely because it by-passed local responsibility in this field. The Housing act of 1937 introduced a decentralized approach to this problem through a program of federal loan and subsidy aids to local public bodies building and operating low-rent public housing for low-income families. The Housing act placed upon the states and their localities the responsibility for chartering local housing authorities. These authorities in turn were required to study the low-income housing needs of their respective communities and to apply to the federal government for loan assistance to finance project construction and for subsidy aids to make possible the operation of projects at low-rent scales within the economic grasp of low-income families. Under this program and the earlier program of direct federal construction a total of more than 191,000 low-rent public-housing units was erected by the end of World War II, part of it being built initially to serve as wartime housing but converted to low-rent use after the war.

4. Comprehensive Survey. — The first comprehensive national survey of housing was authorized as part of the decennial census for 1940. This census reported a total of 37,325.000 dwelling units in the nation. of which 21,616,000 were classified as urban, 8,066,000 as rural nonfarm and 7,642,000 as farm. Of the urban units, 5,735.000 were reported to be lacking indoor running water, bath or toilet or to be in need of major repairs, or both, Of the rural nonfarm units, 4,892,000 were deficient in these respects, and 6,605,000 of the farm units were similarly deficient.

By the time the census results were available, however, long-range considerations of housing were eclipsed by the immediate needs of the war.

5. Later Programs. — After World War II exhaustive congressional investigations of housing led to enactment of long-range legislation in the Housing act of 1949. This act marked a significant extension of government responsibility in housing beyond the

previously established aids to private home financing. In addition to expanding the earlier public-housing program it added three new fields of activity—slum clearance and urban redevelopment, housing research, and farm housing (under a program to be administered by the department of agriculture)—and stated a basic national housing policy to be applied to all government housing operations. Private enterprise was to be encouraged, and local bodies encouraged and assisted, in the direction of remedying "the serious housing shortage, the elimination of substandard and other inadequate housing through the clearance of slums and blighted areas, and the realization as soon as feasible of the goal of a decent home in a suitable living environment for every American family . . ."

In addition to providing for the continuance, on liberal terms, of the FHA and other peacetime home-financing aids, the Housing act of 1949 set up a new attack on slums, under which the federal government would pay to communities up to two-thirds of the net cost of acquiring. clearing and disposing of slum areas for any type of approved new uses, and would make loans to finance the execution of such projects. New state legislation was also enacted in most of the states in a short time to extend the power of eminent domain to local agencies carrying out such programs, and the use of such powers for clearance of slum areas was later upheld by most state courts and the U.S. supreme court.

The new area approach to slum clearance succeeded the earlier method of replacing slums with low-rent public housing. The 1949 act, however, also provided for an enlarged public housing program for low-income families, authorizing a total of 810,000 additional units to be built at the rate of not more than 135,000 units a year in the following six years.

6. Growth of Urban Problems and Programs.—The decennial census of 1950 provided the basis for detailed analysis of the national housing supply, the adequacy of existing programs and, to a large extent, the further development of federal, state and local legislation and programs. The housing supply had increased 23% since 1940, despite the lean war years, to a total of 45,983.000 units, of which 29,569,000 were urban, 10,056,000 rural nonfarm and 6,358.000 (a 17% decline) farm. Measured by structural condition and provision of essential sanitary facilities. the proportion of substandard units to the larger total was smaller, but the number of such units remained about the same. The census showed that 64% or nearly two-thirds of the population lived in urban areas, ranging from small towns and suburban communities to swelling metropolitan areas that were literally merging with one another to form continuous stretches of urban life. Housing and living standards were inseparably intertwined with this complex of forces underlying urban and industrial expansion.

The most significant new development in government activity related to housing lay in the field of the redevelopment and renewal of urban areas. The country's rapid urbanization accelerated by the war had enlarged many growing urban problems, including those of modern traffic, community facilities needed in the rapidly expanding suburban sections, expansion room for business and commerce and the preservation of the values of existing homes and neighbourhoods being lost in the spread of blight.

The Housing act of 1954 carried the area approach to urban replanning and redevelopment instituted by the Housing act of 1949 to its broader and logical conclusion by setting up a basis for combined local action with federal aid. The objective was not only to clear slums but also to prevent their continued growth by planned action in the whole range of urban problems, along with the rehabilitation of areas afflicted with blight, but not badly enough to require clearance, and the conservation of areas not yet so attacked.

A key part of this new program was the requirement that a locality have a comprehensive "workable program" for the prevention and cure of slums and blight, covering: sound codes and enforcement; planned public works and thoroughfare development; a master plan for the community's future growth; and an analysis of neighbourhoods to guide the clearance, rehabilitation and conservation activities under the new program. New federal aids were added, and most of these were made available only to communities with acceptable workable programs, reflecting the objective of requiring greater local initiative and responsibility in connection with federal assistance.

Two new types of FHA-mortgage insurance were enacted to implement the new urban renewal program. One of these, sec. 220 of the National Housing act, extended FHA-mortgage insurance to the financing of new or rehabilitated housing in urban-renewal areas. The other, sec. 221 of the act, provided FHA-mortgage insurance up to 100% of value for new or rehabilitated housing for lower-income families displaced by urban renewal or other government activities. Federal grants were also authorized to assist planning activities by small communities and metropolitan regions and to carry out demonstration projects in the urban-renewal field.

Under the expanded urban-renewal program 780 communities had active workable programs by the end of 1960. Federal grant reservations and contracts had been approved for 870 projects in 475 communities for a total of $1,900,000,000. Public housing, still the most controversial of the housing programs, continued at a reduced rate after 1953 compared with the 135,000 units annually authorized by the 1949 act. The annual authorization varied from 35,000 to 45,000 units. These were also more closely tied to the rehousing needs resulting from slum clearance and other governmental activities.

Locally the urban-renewal and public-housing programs are administered by separate authorities or by city departments. The number of such agencies grew from 17 in 1935 to more than 2,000 in 1960. Closely related to these programs is the enforcement of minimum standards of housing usually set forth in housing codes which, in large part due to federal requirements and stimulation, were adopted by many communities.

The trend in federal housing legislation after 1932 was toward increasing scope and comprehensiveness. Another major step in this direction was taken by the passage of the Housing act of 1961. Existing programs are continued and in some cases expanded with increases in housing and over-all community development. The mortgage insurance program of the Federal Housing administration was continued and further liberalized. An additional 100,000 dwelling units were authorized for low-rent public housing. For urban renewal an additional $2,000,000,000 in capital grant funds were approved. Authorizations for urban planning, college housing, community facilities and housing for the elderly were increased. New activities included FHA insurance for loans for home improvements up to $10.000 for up to 20 years at an interest rate not to exceed 5%; expansion of "Section 221" program to include moderate income families generally and 100% mortgages for financing of multifamily projects at the market interest rate. The expansion of the scope of the programs administered by the Housing and Home Finance agency was marked by the authorization of $50,000,000 for grants to local public bodies for aid in the acquisition of open land for recreational and other purposes. The act also provided for grants for comprehensive planning for urban mass transportation, for demonstration projects for its improvement and for loans for transportation facilities.

7. Minority Groups.—Incomes and employment opportunities of minority groups have greatly increased during and after World War II. This was reflected in improvement of housing occupied by nonwhite families. Home ownership by this group increased by 46% in the 1950–1960 period as compared with the over-all rate of increase of 39%. The number of units occupied by nonwhites that were dilapidated or lacked certain sanitary facilities declined by 500,000 during the decade. In spite of this improvement 20% of all homeowners' units lacking some or all plumbing facilities and more than 30% of the corresponding rental units were occupied by nonwhites.

The differences in housing conditions of white and nonwhite families are partly due to such factors as education and occupation and partly to patterns of residential segregation. The U.S. Commission on Civil Rights was created in 1957 to find facts which might subsequently be used as the basis for legislation or executive action. It reported that "in the past decade 17 states and numerous cities have taken legislation and administrative action to eliminate racial discrimination in housing, but the Federal Government has not acted meaningfully in this connection," *i.e.*, "to insure that

all people have equal access to the housing benefits it offers." (U.S. Commission on Civil Rights *Report* 4: Housing, p. 139, Government Printing Office, 1961.)

D. Housing Supply and Demand

1. Background.——With the removal of wartime restrictions on building and the rapid demobilization of men and women in the armed forces at the end of World War II. the shortage of housing to meet the suddenly released civilian and veteran demand became acute throughout the country. An emergency program was put into effect in 1946 designed to speed production of construction materials. increase the supply of construction labour and channel it as far as possible into housing construction and to give returning veterans priority in the rental and purchase of new housing. Under the forced draft of these measures, production of both materials and housing advanced steadily as bottlenecks were overcome in key materials and labour. For the year 1946. 670.500 new permanent nonfarm units were started, compared with 209,300 the preceding year. In addition. several thousand units of war housing barracks, trailers and other types of structures provided temporary housing to ease the suddenly swollen demand for additional shelter.

During the next four years housing production continued to expand. The number of new nonfarm units reached 849,000 in 1947, 931.600 in 1948, 1,025,100 in 1949 and a record high of nearly 1,396,000 in 1950.

Satisfaction of the most pressing needs for new shelter during the final years of the decade effectually marked the end of the war and postwar eras and provided an orderly transition of the housing economy from one of emergency techniques to one of long-range programs for sustaining housing production at a high level.

Before housing could settle down to this new prospect of peacetime prosperity. however, it had to weather another crisis following the Korean outbreak in June 1950. Home building, however, continued to exceed 1,000,000 units annually during the next decade.

Housing through the 1950s was dominated by large market demands resulting from rising incomes and standards of living. The home-building industry expanded rapidly to meet these demands. The problems in the housing field shifted away from the limited productive capacity that existed after the war to the ability of credit resources to satisfy the housing market, along with other increased consumer and capital demands, without inflationary strain on the credit system. It was a period of prosperous expansion in which concern centred more on the dangers of too much too soon rather than too little too late.

In addition, residential urban expansion outran the confines of developed areas in the suburban areas, creating record demands for new community facilities and services and simultaneously adding burdens to the already congested and deteriorating central areas of the urban structure. The problems of community needs and growth became an inseparable part of housing growth.

2. The Housing Market.—In the first years of the 1950s the most urgent needs resulting from the curtailment of construction during the defense and war period had been met. The major demands now arose from the changes in size of families, their improved economic status. increases in and shifts of population, and changes in the population structure.

In the decade from 1950 to 1960 the total population increased by 28.000.000 or 18.5%. Of this increase nearly 85% occurred in the metropolitan areas. These areas increased by 26%. However, the total increase in the central cities was only 1.5% if annexations are disregarded. More than one-fourth of the central cities lost population during the decade while the population of the suburban rings increased by nearly 50%. With the construction of approximately 15,000.000 units during this period, the housing supply increased more rapidly than the population. As a result the number of persons per room declined as well as the number of persons per dwelling unit. The change in the supply and demand situation was also reflected in the changing vacancy rates. During the war the number of nonfarm units available for sale or rent dropped to less than 1% of all units. By 1950 it had increased to 1.6% and by 1960 to 3.2%. The vacancy rate for available rental units only rose from 1.101, in 1950 to 2.6% in 1960.

In the early years of the decade households increased rapidly because many families that had been doubled up during the housing shortage found housing units of their own to live in. As this need was met the annual increase of households declined from about 1,500.000 to about 900,000 by the 1960s, when the trend again changed as the babies born during the 1940s began to reach marriageable age and establish families of their own. During the 1950–60 decade the population of the country grew most rapidly in both the younger and the older groups: the population of 65 and over increased by 34.7%; the population under 18 increased by 36.7%: and the population between these two age groups grew by only 7%.

An additional demand for housing beyond that due to population increase results from the continuing high mobility rate. Every year one out of every five persons in the United States moves to a different home, many across county and state lines, in search of better employment opportunities or improved living environments. This has been a major factor in the growth of the suburban rings in the metropolitan areas and in the increase of the population of such states as Florida (95%) and California (53%) and such cities as Phoenix and Tucson. Ariz. (over 300%), and .Houston, Tex., (56%) during the decade.

The continuing rise in the average level of incomes also had a considerable impact on the volume of residential construction. The median income increased from $3,000 in 1947 to $5.600 in 1960 or from $4,000 to $5,600 in terms of 1960 dollar purchasing power.

Another factor of increasing importance stemmed from the decrease of the existing housing supply through demolition due to governmental programs such as urban renewal, public housing, highway construction and stricter enforcement of municipal codes, and because of losses from fire, floods and other disasters.

In spite of the substantial improvement in housing quality which occurred during the 1950s there were still 11.000,000 dwelling units in 1960 which were dilapidated or lacked private toilet or bath or hot-water facilities. A large part of this segment of the housing supply represented additional potential demand for new construction or for extensive rehabilitation as incomes and housing standards continued to rise.

Other factors sustaining the demand for housing included financial arrangements facilitating home ownership and the stimulation of the flow of mortgage funds by Federal Housing administration and Veterans administration programs discussed above.

3. Cost Trends.—The trend toward larger and better houses is indicated by cost data. In 1950 the average cost of permanent privately owned one-family units mas $8.674 (exclusive of cost of land and site improvements, architectural and engineering fees, selling cost, profit, etc.). The average cost increased yearly after 1950. and by 1960 it had reached $13,050, an increase of 50%. Since the construction cost index of identical units went up by 30% during this same period. it is clear that the average quality and size of single-family residences had increased substantially on the average. This was confirmed by studies on characteristics of new units which showed substantial increases in the percentage of new one-family homes having a floor area of 1.000 sq ft. or more. of those having more than one complete bath and of those with three or more bedrooms.

Another aspect of this trend toward greater quality and space was the increase in one-family dwelling units. In the 1920s about 60% of new construction was in such structures. In the early post-World War II period construction ranged between 80% and 89%; by the mid-1950s it had risen to 91%; but by 1960 it had declined to 77% as the volume of apartment house construction began to increase again.

4. Home-Building Industry.—In 1938 the US. bureau of labour statistics found in a study of 72 cities that 63.8% of builders of single-family houses constructed only one house a year and that 86% of all builders erected no more than 4 houses a year. The U.S. residential building industry functioned not as an independent industry but rather as a sporadic aggregation of elemental groups

drawn together generally for the purpose of producing one or several houses. While there was a growing number of builder organizations consisting of relatively stable and permanent groupings of architects, real-estate brokers, general and subcontractors. a labour staff, etc., in the over-all industry, these were the exceptions rather than the rule.

A series of functions must be performed in order to bring additional housing into use. It includes the selection and acquisition of suitable land, the preparation of land for residential use, the planning and design of the structure, the financing of construction, the acquisition of materials, the erection of the structure and the financing and the marketing of the completed housing. In practice the erection of the structure is further subdivided into a series of operations including the excavation for foundations and basement, the laying of the foundation. the framing of the structure, masonry work, installation of plumbing, heating and electrical equipment, lathing and plastering, flooring, painting, flashing and tinsmithing, roofing, glazing and landscaping.

During the 1950s the home-building industry was able to take advantage of, or to develop more rapidly, various technological and management improvements. In 1959 a study conducted by the National Association of Home Builders indicated that 59% of all single-family homes were constructed by 10% of the home builders. This top group averaged over 350 housing units per year. Also, one-half of all the home builders in this study accounted for 92% of the total number of new residential units that were constructed

5. Mobile Homes.—A mobile home is a movable or portable dwelling designed for year-round living and built on a chassis without a permanent foundation but connected to electric and other utilities. Mobile homes commonly are referred to as trailers or house trailers and sites developed for their location are known as trailer parks. There are more than 16.000 such parks in the United States, with more than 500.000 spaces. Large mobile homes are towed to their sites by truck tractors and are moved infrequently; expandable-type units feature living rooms that will expand from 10 to 20 ft. in width.

Mobile homes since about 1930 have provided an increasing number of primary dwelling units to the total housing supply. In 1960 it was reported that more than 3,000,000 people lived in such units. The increasing number of mobile homes and the growth of mobile-home parks, however, created additional problems for many communities in relation to the provision of community services and facilities, schools and city and country planning, zoning and taxation.

6. Farm Housing.—Since farm housing is an integral part of the source of income and employment and is not readily separable from the farm as a whole as security, the nonfarm housing programs have generally not been applicable to farm housing problems. Farm housing, therefore, has been dealt with chiefly as an agricultural matter, the principal government program having been the farm ownership loan program under the Farmers Home administration in the U S. department of agriculture.

The Housing act of 1949 set up in the department of agriculture a sizable but still experimental program of loan and grant assistance and technical advice for farm housing and other farm buildings in an effort to provide a practical method of bringing assistance to farm housing comparable to that available for nonfarm housing. However, in 1951 the necessary funds to continue the grant program were discontinued and this part of the program was discontinued.

Data on farm housing have been particularly inadequate. However. greater farm prosperity in the war and postwar years was reflected in substantial improvement in the condition of occupied farm housing. Highway expansion in farm areas and the spread of electrification accelerated improved standards of housing and housing activities. (R. M. FY.; A. MACD. C.; D. E. MA.)

IV. GREAT BRITAIN AND THE BRITISH COMMONWEALTH

A. GREAT BRITAIN

There probably has been a housing problem in Great Britain, as elsewhere, for as long as there has been a settled population, in the sense that a proportion of the people has always had to live at a standard below what was technically possible and desirable at any particular date. The 20th-century housing problem. however, had its more immediate origin at the end of the 18th century. After the mid-19th century the movement for housing reform endeavoured to improve conditions in three ways: by overcoming shortage; by replacing and improving slums and obsolete dwellings; and by raising standards of accommodation and amenity. A brief survey of progress made through the agencies of philanthropic effort, state intervention and private enterprise will provide a background to an assessment of the housing situation and the outstanding problems after the mid-20th century.

1. Housing Conditions in the 19th Century.—The population of England and Wales was estimated at about 6.000.000 in 1750. By 1801 it was nearly 9.000.000, and in less than two generations it had doubled itself, a process which was to be repeated before World War I, by which time the population was ovkr 36,000,000.

It was not alone the increase in population which so radically altered the whole aspect of the country but the fact that the industrial revolution was concentrating the population in towns, so that places such as Liverpool, Manchester. Birmingham and Sheffield, which were small country towns of from 4,000 to 10,000 inhabitants at the beginning of the 18th century, had increased from five- to tenfold by 1800 and continued a steady and rapid growth up to, and in most cases even after. World War I.

Hands were needed for the new factories and families could no longer maintain a livelihood in the countryside; this created a sudden and enormous demand for accommodation in the cities. Such accommodation had to be within walking distance of the main centres of employment and it had to be cheap since wages were low. There was as yet no appreciation of the danger to public health from the crowding of population into towns or from the lack of proper water supply, town sewerage and house drainage. It is not surprising that employers of labour in mine or factory, who were often prepared to allow men, women and children to work under inhuman conditions, should show no concern for the conditions under which they lived. Town landlords were interested only in obtaining the maximum rent at least cost, and local and central authorities were frequently ignorant, indifferent or corrupt. Thus the only accommodation which the town labourer, and even the better skilled artisan who had become a factory hand, could afford or obtain was little more than the bare essentials for shelter.

Evidence of the resulting conditions is contained in reports of mid-19th-century inquiries, the warnings of medical officers and sanitarians and in the novels and other writings of such authors as Charles Dickens, who thus supported a reform movement. For the most part the dwellings of the English urban poor were of two stories, built in terraces, sometimes back-to-back so that each house had only one outside wall and sometimes around narrow courts opening from the main thoroughfares. Their construction was shoddy, walls were not damp proof and floors were frequently the bare earth. There was no paving or drainage and the cesspool, if such existed, could often only be built under the house itself. Outside toilets and pumps were shared by many households, and in many districts people had to beg or steal water. Overcrowding was rife. Thus all these circumstances, together with the prevailing poverty and often poor working conditions. resulted in appallingly low standards of health. Cholera epidemics swept through the country. The general death rate was 22 per 1,000 of the population in 1838, and death rates from epidemics among the industrial population mere three times as high as among the gentry. Eventually the relationship between public health and living conditions was realized, and an indifferent public was persuaded of the need for reform.

2. Period of Sanitary Reform.—The first efforts at housing reform started in the countryside, when enlightened landlords repaired and improved their tenants' cottages; however, in the newly overgrown cities where there was as yet no tradition of civic responsibility, and where local government was still inefficient and

negligent. it was some time before the reform movement could make any headway. Sir Edwin Chadnick (*q* v), a pioneer of sanitary reform. without which slum conditions could not be improved. norked together with others for the cleansing and paving of streets, the provision of water and drainage and the proper construction and ventilation of dwellings, thus preparing the ground for the Public Health act of 1875 and the building bylaws which enforced a minimum standard of building and ensured adequate drainage and ventilation. This led to a rather more open layout. Terrace houses with through ventilation, aligned along streets of the minimum width by law, took the place of the back-to-back cottage and congested court.

During this time also the first philanthropic trusts were set up to provide model dnellings for working people. The Society for Improving the Conditions of the Labouring Classes was first established in 1830 and was followed by similar model-dwellings companies and charitable trusts, the latter endowed by their founders to build dwellings to let at low rents, any financial return being reinvested to provide further dwellings In 1851, at the Great exhibition, a block of dwellings was erected under the auspices of the prince consort, as an example to enlightened landlords.

With the example of the philanthropists and the support of a growing public opinion, reinforced by reports from the poor-law commissioners and later the royal commission on the health of towns, housing reform became the concern of parliament. In 1848 the first Public Health act was passed, and a central health department was established for a limited period, but not until 1871 was a permanent local government board set up to become the direct predecessor of the ministry of housing and local government.

3. Octavia Hill and the Growth of the Housing Management Profession. — An independent contribution to housing reform which mas to have far-reaching results was started by Octavia Hill (*q.v.*) when, in 1865. John Kuskin bought for her three houses in a court in Marylebone. uhere she was to try out an experiment in housing management. Having come into contact at an early age with the London poor and their housing conditions, and believing that "you cannot deal with people and their houses separately." she set out to show that, if landlord and tenant honoured their responsibilities to each other for the right use and maintenance of dwellings, not only would the physical environment of working-class tenants be improved. but their whole standard of living mould be raised. By training "fellow-workers" in her methods, Octavia Hill initiated a new profession of housing management for women, which had spread to the Netherlands and Sweden before her death in 1912.

4. Beginning of Housing Legislation. — During the second half of the 19th century housing legislation proper first reached the statute book, and the basis of housing law uas already laid down before 1900 on principles which remained in force in the second half of the 20th century. In 1851 the Labouring Classes Lodging Houses act and the Common Lodging Houses act (the Shaftesbury acts) were passed. The first gave power to local authorities to build lodginghouses, including housing accommodation of a type suited to the labouring classes, whether single men and women or families. The second enabled local authorities to inspect and regulate common lodginghouses. Toward the end of the century, philanthropic enterprise entered this field when Lord Ronton endoaed the building of lodginghouses with a separate cubicle for each occupant.

The Artisans and Labourers Dwellings act, 1868 (the Torrens act), gave local authorities powers for the demolition or improvement of insanitary dwellings and so started legislation for slum clearance In 1879 an amending act empowered local authorities to build houses with state loans to replace those closed or demolished and to charge a rate (local property tax) up to 2d. in the £1 toward the cost. The Artisans and Labourers Dwellings Improvement act (the Cross act), 1875, amended four years later, provided for the improvement and clearance of large areas. Although powers were thus enacted for the whole range of housing activity — that is, for the inspection and closing or demolition or improvement of existing dwellings, the clearance and improvement of unhealthy areas and the provision of new accommodation as a public service — little nas done to put them into practice. The acts were complicated and permissive only and, especially in respect of compensation for the compulsory purchase of property. costly to operate. The Housing of the Working Classes act, 1890, which clarified and consolidated existing legislation, was designed to ease these difficulties and to encourage further clearance and building by local authorities.

Nevertheless, private enterprise was still regarded as the main source of supply of houses of all kinds. and local authorities built only about 5% of all dwellings up to World War I. The royal commission on housing. which reported in 1885. had taken evidence from many uho uere genuinely concerned about housing improvement but nho opposed subsidized municipal housing on the ground that it would pauperize the tenants. The prevailing political philosophy regarded the operation of a free economy as adequate incentive to ensure that supply mould meet demand.

However, by 1914 a great improvement had taken place in the condition of towns. Wages had increased, standards were rising and public health legislation had probably had more influence than the housing acts themselves As a result new residential districts were being built to a better standard. Frequently they were monotonous and ugly. and the minimum of the bylaws became the maximum of practice; but at least they were more sanitary, and the houses were better built and ventilated and received more daylight.

5. Town Planning and the Garden City Movement. — Already during the 19th century a few idealistic and humanitarian industrialists, anxious to improve the living conditions of their workers. sought to create for them a better environment by providing new homes within a planned community. Such new towns or villages were to be experiments in social improvement as well as in better housing conditions. By the end of the 18th century, Robert Owen was attempting something of the kind at New Lanark. Scot.. and James Silk Buckingham published an elaborate project for a new town in 1849. The first to go further in practice was Sir Titus Salt (*q.v*), a self-made Bradford woolen manufacturer. who built first a new mill and then new dwellings and community buildings around it for his labourers between 1853 and 1876. Near the turn of the century George Cadbury at Bournville, W. H. Lever at Port Sunlight and Joseph Rowntree at New Earswick were building new communities. In 1898 Ebenezer Howard published his book *Tomorrow:* a *Peaceful Path to Real Reform,* setting out the theory of the garden city, self-contained. with its own diverse industries and separated from other towns by a green belt. He and his friends propagated the idea through the Garden Cities association. Letchworth Garden city, founded by them in 1903, was the first practical result. (*See* also GARDEN CITY.)

As cheap passenger-transport services were developed. towns were able to extend at their fringe, and to secure that such development should be properly planned. the first Housing and Town Planning act was passed in 1909 Its main feature was the town planning section, which empowered local authorities to make a plan to ensure good layout of any land in course of development or likely to be used for building purposes Low-density development of houses at about 12 to the acre, as advocated by the garden-city movement. became the accepted standard.

6. Private Enterprise Houses and the Building Society Movement. — Although the lower-paid wage earner and casual labourer had to rely on rented housing. the needs of the rising lower middle class and skilled artisans could to an increasing extent be met by the purchase of houses for owner occupation. The growth of the building society movement helped the man with a little capital to acquire a house on mortgage. The Small Dwellings Acquisition act of 1899 empowered local authorities to make advances on favourable terms to assist individuals to purchase a house for occupation. These powers were later amended to keep pace with changing conditions.

7. World War I and the Beginning of Rent Control. — At the outbreak of war in 1914, in spite of the general improvement

in standards, house production had not kept pace numerically with need. The Rent and Mortgage Interest Restriction act, 1915, was passed to control the exploitation of the shortage of houses, particularly in the industrial touns and in centres of munitions manufacture, by fixing rents and giving tenants security against eviction. It also prevented increases in the rate of interest on mortgages and the calling in of mortgages.

During the war building ceased while the population continued to increase. But at the same time standards rose and popular opinion demanded better conditions for returning ex-servicemen.

8. The Interwar Period.—Housing Standards.—There had been little conscious attempt to set a standard for working-class housing before World War I, but a committee was appointed by the local government board in 1917 under Sir John Tudor Walters. Raymond (later Sir Raymond) Unwin, the architect and town planner, was a member, as mas Barry Parker of Letchworth Garden city. In a pamphlet, *Nothing* Gained by *Overcrowding*, and in his practice, Unwin advocated better layouts which took account of contours and natural features and used the cul-de-sac in place of gridiron planning; and these principles were embodied in the committee's report.

The Tudor Walters report also laid down standards of room sizes below which it was not considered desirable to build, and discussed plans for two-story houses with over-all floor areas varying from 755 sq ft. to 1,150 sq.ft. These standards were interpreted generously at first, and the building of parlour-type houses with two living rooms downstairs was encouraged immediately after the war.

Housing Subsidies.—The problem facing the postwar coalition government was how to provide dwellings quickly and cheaply at a time of high interest rates and high building costs with a disorganized and inadequate building industry. Rent restriction was prolonged by two acts of parliament in 1919 and 1920, which extended control to houses of higher ratable values but allowed a limited increase in rents.

Private enterprise could not compete on an economic basis with controlled rents, and for the first time government subsidies were made available to stimulate house building. The Housing and Town Planning act. 1919 (the Addison act), made local authorities responsible for supplying houses to meet the need in their areas. A subsidy was offered amounting to the whole of the annual loss on approved schemes or houses less the product of a penny rate—generous but leaving no inducement to local economy. Under this arrangement 176,000 houses were built, but costs rose and efforts to find more labour and alternative forms of construction largely failed. When the slump came two years later this subsidy was repealed and replaced by one limited to a fixed sum per house, although the amount was varied by acts of parliament in 1923 and 1924. Assistance was given in the form of a block grant for small houses built by private enterprise. Furthermore, by a "treaty" with labour in 1924, which convinced the building-trades unions that there would be a long-term program of house building. John Wheatley, minister of health in the Labour government. was able to encourage more men to enter the trade.

But prices had remained high and, with interest rates at about 5%, only skilled workers could afford the rents. Subsidies were regarded as one cause of high prices, and an attempt was made to remove them when unemployment in the building trade began to increase. They were, however, reinstated by a Labour government in 1929 in an attempt to bring rents down to what the lower-paid workers could afford. They were finally withdrawn for general-purpose housing in 1933 when costs had fallen, leaving only the slum clearance and overcrowding subsidies introduced in 1930 and 1935 respectively (see below).

Housing Societies.—Soon after the armistice of 1918, some societies were originated to provide new housing for the working classes or to improve or convert existing houses. These societies (legally termed associations) were recognized under the Housing acts provided that they conformed to certain rules, including the limitation of dividends on borrowed capital. They were in the tradition of the older charitable trusts and model-dwellings companies, some of which also undertook new building. Although not responsible for a numerically significant contribution to house production, they have frequently led the way in experimental work and have provided for special categories of persons, including large. poor families, families with a bad health record, old people, single people, etc.

Slum Clearance and the *Abatement* of Overcrowding.—Slums or, more precisely, dwellings unfit for habitation, although to be found mostly in the great cities, also exist in smaller towns, in rural communities and even among scattered cottages. They are houses in which the structure, accommodation and convenience are of an insufficient standard or which fall below the accepted minimum in respect of at least one of these requirements: houses which by reason of their layout are inadequately lit or ventilated; and houses which, while primarily suitable in themselves, have become slums through being let out in separate tenements without adaptation so that, for example, what was originally a dwelling for one family has come to be occupied by as many as four, five or more.

Although sanitary authorities had powers for dealing with unfit houses and unhealthy areas, by 1914 only 182 of them had taken any action, and their combined efforts from 1890 to 1913 inclusive produced 13,810 new dwellings. During World War I it was estimated that, in order to replace slums, 796,246 houses were needed in England and Wales and 115.565 in Scotland. Slum-clearance legislation passed soon after the war mas somewhat cumbersome and expensive to local authorities, and housing effort mas concentrated on the production of additional dwellings to overcome the shortage. The Housing act, 1930 (the Greenwood, or Slum Clearance, act), in order to encourage local authorities to clear slums and rehouse slum dwellers, provided a subsidy at a fixed rate per person rehoused, with special additional financial help for agricultural workers and for rehousing in flats on expensive sites.

The economic crisis in 1931 held up progress with slum clearance under this new act for the first year or two, but public opinion was by now again aroused. In 1929 the National Housing and Town Planning council had published its Policy for the Slums, and in 1931 a group of voluntary societies held the first New Homes for Old exhibition, presenting the facts about slum conditions. The Housing centre was inaugurated as a permanent organization for housing propaganda and information. In 1933, the minister of health initiated the antislum campaign with a five-year program for local authorities to clear 280,000 insanitary houses and replace them with nearly 300 000 dwellings. The program was extended to some 464,000 dwellings by 1938.

In 1935 the Overcrowding act was passed, setting a penal standard beyond which persons per room were not to be crowded and providing a subsidy for dwellings to abate such overcrowding. A national survey in 1936 showed 341,554 houses overcrowded out of nearly 9,000,000 inspected according to this standard, which was by no means a high one. In some boroughs and districts, particularly in northeast England, 20% and more of the dwellings inspected were overcrowded as compared with the national average of 3 8%. The London average was 7% and 9 out of the 28 metropolitan boroughs had between 10% and 17%. Orders making overcrowding a punishable offense were brought in to cover almost the whole country by 1939.

In 1938 the slum-clearance and overcrowding subsidies were brought into line with one another and paid on the basis of a fixed sum per dwelling, with a higher rate for flats.

Rural *Housing* and Reconditioning.—The Overcrowding act was the first act to offer a special subsidy for houses for agricultural workers, although previously local authorities had had powers under the Housing (Rural Workers) act, 1926, to give grants for the reconditioning of obsolete but structurally sound rural cottages. These grants remained in operation until after World War II although they were not extensively used.

House Production.—After World War I, house production was slow to get under way but was stimulated by the subsidies. It reached a peak in the year ending March 31, 1928, when 239.000 houses were built, of which 104,100 were subsidized houses built by local authorities and 74.600 were subsidized houses built by private enterprise. Production fell after 1928, and output by local

authorities did not again reach the 100.000 mark until the year before World War II.

Low building costs and interest rates, and a wide extension of lending by building societies giving favourable terms for house purchase by the owner-occupier, enabled private enterprise to increase production until by 1934 it was well over 200,000. Local authorities also increased their production as the antislum campaign gained momentum. Total annual production varied between 325,400 and 347,000 for the five years before the outbreak of war in 1939.

Altogether. between 1918 and 1939 about 4,000,000 new houses were built, of which about 1,500,000 were built by local authorities for letting and about 2,500,000 were built by private enterprise and sold mainly to owner-occupiers.

Although between World Wars I and II the shortage of houses had been reduced. the supply of dwellings to let at rents which the lower-paid tenant could afford was still insufficient to enable the Interdepartmental Committee on Rent Control. reporting in 1937, to recommend further general decontrol of rents, except of the more expensive rents of houses already subject to decontrol on vacant possession.

The majority of houses built by local authorities between World Wars I and II were of the three-bedroom non-parlour type with a superficial area of about 760 sq.ft., reductions in standards occurring in the 1920s and again during the economic depression early in the 1930s to meet the needs of tenants with a low rent-paying capacity, particularly those rehoused as a result of slum clearance. Nevertheless, the provision of a fixed bath was stipulated, and in 1924 it was laid down that this should be in a bathroom.

In London. Liverpool. Leeds and other big towns some rehousing took place in blocks of flats at comparatively high densities, most blocks being five stories high and without elevators. Such blocks were often laid out around asphalt courtyards and were dreary and barracklike. Nevertheless, experiments were made in providing amenities such as central hot water, water-borne refuse disposal, facilities for drying clothes, baby-carriage sheds, private balconies, clubrooms and children's playgrounds.

Town *Planning.*—This building activity, although relieving the housing shortage and improving general conditions, was called into question on the count that the new developments lacked urbanity and coherence. Sporadic, unplanned development round big cities resulted in waste of agricultural land, spoliation of natural beauties and danger from traffic. Closely associated with the physical shortcomings of housing estates were their social inadequacies. They were collections of houses, not communities; and many, although the size of small towns, were at first almost totally without churches, schools, shops and clubs.

Although another Town and Country Planning act had been passed in 1932. and a Restriction of Ribbon Development act in 1935, they were not very effective. London attempted to acquire a green belt of open land. and planning projects were drawn up to control development in many areas, but the cost of compensation where land had to be acquired for public purposes, or where development was adversely affected, restricted the effective operation of town planning proposals. The second garden city had been started at Welwyn in 1921 by E. Howard. and the city of Liverpool at Speke and the city of Manchester at Wpthenshawe had developed housing estates which were to varying degrees self-supporting in social amenities. But these were isolated examples The great cities, and particularly the London region, continued to attract population and industry, and the extension of electric suburban railways and motor traffic enabled more and more people to seek better living conditions on the periphery. Most local authorities built estates for rehousing slum dwellers on the edge of the built-up area, because redevelopment of the original sites at lower densities meant that feuer persons could be accommodated on them. The daily journey to work was costly and time-nasting and kept workers so long away from their homes that these outlying residential areas became mere dormitories.

9. Wartime and Immediate Postwar Policy.—On the outbreak of World War II rent control was again promptly imposed and covered almost all dwellings other than the most expensive (those of over £100 ratable value in London and of over £75 elsewhere) and nearly all those owned by local authorities. Civil building was generally stopped, and only some special housing and lodgings for key workers in war industry and agriculture were built during the next six years. Billeting (of civilian war workers, bombed-out families or women and children evacuated to safe areas) was relied upon to cope with the shifts in population caused by the war. Compulsory powers were available.

The situation in 1945 was not unlike that in 1919, and again the need and the popular demand was for additional houses for those who had lost their homes through the war or who had never had an opportunity of setting up homes. About 200,000 houses were totally destroyed by air raids, but about this number had been built during the six years of war. About 3,000,000 had received some war damage and 250,000 were so badly damaged as to be uninhabitable. The number of new households was estimated at about 550.000. The actual shortage in 1945 was estimated at between 750.000 and 1,000,000 dwellings, but this did not take account of any rise in standard, which in fact led to a much greater demand than had been expected.

The first attempt to meet the shortage was the mass production of temporary prefabricated bungalows, financed by and remaining the property of the state but managed by local authorities. By requisitioning and adapting empty houses, also as agents of the central authority, local authorities in badly war-damaged areas were able to add a little to the pool from which they could allocate tenancies. Both projects were someuhat costly to the exchequer. and neither could have any long-term effect. 'The first project was finished by the end of 1948, after 125,000 emergency bungalows had been provided. Requisitioning powers were brought to an end in 1955.

10. **The** Post-World War **II** Period.—For the main long-term contribution to post-World War II housing, national policy looked to local authorities to produce houses to let.

Between 1945 and 1952 control of all civil building was secured by a licensing system which gave priority to work considered to be of urgent national importance and restricted the building of houses by private enterprise according to number, size and price. Local authorities were provided with an allocation related to the resources of their area and the central authority was thus able to regulate output.

Subsidies.—By the Housing (Financial and Miscellaneous) Provisions act, 1946. subsidies were again made available to local authorities at higher rates to meet postwar costs, in the form of a fixed annual amount per dwelling borne three parts by the exchequer and one part by the rates. Although the amounts of subsidy were later varied somewhat, this form of financial assistance was adhered to until 1956, when the rates contribution was made optional

Under the Housing Subsidies act. 1956, the minister had power to vary or to abolish subsidies; thus by the end of that year the subsidy for general-purpose houses was withdrawn, but a reduced subsidy was retained for one-bedroom dwellings with the object of encouraging local authorities to build dwellings suitable for old persons. Subsidies were retained in respect to dwellings built for slum clearance or redevelopment and to accommodate overspill population from overcrowded and congested areas. Additional subsidies on a sliding scale were available for dwellings in blocks of flats of four or more stories or on expensive sites and for some other special cases. These provisions were consolidated in the Housing (Financial Provisions) act, 1958.

Nontraditional House *Construction.*—To counteract the shortage of skilled labour and of traditional building materials. alternative forms of building were sought. A number of these systems. using various concrete and steel constructions, were approved for local-authority housing work, and several hundred thousand dwellings of permanent nontraditional construction were completed. Some Swedish timber houses were imported and allocated to local authorities mainly in Scotland and northern England. There was a severe postwar shortage of building timber, and the amount used per house was rationed for a considerable period.

This led to the development of solid (concrete) ground floor constructions and systems which largely dispensed with soft wood. However, as supplies became normal, new systems of construction could not compete either economically or in popularity with the traditional brick two-story house.

Allocation of *Dwellings*.—In the first postwar years the local authorities were responsible for the letting of about four out of every five new permanent dwellings built and for the allocation of the licence for the other one. The ministry of housing advised local authorities when allocating to consider such things as the housing conditions of the family (*e.g.*, overcrowding, sharing, condition of dwelling); the number of dependent children; any special health needs; war service; etc. Authorities who introduced differential renting (see below) found it easier to observe these principles when letting their own dwellings. Also, in 1949 the Labour government removed the term "working-classes" from the Housing acts, thus making them apply to all sections of the population.

Houszng Management.—Already between World Wars I and II, as the number of council houses increased, more local authorities employed professional housing managers. The Society of Housing Managers (basing their training on the principles initiated by Octavia Hill and at first training only women) and the larger Institute of Housing together had by the 1960s about 1,500 qualified members, both men and women, trained to take responsibility for lettings, rent collection, repairs, supervision of estates and housing welfare and to advise on local housing needs and programs.

Private Enterprise and *Owner-Occupation*.—After 1952 a Conservative government gradually relaxed the licensing restrictions, and the proportion of private enterprise to local authority houses rose until in 1958 the former had outstripped the latter. In 1954 a joint-guarantee plan between the ministry, the local authorities and the building societies was designed to encourage owner-occupation of small houses. Local authorities were empowered to sell council houses to tenants in appropriate cases, but few authorities were in a position to reduce the numbers of houses available for letting in this way. The House Purchase and Housing act, 1959. made exchequer funds available to approved building societies with the object of encouraging the purchase and improvement of older houses for owner-occupation. Local authorities who already had been empowered to make bigger advances for house purchase by owner-occupiers were enabled by this act to lend even more freely. The sale by private enterprise of flats for owner-occupation also became popular.

During the 1930s, when the building of small houses by private enterprise for speculative sale had also enjoyed a boom period, some builders had been criticized for low standards of layout, design and construction. Before World War II the National House Builders' Registration council had been formed among reputable firms prepared to conform to a minimum standard. After the war awards made by the minister of housing for good design and layout of both private and municipal housing projects, in order to encourage the wider employment of architects for estate housing and a higher standard of taste among purchasers, contributed to better design.

Housing Societies.—During the immediate postwar years housing societies were discouraged by rent control from undertaking extensive new building. Nevertheless, several societies were set up in association with industry to build for key workers, and several self-build societies were formed, mainly among ex-service men, the members and their families working on the construction of a group of houses until sufficient numbers were completed to accommodate each member household.

Several large societies, sponsored by the government before World War II to supplement the work of local authorities in Scotland and the northeast of England, greatly increased their output. The Northern Ireland government set up a similar trust in 1945.

After 1954, when recognized housing associations were exempted from rent control, many undertook new programs, especially of new building and conversions for the elderly. Societies were eligible for the same subsidies from the exchequer as local authorities when they carried out housing for recognized purposes.

The Second Slum Clearance Program.—After World War II extensive slum clearance was again postponed until the acute shortage of dwellings had been met. Meanwhile the older dwellings, after minimum permissible maintenance during the war, deteriorated further. Repair costs had increased threefold, which, with the control of rents at 1939 levels, made adequate maintenance uneconomic. However, by 1954 nearly 2,000,000 new dwellings had been built and the shortage was easing in some areas. It was adjudged time for a shift in housing policy similar to that which had taken place in 1930. The Housing Repairs and Rents act, 1954, to encourage the replacement and improvement of old houses and the raising of standards of repairs, modified procedure regarding slum clearance and required local authorities to submit a preliminary five-year program. In 1955 returns showed 847,112 houses scheduled as slums, of which local authorities estimated that they could deal with 375,484 within five years. The 1954 act also made provision for the acquisition and temporary repair of slum and obsolete property for deferred demolition by local authorities.

Under the Housing acts as consolidated in the Housing act, 1957, which became the principal act, no dwelling may be let unless it is in all respects fit for habitation. There are four main types of procedure open to local authorities for securing the closure or demolition of unfit houses and the clearance and redevelopment of slum areas. (1) They may require a landlord, in the case of a single dwelling, to carry out specified work and in his default they may do the work and recover the cost. If it is deemed that the dwelling cannot be made fit at reasonable expense and no offer by the owner to do necessary repairs is made or accepted, the local authority must order the closing or demolition of the dwelling. (2) A whole area may be declared a "clearance" area if the dwellings in it are unfit or dangerous and unhealthy by reason of their bad arrangement, and if these conditions can be most satisfactorily remedied by the demolition of all the buildings. (3) A "redevelopment" area must contain a certain proportion of norking-class dwellings, at least one-third of which must be overcrowded or unfit, and the site must be redeveloped according to the local authority's plan, substantially for rehousing purposes. (4) "Comprehensive development" procedure, which allows for urban renewal on a wider scale, may be used to designate any area for *redevelopment* as a whole in order to deal satisfactorily with extensive war damage. obsolete development or any other purpose of the development plan drawn up by the planning authority under the Tonn and Country Planning act, 1947 (see Town Planning After *World War* **11**, below). Any person affected may appeal against these procedures. Compensation for compulsory acquisition of an unfit dnelling is normally payable for the site value only. plus an allowance for certain classes of owner-occupiers or business-occupiers. The local authority is responsible for rehousing tenants displaced by slum clearance and an exchequer subsidy is available toward the cost of new dwellings for this purpose.

Improvements and Conversions.—The Housing act, 1949, provided grants to landlords, owner-occupiers, local authorities and housing associations for the improvement, other than repair, of houses to bring them up to modern standards or for the conversion of larger houses or other buildings into two or more dwellings.

The House Purchase and Housing act, 1959, introduced new "standard" grants for the provision of standard amenities to improve old dwellings. These grants covered half the cost up to a maximum fixed figure in respect to a fixed bath or shower in a bathroom. a handbasin or lavatory, a hot-water supply, a water closet and food storage facilities, and could be claimed as of right under stated conditions.

Rents.—Between 1939 and the passing of the Housing Repairs and Rents act, 1954, there had been virtually no increase in permitted rents in spite of a more than threefold increase in repair costs The 1954 act allowed an increase of rents of rent-controlled houses up to a maximum figure related to ratable values, with the proviso that the landlord had to prove the expenditure of an

appropriate sum on repairs. Certificates of disrepair, which could be obtained from the local authority by the tenant of a badly maintained house, enabled him to withhold the original 15% rent increase allowed by the act of 1920 in respect to repair costs. The Labour party opposed the relaxation of rent control and proposed the compulsory acquisition of all rented dwellings by the local authorities; however, during 1957 a Conservative government passed a new Rent act introducing decontrol of higher rated dwellings and of all dwellings in vacant possession, and allowing for gradual increases in rents of all controlled houses within limits related to ratable values and conditions of tenancy. The effect of this act was delayed in some respects because landlords were encouraged to give three-year agreements to sitting (occupant) tenants and, by 1960, when the majority of such agreements expired, the shortage of higher-rented accommodation had been somewhat relieved except in London and several other large cities. To minimize exploitation in such areas the minister of housing approved compulsory purchase by the local authority of dwellings where exorbitant rents were being imposed.

After 1930 local authorities had powers to pool the subsidies which they received under different acts and provisions in a single housing revenue account, and to use them to fix rents according to the individual financial needs of the tenant. Some authorities introduced such projects during the 1930s to enable them to rehouse families with low incomes and a number of dependent children, who otherwise would have been unable to afford the rents of new houses. After 1945 full employment, children's allowances and other forms of welfare assistance greatly improved the rent-paying capacity of many tenants, but high building and maintenance costs, high interest rates and, after 1956, the withdrawal of the normal-needs subsidy resulted in high rents. Council houses had been let to tenants uith widely varying incomes according to housing rather than financial need. Local authorities were now therefore encouraged to rationalize their rents in order to avoid too wide a gap between prewar and postwar rents, and between rents of houses built with and without subsidy and at different periods when different interest rates prevailed. Many also introduced new differential rent plans based on a proportion of the income of the head of the household. income from other wage earners, lodgers, etc., and the number of dependent children.

11. Town Planning After World War 11,—The close association between housing and town planning had been realized when interwar town planning acts were passed to attempt to control the overgrowth of the great cities. National and regional planning of physical environment including the right location of new or existing industry were regarded as the key to the problem of the unplanned sprawl of the big towns. The reports of the Barlow commission on the Geographical Distribution of the Industrial Population (1940), of the Uthwatt committee on compensation and betterment and of the Scott committee on land utilization in rural areas (both 1942) together set up the principles for a national planning policy which was partially accepted as a basis for legislation.

The Town and Country Planning act, 1944, gave special assistance for the reconstruction of war-damaged areas. In 1947 a comprehensive Town and Country Planning act introduced a new principle to deal with the problem of compensation and betterment made necessary by town-planning action. This involved the acquisition of development rights of all land on behalf of the community and made all development subject to permission by the local planning authority. This act also required the preparation of development plans covering the whole country. Thus postwar housing development, wherever it took place, was subject to town planning control. The financial provisions covering development rights were, however, repealed in 1953, on the general grounds that they constituted a hindrance to development.

New Towns and Town Expunsion.—Even more significant in relation to housing policy was the New Towns act, 1946. empowering the minister to appoint development corporations and to designate sites for development as New Towns, with finance from public funds (see NEW TOWNS). During World War II an advisory plan for central London by J. H. Forshaw and Sir Patrick Abercrombie, and a plan of Abercrombie for the greater London region, both recommended the development of New Towns, for which sites were suggested. By the early 1960s development was well under way in 15 New Towns, 8 of them being in the London region, 3 in Scotland, 1 in Wales and 1 in the midlands. Further New Towns for the relief of towns in the north and midlands were under consideration.

By Dec. 1960 the New Towns in England and Wales had completed about 80.000 dwellings, but London and the big cities were still crying out for sites where surplus population could be settled. At the same time many small country towns, finding it difficult to maintain the standards expected of a modern community. could well absorb families from congested areas. Under the Town Development act, 1952, agreements could be made by means of which a large, overgrown local authority could promote housing development in another authority's area and could provide financial and technical assistance. The exchequer could make grants toward major expenditure on water and sewerage services; the county council could also assist. The higher rates of subsidy for rehousing overflow population from congested areas were continued after the repeal of the general housing subsidy in 1956, and exporting authorities could make a rates contribution in respect of applicants nominated by them as tenants of such town expansion programs.

In spite of this decentralization, employment opportunities, particularly in office work, multiplied in the big conurbations, which became increasingly congested with traffic. Town planners looked to comprehensive redevelopment to rehabilitate obsolete urban areas. London, Birmingham and other big towns undertook construction of many such projects. The redevelopment of the Barbican area in the City of London, with housing, amenity open spaces, offices and community buildings and with segregation of traffic, was an outstanding example.

12. Design of Dwellings and Neighbourhood Planning.—After World War II the standards of accommodation and design for council houses were based on recommendations of a government advisory committee (the Dudley committee) in their report, The Design of Dwellings, published in 1944, which advocated larger, better-built and better-equipped houses and flats. In spite of several economies made to prevent greatly increased building costs there was a marked improvement in postwar dwellings, and particularly in their heating and hot-water systems and kitchen and sanitary fittings. Many tenants could also afford better furnishings; and some installed their own modern cookers, washing machines, refrigerators, etc., often by means of hire purchase, or installment buying.

Most postwar housing took the form of two-story single-family houses of about 900 sq.ft., in pairs or terraces, although later more multistory flats and maisonettes, or apartment buildings, were used, especially for central area redevelopment, frequently in conjunction with two-story houses and four-story maisonettes for larger families and even with bungalows for old persons.

Before the war town planners had evolved a theory of neighbourhood planning. somewhat obscure in origin, but brought into prominence in England by the analysis of existing communities in the two London advisory plans and the suggestions made in them for new development. The size and space requirements of neighbourhoods were analyzed also in the Dudley report, and this principle was adopted as a guide in most postwar residential areas.

During the interwar years, a movement for the provision of community centres in residential areas had arisen to counteract the lack of social and cultural facilities in the new districts. Although immediately after World War II licences for such building were severely restricted, more estates were planned with local centres and interesting experiments were made in providing for social and communal services.

The increase in the use and ownership of motorcars concentrated attention on garaging, parking and traffic considerations in the design of layouts. Pedestrian shopping precincts and groups of dwellings planned with footpath access segregated from traffic became experimental features in some new towns and redevelop-

ment areas. Some authorities planned for one car to each household, even on low-cost estates.

Greater attention was also paid to the landscaping of housing areas and the provision of play space for children.

13. **New** Problems. — The *1951* census showed an excess of households over dwellings of about *1,169.000.* Despite the building of 2,478,000 new dwellings in the next *10* years, bringing the total of dwellings in Great Britain to about *15,750,000* by *1961,* it was estimated that *1,500.000* dwellings would still be needed within the next *20* years to provide for new households. The *1961* census showed that overcrowding had decreased markedly and it was a serious problem only in a few areas and in isolated cases. The fragmentation of the population into small households, and the economic and social conditions which enabled the large number of aged to live as separate households, increased the demand for small dwellings suited to their needs. The movement of people within the country and to a lesser extent immigration from overseas concentrated pressure for accommodation disproportionately on the London and southeastern regions and to some degree on other big city regions.

About *4,000,000* dwellings were enumerated in *1951* as being without certain amenities and it has been estimated that over *4,000,000* existing dwellings had been built before *1881.* Between *1945* and *1960, 350,000* unfit houses were cleared and more than 1,000,000 persons rehoused. The rate of slum clearance increased after *1956* and *60,000* dwellings were cleared in *1960.* More than *318,000* dwellings were improved or converted with assistance under the Housing acts between *1945* and *1960,* by which time work under the *1959* act was just beginning to gather momentum.

Total production between *1945* and *mid-1961* was about *3,835,000* new permanent dwellings, *2,569,000* erected by public authorities and *1,266,000* by private enterprise.

The rise in income levels and full employment reduced the number of housing difficulties due to poverty except in a hard core of problem families. But old persons, too. found difficulty in meeting the rent of a modern dwelling out of an old age pension or small fixed income, despite supplementary pensions in aid of rent, which assisted many. This meant that the aged were often left behind in low-rent slum areas, so that small. suitable dwellings were especially needed when redevelopment took place.

Several social surveys emphasized the interdependence of different members of the extended family, particularly that of mothers and daughters. Young couples moving to newly developed areas missed the practical and moral support of their parents in the early years of marriage and the bringing up of children. Conversely these young persons were anxious about elderly parents left behind in the old central areas.

Until after World War II Britain was predominantly a country of single-family dwellings of two or at most three stories. The greater space requirements for the redevelopment of overcrowded central areas after *1945* necessitated the building of multistory blocks of flats and maisonettes with elevators besides the rehousing of part of the population outside these areas. The high flats created certain new social problems, in particular that of providing for children's play.

Large old houses in obsolete districts often fell into the hands of landlords who exploited them. In large industrial centres, particularly, immigrant workers frequently obtained lodgings in such houses at scarcity rents which they could ill afford. with the result that the houses became overcrowded. Provisions for ensuring proper management of houses in multiple occupation were included in the Housing act of *1961.*

By *1960* local authorities were building mainly for slum clearance. overspill population and for old-age pensioners; and private enterprise was increasing the output of houses and flats for owner-occupation. There was still a need for modern dwellings for those in the middle-income range. including those better-off single and elderly persons who neither needed nor qualified for subsidized accommodation but who were unable or unwilling to purchase. The Housing act of *1961* envisaged the expansion of the housing-association movement, and provided a special government loan to finance the building of dwellings to let at economic rents to meet the needs of such persons.

This act also introduced a new principle for allocating subsidies to local authorities. Those authorities with limited financial resources for housing would receive subsidy at a higher rate than those whose potential income from rents was already high. It was hoped that this would encourage authorities to introduce differential rent systems, so that those households most in need would benefit to a greater degree from the subsidies.

B. British Commonwealth and Republics of South Africa

In the earlier years of European settlement in most of the British Commonwealth countries, the traditional single-family house was adapted to local conditions. For the most part densities were low, as there was no shortage of land. Urbanization and increasing populations led to the need for planned housing policies during the 20th century; thus in the larger towns of Canada, Australia and New Zealand more flats were built. Government agencies in these countries provided mortgages to assist owner-occupiers. Low-rental public-housing developments, particularly in relation to slum clearance, began mainly after World War II.

In Africa the influx of native workers into urban areas to obtain employment in mines, factories, etc., led to the mushroom development of shanty towns which rapidly deteriorated into slums owing to the temporary nature of the buildings and the lack of adequate services. In some territories housing authorities were set up to build simple dwellings for renting and to provide financial assistance to encourage home ownership and self-build programs. Extensive building was undertaken in the Republic of South Africa after World War II to house detribalized African workers in segregated communities.

In India. after independence, five-year programs envisaged the building of modern housing units. The second program included *1.000.000* such units in assisted projects and *800,000* in private projects.

Pakistan. with its housing situation aggravated by large-scale immigration of displaced persons. also planned for the settlement of refugees on agricultural Iand and for a number of satellite towns.

In Singapore and Hong Kong, where the need was extremely urgent, housing trusts and authorities produced large estates of multistory dwellings. Similar trusts or government agencies in the West Indies and other smaller communities built for letting, or gave assistance toward home ownership.

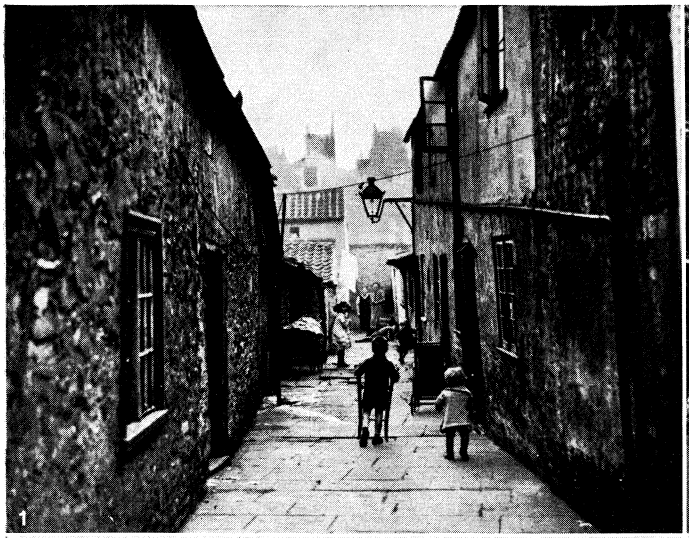
In many cases officers were appointed who had had experience in public-housing administration in Britain. The management principles of the Society of Housing Managers and of the Institute of Housing were adapted to the needs of overseas development and native workers were trained to take over in the fields of administration. management, town planning and building.

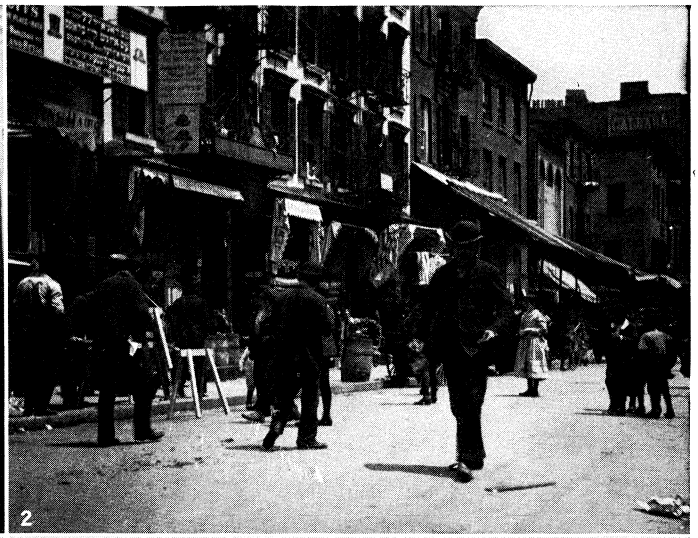
Methods of house construction varied widely according to the climate and indigenous materials of the different territories. In comparatively temperate areas, such as parts of Canada, Australia and New Zealand, more or less traditional constructions were used (although including more timber than in the United Kingdom); however, dwellings in Africa were very simple structures, sometimes of concrete blocks. and with special attention paid to the need for ventilation. In Hong Kong, where an enormous population was concentrated in a limited area and immigration had been very rapid, density standards even of new dwellings were among the highest in the world. (M. C. Br.)

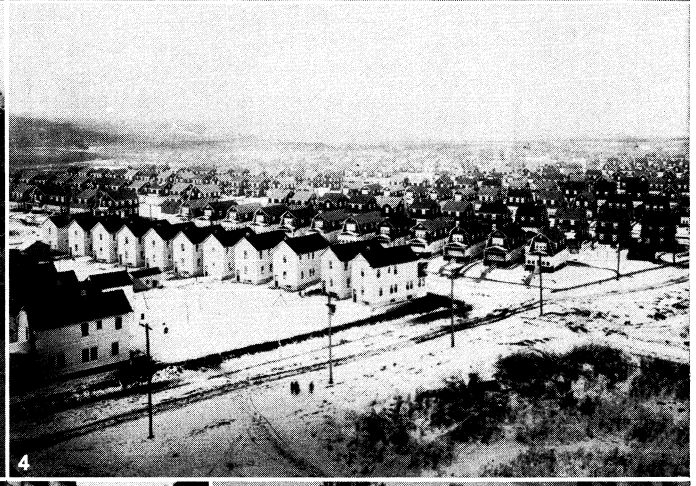
V. OTHER EUROPEAN COUNTRIES

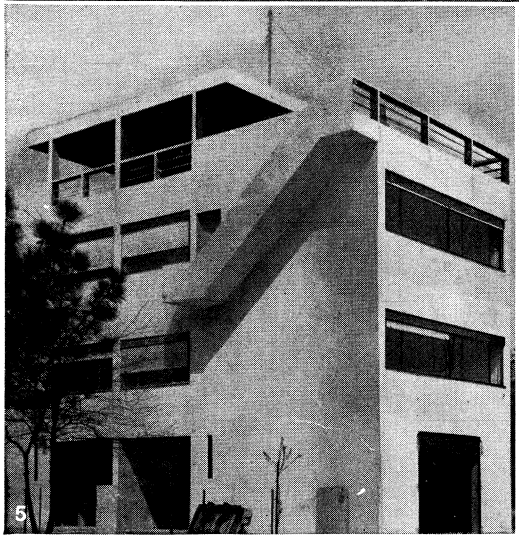
The housing situation in continental Europe varies widely in quantitative and qualitative aspects. Housing shortage and overcrowding result in the first place from the failure of house building to keep pace with growing populations and the rate of urbanization. Urban housing levels, compared with the other essential components of standards of living. are lower in those countries which were industrialized earlier and which have a high proportion of obsolete dnellings in industrial areas. Nevertheless, taking Europe as a whole, rural areas have a higher proportion of sub-

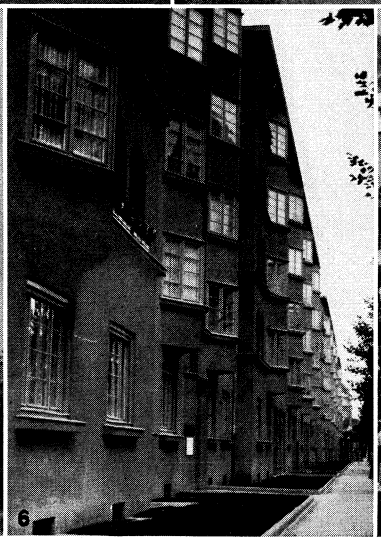
HOUSING

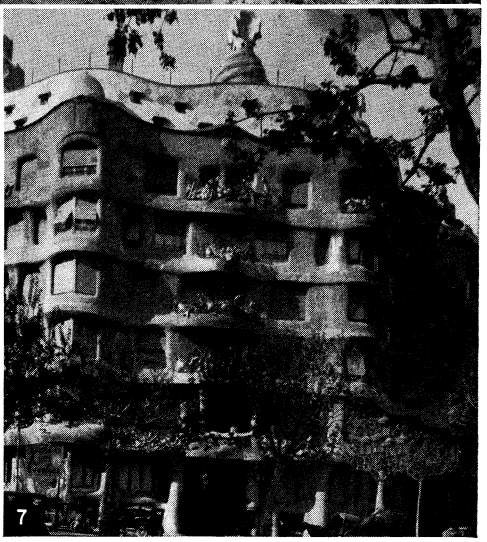












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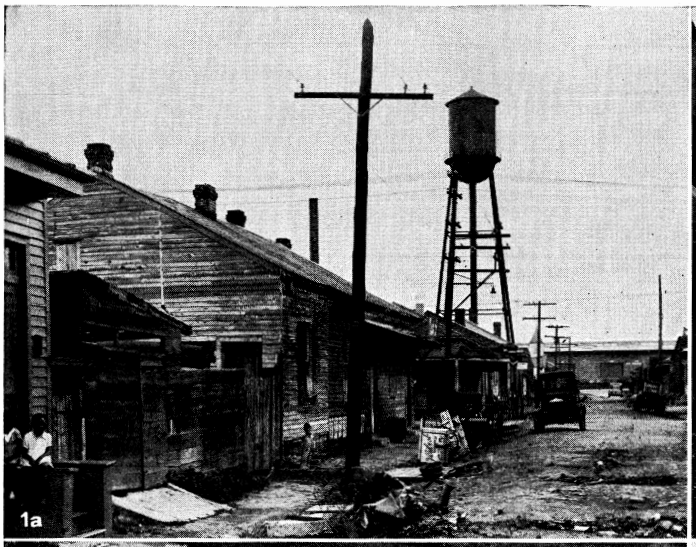
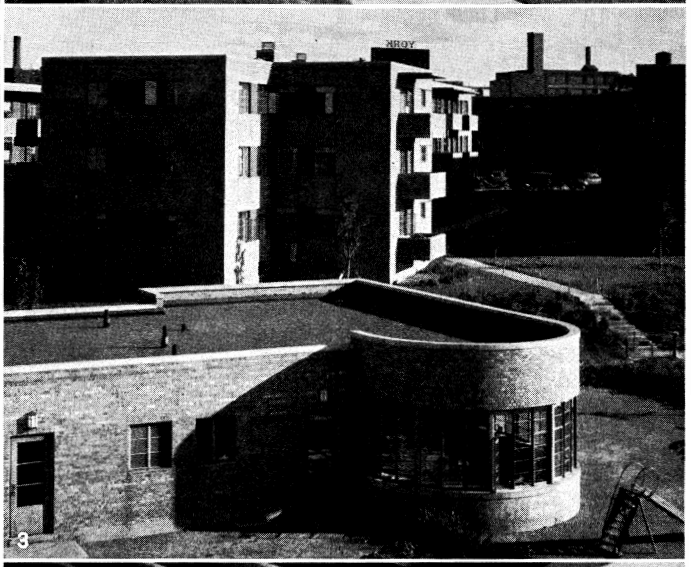
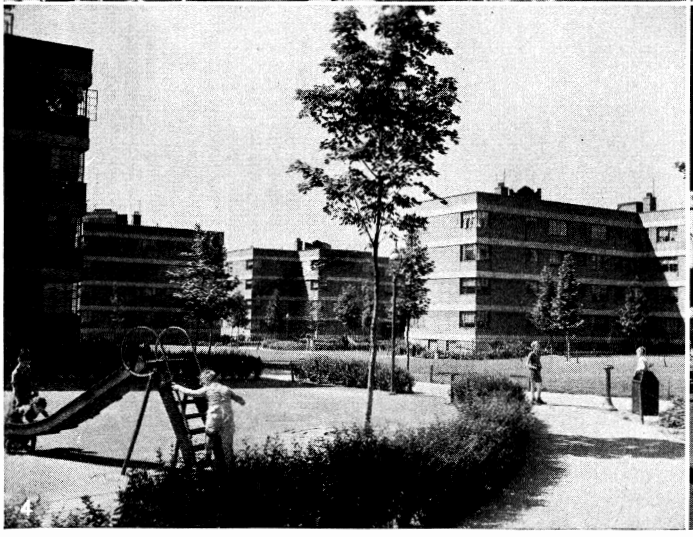
HOUSING OF THE LATE 19TH AND EARLY 20TH CENTURIES

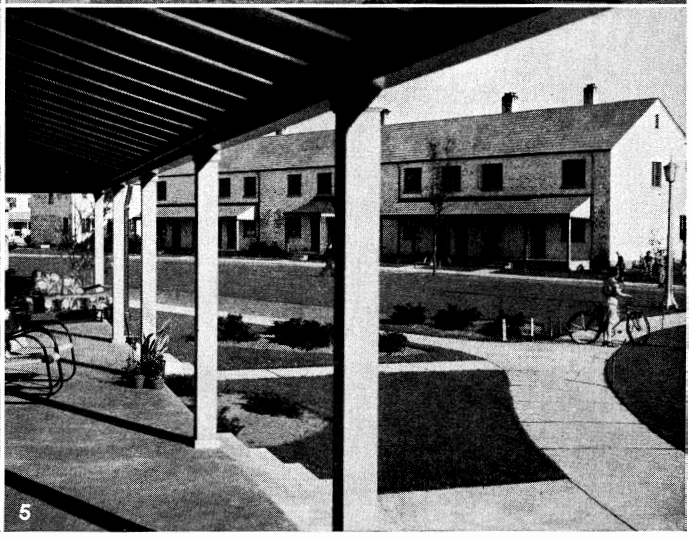
1. English slum alley of the old type
2. Hester street, in the immigrant tenement district of New York city, about 1890
3. Letchworth estate, a housing project of the 1920s in Hertfordshire, England, designed to abolish conditions shown in figure 1
4. A typical U.S. suburb of the post-World War I period, Queens county, New York. Narrow, deep lots and uneconomic houses made costs of street improvement prohibitive
5. Two-family house with garage below, at Pessac, Gironde, France
6. Apartment building in Berlin, reflecting the architectural tendency of the 1920s toward wider openings and slender supports
7. Apartment house in Barcelona, Spain

HOUSING









BY COURTESY OF (1) UNITED STATES PUBLIC HOUSING ADMINISTRATION, (2) FARM SECURITY ADMINISTRATION, PHOTO BY FAIRCHILD AERIAL SURVEYS, (3, 5) UNITED STATES HOUSING AUTHORITY, (4) NEW YORK CITY HOUSING AUTHORITY

U.S. PUBLIC HOUSING PROJECTS IN THE 1930s and 1940s

1a and 1b. Scene in the "Irish Channel," New Orleans, and the same area after completion of a low-rent public housing project of more than 900 units

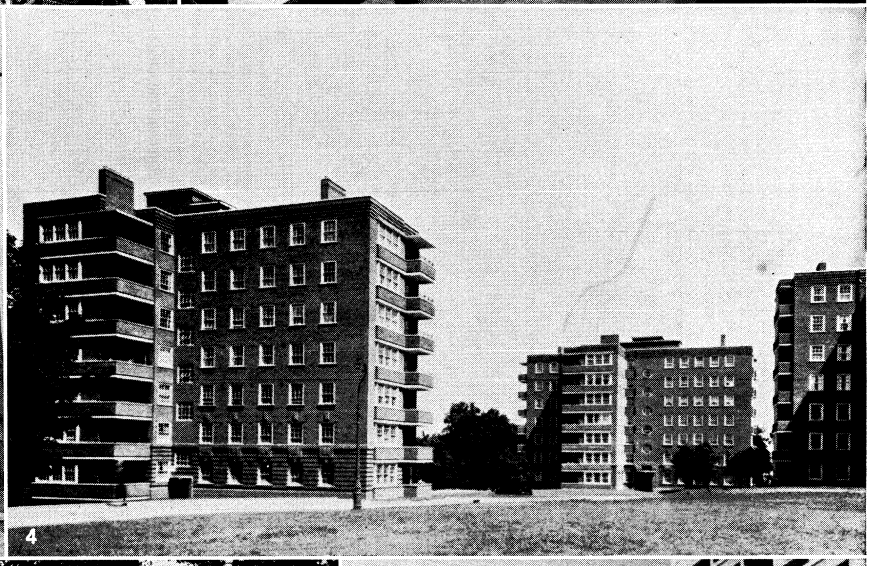
2. Aerial view of Greenbelt, Md., a model housing community of the Farm Security administration

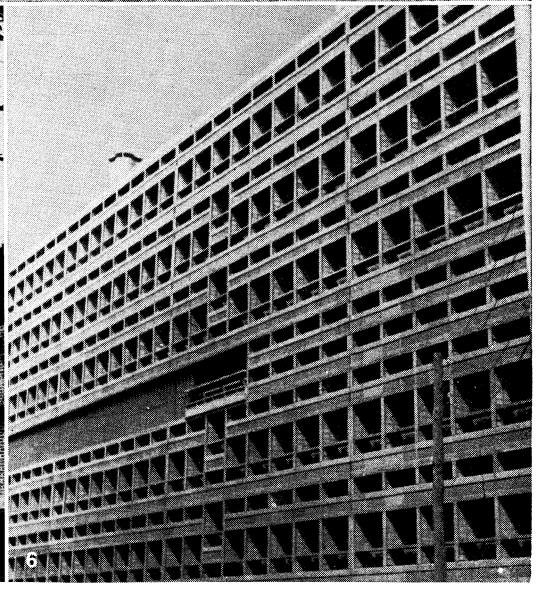
3. A representative project of the U.S. Housing authority — Lakeview Terrace, Cleveland, O., built by the Public Works administration. Only 17% of the site was covered and large window areas were stressed

4. Williamsburg houses, a development of the New York City Housing authority

5. Meeting Street Manor and Cooper River court, Charleston, S.C. A U.S. Housing authority development of one- and two-story row houses, attractively arranged to avoid any semblance of monotony

HOUSING





BY COURTESY OF (1) METROPOLITAN LIFE INSURANCE CO. PHOTO BY THOMAS AIRVIEWS; PHOTOGRAPHS, (2) POST-DISPATCH PICTURES FROM BLACK STAR, (3) WIDE WORLD, (4) BRITISH INFORMATION SERVICES, (5) FOX PHOTOS, LTD., (6) ABC FROM BLACK STAR

HOUSING OF FOUR NATIONS AFTER WORLD WAR II

1. Stuyvesant Town (foreground) with 8,755 apartments, built by the Metropolitan Life Insurance company, rehabilitated 18 blocks on Manhattan's lower east side, New York city
2. Typical interior at Quality Hill towers, a privately financed housing development in Kansas City, Mo., which replaced former slum units
3. Co-operative apartment house in Munich, Germany
4. Block of apartment houses built to government specifications at Hornsey in the London area to remedy the housing shortage caused by war damage to more than 4,000,000 British homes
5. Housing at Crawley, Sussex, England, one of the areas around London designated as a new town to relieve industrial overcrowding in London
6. Le Corbusier's "Vertical Community" in Marseille, France. It was designed to house more than 1,500 persons and included community centres, shops, playgrounds and a post office

standard dwellings lacking in amenities than do the towns.

Public responsibility for housing standards and production developed in most western and central European countries toward the end of the 19th and the beginning of the 20th centuries. In some countries the principal agencies for home building for the lower income groups have been co-operatives or housing associations, for example in the Scandinavian countries, the Netherlands. Belgium and Germany. In others, for instance in Austria between World Wars I and II, municipalities built and rented dwellings. Private enterprise also played a big part both in building for owner-occupation and for renting, mainly for the higher-income groups, and has sometimes been assisted by special tax concessions, mortgage guarantees and similar measures.

Between the two wars, in most continental cities in western and central Europe, low-cost housing was built in flats and although the popularity of the single-family house was marked, living in flats was accepted as normal. Nevertheless, development of low-density housing on garden-city lines took place extensively. Much thought was also devoted to the development of low-cost flats at fairly high densities. In Austria the municipality of Vienna erected blocks of dwellings, at first arranged around large central courtyards, provided with facilities such as laundries, nurseries, schools, etc. In France a water-borne system of refuse disposal was first used and after World War II the French architect Le Corbusier received world-wide acknowledgment for the bold conception of one large high building containing dwellings and communal facilities designed to a standard module; this first "United Habitation" was erected outside Marseilles. German layouts generally took the form of slab blocks, orientated to give the best aspect to every dwelling and allowing greater openness than the earlier courtyard layouts. In Scandinavia almost all building by the co-operatives was of flats, although Sweden developed a self-build program for smaller houses. particularly in the suburbs of Stockholm where many single-family timber houses were built (*see* also *Trends in World Housing,* above). These countries were also pioneers of the tower block.

A survey by the United Nations Economic Commission for Europe of the housing situation, published in 1956, gave a general picture of housing shortage, including some information about the condition and equipment of dwellings. This same survey attempted some classification according to basic services, such as electricity. inside running water and bath, showing a generally higher standard in the Scandinavian countries, the United Kingdom, Ireland, Switzerland, western Germany and the Netherlands, although an assessment of obsolescence among dwellings showed that France and the United Kingdom contained a higher proportion of obsolescent housing than other European countries for which information was available.

In spite of greater interwar activity, no European country could boast a fully adequate housing stock at the outbreak of World War II. All suffered from the lack of building during the war years, and war damage resulted in great losses in some countries and districts.

By 1955 the over-all housing situation had improved, and since then in most countries in northern and central Europe the rate of output has been stabilized at approximately prewar levels.

(M. C. SN.; ET. W.)

See also references under "Housing" in the Index volume.

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For current developments and statistics *see* the *Britannica Book of the Year.*

HOUSING AND BUILDING LAWS. The object of housing lams is to protect the health and safety of the community by fixing minimum standards for the construction and maintenance of buildings.

Housing laws, as distinguished from building laws, are concerned with prescribing standards for buildings used for habitation. Such laws apply to existing buildings and require that they con-

form to minimum standards of sanitation, maintenance and habitation, even though the structure as originally built did not conform to this standard.

Building laws are designed to achieve minimum standards in new construction as well as in the alteration of existing buildings. These laws apply not only to housing but to industrial and commercial buildings as well. In general, they deal with basic construction, electric and plumbing installations, and fire prevention. Housing and building laws are not mutually exclusive, and their provisions may overlap.

Historically, building regulation may be traced back to the rudimentary fire-protection ordinances of the Romans, with a succession of similar legislation such as the English regulations of Henry Fitz-Elwyne, dating from about 1189, the several statutes in the 17th and 18th centuries pertaining to the City of London and the early ordinances in New Amsterdam in 1648. Modern building laws reflect the impact of the great urbanization of the 19th century which focused attention on the need for legislation to assure the preservation of safety and health.

United States.—Housing Laws.—The growth of cities in the U.S. brought about a concentration of population, swelled by the large immigration of the 19th century. With this concentration came the tenements, and with the tenements came the squalor so vividly portrayed by Jacob Riis in How the Other Half Lives (1890). Then came the New York Tenement House law of 1901—a pioneer effort to meet the onslaught of the slums.

In their modern context, housing laws are one element in the over-all attack against urban blight sought to be achieved by total community planning. The National Housing act of 1949, as amended, has stimulated an eagerness by communities to adopt housing laws. This eagerness derives from the need to meet the requirements under the act for a "workable program" to eliminate slums and thereby be eligible for federal grants and loans (42 *U.S.C.*, sec. 1451(c), as amended).

Though there are instances of state-wide housing laws (*e.g.*, Michigan and New York), normally such legislation is the product of the local municipal government. The general pattern is to define those dwellings falling within the ambit of the law; to fix standards for such matters as space and occupancy, sanitation, safety, heating and electricity; and to provide procedures for enforcement. Definitions are important in that the specific standards applicable to different types of occupancy must be clearly stated. Because of the special problems regarding transient accommodations such as hotels, lodginghouses, rooming houses and boarding houses, these are often given special treatment, including provision for licensing. Standards for space and occupancy are designed to avoid the overcrowding of dwelling units. An illustration of this type of regulation is the requirement prescribing the minimum floor area and air space lor sleeping units, depending upon the number of occupants and their ages.

Sanctions for enforcement vary from fines and imprisonment to demolition in the case of dwellings unfit for habitation or dangerous for occupancy. As to the latter, enforcing officers are authorized to order the building to be vacated and also to order the making of repairs as well as the demolition of the building, with power to carry out the order if it is not obeyed.

These rights of the enforcing officer derive from the legal doctrine of nuisance and the power of the sovereign authority to abate nuisances (Miller v. Foster, 244 Wis. 99, 153 A.L.R. 845). A necessary element in enforcement procedure is the power to make inspections of buildings, a provision usually found in housing laws.

In U.S. law, with the constitutional requirement of due process (*q.v.*), the legal justification for regulatory measures dealing with housing derives from the police power of the state to enact legislation for the common welfare. "At the point where economic self-interest ceases to be a sufficiently potent force for the promotion of the general welfare, or, indeed, becomes a force which may actually injure the general welfare, the Legislature may intervene and require that buildings intended for use as . . . multiple dwellings shall conform to minimum standards which may reasonably be regarded as essential for safe, decent, and sanitary dwelling places" (Adamec v. Post, 273 N.Y. 250, 255). Furthermore, singling out existing buildings for special treatment (*e.g.*, new fire regulations for lodginghouses though they complied with the law when originally constructed) does not necessarily transgress constitutional guarantees against deprivation of property without due process of law or necessarily create an invidious distinction that is contrary to the constitutional guarantee of equal protection of the laws; there may be ample justification in the facts for such special treatment (Queenside Hills Realty Co., Inc. v. Saxl, 328 U.S. 80).

Building Laws.—These laws, commonly called codes, though prescribing standards for new construction and embracing nondwelling structures as well as those used for dwellings, are as important a component as housing laws in the workable program for the control of blight.

The general pattern of administration and enforcement is to require the approval of building plans before beginning construction; to provide for the issuance of a permit allowing the project to go forward if the plans are found to comply with code requirements and for the inspection of the work during the period of construction; to sanction the issuance of "stop-orders" if inspection reveals violations; and to authorize the issuance of a certificate of occupancy upon final completion in accordance with code requirements. These preventive measures are usually coupled with punitive sanctions for willful violations of the code.

On the substantive side, the code may describe the particular materials or construction that are to be employed in a given situation. Alternatively, in accord with the modern trend, the code may use the so-called functional principle and indicate a standard of performance to be achieved, thus allowing greater flexibility in the use of new materials made available by technological advances. An illustration of a functional requirement would be that a certain column shall have a fire-resistance rating of not less than a certain number of hours in accordance with a recognized testing procedure. The use of recognized standards reduces the necessity of manufacturing several items serving the same function in order to satisfy the rigid requirements of different codes. As standards are changed or new ones developed, it is important that there be no lag between the sanctioned procedures of the community and those that have been accepted by disinterested groups. These legislative lags, however, are an ever-present problem, particularly where the functional principle is not employed.

There are several complete codes that have been prepared by private groups as models for enactment by local municipalities, and several states have enacted legislation which permits municipalities to adopt such codes by reference. This practice relieves a municipality from complying with any state law requirement that makes publication of a proposed ordinance a prerequisite for its enactment—a costly procedure, considering the bulkiness of most codes; in the absence of state legislation allowing such adoption by reference there may be questions under state law regarding the legality of this procedure.

The question of legality may arise, however, wherever the adoption by reference includes the possibility of amendments to the code that may be made by the municipality in the future (City of Tucson v. Stewart, 45 Ariz. 36, 96 A.L.R. 1492). A few states (*e.g.*, New Jersey, New York and Connecticut) have initiated their own programs for a model code available for adoption by municipalities within the state.

England.—Legislation respecting housing that is unfit for habitation is covered in the Housing act, 1957, which enumerates the particular matters to be taken into account in determining fitness. These embrace collectively, safety, plumbing and sanitation, and facilities for storage and the preparation of food, with a special part of the act devoted to overcrowding. Local authorities are required to make periodic inspections to ascertain if houses are unfit for habitation.

Similar to G.S. housing laws, provision is made for ordering repairs and for the demolition and closing of houses. If, upon appeal to a court or judge, it is determined that a repair which has been ordered cannot be made at a reasonable expense the local authority, if so empowered by the minister of housing and local government, may compel the owner of the house to sell it

to the authority, in which event the latter must carry out the repairs. There are similar provisions for compulsory sale in lieu of a demolition or closing order if it appears that the house "can be rendered capable of providing accommodation which is adequate for the time being . . ." (s. 17).

By the Public Health act, 1936, local authorities outside of London may adopt building bylaws which, together with the act itself, control the construction and alteration of buildings. The matter of adopting bylaws is not wholly optional; the minister of housing and local government may require a local authority to make bylaws, and if it fails to do so after a lapse of three months, the minister himself may make such laws. Bylaws must include certain matters specifically set forth in the act; these cover, in general, items of construction and items pertaining to sanitation. Bylaws cease to have effect after ten years unless extended by the minister of housing and local government. Model bylaws issued by the ministry of housing and local government adopt the functional principle described above in connection with U.S. codes. Local authorities, in addition to the right to take measures for the collection of fines, may require an owner to remove any construction that contravenes a bylaw or to make appropriate alterations. In addition to the Public Health act of 1936, the planning requirements of the Town and Country Planning act. 1947, also has an impact on building operations. The administrative county of London is governed in the matter of building not by the Public Health act, 1936, but by a series of acts collectively known as the London Building acts, 1930–1939, with their appropriate bylaws.

Scotland.—By the Building (Scotland) act, 1959, local authorities have a uniform building code. Provision is made for building standards to be established by regulations of the secretary of state after consultation with the building standards advisory council. The standards may employ the functional principle. Certificates of completion are provided for, similar in function to the certificate of occupancy in U.S. codes.

Canada. — Building codes are matters within the jurisdiction of the provincial and municipal governments. A National Building code. issued under the auspices of the associate committee on the national building code (National Research council, Ottawa) is purely advisory. The code includes a part devoted to housing accommodations. with standards for heating, room heights: plumbing and windows.

See also HOUSING; CITY PLANNING; ZONING.

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In addition to the English model bylaws and the Canadian National Building code, the following model codes are available: *A Proposed Housing Ordinance* (American Public Health Association, New York city); *Model Minimum Housing Standards Ordinance* (National Institute of Municipal Law Officers, Washington, D.C.); *Uniform Building Code* (International Conference of Building Officials, Los Angeles, Calif.); *Basic Building Code* (Building Officials Conference of America, Chicago, Ill.); *Southern Standard Building Code* (Southern Building Code Congress, Atlanta, Ga.); *National Building Code* (National Board of Fire Underwriters, New York city, Chicago, San Francisco). A survey of several local U.S. housing laws is contained in *Provisions of Housing Codes* (Urban Renewal Bulletin No. 3, Housing and Home Finance Agency, Urban Renewal Administration, 1956). For a description of the "workable program" under the National Housing act of 1949, as amended, see *Program for Community Improvement* (Housing and Home Finance Agency).) (B. H. G.)

HOUSMAN, ALFRED EDWARD (1859–1936), English scholar and poet, best known as a writer of lyrics expressing an elegiac pessimism in strikingly simple form, was born on March 26, 1859. at Fockbury, Worcestershire. He was educated at Bromsgrove school (1870–77) and was a scholar (1877–81) and afterward honorary fellow of St. John's college. Oxford. After leaving Oxford he held a post in H.M. patent office till he was appointed professor of Latin at Cniversity college. London, in 1892. In 1911 he was made a fellow of Trinity college. Cambridge. and professor of Latin in that university. His chief publications. besides many papers in classical journals (see *A* List of *Adversaria,* Cambridge, 1926) are editions of *Juvenal* (1905), *Manilius* (I. 1903; II, 1912; III. 1916; IV, 1920; V, 1930) and *Lucan* (1926); two volumes of lyrics. A *Shropshire* Lad (1896) and Last Poems (1922); and a lecture. The *Name* and *Nature* of Poetry (1933).

As a scholar Housman invites comparison with Richard Bentley for learning. ingenuity and controversial vigour. He led the attack on superstitious fidelity to the "best manuscript" and "palaeographicalprobability," and brought to the defense of common sense in scholarship an armoury of sarcastic wit which helped to make him the most widely feared of contemporary scholars. It was not these powers, however, nor the range. depth and unfailing accuracy of his learning, but the strength and keenness of his intellect, that gave to his work its quality of greatness and to him his claim to pre-eminence in the world of scholarship.

As a poet Housman appealed to a larger public. The popularity of *A Shropshire* Lad grew slowly but so surely that *Last Poems* had an immediate success greater than that of any other book of poetry published in England during the century. The poems are enjoyed by those readers whose interests are not literary because the language is simple and the verse melodious and the thought is easily understood; they are admired by critics because they are flawless in taste and execution and possess a quality both in their form and in their feeling which it is equally vain to imitate and to seek elsewhere in literature: they are as romantic as ballads. as classical as the Greek anthology. The poems number little more than 100; about a third are written in the character of a country boy exiled in London; they deal with the vicissitudes of friendship, the passing of youth, the beauty and the cruelty of nature, and the vanity of human wishes.

Housman died on April 30. 1936. By his will he permitted his brother. Laurence. to publish such of his unpublished poems as appeared not inferior in merit to his other works; and in Oct. 1936 a volume appeared under the title *More Poems*. These verses did not alter, for better or worse, Housman's reputation as a poet; but, like two books of reminiscences by his brother—*A. E. H.* (1937)—and his publisher, Grant Richards—*Housman 1897–1936* (1941)—they partially threw aside the veil of reserve which had hidden Housman's personality during his lifetime. The best account of Hcusman's life and his work is that contained in A. S. F. Gow's *A.* E. Housman (New York, Cambridge, 1936).

HOUSSAY, BERNARDO ALBERTO (1887– (J. Sp.)), Argentine physiologist and Nobel laureate, was born on April 10, 1887, in Buenos Aires. Houssay was a precocious child: he enrolled in the Colegio Británico at the age of 9 and was an intern in a hospital at 13. Appointed to the faculty of the University of Buenos Aires in 1907, he was given the chair of physiology of the faculty of medicine in 1919. He was dismissed for political reasons in 1943, and although he was reinstated shortly afterward, he was asked to resign in 1946. He founded the privately endowed Institute of Biology and Experimental Medicine in Buenos Aires in 1944 and served as its director. In 1955 he was again appointed professor and director of the physiological institute of the university.

Houssay's researches demonstrated that the hormone secreted by the anterior lobe of the pituitary gland prevents the metabolism of sugar, and that the injection of pituitary extract induces symptoms of diabetes. His work in this area won him. jointly with C. F. and G. T. Cori, the Nobel prize for physiology in 1947. In addition to hundreds of .research reports, he wrote a comprehensive text of physiology, Human Physiology (1951).

HOUSTON, SAM or SAMUEL (1793–1863), American general and statesman, of Scotch-Irish descent, was born near Lexington, Va., on March 2, 1793. His father, who had fought in the Revolutionary War, died in 1806, and soon afterward Samuel moved with his mother to the frontier in Blount county, Tenn. When he was about 15 his elder brothers obtained for him a place

as clerk in a trader's store, but he ran away and lived with the Cherokee Indians of east Tennessee for nearly three years. On his return he opened a country school, and later attended a session or two of the academy at Maryville. During the War of 1812 Houston served under Andrew Jackson against the Creek Indians

In 1817 he was appointed subagent in managing the removal of the Cherokees from east Tennessee to a reservation in what is now Arkansas, but he was offended at a rebuke from John C. Calhoun, then secretary of war, for appearing before him in Indian garments, as well as at an inquiry into charges affecting his official integrity, and he resigned in 1818. He entered a law office in Nashville. and was admitted to the bar. From 1823 to 182; Houston represented the 9th district of Tennessee in congress, and in 1827 was elected governor of the state by the Jackson Democrats.

He married Eliza Allen in Jan. 1829. His wife left him three months later, and he resigned his office of governor, again took up his residence among the Cherokees. who were at this time about to remove to Indian territory, and was formally adopted a member of their nation.

In 1830 and again in 1832 he visited Washington to expose the frauds practised upon the Cherokees by government agents. Commissioned by President Jackson, Houston went to Texas in Dec. 1832 to negotiate treaties with the Indian tribes there for the protection of American traders on the border. He decided to remain in Texas, and was elected a delegate to the constitutional convention which met at San Felipe on April 1. 1833, to draw up a memorial to the Mexican congress. This memorial asked for the separation of Texas from Coahuila, in which the anti-American party was in control, and framed a constitution for the commonwealth as a new member of the Mexican republic. In Nov. 1835, soon after the outbreak of the War for Texan Independence, he was chosen commander in chief of the Texan army. On April 21, 1836, while in command of 743 raw troops, he met on the bank of the San Jacinto about 1.600 Mexican veterans led by Santa Anna and completely routed them; on the next day Santa Anna was taken prisoner.

Texan independence was won by this victory and Houston was elected president of Texas, Sept. 1, 1836. His term expired in Dec. 1838; he was elected again in 1841 and served until 1844. During his first term a newly founded city was named in his honour and this was the seat of government in 1837–39 and in 1842–45. Texas having been admitted as a state of the American union in 1845, Houston was elected one of its first two U S. senators. He served as a stalwart Union Democrat from 1846 until 1859; he opposed the Kansas-Nebraska bill in an able speech and spoke frequently in defense of the rights of the Indians. In 1859 he aas elected governor of Texas and tried to prevent the secession of his state. Upon his refusal, in March 1861, to swear allegiance to the Confederacy he was declared deposed. He died at Huntsville, Tex., on July 26, 1863.

Houston was an able soldier, wary, intrepid and resolute; and was a legislator of rare foresight, cool discrimination and fearless candour.

See A. *M*. Williams, *Sam Houston and the War of Independence in Texas* (1893) ; Henry Bruce, *Life of General Houston* (1891) ; *W*. C. Crane, *Life and Select Literary Remains of Sam Houston* (1884) ; S. B. Elliot, *Sam Houston* (1900); *S*. Acheson, "Sam Houston," *American Mercury*, vol. ii (1927); G. Creel, *Sam Houston, Colossus in Buckskin (1928)*; *M*. James, *The Raven: the Life of Sam Houston* (1929).

HOUSTON, an inland port city of southeastern Texas, U.S., and seat of Harris county, is located on the Gulf coastal plain and linked by the Houston Ship channel to the Gulf of Mexico, 52 mi. S.E., at Galveston (*q.v.*). One of the nation's principal industrial cities and a world port, Houston is a leading oil and petrochemical centre, manufacturer of oil-field equipment and the focal point for networks of pipelines carrying natural gas. Its corporate limits of 352 sq.mi. surround 14 of 23 cities in Harris county, its standard metropolitan statistical area. Its principal suburbs are Bellaire. Pasadena, West University Place (*qq.v.*) and Galena Park. Annual normal rainfall is 45.37 in. and annual normal temperature is 70° F. The climate is mild but humid. Houston's average altitude is 54 ft.

History. — Houston was planned as a real-estate promotion. Harrisburg. which became part of Houston in 1926, was laid out in 1826 for John Richardson Harris, who is believed to have named the town for Harrisburg, Pa. (which was founded by and named for his great-grandfather) as well as for himself. Mexican forces burned Harrisburg five days before the battle of San Jacinto (April 21, 1836) in which Gen. Sam Houston led Texans to victory and independence from Mexico. Land speculators, among them Augustus C. and John K. Allen. eyed the Harrisburg area with interest. It mas early seen that Buffalo bayou, a tidewater stream extending through the present site of the city about 45 mi. E. to the San Jacinto river. would become valuable as a means of access to the rich agricultural lands along the Brazos.

The Allens tried to buy the Harrisburg property, but its title was involved in fraudulent claims against the estate of Harris, who had died in 1829; therefore. they chose a site 12 mi. farther up the bayou at the most interior point of navigation in Texas. Harrisburg was rebuilt after the battle of San Jacinto and although its site was in some ways superior to Houston's it lacked promoters with the Allens' skill. The brothers bought the Houston town site on Aug. 24 and 26, 1836, and shrewdly named the town for the flamboyant Texas hero. Four days later they advertised their proposed town using the phrase "One Million Dollars." in capital letters, in the advertisements. But it was not until October that Moses Lapham, a surveyor, staked out the town.

In October also! when Houston was still an unoccupied town site, John Allen made a proposal to the congress of the Republic of Texas (of which he was a member) meeting at Columbia to move the seat of government to Houston, and he promised to build a capitol. The Texas congress voted accordingly to move the capital temporarily to Houston and the Allens, having made their site the republic's capital before the town existed, began building in fact what had succeeded in fancy. They sold the first lots in Jan. 1837; the government moved to Houston in May of that year before the building to house it was finished; and the city was incorporated in June.

Houston was the capital of the republic until Jan. 1810. and was briefly the capital again in 1842. Muddy and beset by recurring epidemics of yellow fever, the town grew slowly until the Civil War. When the Civil War began. its citizens voted overwhelmingly for the secession of Texas from the United States. The town became a lair for blockade runners and on Jan. 1. 1863, using two small vessels fortified with bales of cotton. an amphibious attack was mounted by Houstonians down Buffalo bayou to help recapture Galveston Island which had been seized by Federal forces three months earlier. In the same year Houston became the headquarters for the Confederate district of Texas, New Mexico and Arizona. The period of Reconstruction lasted from June 20. 1865, when Houston was occupied by Federal troops, until Jan. 1874. Houston's growth between Reconstruction and World War I came largely as a result of its importance as a railroad centre.

Houston's beginnings arose from the battle of San Jacinto. Though its people suffered to some extent from the Civil War and much more from the period of Reconstruction. Houston prospered and grew for the first time into a substantial municipality. It took a decisive lead in its long competition with Galveston after the Galveston flood and tidal wave of Sept. 8, 1900, in which an estimated 6.000 lives were lost and nearly half of the city was destroyed. The greatest proportional growth of the city's population, 111.4%, came in the 1920s largely as a result of the impetus given by World War I, and the most important period in its history was the decade following World War II.

Industrial and Commercial Growth. — Houston owes its remarkable growth in the 1940s and 1950s to its industrial complex. This consists of the ship channel, abundant natural resources (petroleum. natural gas. sulfur, lime. salt and water) and the fact that the product of one chemical plant is often the raw material of another. This combination. created on the banks of the ship channel, is one of the world's greatest concentrations of petrochemical industries which are dependent on the by-products of

oil refining. By the 1960s Houston became a pre-eminent example of the new urban U.S. caused by the economic impetus of World War II and the increased postwar migration of rural people to cities.

The shift in the city's character is shown by two contrasting popular names: the first was current between Reconstruction and the depression of the 1930s: the second in the period following o r l d War 11 Houston called itself the "Magnolia city" until the 1920s, when industry had effaced the magnolias and other natural beauty on Buffalo bayou, the lower part of which became the ship channel. After World War II. but not from its own conception, the city was called the "Land of the Big Rich." This name, which became a liability, was a fanciful allusion to Houston's supposed prevalence of oil millionaires.

No period in the city's history approaches the importance of the World War II era prior to which Houston was an ambitious medium-sized city. A few years afterward, its former hopes lying in the shadow of sudden and preposterous growth, the city was altered in character, aspirations and appearance. Since the 1920s Houston has given the impression of being continually new; nothing old was allowed to exist for long. No historic structures were preserved except the Noble house, built in the 1840s. The city showed little concern for its history until 1954 when a society was formed to preserve any remaining evidence of the past. Houston is a restless city spread across grazing land, and is one of the largest cities in the U.S. without a zoning ordinance, a notable lack caused by the individualism of its people.

The metropolitan area alone, which has seven oil refineries, was producing nearly 80,000 bbl. of oil daily in the late 1950s. when oil rigs were within a few yards of South Main street and the city was receiving oil royalties from wells drilled at the city garbage dump. Two major oil companies and hundreds of small ones have headquarters in Houston. most of whose downtown skyscrapers were either built by petroleum or banking interests. The city is the geographic and financial centre of the Texas Gulf coast region. In the 1960s most of the nation's sulfur deposits. nearly 7% of its petroleum reserves and about 11% of its refining capacity were located in a 19-county area surrounding Houston. An estimated three-quarters of the nation's petro-chemical production was also coming from the Texas Gulf coast area. Shipbuilding, an integrated steel mill, tool and oil-field equipment. paper mills. synthetic rubber, cement; grain elevators: tile milling. cottonseed oil. paints, furniture. breweries and food processing are other important aspects of Houston's industry. In 1961 the National Aeronautics and Space administration established a research. development and astronaut-training centre near Houston.

It was a paradox that Harris county. which is hundreds of miles from the state's chief cattle-raising areas. and despite the great industrial and commercial expansion of the Houston metropolitan area. had more cattle than any other county in Texas in the 1950s. Irrigation made the county a rice producer of importance; about 28% of the nation's rice is grown within a 100-mi, radius of Houston, and the city is one of the world's leading spot cotton markets.

The *Port of Houston and* the *Houston Ship* Channel.—The histories of the port, which is virtually devoid of the colour and romance of most U.S. ports, and the ship channel are one. In 1837 the first steam vessel of size succeeded in reaching a boat landing at Houston. Within two years steamboats were making daily runs between Houston and Bolivar roads at the entrance to Galveston harbour. The improvement of the Buffalo bayou channel was begun in 1839 with funds raised by public subscription and lotteries. The first local dock was built in 1840 and the Port of Houston was established by city ordinance in 1841. Widening and deepening of the channel was begun in 1869 and continued in the 1960s. by which time the minimum depth of the channel was 36 ft. and the minimum width was 300 ft: The port handles more than 50,000,000 tons of foreign. coastwise and internal canal shipping annually and is linked with the Gulf Intracoastal waterway.

Population.—Though the reality of Houston is obscured by the myth of its millionaire legend, it is primarily a city of working people. They came in mass during World War II—40,000 to the shipyards alone—and most remained. Unlike the state, whose population growth was mainly due to natural increase, Houston grew more from people moving in from the rest of Texas and from other states. Its population differs from that of most U.S. urban areas, having proportionally fewer industrial craft workers and more professional, technical and white-collar workers. The difference is caused by automation and the technical nature of three of the four dominant industries: processing oil, natural gas and petrochemicals. These, especially the latter, require fewer but more highly-trained workers than other industries. The proportion of total employment to capital investment in making chemicals is small compared, for example, with making steel or automobiles. The comparatively high pay received by workers in the three industries has caused Houston to have fewer apartments and more houses than older U.S. cities of comparable size.

Germans, immigrating to Texas in great numbers in the 19th century, once dominated Houston's population and continue to be a major element. In 1960, one-fifth of the population was Negro and nearly one-twelfth was Mexican. Many traders, scientists and executives were drawn to the city from other countries, first by cotton and later by oil and chemicals. Though the city's heritage is southern, the southwest gradually became dominant in its character in the first half of the 20th century. Houston's gusto in the 1950s was epitomized by "M Day," as July 3, 1954, was called. Statisticians divined ahead of time that the city's metropolitan population would reach 1,000,000 on that date and a festival was staged to welcome the millionth citizen. Houston's population was 2,396 at the first federal census of 1850, 16,513 in 1880, 44,633 in 1900, 78.800 in 1910, 138,276 in 1920, 292,352 in 1930 and 384,514 in 1940; in 1950 (of city), 596.163 (of standard metropolitan statistical area), 806,701; in 1960 it was 938,219 and 1,243.158 respectively.

Culture.—The chief aspects of the city's cultural life were the Houston Symphony orchestra (1913), a grand opera company, three chamber music groups of distinction, a contemporary music society (founded by Leopold Stokowski), three professional theatres operating the year round and two art museums. The older museum, the Houston Museum of Fine Arts, became an example of architectural excellence when a new wing, designed by Ludwig Mies van der Rohe, was opened in 1958. The city is notably lacking in parks, but the nearness of the Gulf of Mexico. the bay shore area and Lake Houston make it a centre of sailing, boating and fishing. The principal colleges are Rice university (nonsectarian. 1912). the University of Houston (1934), Texas Southern university (Negro, 1947), University of St. Thomas (Roman Catholic, 1947). Baylor university college of medicine and the University of Texas school of dentistry. Except for one hospital, the site of the Texas Medical centre was a forest within the city in 1946. At a cost of more than $50.000.000. most of which was paid by oil and cotton philanthropies, one of the nation's leading medical, research, educational and hospital centres was established there.

The San Jacinto battleground on the banks of the ship channel is a state park 22 mi. S. of Houston. It is the site of the San Jacinto monument, 570 ft. high, and the permanent berth of the battleship "Texas."

The city's most gifted leader was Will C. Hogg, a son of former Texas Gov. James Stephen Hogg, who in 1926 organized the Forum of Civics. Hogg, an altruist and a man of great wealth, died too soon to fulfill his dreams for the city. The city's most effective leaders in the first half of the 20th century were Jesse H. Jones, secretary of commerce and head of the Reconstruction Finance corporation under Pres. Franklin D. Roosevelt, and Oscar F. Holcombe. mayor for 11 two-year terms between 1920 and 1956.

See George Fuermann, *Houston: Land of the Big Rich* (1951).

(G. M. F.)

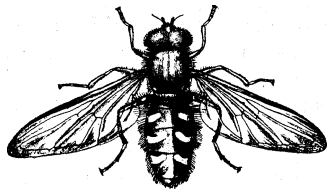
HOVE, a municipal and parliamentary borough in East Susses, Eng.. adjoining Brighton (*q.v.*) on the west. Pop. (1961) 72.843. Area 6.2 sq.mi. During the 19th century Hove became the most exclusive toun on the Sussex coast and the lawns on the sea front were among the most fashionable parade grounds in England. It

is a well laid out residential and seaside holiday town with the Sussex county cricket ground in its centre.

The name seems to be connected with an Old English word *hufe* meaning "shelter" and a settlement existed at Hove at the time of the Roman invasion.

HOVER FLY, any member of the family Syrphidae of the order Diptera (*q.v.*); one of the largest and most populous families of. flies, distinguished by the presence of a spurious vein between the third and fourth longitudinal veins. They are of great importance in the control of aphids and the pollination of flowers; a few are injurious. Other names are flower flies, sweat flies, sweat bees. syrphids and drone flies. They mostly visit flowers, but a few genera, such as *Microdon*—the larvae of which live in the nests of ants and termites—rarely do and they are poor fliers. Almost all others are able to hover for long periods. The larvae of many genera are predaceous upon aphids or plant lice, mealy bugs, etc., often destroying several hundreds during their brief existence; there may be several generations each year; larvae of *Pipiza* and allies attack woolly aphida. and in England feed upon American blight (*Eriosoma lanigerum*), which was introduced on the roots of American elm and causes serious damage to apple trees.

The larvae of some species of Cheilosinae feed under the bark of living trees; the most injurious species is the bulb fly, *Merodon equestris,* which pores into the bulbs of various cultivated flowers. It originated in Europe and is now common in parts of North America.



FROM c H CURRAN INSECTS OF THE PACIFIC WORLD" (THE MACMILLAN COMPANY)

A species of *Syrphus,* the larvae *dl* which are predaceous in Aphids

The lesser bulb flies (*Citabaena* or *Eumerus*), also of European origin, are found in various bulbs and corms of cultivated plants, including onions. but they are secondary and cause no damage. The truly aquatic larvae have a long, telescopic breathing tube which they extend to the surface of the water; the semiaquatic ones, living in tree holes and wet decaying vegetation, have a short, stout posterior breathing tube; some live under bark and may be predaceous. A few live in garbage, others in cacti; still others in pollen collected in the axils of leaves of corn, etc. *Volucella* bombylans lives in the nests of bumblebees, other species live in the nests of other bees and wasps. Many of the adults are banded with yellow and both resemble and act like wasps. even going through the stinging motion; the sweat bees are a small, banded species that are attracted by perspiration; they do not sting or bite. The long, slender species of Baccha like wooded and garden areas. The drone fly resembles honeybees, as do many others, and it was believed by the ancients to be one; it is almost cosmopolitan. More than 200 species occur in the British Isles. some of which are quite rare, others very common; they come out on the first warm days of spring and fly until frost.

See G. H. Verrall, British *Flies,* vol. viii (1901); P. Sack, "Syrphidae" in Lindner, *Fliegen Palaerkt.* Reg. *(1928--32).* (C. H. CN.)

HOWARD, the name of a famous English family of which the duke of Norfolk, premier duke and hereditary earl marshal of England, is head, while the earls of Suffolk, Carlisle and Effingham and the Lord Howard of Glossop and Lord Stafford represent in the peerage its younger lines.

The founder of the family was a lawyer, William Howard or Haward of East Wynch, Norfolk, who was summoned to parliament as a justice in 1295 and appointed a justice of the common pleas in 1297. William Howard's eldest son. Sir John Howard. served in Edward II's wars in Scotland and Gascony. was sheriff of Norfolk and Suffolk and governor of Norwich castle. When he died in 1331 he was seised of many Norfolk manors. His son and heir, another Sir John, admiral of the king's navy in the north, was a banneret who displayed his banner in the army that laid siege to Calais. By the admiral's wife Alice, sister and heir of Sir Robert de Boys, the Howards had the Boys manor of Fersfield, near Diss, which is still among the possessions of the dukes of Norfolk. His son Sir Robert Howard, who had married a daughter of Sir Robert Scales (Lord Scales), died before his father in 1388. From Sir John Howard, the only son of Sir Robert, two branches of the house of Howard sprang. The elder line was soon extinct. By his first wife, Margaret, daughter and heir of Sir John Plays, Sir John Howard had a son who died before him, leaving a daughter who married John de Vere, 12th earl of Oxford, and through whom descended to their issue, the Veres. earls of Oxford, the ancient Norfolk estates of the Howards at East Winch and elsewhere with the lands of the houses of Scales. Plays and Walton, brought in by the brides of her forefathers. By'his second wife, heir of the Tendrings of Tendring, Essex, he had a second son, Sir Robert Howard, a knight who fought under Henry V in France, and died, like his half-brother, before the old knight's career ended in 1436 in Palestine.

Robert Howard married Margaret Mowbray, daughter of Thomas Mowbray, 1st duke of Norfolk. Their son John (c. 1430–85) eventually, on the death of the 4th duke's daughter Anne, inherited the lion's share of the Mowbray estates and by a patent of June 28, 1483, was created duke of Norfolk and earl marshal of England with a remainder to the heirs male of his body (see NORFOLK. EARLS AND DUKES OF; MOWBRAY).

The eldest of the cadet branches of the ducal house has its origin in William (c. 1510–73), eldest son of the 2nd duke by his second marriage (see HOWARD OF EFFINGHAM, WILLIAM HOWARD, 1st Baron). William's eldest son, Charles (1536–1624), was lord high admiral and commanded the fleet which defeated the Spanish Armada (see NOTTINGHAM, CHARLES HOWARD, 1st Earl of). On the death of the 3rd earl of Nottingham in 1681 Sir William Howard of Lingfield. younger brother of the great admiral, carried on the Effingham line, his great-grandson succeeding to the barony on the extinction of the earldom. Francis, 7th Lord Howard of Effingham, was created earl of Effingham in 1731, a title extinct in 1816 with the 4th earl, but revived again in 1837 for the 11th baron. who had served as a general officer in the Peninsular campaign. Henry (1540–1614), eldest son of Henry Howard, earl of Surrey, and brother of the 4th duke of Norfolk, was created earl of Northampton in 1604, but the title died with him (see NORTHAMPTON, EARLS AND MARQUESSES OF).

Thomas (1561–1626), son of the 4th duke of Norfolk's marriage with the daughter and heir of 'Thomas, Lord Audley of Walden, founded the line of the present earls of Suffolk and Berkshire and of the extinct Lords Howard of Escrick. His barony of Howard of Walden has descended to his heirs general. Another son. Lord William Howard, married in 1577 one of the three co-heirs of the Lord Dacre of Gillesland. His great-grandson Charles Howard was created. in 1661, earl of Carlisle. Viscount Howard of Morpeth and Baron Dacre of Gillesland, titles which are still held by his descendants (*see* CARLISLE, EARLS OF). From Sir Francis Howard, a Cavalier colonel and a younger son of "bauld Willie," come the Hon-ards of Corby Castle in Cumberland, a branch without a hereditary title.

William Howard (1614–80), Viscount Stafford, was the fifth son of Thomas, earl of Arundei. Marrying the sister and heir of the 5th Lord Stafford. who died in 1637, he and his wife were created Baron and Baroness Stafford by a patent of 1640. with remainder, in default of heirs male, to heirs female. A grant of the precedence enjoyed by the bride's father being held illegal. he was in 1640 created Viscount Stafford. Roger Stafford, cousin of the 5th Lord Stafford and heir of the ancient Staffords, had been forced to surrender his barony in 1639. The viscount, accused by Titus Oates. was sent to the Tower in 1678 and beheaded in 1680. He was beatified in 1929. In 1688 his widow was created countess of Stafford for life, and his eldest son, Henry, had the earldom of Stafford. with special remainder to his brothers. This earldom ended in 1762. but the attainder was reversed by an act of 1824 and in the following year Sir George Jerningham, the heir general, established his claim to the Stafford barony of 1640.

See G. Rrcnan and E. P. Statham, *House of Howard;* 2 vol. (1907).

HOWARD, BRONSON CROCKER (1842–1908), U.S. playwright, considered during the last years of his life the leading U.S. dramatist! was born in Detroit, Rich., Oct. 7, 1842, the son of the Detroit mayor, Charles M. Howard. After schooling in

Detroit and at Russell's institute in New Haven, Conn., he began his career as a playwright with *Fantine* in 1864. In New Uork city. between 1865 and 1870, Howard worked on various newspapers while striving to have his plays produced. *Saratoga* was produced in 1870 by Augustin Daly at the Fifth Avenue theatre and was an immediate success, having a run of 101 nights. In 1873 *Lillian's Last Love* was unsuccessful in Chicago, but, rewritten and produced as *The Banker's Daughter* at Palmer's Cnion Square theatre, New Uork, in 1878, it enjoyed a good run. After another success, *Young Mrs. Winthrop* (1882), his *One* of Our *Girls* (1885) began a run of 200 nights at the Lyceum theatre. *The Henvietta,* a melodrama of business tycoons, ran 68 weeks at the Union Square theatre, beginning in 1887. Howard's most popular play was *Shenandoah,* on a Civil War theme, written in 1888. Produced under Charles Frohman's direction in New York, it was popular for years throughout the Cnited States and Europe.

Bronson Howard wrote few plays. concentrating on quality. He founded and was first president of the American Dramatist's club! which later became the Dramatists' guild of the Authors' League of America. He led a successful campaign to overhaul the national copyright laws. He died Aug. 4, 1908. (S. W. H.)

HOWARD, CATHERINE: *see* CATHERINE (Catherine Howard).

HOWARD, JOHN (1726–1790), English philanthropist and prison reformer, was born at Hackney, London, probably on Sept. 2, 1726. Howard inherited considerable property on his father's death and decided to travel. He was on his way to Portugal in 1754 when the ship was taken by a French privateer, the crew and passengers being carried to Brest, France, where they were treated with great severity. Howard was permitted to return to England on parole to negotiate an exchange. He settled at Cardington, Bedford, interesting himself in meteorological observations, and was admitted a member of the Royal society in 1756. In 1773 he became high sheriff of Bedford and paid visits to the jail. Howard found it, like all the prisons of the time, wretchedly defective in its arrangements; neither the jailer nor his subordinates were salaried officers, but were dependent on fees from prisoners. He found that persons were detained in prison for months for no reason except that they could not pay the fees of jail delivery. His prompt application to the justices for a salary to the jailer in lieu of his fees mas met by a demand for a precedent in charging the county with an expense, but he could find no precedent. In 1774 he gave evidence before a committee of the house of commons, and almost immediately an act was passed which provided for the liberation, free of all charges, of every prisoner against whom the grand jury failed to find a true bill, giving the jailer a sum from the county rate in lieu of the abolished fees. This was followed by another act requiring justices of the peace to see that the walls and ceilings of prisons were scraped and whitewashed once a year at least; that the rooms were regularly cleaned and ventilated; that infirmaries were provided for the sick, and proper care taken to get them medical advice; that the naked should be clothed; that underground dungeons should be used as little as possible; and generally that such courses should be taken as would tend to restore and preserve the health of the prisoners. In 1777 appeared *The State of the Prisons in England and Wales, with Preliminary Observations, and an Account of Some Foreign Prisons.* One result was the drafting of a bill for the establishment of penitentiary houses, where, by means of solitary imprisonment accompanied by well-regulated labour and religious instruction, the object of reforming the criminal and inuring him to habits of industry might be pursued. New buildings were manifestly necessary; and Howard volunteered to go abroad and collect plans. He first went to Amsterdam (1778) and carefully examined the spinning houses and rasp houses, where prisoners were set to useful work; next he traversed Prussia, Saxony, Bohemia, Austria and Italy. The information he thus obtained was presented to parliament, and a bill was passed for building two penitentiary houses; Howard was appointed first supervisor, but he resigned the post before anything practical had been achieved. In 1780 he had published an appendix to his *State of Prisons,* and in 1784, a second appendix. The remaining years of his life were devoted to researches on the means for prevention of the plague and for guarding against the propagation of contagious diseases in general. He inspected prisons of the United Kingdom in 1787, and prepared his *Account of the Principal Lazarettos in Europe* (1789). In 1789 he traveled to St. Petersburg and Moscow, visiting the principal military hospitals that lay on his route. At Kherson he contracted a disease and died on Jan. 20. 1790.

See publications of the Howard League for Penal Reform.

HOWARD, OLIVER OTIS (1830–1909), U.S. soldier, was born in Leeds, Me., on Nov. 8, 1830. He graduated from Bowdoin college, Brunswick, Me., in 1850, and from the U.S. military academy in 1854. At the beginning of the Civil War he resigned to become colonel of a Maine volunteer regiment and at the first battle of Bull Run was in command of a brigade. He served in the Peninsular campaign, and at the battle of Seven Pines (Fair Oaks) he was twice nounded, losing his right arm. On his return to active service in Aug. 1862, he took part in the Virginian campaigns of 1862–63; at Antietam he succeeded Sedgwick in command of a division, and he became major general of volunteers in March 1863. In the campaign of Chancellorsville *(see* WILDERNESS) he commanded a corps which was routed by "Stonewall" Jackson, and in the first day's battle at Gettysburg he was for some hours in command of the Union troops. Howard's corps was transferred to Tennessee after Rosecrans' defeat at Chickamauga, and formed part of Hooker's command in the victory of Chattanooga. When Sherman prepared to invade Georgia in the spring of 1864 Howard was placed in command of a new corps, and took part in the actions of the Atlanta campaign, receiving another wound at Pickett's mills. On the death in action of Gen. James B. McPherson, Howard was selected to command the army of the Tennessee in July 1864. In this position he took part in the "March to the Sea" and the Carolinas campaign.

Howard served as commissioner of the bureau of refugees, freedmen and abandoned lands from 1865 until 1874; in 1872 he was special commissioner to the hostile Apaches of New Mexico and Arizona; in 1874–81 he was in command of the department of the Columbia and conducted the campaign against Chief Joseph in 1877 and that against the Bannocks and Paiutes in 1878. In 1886 he was promoted to major general, and in 1894 he retired. Howard was deeply interested in the welfare of the Negroes; and the establishment by the U.S. government in 1867 of Howard university, at Washington, D.C., especially for their education, was largely due to him; it was named in his honour, and from 1869 to 1873 he presided over it. In 1895 he founded for the education of the "mountain whites" the Lincoln Memorial university at Cumberland Gap, Tenn. He died at Burlington, Vt.. Oct. 26, 1909. He wrote, among other works, *Donald's Schooldays* (1877); *Chief Joseph* (1881) ; a life of Gen. Zachary Taylor (1892) in the "Great Commanders Series"; *Isabella of Castile* (1894) ; *Fighting for Humanity* (1898); *Henry in the War* (1898); papers in the "Battles and Leaders" collection on the Atlanta campaign; My *Life* and *Experience Among our Hostile Indians* (1907); and *Autobiography of O O. Howard* (1907).

HOWARD, PHILIP (in religion THOMAS) (1629–1694), cardinal of Norfolk, a Dominican who restored the English province of the order, was born in London on Sept. 21, 1629, into the ducal house of Norfolk. He was brought up a Roman Catholic, although the head of the house had been an Anglican since 1613, and became a Dominican at Cremona, Italy, at the age of 16 against the wishes of his family. Thereafter he directed all his energies to reconverting England to the Roman Catholic Church and to restoring the English Dominican province.

Howard was ordained priest in 1652, and in 1673 he became prior of the new Dominican house he had founded at Bornem, Flanders, to house the remnant of the former English province then exiled on the continent. In the reign of Charles II he was made grand almoner to the queen, Catherine of Braganza, but an outbreak of Puritan violence drove him back to Flanders. After being created cardinal by Clement X in 1675, he lived in Rome, where his cardinalitial church was Sta. Maria sopra Minerva. In 1679 he was made cardinal protector of England and Scotland. He died in Rome on June 18, 1694.

His literary remains consist of letters, which are of no small interest to historians. These were edited by B. Jarrett in *Publications of the Catholic Record Society,* vol. xxv (1925).

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HOWARD, SIR ROBERT (1626–1698), English dramatist, sixth son of Thomas Howard, 1st earl of Berkshire, was born in 1626. He was knighted at the second battle of Newbury (1644) for his signal courage on the Royalist side. Imprisoned in Windsor castle under the commonwealth, his loyalty was rewarded at the Restoration, and he eventually became auditor of the exchequer. His best play is a comedy, *The Conzmittee, or the Faithful Irishman* (1663; printed 1665), which kept the stage, long after its interest as a political satire was exhausted, for the character of Teague, said to have been drawn from one of his own servants. He was an early patron of Dryden, who married his sister, Lady Elizabeth Howard; and in the *Indian Queen,* a tragedy in heroic verse (1664; printed 166j), Howard had assistance from Dryden, although the fact was not made public until the production of Dryden's *Indian Emperor.* The magnificence of the spectacle made a great sensation. In 1665 Howard published *Foure New Plays,* in the preface to which he opposed the view maintained by Dryden in the dedicatory epistle to *The Rival Ladies,* that rhyme was better suited to the heroic tragedy than blank verse. Howard made an exception in favour of the rhyme of Lord Orrery, but by his silence concerning Dryden implicated him in the general censure. Dryden answered by placing Howard's sentiments in the mouth of Crites in his own *Essay on Dramatic Poesy* (1668). The controversy continued, but Dryden worsted his adversary in the 1668 edition of *The Indian Emperor.* Howard died on Sept. 3, 1698.

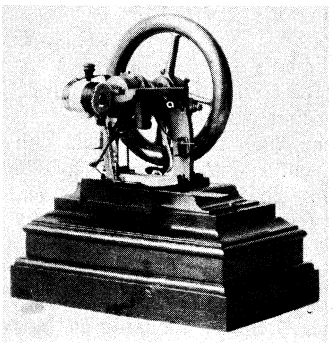
HOWARD, SIDNEY COE (1891–1939), U.S. playwright and author, was born in Oakland. Calif., on June 26, 1891. He graduated from the University of California, Berkeley, in 191j and during the next year worked under George Pierce Baker at Harvard university. During World War I he served with the American ambulance corps and was later a captain in the U.S. air corps. He served on the editorial staff of *Life,* 1919–22, and in 1923 was a feature-story writer for Hearst's *International Magazine.* In 1922 he was married to Clare Eames. the actress. Among his plays are *Swords* (1921); *Casanova* (1923); *They Knew What They Wanted* (1924), which won a Pulitzer prize in 1925; *Lucky Sam McCarver* (192j); *The Silver Cord* (1926); *The Late Christopher Bean* (1932); *Alien Corn* (1933); *Yellowjack* (1934); an adaptation of Sinclair Lewis' novel *Dodsworth* (1934); and *Madam, Will You Walk* (1939). He died in an accident at Tyringham, Mass., Aug. 23. 1939, at a time when he was dramatizing Carl Van Doren's *Benjamin Franklin.* He translated and adapted European dramas and published a volume of stories. *Three Flights Up* (1924).

HOWARD OF EFFINGHAM, CHARLES HOWARD, 2ND BARON: *see* NOTTINGHAM, CHARLES HOWARD, 1ST EARL OF.

HOWARD OF EFFINGHAM, WILLIAM HOWARD, 1ST BARON (*c.* 1510–1573), English lord high admiral, was the son of the 2nd duke of Norfolk (d. 1524). At Anne Boleyn's coronation he was deputy earl marshal. In 1541 he was charged with abetting his relative Queen Catherine Howard and was convicted of misprision of treason, but pardoned. In 1552 he was made governor of Calais, and in 1553 lord high admiral, being created Baron Howard of Effingham in 1554 for his defense of London in Sir Thomas Wyat's rebellion against Queen Mary. He befriended the princess Elizabeth, but his popularity with the navy saved him from Mary's resentment; and when Elizabeth became queen he filled various important posts. His son, the and baron, the victor over the Armada, was created earl of Nottingham (*q.v.*); and from a younger son the later earls of Effingham were descended.

HOWE, ED(GAR WATSON) (1853–1937), U.S. editor, novelist and essayist, was born at Treaty, Ind., on May 3, 1853. He went to work at the age of seven on his father's homestead near Bethany, Mo. An apprentice printer at 12, he worked at the trade in Missouri, Iowa, Nebraska and Utah (1867–72). At 19 he was publisher of the *Golden* (Colo.) *Globe* and in 1877 founded the *Atchison* (Kan.) *Daily Globe,* made famous by frequent reprinting of his paragraphs throughout the U.S. His first and most successful novel, *The Story of a Country Town* (1883), was the first realistic novel of midwestern small-town life. He published and edited *Howe's Monthly* (1911–33) and wrote essays, travel books and an autobiography, *Plain People* (1929). He died Oct. 3, 1937.

HOWE, ELIAS (1819–1867), U.S. sewing-machine inventor, was born in Spencer, Mass., on July 9, 1819. As a boy he worked on his father's farm and in his gristmills and sawmills, taking particular interest in the machinery. After learning the machinist's trade he conceived the idea of a sewing machine and for five years spent all his spare time in its development. In Sept. 1846 a patent for a practical sewing machine was granted to him; and Howe spent the following two years (1847–49) in London, employed by William Thomas, a corset manufacturer, to whom he had sold the English rights for £250. Years of disappointment and discouragement followed before he was successful in introducing his invention, while several other machines, particularly that of Isaac Merrit Singer (*q.v.*), had already been introduced and were widely used. Howe's rights were established after much litigation in 1854, and thereafter until the expiration of his patent in 1867 he received royalties on all sewing machines made in the U.S. He died in Brooklyn, N.Y., on Oct. 3, 1867.



BY COURTESY OF SMITHSONIAN INSTITUTION

ONE OF THE EARLY SEWING MACHINES INVENTED BY ELIAS HOWE. IN THE U.S. NATIONAL MUSEUM, SMITHSONIAN INSTITUTION, WASHINGTON, D.C.

(W. E. HD.)

HOWE, HENRY MARION (1848–1922), U.S. metallurgist, whose *Metallography of Steel and Cast Iron* (1916) was the most learned and authoritative work on the subject up to that time, was born in Boston, Mass., on March 2, 1848. The son of Samuel Gridley Howe and Julia Ward Howe, he attended Boston Latin school, Harvard college and Massachusetts Institute of Technology. His industrial experience covered the years 1872–85 in the copper and the steel industries. Four of his books, *Copper Smelting* (1885), *The Metallurgy of Steel* (1890), *Metallurgical Luboratory Notes* (1902) and *Iron, Steel and Other Alloys* (1903), written during his academic career as lecturer at M.I.T. (1883–97) and professor of metallurgy at Columbia university (1897–1913), brought him awards and honours from German, French, Swedish, British, Russian and United States scientific and technical societies and from the French and Russian governments. He was the author of many technical papers and the consulting metallurgist for the national bureau of standards and took an active and leading part in the affairs of technical societies. He died at Bedford Hills, N.Y., on May 14, 1922. (F. B. F.)

HOWE, JOHN (1630–1706), English Puritan minister, was born on May 17, 1630, at Loughborough, Leicestershire, where his father was vicar. He studied at Christ's college, Cambridge, became fellow and chaplain of Magdalen college, Oxford, and held a Devonshire curacy. In 1657 Howe became domestic chaplain to Cromwell. In this position his conduct was such as to win the praise of even the bitterest enemies of his party. Without overlooking his fellow Puritans, he was always ready to help pious and learned men of other schools. Seth War (afterward bishop of Exeter) and Thomas Fuller were among those who profited by Howe's kindness, and were not ashamed subsequently to express their gratitude for it. On the resignation of Richard Cromwell, Howe returned to Great Torrington, to leave it again in 1662 on the passing of the Act of Uniformity. For several years he led a wandering and uncertain life, until he found a home with Lord Massereene, of Antrim castle, Ireland, with whom he lived for five or six years as domestic chaplain. Here he produced the most eloquent of his shorter treatises, ***The*** *Vanity of Man as*

Mortal, and On Delighting in God, and planned his best work, The Living *Temple.* In 1676 he became joint pastor of a nonconformist congregation at Haberdashers' hall, London; and in the same year he published the first part of *The* Living Temple, entitled Concerning God's Existence and his *Conversableness with Man:* Against Atheism or *the Epicurean* Deism.

For five years after his settlement in London Howe enjoyed comparative freedom, and was on not unfriendly terms with many eminent Anglicans, such as Stillingfleet, Tillotson. John Sharp and Richard Kidder; but in 168j he left England with Philip, Lord Wharton. In 1656 he determined to settle for a time at Utrecht. where he officiated in the English chapel. Among his friends there was Gilbert Burnet, who introduced him to William of Orange. In 1687 Howe returned to England. He died in London on April 2, 1706. Richard Cromn ell visited him in his last illness.

HOWE, JOSEPH (1804–1873), Canadian statesman, was born at Halifax. Nova Scotia. on Dec. 13 1804. the son of John Howe (1752–1835), a United Empire Loyalist who was for many years king's printer and postmaster general for the Maritime Provinces and the Bermudas. In 1827 he started the Acadian, a weekly nonpolitical journal, but soon sold it, and in 1828 purchased the *Nova* Scotian, which later became amalgamated nith the Morning Chronicle. In 1836 he was elected member for Halifax in the provincial assembly, and during the next twelve years agitated for responsible government for Nova Scotia. This brought him into conflict with the lieutenant governor. Lord Falkland (1803–1884), whom he forced to resign. Responsible government was finally conceded in 1848 by the imperial authorities. In 1850 he was sent to England on behalf of the Intercolonial railway, for which he obtained an imperial guarantee. In 1854 he resigned from the cabinet, and was appointed chief commissioner of railways.

From 1860 to 1863 he was premier of Nova Scotia. Though his eloquence had done more than anything else to make practicable a union of the British Korth American provinces, he opposed confederation, but finally entered (on Jan. 30, 1869) the cabinet of Sir John Macdonald as president of the council. In May 1873 he was appointed lieutenant governor of Nova Scotia, but died suddenly on June 1 of the same year.

His Letters and Speeches were published in 1858 in Boston, Mass., in 2 vols., edited nominally by William Annand, really by himself. See also Public Letters and *Speeches* of Joseph Howe (Halifax, 1909). The Lije and Times by G. E Fenety (1896) is poor The Life by the Hon James W Longley (Toronto, 1904) is dispassionate, but otherwise mediocre. Joseph Howe, by George Monro Grant (reprinted Halifax, 1904), is a brilliant sketch.

HOWE, JULIA (nie WARD) (1819–1910), U.S. author and lecturer. best known for her "The Battle Hymn of the Republic," was born in New York city, May 27, 1819. and died in Newport, R.I.. Oct. 17, 1910. The daughter of Samuel Ward, New York banker, she was educated by private tutors in music and languages, continuing these studies during her long life. In 1843 she married Samuel Gridley Howe of Boston, Mass., reformer and teacher of the blind. The "Battle Hymn" was first published in the Atlantic *Monthly,* Feb. 1862. Moved by the economic plight of Civil War widows, Mrs. Hotve worked for equal education, professional and business opportunities for women. She was the author of travel books, biography, drama and verse and a composer of songs for children. She combined social gifts with executive ability, was a founder of women's clubs and equal suffrage organizations. Widowed in 1876, she contributed to the support of her children by lecture tours.

See Laura E. Richards and Maud Howe Elliott, Julia Ward Howe; *1819–1910* (1916); Louise Hall Tharp, Three Saints and a Sinner (1956). (L. H. T.)

HOWE, RICHARD HOWE, EARL (1726–1799), British admiral who commanded the channel fleet at the battle of the First of June (*q.v.*) was born in London on March 8, 1726. He entered the navy in 1740, saw much active service and was rapidly promoted. In 1755 he went with Edward Boscawen to North America as captain of the "Dunkirk" (60 guns), and his seizure of the French "Alcide" (64) was the first shot fired in the war. From that date till the peace of 1763 he served in the English channel in various more or less futile expeditions against the coast of France, with a steady increase of reputation as a firm and skillful officer. On Nov. 20, 1759, he led Hawke's fleet as captain of the "Magnanime" (64) in the victory of Quiberon.

By the death of his elder brother, killed near Ticonderoga on July 6. 1758, he became Viscount Howe—an Irish peerage. In 1762 he was elected M.P. for Dartmouth. During 1763 and 176j he was a member of the admiralty board, and from 1765 to 1770 mas treasurer of the navy. In that year he was promoted rear admiral, and in 1775 vice-admiral. In 1776 he was appointed to the command of the North American station. The rebellion of the colonies was making rapid progress, and Howe was known to be in sympathy with the colonists. He had sought the acquaintance of Benjamin Franklin, and it was perhaps because of his known sentiments that he was joined in commission with his brother, Gen. Sir William Howe, to make a conciliatory arrangement. A committee appointed by the Continental Congress conferred uith the Howes in Sept. 1776 but nothing was accomplished. The appointment of a new peace commission in 1778 offended the admiral deeply, and he sent in his resignation. Before it could take effect France declared war, and a powerful French squadron was sent to America under the Count d'Estaing. Being greatly outnumbered, Howe had to stand on the defensive, but he baffled the French admiral at Sandy Hook, and defeated his attempt to take Newport in Rhode Island by a fine combination of caution and calculated daring. On the arrival of Adm. John Byron from England with reinforcements. Howe left the station in September. Until the fall of Lord North's ministry in 1782 he refused to serve, assigning as his reason that he could not trust Lord Sandwich. He considered that he had not been properly supported in America, and was embittered both by the supersession of himself and his brother as peace commissioners, and by attacks made on him by ministerial writers in the press.

On the change of ministry in March 1782 he was selected to command in the English channel, and in the autumn of that year he carried out the difficult operation of the final relief of Gibraltar. The French and Spaniards had in all 46 line-of-battle ships to his 33, and his ships were ill-equipped and manned. He was, moreover, hampered by a great convoy carrying stores. But Howe handled his ships well, the enemy was awkward and unenterprising and the operation was brilliantly successful. From Jan. 28 to April 16. 1783, he was first lord of the admiralty, and again from Dec. 1783 until Aug. 1788, in William Pitt's first ministry.

On the outbreak of the French Revolutionary War in 1793 he was again named to the command of the channel fleet. In 1794 he won the epoch-making victory of the First of June (see FIRST OF JUNE). Though Howe was then nearly 70 and had been trained in the old school, he displayed an originality not usual with veterans, and not excelled by any of his successors in the war, not even by Kelson, since they had his example to follow and were served by more highly trained squadrons than his. In 1797 he was called on to pacify the mutineers at Spithead, and he showed great influence with the seamen. He died on Aug. j, 1799, and was buried in his family vault at Langar.

In 1782 he was created Viscount Howe of Langar, and in 1788 Baron and Earl Howe. In June 1797 he was made a knight of the garter. His nickname of "Black Dick" was given because of his swarthy complexion, and the portrait by Thomas Gainsborough shows that it was apt.

The standard Life is by Sir John Barrow (1838). Interesting reminiscences will be found in the Life of Codrington by Lady Bourchier. Accounts of his professional services are in Charnock's *Biographia Navalis,* vol. 457, and in Ralf's Naval Biographies, i, 83. See also Beatson's Naval and Military Annals, James's Naval History, and Chevalier's *Histoire* de la *Marine française,* vol. i and ii.

HOWE, SAMUEL GRIDLEY (1801–1876), U.S. educator and first director of the Perkins School for the Blind, was born at Boston, Mass., on Nov. 10, 1801. He attended Harvard medical school and was admitted to practice, but abandoned the medical field to take part in the Greek revolution. After six years with the Greek army, acting as fighter and surgeon and helping in reconstruction of the devastated country, he returned to the United States and in 1831 received a proposal to direct the establishment

of a New England asylum for the blind at Boston. Howe set out at once for Europe to investigate the problem. There he was temporarily diverted from his task by becoming involved in the Polish revolt, suffering arrest and imprisonment. Returning to Boston in July 1832, he began receiving a few blind children at his father's house in Pleasant street, the beginning of what was to become the Perkins school. One of his notable successes was in teaching Laura Bridgman (*q.v.*).

In 1843 he married Julia Ward (see HOWE, JULIA WARD) and with her made a prolonged European trip. Upon return to the United States. Howe interested himself in the condition and treatment of mentally defective children. He uas also an ardent abolitionist and a member of the Free Soil party. He died on Jan. 19, 1876, at Boston.

HOWE, WILLIAM HOWE, 5TH VISCOUNT (1729–1814), British general, was the younger brother of George Augustus. 3rd viscount. killed in the Ticonderoga expedition of 1758. and of Richard. 4th viscount and afterward Earl Home, the admiral. He entered the army in 1746. In Wolfe's expedition to Quebec he distinguished himself greatly at the head of a composite light battalion. He led the advanced party in the landing at Wolfe's Cove and took part in the battle of the Plains of Abraham which followed. He commanded his own regiment in the defense of Quebec in 1759–1760, led a brigade in the advance on Montreal and took part on his return to Europe in the siege of Belleisle (1761). He was adjutant general of the force which besieged and took Havana in 1762, and at the close of the war had acquired the reputation of being one of the most brilliant of the junior officers of the army. He mas made colonel of the 46th Foot in 1764 and lieutenant governor of the Isle of Wight four years later. From 1758 to 1780 he was M.P. for Nottingham. In 1772 he became major general, and in 1774 he was entrusted with the training of light infantry companies on a new system.

Shortly after this he was sent out to North America. He did not agree with the policy of the government toward the colonists, and regretted in particular that he was sent to Boston, where the memory of his eldest brother was still cherished, and General Gage, in whom he had no confidence. commanded in chief He was the senior officer after Gage, and led the troops actively engaged in the storming of Bunker Hill, he himself being in the thickest of the fighting. In the same year Howe was made a K.B. and a lieutenant general, and appointed. with the local rank of general, to the chief command in the seat of war. For the events during his command see AMERICAN REVOLUTION. He retained it until May 1778—on the whole with success. He resigned because he thought the home government had not afforded the proper support, and after his return to England. he and his brother engaged in a heated but fruitless controversy with the ministers. In 1782 Howe was made lieutenant general of the ordnance; in 1790 he was placed in command of the forces organized for action against Spain, and in 1793 he was made a full general. He held various home commands in the early part of the French revolutionary war, in particular that of the eastern district at the critical moment when the French established their forces on the Dutch coast. When Earl Howe died in 1799, Sir William succeeded to the Irish viscounty. He had been made governor of Berwick-on-Tweed in 1795, and in 1805 he became governor of Plymouth, where he died on July 12, 1814. With his death the Irish peerage became extinct.

HOWEL DDA ("the Good") (d. 950). prince of Deheubarth (south central Wales) before 915, and king of Wales from 943 to 950, was the grandson of Rhodri Mawr (the Great), who had united practically the whole of Wales under his supremacy. As Idwal Voel succeeded his father Anarawd, the elder son of Rhodri, as lord of Gwynedd in 915, so Howel at some time before that date succeeded Rhodri's younger son Cadell as prince of Deheubarth. Howel married Elen, daughter of the last king of Dyfed, and also added Kidweli and Gwyr to his dominions, while on the death of Idwal, who was slain by the English in 943, he took possession of Gwynedd Both these princes had done homage to the English kings, Eduard the Elder and Aethelstan, in 922 and 926, and we find that Howel attended the witans of the English kingdom and witnessed about ten charters between the years 931 and 949. He was secure, therefore, from attack on the eastern side of his kingdom, and it is not certain whether he was engaged in any of the battles recorded during these years in Wales, either in Môn 914, at Dinas Newydd 919 or at Brun 93;. To the peaceful character of his reign is probably due the high place which he holds among the Welsh princes. From 943 to 950 Howel Dda was probably ruler oi all Wales except Powys (apparently dependent on Mercia), Brecheiniog, Buallt, Gwent and Morgannwg. With Morgan Hen, king of Morgannwg, Howel had a dispute which was eventually settled in favour of the former at the court of the English king. Howel died in 950, and such unity as he had preserved at once disappeared in a war between his sons and those of Idwal Voel. The code of laws attributed to this prince is perhaps his chief claim to fame He is said to have summoned four men from each cantref in his dominions to the Ty Gwyn (perhaps Whitland in Carmarthenshire) to codify existing custom. Three codes, accordingly called T'enedotian, Demetian and Gmentian, are said to have been written down by Bleggwryd, archdeacon of Llandaff (*see* WELSH LAWS).

See Sir John Rhys and Brynmor-Jones, *The Welsh People* (1900); and Aneurin Owen, *Ancient Laws and Institutions of Wales (1841).*

HOWELL, JAMES (c. 1594–1666), English writer, is known for his *Epistolae Ho-Elianae,* an early and lively example of essays written in the form of letters and in most cases intended for publication. Howell came of an old Welsh family and was born probably at Abernant, Carmarthenshire. From the grammar school at Hereford he went to Jesus college, Oxford. and then traveled abroad, becoming a versatile linguist and, as he himself said, "a true cosmopolite." Minor posts in government service and election (1627) as M.P. for Richmond, Yorkshire, added to his many acquaintances in literary and public life. From 1643 until 1651 he was held in the Fleet prison, whether principally on account of unpaid debts or royalist opinions is uncertain, and was there obliged by necessity to make writing his profession. At the Restoration the post of historiographer royal was created for him. He was buried in the Temple church, London, on Nov. 3, 1666. His writings include translations, dictionaries, imaginative works, political pamphlets and the Epistolae Ho-Elianue, 4 vol. (1645–55). Howell plagiarized freely and added fictitious dates so that. notwithstanding their vivid impressions of contemporary events and opinions. the letters live for their qualities as essays rather than as reliable reporting. The standard edition is edited by J. Jacob, 2 vol. (1890–92).

HOWELLS, WILLIAM DEAN (1837–1920), **U.S.** novelist and critic, spokesman of realism in American fiction, was born at Martin's Ferry, O., March 1, 1837. From his father, a printer-journalist, the boy acquired equalitarian ideas, and from the family reading of Swedenborg a persisting ethical bent. Howells spent his formative years in Jefferson and Columbus, O., as typesetter. reporter and editor with various newspapers, teaching himself Spanish and German, reading Cervantes, Heine and Shakespeare and writing poetry late into the night. They were years at times shadowed by sleeplessness, overwork and youthful recurring fears of hydrophobia and insanity. Writing his campaign biography of Lincoln (1860) became a turning point in Howells' life, for it financed the journey to New England during which he met James Russell Lowell and the established American writers, and led to his appointment as U.S. consul at Venice, his marriage to Elinor Mead and the Italian years (1861–65), in which he completed his education as a writer.

With the publication of Venetian Life (1866) he entered upon a period of influence and renown as assistant editor and then editor of the Atlantic *Monthly* (1866–71; 1871–81). Howells transformed the Atlantic into a national magazine, introducing new features, making the style more colloquial and enlisting the aid of writers as different in all but talent as Henry James and Mark Twain. Meanwhile he was adapting his skill in writing sketches of travel to creating travel novels, Their Wedding Journey (1872) and *A* Chance Acquaintance (1873), and international novels contrasting European and American manners, A Foregone Conclusion (1875). The Lady of the Aroostook (1879) and Indian Summer (1886). He was also beginning to write plays, and without much success to lay siege to the theatre.

Howells' leaving Boston for New York in 1888 signalized an expansion of his intellectual and imaginative horizons. In the essay, "Henry James, Jr." (1882), he had unconsciously precipitated an international controversy over realism by asserting that "The

art of fiction has become a finer art in our day than it was with Dickens and Thackeray." and in the "Editor's Study" of *Harper's Magazine* he carried the battle to the romantic critics for six years, 1886–92. Tolstoy's art and ethics and the social ferment of which Laurence Gronlund, Henry George and Edward Bellamy were a part stirred Howells mightily. In 1887 he risked both livelihood and reputation, as he thought, by writing an open letter asking clemency for the Chicago anarchists involved in the Haymarket riot, on the ground that they had been convicted for their political beliefs. The effect of these experiences appears in the broader scope of *The Minister's Charge* (1887), *Annie Kilburn* (1889), *A Hazard of New Fortunes* (1890) and *A Traveler From Altruria* (1894).

The death in 1889 of his elder daughter, Winifred, a talented girl long an invalid. set in Howells for the rest of his life the conviction that material gain and personal happiness were secondary or even delusory human aims. Thus in the 1890s he was championing new writers like Hamlin Garland. Stephen Crane, H. B. Fuller and Frank Norris, and collected a portion of his polemical "Editor's Study" in *Criticism and Fiction* (1891). Thus at the turn of the century he played an active role in the anti-imperialist movement with Mark Twain. Honours accrued to him thereafter as the dean of American letters and his official reputation increased; but the number of his readers began to dwindle. and before his death on May 10, 1920, he knew, as he said, that he had become "comparatively a dead cult with my statues cut down and the grass growing over them in the pale moonlight."

His **Value** as Critic.—Howells is distinguished in American history and literature as the editor and friend of Henry James and Mark Twain, the most influential critic of his day and a prolific, able novelist. Though he undervalued criticism he was himself a lifelong practising critic, whose reviews and articles evinced a taste both catholic and sensitive and interpreted the work of three generations of writers. He was an admiring, rather uncritical interpreter of Lowell, Longfellow and Holmes *(Literary Friends and Acquaintance,* 1900) partly because he was their heir: Lowell had first accepted his poems, and the three Brahmins with J. T. Fields had made him editor of the *Atlantic*. Walt Whitman's apparent formlessness put Howells off, though he thought Whitman's best poems were "stellar." Hawthorne he greatly admired. But the remote Emerson, with his idea that the vulgar tongue is the true language of poetry and that the "familiar; the common, the low" are proper poetic matter, probably influenced Howells most, among Americans.

Howells judged his own contemporaries with great shrewdness. From the beginning he valued the stories of Henry James, Jr., predicted that James would have to create his own audience. and during his writing life helped to create that audience by publishing his work. reviewing his books, and even at times acting as his agent. Similarly, he was the first critic consistently to acknowledge Mark Twain's powers as satirist and storyteller, and to gauge the "depth of fury" beneath his fun; he was Mark Twain's trusted editor; and in their collaborative failures the two writers enjoyed "gaudy times'! together. In the 1890s Howells praised discriminatingly both Emily Dickinson's metaphysical verse and Thorstein Veblen's sardonic analysis of leisure class behaviour. This breadth of taste was due in part to his knowledge of European literature. With T. S. Perry, he persuaded Americans to read Turgenev, Bjornson, Ibsen, Zola, Pérez Galdós and Verga, as well as Jane Austen, George Eliot, Hardy and Shaw. Tolstoy was his great modern writer.

Howells' practical criticism, then, was very often just and penetrating. His critical theory was simple. He classified fiction, for example, historically and qualitatively as novel, romance and romanticistic novel (an inferior kind), and formally as autobiographical (first-person novel), biographical (point-of-view novel) and historical (omnipotent-author novel, the primal or epic form). More generally Howells held that the writer should (1) render with scrupulous honesty his own impressions of life; (2) create a perspective in his work, wherein men and events might be seen in true "proportion and relation"; (3) present motives in their manifold, recondite, "God-given complexity": (4) treat action dramatically, without comment, subordinating it to character; (5) by fulfilling these artistic standards, achieve the aim of "dispersing the conventional acceptations by which men live on easy terms with themselves and obliging them to examine the grounds of their social and moral opinions."

Novels.—Three general phases may be distinguished in Howells' career of 40 years as a novelist:

1. After publishing two popular stories of travel, he wrote his first true novel in *A Foregone Conclusion,* a study of misunderstandings between an American girl and a Florentine priest, her tutor, who falls in love with her. The tale ends on a note of pathos with the death of the disillusioned priest. *Indian Summer,* the culminating novel of the first phase, is almost pure comedy. Yet both of them, like *The Lady of the Aroostook* and *A Fearful Responsibility* (1881) are *nouvelles* presenting only three or four characters dramatically and intensively. in the manner of Turgenev or Hawthorne. The action is antiromantic, and arises out of sectional or international differences. The setting is finely drawn and often symbolically shaded, as in the Italian fountain and garden scenes. The tone tends to be ironic and witty. From 1875 to 1886. in short, Howells, like James, became famous as the creator of novels in which "the American girl," innocent, beautiful, willful and morally strong, was portrayed against a splendid, often sombre European background.

2. Howells consciously abandoned his international romances, for he did not intend to compete any longer with James, and he was increasingly drawn to a new field, the depicting of American social conflicts. Thus *The Undiscovered Country* (1880), which initiates the second period, takes as its motive spiritualism replacing religious faith in New England. *Dr. Breen's Practice* (1881) imagines a woman in medicine with the same quietly satirical detachment. *A Modern Instance* (1882) became Howells' "strongest novel" as he thought because he had in it a "great but simple" theme—love turned to indifference and to hatred. Inspired by Euripides, he produced a new Medea and Jason whose New England marriage of passion ends in an Indiana divorce court. In *The Rise of Silas Lapham* (1885), his best-known novel, Howells at once touched American experience and imagination with the nenly rich Lapham's effort to rise into Boston society, Silas' financial ruin and. in spite of tempting evasions, his preserving his integrity in the end. The last novel of the period, *The Minister's Charge* (1887), recounted the failure of Lemuel Barker. a country boy, to succeed in Boston. In general, the novels of 1880–87 are full length. They may be told in part from a central character's point of view. Certain figures like the Rev. Mr. Sewell or Bromfield Corey tend to reappear. The novels deal with social problems rather than nith manners. and nearly all of them represent a provincial character in Boston who is defeated by the city.

3. In the third phase. 1888–94, Howells' social and economic views tended to become more explicit. The Tolstoyan doctrine of complicity, the belief that a man is ultimately responsible for the poverty or misery or criminality of any other man, first touched on in *The Minister's Charge,* was here fully explored. Howells drew his characters from varied social. racial and political groups, multiplied their number and rendered his background in closely realistic fashion, with less symbolic reference than in the early novels, New York replacing Boston. A strongly prolabour novel embodying a plea for justice rather than charity, *Annie Kilburn* (1888), marked the beginning of the period. *Tlze Quality of Mercy* (1892), in which he shows the far-reaching effect of a banker's defalcation upon others, and *The World of Chance,* the haphazard world of book publishing. preceded Howells' most formulated criticism of contemporary capitalism in the utopian novel, *A Traveler From Altruria* (1894). But it was A *Hazard of Sew Fortunes* (1890) that Howells rightly considered the "most vital" of his fictions, dramatizing and picturing the teeming competitive life of Yew York city by means of a representative group of characters struggling to establish a magazine there. They range from the ignorant and aggressive backer. a millionaire in natural gas, to his opponent, the German socialist exile of 1848 who had lost an arm in the American Civil War, and who is killed in a trolley strike as the novel ends.

This three-phase schematization of Howells' more than 40 volumes of fiction does not, it must be noted, account for the experimental novel. *The Shadow* of *a Dream* (1891), a study of psychotic jealousy: or the ghostly tales; or the late ironic novels of courtship like *April Hopes* (1888) or *Fennel* and *Rue* (1908). With his last major novel. *The Landlord at Lion's Head* (1897), Howells partially reverted to his earlier manner, coming to believe that "fiction can deal with the facts of finance and industry and invention only as the expression of character."

In the 1920s, reacting against his long-held primacy. H. L. Mencken and Sinclair Lewis damned Howells' realism as genteel, his treatment of love as namby-pamby and his "optimism" as unjustified. Critics of the depressed 1930s revised this judgment somewhat by praising his political and economic views. though they largely ignored other essential aspects of his thought and literary accomplishment. Still later. critics distinguished his best work from the dated or mediocre. and reappraised the nature and the extent of his influence. A number of readers as well rediscovered the style and humour which charmed his contemporaries, the truth of his characters and the moral vein of iron in his best novels.

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HOWLAND ISLAND, a coral atoll in the central Pacific ocean (latitude 0° 48' N., 176° 38' W.), about 1,620 mi. S.W. of Honolulu. It is low and flat, about 2 mi. long and ½ mi. wide. Discovered in 1842 by Capt. George E. Netcher of New Bedford, Mass., it was taken into possession by the American Guano company in the name of the United States in 1857. American, British and German interests worked the guano deposits until 1890. A small U.S. colony was established there in 1935, and on May 13, 1936, Pres. Franklin D. Roosevelt placed it under the jurisdiction of the department of the interior. An airfield was constructed in 1937 for Amelia Earhart's round-the-world flight. She took off from New Guinea for Howland on July 2, 1937, but disappeared. The Japanese attacked the island on Dec. 8, 1941, killing two of the four colonists. The two survivors were evacuated by a U.S. destroyer on Jan. 31, 1942, and the colony was not re-established after World War II. (J. H. K.)

HOWLER, a name applied to the members of the genus *Alouatte* of tropical American monkeys. These monkeys, which are of large size. with thick fur, red or black in colour, are characterized by the inflation of the hyoid bone (which in the males supports the tongue) into a large shell-like organ communicating with the windpipe. and giving peculiar resonance to the voice. The muzzle is projecting. and the profile of the face slopes regularly backward. The long tail is prehensile. thickly furred, with the under surface of the extremity naked, to secure a better grip, Howlers dwell in companies, and in the early morning and evening make the woods resound with their cries, which are often continued throughout the night. They feed on leaves. and are in the habit of sitting on the topmost branches of trees. When on the move they progress in order. led by an old male.

"Howler" is also a slang term for conspicuously absurd blunders.

HOWRAH, a city and district in the Burdwan division of West Bengal. India. The city is opposite Calcutta. with which it is connected by a cantilever bridge. Pop. (1961) 514,090. Since 1881 the population has been more than doubled, owing to the great industrial development that has taken place.

Howrah is the terminus of the Eastern and South-Eastern railways; also of two light railways which run to Amta and Sheakhala. Further. it is the centre of the jute-manufacturing industry, with many jute mills and presses. The botanic garden, established in 1786 and the Bengal engineering college (Calcutta university). which occupies the buildings of the bishop's college, originally a theological college founded in 1824. are in the suburb of Sibpur. Four other colleges of Calcutta university are in Howrah.

HOWRAH DISTRICT extends southward down the right bank of the Hooghly to the confluence of the Damodar river. Its area is 575 sq.mi.; pop. (1961) 2,043,225. In addition to the railways, the district is crossed by the high-level canal to Midnapore, which communicates with the Hooghly at Ulabaria. The district is densely populated (2.802 persons per square mile). Manufacturing industries of Howrah extend beyond the city, but a large part of the district is rural in character. Drainage schemes affecting 320 sq.mi. have been constructed through marshy areas.

HOY (Norse *Haey,* "high island"), the second largest island of the Orkneys, county of Orkney. Scotland. Pop. (1951) 957; area 53 sq.mi. It is situated 2 mi. S.W. of Pomona, from which it is separated by Hoy sound. It is a lofty island and its shore line is much broken; Long Hope forms a good natural harbour.

Off the eastern coast lie the islands of Graemsay. Cava, Risa, Fara. Flotta and Switha. while the peninsula of South Walls. forming the southern side of the harbour of Long Hope. is almost cut off by the sea. Red sandstone cliffs, sometimes more than 1,000 ft. in height, stretch for 10 to 12 mi. on the Atlantic front. The detached pillar called the Old Alan of Hoy (450 ft.) is a landmark to sailors and a remarkable example of sea denudation. The only break in this remarkable run of rocky coast is at Rackwick in the bight below the head of Rora. In the interior, Ward hill (1,565 ft.) is the loftiest summit in either the Orkneys or Shetlands while the Cuilags reach 1,420 ft. and the Knap of Trewieglen 1,308 ft. Between Ward hill and the ridge of the Hamars to the southeast is the famous Dwarfie Stone. an enormous block of sandstone. with associations with Scandinavian folklore and signs of ancient habitation. The island is thought to be the most southerly point in the British Isles where the great skua breeds.

HOYLAKE, a seaside town and urban district in the Wirral parliamentary division of Cheshire. Eng.. near the mouth of the Dee estuary. 7½ mi. W. of Birkenhead. Pop. (1961) 32.265. Area 9.4 sq.mi. The district. entirely residential. includes West Kirby. The Royal Liverpool golf links lie along the estuary and there are 4 mi. of sandy sea front.

HOYLAND NETHER, an urban district in the Penistone parliamentary division of the West Riding of Yorkshire. Eng., 10 mi. N. of Sheffield, by road. Pop. (1961) 15,707. Area 3.1 sq.mi. Coal mining, foundries and clothing are the industries.

HOYLE, EDMOND (1672?–1769), first systematizer of the laws of whist, and author of a book on games. His birthplace is unknown. For the use of his pupils in whist he drew up a *Short Treatise* (1742). The laws of Hoyle continued to be regarded as authoritative until 1864, after which they were gradually superseded by the new rules adopted by the Arlington and Portland clubs in that year (*see* WHIST). The weight of his authority is indicated by the phrase "according to Hoyle." which, doubtless first applied with reference to whist, has gained currency as a proverb. Hoyle died in London on Aug. 29. 1769.

HRABANUS, or RABANUS MAGNENTIUS MAURUS (*c.* 776–856). archbishop of Mainz. was born of noble parents at Mainz, and educated at Fulda and Tours under Alcuin, who in recognition of his ability surnamed him Maurus, after St. Maur the favourite disciple of Benedict. In 803 he became director of the school at Fulda. which under him acquired great fame. He was ordained priest in 814 but shortly afterward, apparently on account of disagreement with Ratgar, he withdrew from Fulda, and made a pilgrimage to Palestine. He returned to Fulda on the election of a new abbot (Eigil) in 817, upon whose death in 822 he himself became abbot. After an efficient and successful tenure of office. he retired in 842, but five years later, succeeded Otgar in the archbishopric of Mainz, where he remained for eight years.

Hrabanus died at Winkel on the Rhine, on Feb. 4. 856.

In politics, Hrabanus gave his support to Louis the Pious against his rebellious sons, and after the death of the emperor sided with Lothair, the eldest son. In theology and philosophy, a sphere in which he came into conflict with Gottschalk, he was one of the most learned men of his time. Besides his extensive commentaries on the Bible, his chief works were the encyclopaedic dictionary *De Universo,* the *Glossaria Latino-Theodiscn* and the pedagogical treatise *De Institutione clericorum.*

HRADEC KRÁLOVÉ (German KÖNIGGRÄTZ), town of Czechoslovakia. at the confluence of the Orlice with the Elbe. Pop. (1957 est.) 55.257. It is the natural market centre of a fertile region. the "Golden Road." where settlement has existed from prehistoric time. Hradec Králové was one of the dower towns of

Elizabeth of Poland. the wife of King Wenceslas II of Bohemia, and was the first town to declare for the national cause in the Hussite Wars. It is famous for the decisive battle of Sadowa in the Austro-Prussian War of 1866. The growth of the modern town is across the Elbe toward the railway and the industrial centre of Kukleny. There are engineering works, tanneries and sawmills. Other industries include soap, candles. confectionery and pianos.

HRDLIČKA, ALEŠ (1869–1943), U.S. physical anthropologist, an expert on early man in America, was born at Humpolec, Bohemia, on March 29, 1869. His early education was received in Bohemia. He studied at the New York Eclectic, Homoeopathic and Xllopathic colleges, graduating in medicine in 1892 and 1894. In 1894 he joined the New York state service and in 1896 became associate in anthropology in the state pathological institute.

In 1898 Hrdlička was given charge of physical anthropology in the Hyde expedition to Mexico and the southwestern United States, in connection with the American Museum of Natural History of Kew York. In 1903 he was called as assistant curator to organize the division of physical anthropology at the U.S. National museum, Washington, D.C.. becoming curator in 1910. He retired in 1942 and served as associate in anthropology at the Smithsonian institution. He died Sept. 5. 1943.

Hrdlička was an early exponent of the theory, later accepted, that the North American Indian is of Asiatic origin; he also proposed that the cradle of man's development was not in Asia but in Europe and that the Neanderthal man was not a separate species of man but only a phase of his evolution. He was the founder (1918) and editor of the *American Journal of Physical Anthropology* and the founder (1929) and first president of the American Association of Physical Anthropologists. His works include *Ancient Man in North America* (1907); *Ancient Man in South America* (1912); *Old Americans* (1925); *Anthropology of the American Indian* (1927); *The Skeletal Remains of Early Man* (1930); *Practical Anthropometry* (1939).

HRÓLFR KRAKI, perhaps the most famous of the Danish kings of the heroic age. In *Beowulf,* where he is called Hrothwulf, he is represented as reigning over Denmark in conjunction with his uncle Hrothgar, one of the three sons of an earlier king called Healfdene. In the Old Norse sagas Hrólfr is the son of Helgi (Halga), the son of Halfdan (Healfdene). He is represented as a wealthy and peace-loving monarch similar to Hrothgar in *Beowulf,* but the latter (Hróarr, or Roe) is quite overshadowed by his nephew in the Northern authorities. The chief incidents in Hrolfr's career are the visit which he paid to the Swedish lung Aðils (Beowulf's Eadgils), of which several different explanations are given, and the war, in which he eventually lost his life, against his brother-in-law Hiörvarðr. The name Kraki (pole-ladder) is said to have been given to him on account of his great height by a young knight named Vöggr, whom he handsomely rewarded and who eventually avenged his death on Hiörvarðr. There is no reason to doubt that Hrólfr was an historical person and that he reigned in Denmark during the early years of the 6th century.

HROSVITHA (rōs-vēth'ą) (ROSWITHA, properly HROTSUIT) (*c.* 935–*c.* 1002), German dramatist and chronicler. Some time before 959 she entered the Benedictine nunnery of Gandersheim, a foundation highly favoured by the Saxon dynasty, and lived there until her death about the turn of the century. She wrote eight narrative religious poems, in leonine hexameters or distichs, dealing with the Nativity of the Virgin (from the apocryphal gospel of St. James, the brother of our Lord), the Ascension and a series of legends of saints (Gandolph, Pelagius, Theophilus, Basil, Denis, Agnes). Her comedies are six in number, being doubtless in this respect intended to recall their nominal model, the comedies of Terence. They are written in prose, with an element of something like rhythm, and an occasional admixture of rhyme. Founded upon legends of the saints, and exhibiting a knowledge of the Fathers and of Christian philosophers, they nevertheless contain many elements of comedy and even of farce, though they were written to glorify virginity. How far Hrosvitha's comedies were an isolated phenomenon of their age in Germany is uncertain, but in the history of the drama they form the bridge between the few earlier attempts at utilizing the forms of the classical drama for Christian purposes and the miracle plays.

The third group of the writings of Hrosvitha contains her versified historical chronicles. At the request of the abbess Gerberga, she composed her *Carmen de gestis Oddonis*, an epic attempting to follow the great Roman model. It was completed by 968, and presented by the authoress both to the old emperor and to his son (then already crowned as) Otto II. Unfortunately only half of it remains; the part treating of the period from 953 to 962 is lost with the exception of a few fragments, and the period from 962 to 967 is summarized only. Subsequently, in a poem (of 837 hexameters) *De primordiis et fundatoribus coenobii Gandersheimensis,* Hrosvitha narrated the beginnings of her own convent, and its history up to 919.

HROZNY, FRIEDRICH (BEDRICH) (1879–1952), Czech archaeologist who succeeded in deciphering the Hittite language, was born on May 6, 1879, at Lysa nad Labem, Bohemia. He studied in Prague, Vienna, Berlin and London. In 1904 he took part in the Seelin excavations in Ta'anuk (north Palestine), on the basis of which he wrote *Die Keilschrifttexte von Ta·annek* (1904) and *Die neugefundenen Keilschrifttexte von Ta'annek* (1906). In 1905 he was appointed professor at Vienna, and in 1919 professor of cuneiform research and ancient oriental history at the Charles university in Prague. Hrozny left the solution of the Hittite hieroglyphics to chance, proceeded to work on the basis of Hittite documents from the Bogazkoy archives written in cuneiform script and, in 1915, deciphered the language, proving it to be an Indo-European tongue. His solution was attacked from many quarters, but he substantiated his claim by the success with which he read and translated a number of documents, among others a Hittite legal code (published in Paris, 1922, under the title *Code Hittite provenant de l'Asie Mineure, I Partie: Transcription, traduction française*). In 192S excavations for the purpose of further research were made under his direction by a Czech scientific expedition to Asia Minor. He died on Dec. 18, 1952, in Prague. *See* HITTITES, THE.

HSIANG-T'AN (SIANGTAN), industrial city in Hunan province, China, on the Hsiang river, 20 mi. S.S.W. of Ch'ang-sha (*q.v.*), the provincial capital. Hsiang-t'an is situated on the Hunan-Kweichow railroad, begun in 1958. The city trades in rice, tea, tung oil. textiles and paper. After 1949, it became an important industrial centre, producing electrical goods, cotton textiles, wire, machine tools, cement and ammonium sulfate fertilizer. As a result of industrial development, the city's population more than doubled in the first four years under Communist rule, rising from an estimated 80,000 in 1949 to 183,600 (1953 census). (T. SD.)

HSI CHIANG (SI KIANG), main river system of south China, rising in the Yiinnan-Kweichow plateau, at an elevation of more than 6,000 ft., and flowing 1,200 mi. E. to the Canton delta on the South China sea. The name Hsi Chiang, which means "West river," is applied only to its lower course. The headwaters consist of a number of major branches. The principal headstreams are the Nan-p'an Chiang and Pei-p'an Chiang (South Pan and North Pan rivers) which join on the Kweichow-Kwangsi border to form the Hung-shui Ho. The Hung-shui flows through the deeply dissected karst-type landscape of western Kwangsi, dropping rapidly to an elevation of about 600 ft. At Shih-lung, the Hung-shui receives the Liu Chiang on the left, thus forming the Ch'ien Chiang. The Liu Chiang is formed near Liu-chou by the junction of two other headstreams — the Jung Chiang (Pei-liu Ho) and the Lung Chiang, both of which rise in southeastern Kweichow.

The Ch'ien Chiang flows through a rapid-strewn gorge, extending for 20 mi. between Wu-hsiian (Mosiin) and Kuei-p'ing (Kweiping) and forming an obstacle to navigation. At Kuei-p'ing, the Ch'ien Chiang receives a major tributary on the right, the Yü Chiang, to form the Hsüan Chiang. The Yü Chiang is formed near Nan-ning by the junction of two headstreams, the Yu Chiang and the Tso Chiang (Li Chiang), which rise in the uplands of North Vietnam and easternmost Yunnan. The Hsuan Chiang flows past T'eng-hsien (Tengyun) where it receives the Jung Chiang on the right, and then past Wuchow, where it receives the Kuei Chiang on the left.

It is only below Wuchow that the river is strictly the Hsi Chiang, the name by which the river system is generally known. At San-shui (Samshui), the Hsi Chiang joins the Pei Chiang (North river) to form the vast Canton delta, which is also joined from the east by the Tung Chiang (East river).

The Hsi Chiang is the great commercial waterway of south China, linking Hong Kong, Canton, Macao and other delta centres with Wuchow and the interior. In flood time. the river is navigable for vessels drawing 16 ft. as far as Wuchow. At ordinary times, the same city can be reached by vessels drawing 6 ft. or more. The headstreams are navigable in part for shallow-draft junks. (T. Sd.)

HSIN-CHU (SIN-CHU), a city of Taiwan (Formosa), pop. (1956) 125,814, is on the main north-south railroad 38 mi. S.W. of T'ai-pei and three miles inland from Formosa strait. The capital of Hsin-chu county, the city is located near sources of natural gas, coking coal, glass sand, stone and both hard and soft timber. It is a major tea and citrus marketing centre.

Hsin-chu lies at the junction of three railway routes. It is a growing industrial centre, producing fertilizers, wood products, electric light bulbs, matches, glass, cosmetics and hand-carved furniture. Hsin-chu became the nuclear research centre of Taiwan in the late 1950s. (N. S. G.)

HSUAN TSANG (c. 605–664), Chinese traveler and collector of the narratives of Chinese Buddhists, who traveled to India to visit the sites consecrated by the history of Sakya Muni, to study at the great convents and to collect books, relics and other sacred objects. Two Chinese works, translated into French by Stanislas Julien, relate to his works: the *Ta-T'ang-Si-Yu-Ki* ("Memoirs on Western Countries Issued by the T'ang Dynasty") compiled under Hsuan Tsang's supervision; and a biography by two of his contemporaries. Born in the Keu-Shi district near Honan-Fu about 605, he was a grave and studious child. He adopted the monastic life. After traveling over China, teaching and studying, for several years, he settled at Ch'ang-gan (now Sian) and won a great name for learning.

In August 629 he started alone for India, plunging into the desert of the Gobi. After great suffering he reached Igu, the seat of a Turkish principality, skirted the southern foot of the Tien Shan and crossed by a glacier pass. He reached the basin of the Upper Oxus, passed Bamian, crossed Hindu-Kush, went down to Nagarahara and thence to Peshawar. He spent two years (631–633) studying in the convents and visiting the many monuments of his faith. He traveled further, making a tour of the most famous sites of Buddhist and ancient Indian history. At Nalanda, the most famous and learned monastery and college in India, he spent nearly two years in mastering Sanskrit and the Buddhist philosophy. Traveling again, he went down the banks of the Ganges, turned east into what is now Assam, passed the great ports and reached Kanchipara (Conjeeveram) about 640. Then he turned north, ultimately recrossing the desert to Kwa-chow, from which he had plunged into the waste 15 years before. He carried with him great collections of books, precious images and relics, and was received (April 645) with public and imperial enthusiasm. The emperor T'ai Tsung ordered the compilation of the *Ta-T'ang-Si-Yu-Ki* and asked Hsuan Tsang to abandon the monastic life and serve the state. He declined the latter request and settled down to the supervision of the compilation and to the translation of the books he had brought back with him from India. The compilation was completed in 648. In 664 Hsuan Tsang died in a convent at Ch'ang-gan.

On the approach of death he caused one of his disciples to frame a catalogue of his good works, of the books he had translated or caused to be transcribed, of the sacred pictures executed at his cost, of the alms that he had given and of the living creatures that he had ransomed from death.

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HSUAN T'UNG (1906–), last emperor of China, or, more correctly, the Ch'ing emperor. At a meeting of the grand council held on Nov. 13, 1908, under the presidency of the empress dowager Tzu-Hsi, in anticipation of the death of the emperor Kuang Hsu, Pu Yi, the infant son of Prince Ch'un, was selected to succeed his uncle, under the style of Hsuan T'ung. The emperor died on Nov. 14 and the empress dowager on Nov. 15, whereupon Prince Ch'un became regent for his son. The reign lasted for three disturbed years during which the demand for reforms grew in intensity to a point when on Feb. 12, 1912, a decree of abdication was issued. The boy was permitted to retain his title of emperor and to reside in the imperial palace, a subsidy being voted for the maintenance of the imperial family. In July 1917, during the presidency of Li Yuan-hung, an attempt by Gen. Chang Hsun to restore the emperor was frustrated by Tuan Chi-jui after a few days' nominal "reign." The emperor's education was upon modern lines and included the services of an English tutor. In 1922 he married a daughter of Jung Yuan, a Manchu noble. The ceremony took place with every symbol of imperial magnificence. He then cut off his queue and resumed his personal name, Pu Yi. In Nov. 1924, during the occupation of the capital by the Kuomentang, or Nationalist army, he left the palace under duress, to reside in the Japanese concession at Tientsin. On March 9, 1932, he was installed as president, and from 1934 to 1945, was emperor of the state of Manchoukuo (Manchuria), holding the title Kang Teh.

HSUN-TZU (3rd century B.C.), Chinese philosopher, is the third member in the great Confucian triumvirate of Chinese antiquity which includes Confucius himself and Mencius (*qq.v.*). His surname was Hsun, his personal name K'uang, and he bore the honorary cognomen of Ch'ing, so that he may be called either Hsun K'uang or Hsun Ch'ing. Most commonly, however, he is known simply as Hsun-tzu, "the Master Hsun" (*tzu* being an honorific suffix attached to the names of many philosophers of his time).

Hsun-tzu's exact dates are unknown; and little is known of his life save that he was a native of the state of Chao (in modern Shansi province, north central China), that he belonged for some years to the Chi-hsia academy of philosophers maintained in Ch'i by the ruler of that eastern state and that, later, because of slander, he moved south to the state of Ch'u, where he became magistrate of a small district and later died in retirement.

The position of Confucius, Mencius and Hsun-tzu in Chinese thought has been likened to that of Socrates, Plato and Aristotle in the west. Hsun-tzu exceeded his predecessors in erudition and was the first of the three to express his ideas not merely by means of the sayings and conversations recorded by disciples, but also in the form of well-organized essays written by himself. The book today known as the *Hsun-tzu,* in 32 chapters, is regarded as being in large part from his own hand.

Hsun-tzu's most famous dictum is that "the nature of man is evil; his goodness is only acquired training." What Hsun-tzu preached was thus essentially a philosophy of culture. Human nature at birth, he maintained, consists of instinctual drives which, left to themselves, are selfish, anarchic and antisocial. Society as a whole, however, exerts a civilizing influence upon the individual, gradually training and molding him until he becomes a disciplined and morally conscious human being. Of prime importance in this process are the li (ceremonies, rules of social behaviour, traditional mores) and music (which Hsun-tzu, like Plato, regarded as having a profound moral significance).

Hsun-tzu's view of human nature was, of course, radically opposed to that of Mencius, who had optimistically proclaimed the innate goodness of man. Both thinkers agreed that all men are potentially capable of becoming sages, but for Mencius this meant that every man has it within his power to develop further the shoots of goodness already present at birth, whereas for Hsun-tzu it meant that every man can learn from society how to overcome his initially antisocial impulses. Thus began what became one of the major controversies in Confucian thought.

The difference between Mencius and Hsun-tzu is metaphysical as well as ethical. T'ien (Heaven) for Mencius, though definitely not an anthropomorphic deity, constituted an all-embracing ethical power; therefore it is inevitable that man's nature should be

good, since it is what he receives from Heaven at birth. For Hsun-tzu, on the other hand, T'ien embodied no ethical principle and was simply the name for the functioning activities of the universe (somewhat like our word Nature). These activities he conceived of naturalistically and almost mechanistically. Moral standards, therefore, have no metaphysical justification but are man-made creations.

One may ask how, if man is born "evil" (by which Hsun-tzu really meant uncivilized), it is possible for him to create the higher values of civilization. Hsun-tzu's reply was that man differs from other creatures in one vital respect: besides his instinctual drives, he also possesses an intelligence which enables him to form co-operative social organizations. Hence the sages, realizing that man cannot well survive in a state of anarchy, used this intelligence to formulate the social distinctions and rules of social behaviour (li), which would check the encroachments of one individual upon another and thereby insure sufficiency for all. In this utilitarian explanation of the creation of social institutions, Hsun-tzu shows probably indebtedness to the non-Confucian thinker Mo Ti (*q.v.*).

Hsun-tzu's denial of supernaturalism led him into a sophisticated interpretation of popular religious observances and "superstitions." These were merely poetic fictions, useful for the common people because they provided an orderly outlet for human emotions, but not to be taken as true by educated men. There Hsun-tzu inaugurated a rationalistic trend in Confucianism which has been congenial to scientific thinking. At the same time, however, Hsun-tzu's distrust of "nature in the raw" caused him to warn men to shun the investigation of natural phenomena and to keep to humanistic studies; his own conception of the universe, moreover, was a static and antievolutionary one, in which past and present are the same and the many are like the one. In these respects, therefore, Hsun-tzu's influence was decidedly hostile to scientific development.

Hsun-tzu nevertheless made important contributions to psychology, epistemology and dialectic, yet his primary interest in dialectic was as a tool for exposing the "fallacies" of rival schools; and he bitterly lamented the need for dialectic in the absence of a centralized political authority that could impose ideological unity from above. Hsun-tzu, indeed, was an authoritarian who formed a logical link between Confucianism and the totalitarian Legalists; it is no accident that among his students were two of the most famous Legalists, the theoretician Han Fei-tzu (c. 280–233 B.C.) and the statesman Li Ssu (c. 280–208 B.C.). Hsun-tzu himself remained Confucian in his firm rejection of the amoral philosophy and compulsive techniques of the Legalists, and his insistence on Confucian morality as the basis for society.

For several centuries after Hsun-tzu's death, his influence remained higher than that of Mencius. This is indicated, for example, by the borrowings from Hsun-tzu found in such ritualistic compilations as the Li *Chi* ("Book or Record of Rites") (*see* CHINESE CLASSICS). Only with the rise of Neo-Confucianism (9th century A.D. onward) did his influence wane, and it was not until the 12th century that the triumph of Mencius was formalized through the inclusion of the Mencius among the Confucian classics. *See* also CONFUCIANISM; CHINESE PHILOSOPHY.

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HUAI HO (HWAI HO), river of eastern China, between the Yellow river and the Yangtze, rises in Honan province in the northern foothills of the Ta-pieh Shan (Huai-yang-shan) and flows eastward for 800 mi. past the cities of Huai-nan (Hwainan) and Pengpu (Pang-fou) through Anhwei and Kiangsu provinces to the lake Hung-tse Hu. In the 11th century the Huai Ho ran directly into the Yellow sea, but after one of the frequent course changes of the Yellow river, the Huai Ho was diverted into the lake. From there its waters passed through the Grand canal (Yün Ho) to the Yangtze and finally to the sea. The absence of a direct outlet to the sea has resulted in floods affecting most of the 60,000,000 inhabitants of the area. The Communists, after 1949, embarked on an ambitious flood-control program. Old river dikes were repaired, new dikes built and silted channels dredged. A 105-mi. canal was dug in 1952 from Hung-tse Hu to the Yellow sea, providing a direct outlet for the flood waters. Storage reservoirs were built on many tributaries. (T. SD.)

HUANCAVELICA, a department in central Peru, bounded by Junin on the north, by Ayacucho on the east and south and by Ica and Lima on the west. Area 8,830 sq.mi.; pop. (1958 est.) 368,237. It is a rugged mountain region, with a high-level surface of gentle relief about 15,000 ft. above sea level, surmounted by a few clusters of ranges of very high mountains and cut by deep canyons, chief of which is the Mantaro. Huancavelica city (pop. 1958 est. 11,895), the departmental capital, is located about 50 mi. S. of Huancayo and 140 mi. S.S.E. of Lima. The city is connected with Lima by rail and an all-weather highway. The chief products of the department include wheat, barley, maize and potatoes. It is a source of meat for Lima and also of some wool for local use. Silver, lead and mercury are mined.

Huancavelica was made famous by its mercury deposits, which were of great importance during the colonial period. The Santa Bárbara mine, some 2,000 ft. above the town, was acquired by the Spanish crown in 1570. Mercury was essential in the extraction of silver from the native ore; and with the decline of silver mining in the 19th century, mining of mercury also decreased. Mining was resumed by the Fernandini interests after the railroad gave access to a shipping port in 1926, but the Huancavelica mines were high-cost producers at mid-20th century.

See A. P. Whitaker, *Huancavelica Mercury Mine* (1941). (P. E. J.)

HUANCAYO, a city of central Peru (pop. 1958 est. 47,486), capital of the department of Junin (*q.v.*). It lies at 10,690 ft. above sea level on a plain watered by the Mantaro river, and has a temperate climate. The city, founded by the Spaniards in 1538 on an old Inca highway, became an important centre for mining and agriculture. Mineral resources of the surrounding region include copper, silver and coal; wheat, barley, maize and potatoes are cultivated there. Of greatest interest to the tourist are the renowned Sunday market, attended principally by Indians from nearby areas; the Carnegie Magnetic observatory (now a facility of the Peruvian government); the Saturday fair at Chupaca; and the convent of Ocopa. Huancayo is situated 77 mi. S.E. of La Oroya and may be reached by the central highway from Lima to Cusco and by the central railroad. The distance from Lima is 195 mi., (J. L. TR.)

HUANUCO, a central sierra department of Peru (pop. [1958 est.] 381,669; area, 13,635 sq.mi.), bounded north by La Libertad and San Martin, east by Loreto, south by Junin, west by Lima and Ancash. The department, forming a saddle between the central and eastern cordilleras, is watered by the Ucayali, the Huallaga and the Marañón rivers. It is crossed by the trans-Andean highway extending from Lima to Pucallpa on the Ucayali, a distance of 522 mi.

The city of Huánuco (pop. 1958 est. 19,087), the departmental capital, is a popular overnight stop on the two-day journey. It lies at 6,271 ft. above sea level on the upper Huallaga. Founded in 1539 by Gómez de Alvarado, Huánuco city is situated in a beautiful valley, and the climate is referred to as "perpetual spring." Crops cultivated in the region include fruits, cereals, maize, potatoes, coffee, sugar, cotton, tobacco and coca. Cattle, sheep and hogs are bred extensively. Important mineral resources of the department are gold, silver, mercury, coal, iron, copper and petroleum. The population is chiefly Indian and mestizo. Tingo Maria, located in the montaiia, lies 83 mi. N.W. of Huánuco city. (J. L. TR.)

HUASTEC, a native people of the Atlantic coast of Mexico, south of Tampico and the lower Panuco river. They form an isolated offshoot of the great Maya family of Yucatan and Guatemala, but decisive evidence is lacking as to whether Huastec

speech represents an archaic form of the Mayan language and the people a remnant left behind in an ancient southward migration of the stock, or the reverse.

Culturally the Huastec belong rather in the Toltec-Aztec than in the Maya province, although their lowland habitat brought with it many differentiations. They formed the northeastern frontier of the higher civilization of ancient Mexico. About 20,000 Huastec-speaking Indians survive.

HUBAY, JENO DE (1858–1937), Hungarian composer and violinist, sometimes known as Eugen Huber, was born at Budapest Sept. 15, 1858. His first teacher was his father, who was a professor of the violin, and conductor of the Hungarian national opera. From 1871 to 1875 he studied in Berlin under Joseph Joachim, and later, on the recommendation of Franz Liszt, gave successful violin recitals in different countries including England. While in Paris he was associated with Henri Vieuxtemps and Jules Massenet. In 1882 he succeeded Henri Wieniawski as professor of the violin at the Brussels conservatoire, and in 1886 was appointed to a similar post at the Budapest academy, of which he was the director from 1919 on. His pupils included many eminent violinists, among them Vecsey, Jelly d'Aranyi and Joseph Szigeti. Hubay wrote a number of operas *(The Violin Maker of Cremona, Anna Karenina, Alienor, Die Maske, Moosröschen, Lavottas Liebe,* etc.) as well as symphonies, violin concertos, smaller instrumental works and songs.

Hubay died March 12, 1937.

HUBBARD, ELBERT GREEN (1856–1915), U.S. author, editor and publisher, was born in Bloomington. Ill., on June 19, 1856. He founded his Roycroft press at East Aurora, N.Y., on the model of William Morris's (*q.v.*) communal Kelmscott press, which he had visited in England. Beginning in 1894 he monthly issued the famous "Little Journey" booklets, pleasant biographical essays in which fact mas interwoven with comment and satire. and *The Philistine,* an avant-garde magazine. In an 1899 number of *The Philistine* "A Message to Garcia" appeared. the most famous single piece he wrote (the importance of perseverance was drawn as a moral from a Spanish-American War incident).

In 1908 Hubbard began to edit and publish a second monthly, *The Fra.* His printing establishment in time expanded to include furniture and leather shops, a smithy and an art school, the aim being to create articles of the fine craftsmanship that had prevailed before the Industrial Revolution. He died in the sinking of the "Lusitania" on May 7, 1915.

Hubbard's writings contain a bizarre mixture of radicalism and conservatism. He apotheosized work and efficiency in a vigorous, epigrammatic style. His works include *Time and Chance* (1899); *So Here Cometh White Hyacinths* (1907); *The Man of Sorrows* (1908); and the *Roycroft Dictionary* (1914). Valuable collections are "Little Journeys" (14 vol., 1915), and "Selected Writings" (14 vol. 1923). His *Scrap Book* (1923) and *Note Book* (1927) were published posthumously.

HUBBLE, EDWIN POWELL (1889–1953), U.S. astronomer, who, working with the large telescopes of the Mount Wilson and Palomar observatories, accumulated a wealth of significant data, which was fundamental in character and important to the theories of cosmology. Hubble was born Nov. 20, 1889 in Marshfield, Mo. Following undergraduate study at The University of Chicago, he attended Oxford as a Rhodes scholar. He returned to Chicago and in 1917 received the Ph.D. degree. After a period of research at the Yerkes observatory (1914–17), he enlisted in the U.S. army and served with the American expeditionary force in France. In 1919 he joined the astronomy staff of the Carnegie Institution of Washington's Mount Wilson observatory, where he remained until his death, Sept. 28, 1953, in San Marino, Calif.

Huhhle's discovery in 1923 of a distance-indicating Cepheid variable star in the Andromeda nebula furnished the first certain evidence that extragalactic nebulae were situated far outside the boundaries of our own galaxy; in fact, were independent stellar systems. He surveyed nebulae to very faint limits and found the large-scale distribution approximately uniform in all directions with numbers increasing at a constant rate as fainter limits were reached. From a study of several thousand photographs he derived the first significant classification system for extragalactic nebulae. He announced in 1929 his important finding that velocities (red shifts) of nebulae increase in a linear manner with distance. The relation, $H = 180$ km./sec. per 10^6 parsecs, is known as "Hubblc's law of the red shifts" or "Hubble's constant."

Other important research results appear in papers on extragalactic nebulae as stellar systems, novae in nebulae, distribution of luminosity in elliptical nebulae, nebulous objects in the Andromeda nebula identified as globular clusters, angular rotations of spiral nebulae, the luminosity function of nebulae and the direction of rotation in spiral nebulae.

In addition to Hubble's long scientific bibliography, are the Silliman lectures at Yale University published under the title of "The Realm of the Nebulae"; reference should be made also to the Rhodes Memorial Lectures given at Oxford, England, entitled "The Observational Approach to Cosmology." (M. L. HN.)

HUBER, JOHANNES (1830–1879), German philosophical and theological writer, and one of the original leaders of the Old Catholics (*q.v.*) in Germany, was born in Munich, Aug. 18, 1830. He became professor of philosophy there in 1864. He strongly opposed the growing influence of the Jesuits and of scholasticism in the Roman Catholic Church, but was also a vigorous adversary of such writers as Darwin and D. F. Strauss with their apparent threat to the foundations of faith. Huber wrote many works, but his quarrel with the church dated from the publication in 1859 of *Die Philosophie der Kirchenväter,* which was placed on the Index the following year. In 1869 he joined Dollinger (*q.v.*) in the "Janus" letters, a series of newspaper articles criticizing the Vatican council, later published as *Der Papst und das Konzil.* He was also joint author with Dollinger of the *Romische Briefe vom Konzil.* Huber died in Munich, March 20, 1879.

See E. Zirngiebl, *Johannes Huber* (1881).

HUBER, LUDWIG FERDINAND (1764–1804), German playwright, critic and newspaper editor; the husband of Thérèse Huber (1764–1829), a notable woman of her time who was one of the first to recognize Goethe's significance. Huber was born in Paris; the exact date is uncertain. He was brought up in Leipzig, where he became the friend of Christian Korner and of Schiller. From 1787 to 1792 he was secretary to the Saxon legation at Mainz. There he conceived a passion for Thérèse, wife of the naturalist Georg Forster, and married her after Forster's death in 1794. From 1798 to 1803 he edited the *Allgemeine Zeitung.* He died in Ulm, Dec. 24, 1804. Huber wrote plays (*e.g., Das heimliche Gericht,* 1790) as well as political commentary. His criticism may be found in his *Vermischten Schriften* (2 vol., 1793). The stories published under his name were by Thérèse, who published his works with a biography (4 vol., 1806–19).

See L. Geiger, *T. Huber* (1901); *F.* Ernst, *Essays,* vol. 2 (1946).

HUBERT, SAINT (d. 727), the "Apostle of the Ardennes," succeeded St. Lambert as bishop of Maastricht in 7oj after Lambert's murder. He had Lambert's remains buried at Liege, then only a village, in a church which Hubert built at the site of the murder and made his cathedral church, transferring to Liege the see of Maastricht. Hence Hubert is regarded with great devotion in Belgium as the founder of the city and diocese of Liege. Most of the incidents related of him—such as his conversion while hunting on Good Friday by the miraculous appearance of a stag bearing between its horns a cross or crucifix surrounded by rays of light—first occur in lives written in the 12th and 14th centuries. Because of that legend he is regarded as the patron of hunters; he is also invoked against rabies. His feast day is Nov. 3.

(J. N. G.)

HUC, ÉVARISTE RÉGIS (1813–1860), French missionary traveler, was born at Toulouse, on Aug. 1. 1813. He entered the congregation of the Lazarists at Paris, and shortly after receiving holy orders in 1839 went out to China. At Macao he spent some 18 months in the Lazarist seminary, preparing himself for the regular work of a missionary. He at first superintended a Christian mission in the southern provinces, and then perfected his knowledge of the language at Peking, eventually settling in the Valley of Black Waters or He Shuy. just within the borders of Mongolia. There, beyond the Great Wall, a large, scattered

population of native Christians had found refuge from the persecutions of Kia-King, to be united half a century later in an apostolic vicariate. Huc studied the dialects and customs of the Tatars, translated various religious works, and in 1844, at the instigation of the vicar apostolic of Mongolia, undertook an expedition to Tibet.

Accompanied by his fellow-Lazarist, Joseph Gabet, and a young Tibetan priest who had embraced Christianity, he set out from Dolon Nor. To escape attention the little party assumed the dress of lamas or priests. Crossing the Hwang-ho, they advanced into the sandy tract known as the Ordos desert. After terrible sufferings they entered Kansu, having recrossed the flooded Hwang-ho, and in Jan. 1845 reached Tang-Kiul on the boundary. There they waited for eight months, and studied the Tibetan language and Buddhist literature, residing for part of the time in the Kunbum lamasery, which was reported to accommodate 4,000 persons. Toward the end of September they joined a returning Tibetan embassy from Peking, which comprised 2,000 men and 3,700 animals. Crossing the deserts of Koko Nor, they passed the lake of that name, with its island of contemplative lamas, and, following a difficult and tortuous track across snow-covered mountains, they at last entered Lhasa on Jan. 29, 1846. Favourably received by the regent, they opened a little chapel, but the Chinese ambassador interfered and had the two missionaries conveyed back to Canton, where they arrived in October of the same year. For nearly three years Huc remained at Canton, but Gabet, returning to Europe, proceeded thence to Rio de Janeiro, and died there shortly afterward. Huc returned to Europe in shattered health in 1852. He died in Paris on March 31, 1860.

His writings comprise, besides numerous letters and memoirs in the *Annales de la propagation de la foi,* the famous *Souvenirs d'un voyage dans la Tartarie, le Thibet, et la Chine pendant les années 1844–1846* (2 vol., 1850; Eng. trans. by W. Hazlitt, 1851, abbreviated by M. Jones, 1867); its supplement, crowned by the Academy, entitled *L'Empire chinois* (2 vol., 1854; Eng. trans., 1859); and an elaborate historical work, *Le Christianisme en Chine, etc.* (4 vol., 1857–58; Eng. trans., 1857–58).

HUCBALD (HUGBALDUS, HUBALDUS, UBALDUS) (*c.* 840–930?), Benedictine monk and writer on music, was born at the monastery of Saint Amand near Tournai. He studied at the monastery, where his uncle Milon was head of the school. Hucbald's success in music is said to have excited his uncle's jealousy and to have made it necessary for him to leave Saint Amand. In 860 he was at Saint Germain d'Auxerre, bent upon completing his studies, and in 872 he was back again at Saint Amand as successor to his uncle, to whom he had been reconciled in the meantime. Between 883 and 900 Hucbald went on several missions of reforming various schools of music, including that of Reims, but in 900 he returned to Saint Amand, where he died on June 25, 930, or, according to other chroniclers, on June 20, 932.

The only work which can positively be ascribed to him is his *De harmonica institutione.* The *Musica Encheiriadis,* published with other writings of minor importance in Gerbert's *Scriptores ecclesiastici de musica,* and containing a complete system of musical science as well as instructions regarding notation, dates from the close of the 10th century. This work, formerly assigned to Hucbald, is celebrated chiefly for an essay on a new form of notation described in modern times as *Daseian notation.* The author of the *De harmonica institutione* wrote numerous lives of the saints and a curious Latin elegy on the death of Charles the Bald in which every work begins with *c* for *calvus* ("bald").

See G. Reese, *Music in the Middle Ages* (1941).

HUCH, RICARDA (1864–1947), German poetess and historical novelist, was born at Brunswick on July 18, 1864, and educated in Brunswick and Zürich. She was appointed secretary of the library in Zürich and married first Ermano Ceconi, and later her cousin Richard Huch, a lawyer. She spent much time in Italy before she finally settled in Munich. She wrote a number of romantic and imaginative novels marked by a fine psychological sense and a plastic style, in the manner of C. F. Meyer, among which may be mentioned *Erinnerungen von Ludolf Ursleu dem Jüngeren* (1893, Eng. trans. *Eros Invincible,* 1931); *Aus der Triumphgasse* (1901); *Vita somnium breve* (1902). Her most important historical works are *Blütezeit der Romantik* (1899); *Ausbreitung und Verfall der Romantik* (1902); *Aus dem Zeitalter des Risorgimento* (1908); *Der grosse Krieg in Deutschland* (1912–14); *Das Römische Reich deutscher Nation* (1934). In 1919 appeared a volume of reflections, *Der Sinn der heiligen Schrift,* which reveal a profound knowledge of psychology. One of the leaders of the revolt against naturalism, Ricarda Huch attained at her best a high degree of musical rhythm and romantic beauty. She died on Nov. 17, 1947, at Frankfurt-on-Main.

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HUCHOW (HU-CHOU, formerly WU-HSING or WUHING), a Chinese city in northern Chekiang province, lying south of Tai Hu (lake). Pop. (1953) 62,700. The T'iao Ch'i (river) runs through the city, which lies about 40 mi. N. of Hangchow and 120 mi. W.S.W. of Shanghai. Huchow was the last stronghold of the T'ai-p'ing rebellion (1864). Its *hsien* or district is the centre of the Yang-tzu delta silk region where mulberry bushes are cultivated. To the east is the small town of Nan-hsin, a silk and salt mart which is linked to Huchow by a canal that continues eastward into the Grand canal (Yün Ho). Southwest of the district rises the beautiful forested mountain and noted resort of Mo-kan-shan. Although competition from Shanghai, Wu-shih and Hangchow prior to World War II had decreased its silk industry, Huchow retained many silk filatures which processed most of the local cocoons, while it exported cocoons as well as raw silk.

(H. J. Ws.)

HUCHOWN "of the Awle Ryale," a poet who lived, if he lived at all, in the 14th century. The only reference to him is in Andrew of Wyntoun's *Oryginale Chronykil of Scotland* (*c.* 1420):

> He made a gret Gest of Arthure,
> And the Awntyr of Gawane,
> The Pistil als of Suet Susane.
> He was curyousse in his stille,
> Fayr of facunde and subtile,
> And ay to pleyssance hade delyte. . .
>
> (Cott. Ms. V. 11, 4308 ff.)

Of the three poems here attributed to Huchown, the third is the only one which can be identified with certainty. *The Pistill of Susane,* a version of the story of Susannah and the Elders in 13-lined alliterative stanzas, survives in five manuscripts: Add. Ms. 22283 (*c.* 1390) and Ms. Cott. Caligula A II (*c.* 1430) in the British museum, London; Vernon Ms. (*c.* 1375) in the Bodleian library, Oxford; and two others privately owned (ed. by D. Laing, *Select Remains* [1822]; E. Horstmann in *Anglia,* vol. i [1877]; F. J. Amours, *Scottish Alliterative Poems,* for the Scottish Text society, 2 vol. [1892, 1897]).

The "Gest of Arthure" has been reasonably identified as the *Morte Arthure,* a romance based on Geoffrey of Monmouth's *History,* in more than 4,000 unrhymed alliterative lines, and surviving in the Thornton Ms. in Lincoln Cathedral library (ed. by E. Brock for the Early English Text society [1871]; *see* E. Trautmann in *Anglia* [1877]).

The identity of the "Awntyr of Gawane" is disputed; suggestions include *The Awntyrs of Arthure at the Terne Wathelyne,* a romance in 13-lined romance stanzas surviving in the Thornton Ms. and in two others (ed. by D. Laing and by F. J. Amours, as above). Taking account of these attempts to identify the poems mentioned by Wyntoun, common authorship is unlikely; and it is probable that Wyntoun was misled by the chance contiguity of the three in a single manuscript.

It has been assumed from Wyntoun's reference that Huchown was a Scottish poet. But the *Pistill of Susane* shows no linguistic traces of Scottish origin; the extant copies are English, and it is very unlikely that a Scottish poem could be taken south early enough for an anglicized copy of it to occur in a southern manuscript written before 1400 (*see* W. A. Craigie in *The Proceedings of the British Academy,* xxviii [1942]). There is only the interest

of misdirected ingenuity in the attempts to identify Huchown with Syr Hew of Eglintoun (d. 1377), justiciary of Lothian, and perhaps lamented in Dunbar's *Timor mortis conturbat me* but otherwise unknown as a poet *(see* G. Neilson, *Sir Hew of Eglintoun and Huchown* [1901] and *Huchown of the Awle Ryale* [1902]). Henry Bradley thought Huchown of Cumbrian origin *(Collected Papers,* [1928]); S. O. Andrews in *The Review of English Studies,* vol. v (1929) places him in the northwest midlands. But he remains a shadow. (J. Ky.)

HUCHTENBURGH (HUGTENBURG), **JAN VAN** (1647–1733), Dutch painter of hunting and battle scenes, was born in Haarlem, where he studied under Thomas Wijck. As a youth he traveled to Italy, where he joined his elder brother, the landscape painter Jacob van Huchtenburgh (1640/43–1675), in Rome. In 1667 he was in Paris, where he was employed as a tapestry designer at the Gobelins factory under Charles Le Brun and A. F. van der Meulen. In 1670 he was back in Haarlem and was married there in the same year. He worked in Haarlem and Amsterdam (where he died in July 1733), and in 1708–09 went to Italy in the service of Prince Eugene of Savoy. The style and subject matter of his pictures derive from Philips Wouwerman and Van der Meulen, progressing from hunting scenes, robber encampments and cavalry skirmishes to large-scale battle pictures. Many of these are in the major European galleries, including a series, depicting Eugene's battles, in the Turin (Italy) gallery. (R. E. W. J.)

HUCKABACK, the name given to a type of cloth used for towels. For this purpose it has perhaps been more extensively used in the linen trade than any other weave. One of the chief merits of a towel is its capacity for absorbing moisture; plain and other flat-surfaced cloths do not perform this function satisfactorily, but cloths made with huckaback, as well as those made with the honeycomb (*q.v.*), and similar weaves, are particularly well adapted for this purpose. The body or foundation of the cloth is plain and therefore sound in structure, but at fixed intervals some of the warp threads float on the surface of the cloth, while at the same time a number of weft threads float on the back. Thus the cloth has a somewhat similar appearance on both sides. (T. W.)

HUCKLEBERRY, the popular name in the northeastern United States of the genus *Gaylussacia* (family Ericaceae), small branching shrubs resembling in habit the English bilberry (*Vaccinium*), to which it is closely allied, and bearing a fleshy fruit with ten nutlike seeds, differing in this respect from the blueberry. The common huckleberry of the northern states is *G. baccata;* while *G. brachycera* and *G. dumosa* are known respectively as box and dwarf huckleberry. The name *Gaylussacia* commemorates the famous French chemist J. L. Gay-Lussac (*q.v.*).

HUDDE, JOHAN VAN WAVEREN (1628–1704), Dutch mathematician and statesman, who promoted Cartesian geometry and philosophy in Holland, was born at Amsterdam on April 23, 1628 and died there on April 15, 1704. He is regarded as the first to take literal coefficients in algebra as indifferently positive or negative. Two of his discoveries, dating from 1657–58, are known as Hudde's rules: (1) If r is a double root of the polynomial equation $a_0x^n + a_1x^{n-1} + \ldots + a_{n-1}x + a_n = 0$, and if $b_0, b_1, \ldots, b_{n-1}, b_n$ are numbers in arithmetic progression, then r is a root also of $a_0b_0x^n + a_1b_1x^{n-1} + \ldots + a_{n-1}b_{n-1}x + a_nb_n = 0$; (2) if the polynomial $a_0x^n + a_1x^{n-1} + \ldots + a_{n-1}x + a_n$ takes on a relative maximum or minimum value for $x = a$, then a is a root of the equation $na_0x^n + (n-1)a_1x^{n-1} + \ldots + 2a_{n-2}x^2 + a_{n-1}x = 0$. These were published in *Geometria a Renato Des Cartes,* edited by Frans van Schooten (2nd ed., vol. i, 1659). Hudde anticipated the power series expansion (1656) for $ln\ (1 + x)$ and the use of space co-ordinates (1657).

Born of a patrician family, Hudde served 19 times as burgomaster of Amsterdam, and in 1672 he directed the work of inundating Holland to obstruct the advance of the French army. He corresponded with Christiaan Huygens on prohlems of canal maintenance, probability and life expectancy; and Leibniz reported that Hudde's manuscripts, never published, contained many excellent results.

See for bio-bibliographical details the article "Johannes Hudde, heer van Waveren en Sloterdijk" in *Nieuw Nederlandsch Biografisch Woordenboek,* vol. i, columns 1172–76 (1911). (C. B. Br.)

HUDDERSFIELD, a municipal, county and parliamentary borough in the West Riding of Yorkshire, Eng., 15 mi. S.W. of Leeds and 184 mi. N.N.W. of London by road. Pop. (1961) 129,302. Area *22.1* sq.mi. The town is on slopes of the Pennines where they merge, to the east, in the Lower Coal measures, and on the left bank of the Colne river, a tributary of the Calder. It has connections by rail and road with all the important towns of industrial northern England, and the Sir John Ramsden's canal links it with the Calder navigation.

Though there are traces of prehistoric and Roman occupation, Huddersfield *(Oderesfelt* in Domesday Book) rose to importance only after the introduction of the woolen trade in the 17th century; the suburb of Almondbury, where the Tudor Woodsome hall is now a golf club, was probably the original settlement. On Castle hill is an ancient British encampment. After the Conquest, William I granted the manor to Ilbert de Lacy. It passed to Thomas Plantagenet, duke of Lancaster, through his marriage with Alice de Lacy, and so to the crown. In 1599 Elizabeth I sold it to William Ramsden, whose descendants held it until 1920, when it was bought by the corporation. It contained 4,300 ac., mostly in the centre of the town. By the beginning of the 18th century Huddersfield had become a "considerable town," chiefly because of the manufacture of woolen kersies, which was aided by good local water; and toward the end of the same century. trade was increased by two events — the opening of navigation on the Calder in 1780 and the completion of the cloth hall or piece hall, built and given to the town by Sir John Ramsden in 1784. Originally erected as a clothiers' emporium, it was demolished in 1930 and partly re-erected at Ravensknowle park, Dalton.

The town is almost entirely modern, with great warehouses and business premises, built principally of gray gritstone. The market hall, on the site of the old Shambles, dates from 1878. The parish church of St. Peter was rebuilt in 1836–37 and occupies a site which has carried a church since the 11th century. There are a public library and art gallery, and a local history museum in Ravensknowle. The technical college. affiliated to the University of Leeds in 1905, started as a small society in 1841. The Huddersfield Choral society, the Glee and Madrigal society and the Association football team are well known. Huddersfield is the chief seat of the West Riding woolen and worsted industry, and rayon and cotton as well as wool yarns are made. Dyeing and textile machinery making are two of the many industries auxiliary to wool, and there are iron foundries and engineering works.

The town was incorporated in 1868 and created a county borough in 1888. It was made a parliamentary borough in 1832 and returns two members.

HUDLESTON, JOHN (1608–1698), English Roman Catholic priest and Benedictine monk, one of those who helped King Charles II after the battle of Worcester, reconciled the king to the Roman Catholic Church on his deathbed. He was born at Farington Hall in Lancashire on April 15, 1608, and educated at Great Blencow in Cumberland, at St. Omer and at the English college in Rome. In 1651 he was living at Moseley in Staffordshire as chaplain to the Whitgrave family; there, during the night of Sunday, Sept. 7, King Charles was brought in disguise. Two days later soldiers came to search the house, and the king and Hudleston were shut away in the priest's hiding hole; however, the troops were persuaded to leave without a search. After the Restoration Hudleston became chaplain to the queen. On Feb. j, 1685, between 7:00 and 8:00 P.M., the duke of York brought Hudleston to the dying king. Hudleston heard his confession and gave him absolution, extreme unction and the viaticum. He left an account of the scene in his own words, *A Brief Account of . . . the Happy Death of Our Late Sovereign* (1688). Hudleston died in 1698 and was buried on Sept. 13 in the churchyard of St. Mary le Strand.

See T. Blount, *Boscobel* (1660). (J. D. A.)

HUDSON, GEORGE (1800–1871), English railway financier, who by 1844 controlled more than a thousand miles of railway, was born in York in March 1800. He rose from apprenticeship in the drapery business to partnership in the firm and, on receiving

a £30,000 bequest in 1827, invested it in North Midland railway shares. He helped to secure the passage of an act of parliament to raise capital for the York and North Midland railway and was subsequently appointed chairman of that company. In that year the mania for railway speculation was at its height, and no man was more courted than the "railway king." Deputy-lieutenant for Durham and thrice lord mayor of York, he was returned as a Conservative member of parliament for Sunderland in 1845. He was suddenly ruined by the disclosure of the Eastern Counties railway frauds, losing influence and fortune at a single stroke. The rest of his life was spent mainly in litigations and attempts to operate financially abroad. He died in London on Dec. 14, 1871.

See R. S. Lambert, *The Railway King* (1934). (W. H. D.)

HUDSON, HENRY (d. 1611), English navigator and explorer, made four voyages seeking a short route to China by way of the Arctic ocean. His first voyage was made for the Muscovy company in 1607. Sailing to east Greenland, he traced the boundary of sea ice eastward to Spitsbergen, reaching a previously unknown portion of the coast in approximately 80° N. lat. On the homeward voyage he discovered an island in about lat. 71° which he named Hudson's Tutches, now called Jan Mayen (*q.v.*). His reports led to the establishment of the English whale fisheries at Spitsbergen.

On April 22, 1608, the Muscovy company dispatched Hudson to seek a northeast passage to China between Spitsbergen and Novaya Zemlya. He scoured Barents sea, vainly seeking a passage. Before docking at Gravesend on Aug. 26, Hudson's mind had already turned to a search for a northwest passage.

Later that year Hudson was invited to Amsterdam to consider undertaking explorations for the Dutch. With a Dutch and English crew, Hudson sailed from the island of Texel, North Holland, in the "Half Moon" on April 6, 1609, for his third exploration. By May 5 he was in Barents sea, encountering ice off Novaya Zemlya. Some of his men becoming mutinous, he offered to go either to Lumley inlet or to seek a passage through Virginia in about 40° N. lat. The latter plan was adopted, and on May 14 Hudson set his face toward the Chesapeake. On Sept. 3 he entered New York harbour. After ascending the river which bears his name some 150 mi. to the vicinity of the present Albany, parleying with the Indians, surveying the country and trying the stream above tidewater, he concluded that this channel did not lead to China. On Oct. 4 the "Half Moon" left for the Texel and on Nov. 7 arrived at Dartmouth, where she was detained by the English government. Hudson and the other Englishmen aboard were commanded henceforth to serve their own country. The voyage exploded the myth that near 40° N. lat. only a narrow isthmus, like the isthmus of Panama, separated the Atlantic and Pacific oceans.

A new company was formed to support Hudson in another attempt on the northwest passage, the principal promoters being Sir Thomas Smythe, Sir Dudley Digges and John Wolstenholme. Hudson determined to carry out his old plan of searching for a passage up Davis strait. Sailing from London in the ship "Discovery" (55 tons) on April 17, 1610, Hudson entered the strait which bears his name about mid-June. He reached Hudson bay on Aug. 3 and spent three months examining the eastern shore of the bay. On Nov. 1 the "Discovery" went into winter quarters in the southwest corner of James bay, being frozen in a few days later. After the ship broke out of the ice in the spring, Hudson was accused of unjust distribution of rations. A young protégé of Hudson's, Henry Greene, incited part of the crew against him. Hudson, his young son and seven others were put in a small boat on June 22, 1611, and set adrift. Robert Bylot was elected master. During the voyage home Greene and several others were killed in a fight with the Eskimos. A portion of the remnant that reached England, in September, were later brought to trial, but mere adjudged not guilty. Nothing was ever heard of the deserted'men. An expedition sent out the next year failed to find them. The remains of a structure found in 1631–32 may have been built by Hudson's party.

The three great geographical landmarks which keep Hudson's memory alive—Hudson bay, strait and river—had repeatedly been visited and even drawn on charts before he set out on his voyages; but he carried his discoveries beyond the limits of his predecessors. The fisheries of Spitsbergen and the fur industry of the Hudson bay region were the immediate fruits of his labours.

See also ARCTIC, THE.

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HUDSON, WILLIAM HENRY (1841–1922), British naturalist and writer, was born at Quilmes, near Buenos Aires, Arg., on Aug. 4, 1841, and remained on the pampas until 1874, when he went to England. Thereafter the greater part of his life was spent in poverty and marked by frequent ill health. His wife, Emily, long kept a boardinghouse in London, where Hudson too lived, known to only a small circle of appreciative friends. A civil list pension granted in 1901 aided him somewhat, but he relinquished this when belated success reached him. He died in London on Aug. 18, 1922, and was buried at Broadwater, Sussex. Hudson called himself a field naturalist, and though the charms of wild life made a pre-eminent appeal to his sincere observing mind, he was not without an understanding of simple human joys and sorrows. This versatility of his sensitive nature is well instanced in his last work, *A Hind in Richmond Park,* published posthumously in 1922.

His other writings include the memorable pictures of the South America of his youth, such as *The Purple Land* (1885), *A Crystal Aga* (1887), *El Ombú* (1902), *Green Mansions* (1904) and *Far Away and Long Ago* (1918); of the English countryside, such as *Afoot in England* (1909), *A Shepherd's Life* (1910) and *Dead Man's Plack* (1920); ornithological works, as his collaboration with P. L. Sclater in *Argentine Ornithology* (1888), his own *British Birds* (1895), *Birds of La Plata* (1920) and many pamphlets for the Society for Protection of Birds.

A bird sanctuary with a decoration by Jacob Epstein was erected to Hudson's memory in Hyde Park, London, in 1925.

HUDSON BAY, a large gulf or inland sea in northeastern Canada, is an extension of the Atlantic ocean separating Baffin Island from mainland Canada. In this broad sense it includes Hudson bay proper, James bay, Foxe channel, Fose basin, Hudson strait and Ungava bay. Its area is about 480,000 sq.mi. (Hudson bay proper, 250,000 sq.mi.). The length of the mainland coast line alone exceeds 4,400 mi. Islands, including Baffin itself and island groups—Foxe basin, Southampton, Hudson strait, Belcher, and James bay—increase this total by at least 70%. It is bordered by Quebec on the east and by Ontario, Manitoba and the Northwest Territories on the west and south, its islands comprising a part of the latter.

Most of Hudson bay proper has depths of between 120 and 600 ft., increasing to 846 ft. in a submarine valley extending from about 61° N. to 88° W. toward Hudson strait. The strait itself is mostly 600–1,200 ft. deep, though a depth of 2,886 ft. occurs at the eastern end. Ungava bay and Foxe channel are generally shallower than 420 ft.; Foxe basin and James bay, shallower than 180 ft.

The waters of Hudson bay are cold, being chiefly of Arctic origin; they have low salinity values because of dilution by numerous tributary rivers. Having been funneled southeastward through Fury and Hecla strait, the Arctic sea water develops major counterclockwise circulations in Foxe basin and in Hudson bay proper, finally discharging eastward along the south side of Hudson strait. Minor counterclockwise circulations also prevail in James and Ungava bays. Hudson strait's north shore is dominated by an inflow of mild, saline water from the Labrador sea, which, however, recurves southwards and eastwards to join the main Hudson bay outflow.

Most of the Hudson bay system, which is situated between 65° and 95° W. and 52° and 70° N., is covered with floating ice from January until May. In Hudson bay proper there is usually a strip of fast ice along the shore, separated from a vast central ice mass by a strip of open water. The central mass is relatively thin, smooth and unbroken. Beginning late in May, melting and disintegration spread northward from James bay, and by mid-September Hudson bay proper is entirely free of ice. In Foxe basin and Foxe

channel open leads may occur anywhere during wintertime; the ice is much older, thicker and rougher than in Hudson bay proper. This northern ice is slow to melt in summer: large masses of it persist in the eastern part of Foxe basin; other masses float through Foxe channel to western Hudson strait, where their progress is impeded by Nottingham, Mill and Salisbury islands. Usually no serious ice jam develops there, but navigation of the bottleneck is liable to be difficult in cool years. The main part of Hudson strait is never completely ice-covered because of the frequency of winter storms; by late summer it is usually ice-free.

Hummocky or, locally, hilly rocks of the Canadian shield form the coast around the greater part of Hudson bay, but limestone plains occur on the south coast, on Southampton, Coats and Mansel islands and around Foxe basin. The whole region lies north of the tree line, except for southern James bay. Spruce, balsam and poplar grow to a fair size as far as the northern limit of James bay. Caribou, musk ox and other animals are found in large numbers, and there is an abundance of feathered game — ducks, geese, loons and ptarmigan; hunting and fishing form the chief occupation of the Indians and Eskimo who live in scattered bands near the shore. The bay abounds with fish, of which the chief are cod and salmon. Whales were formerly pursued by American whalers, whose destructive methods greatly depleted the supply.

Completion of a railway from Saskatchewan to Churchill in 1931 led to the development of a shipping route through Hudson strait to Europe (the first shipment being made in 1931), for the distance from Edmonton to Liverpool via Churchill is almost 1,000 mi. less than via Montreal. Despite this advantage the Hudson route long suffered from high insurance rates, chiefly because accurate ice distribution and forecast data were lacking. By the second half of the 20th century, however, Churchill was handling 50–60 cargo vessels a year, exporting 18,000,000–20,000,000 bu. of wheat, and importing manufactured goods.

Another railway, to Moosonee at the head of James bay, was completed in 1932. Other economic developments include those at Rankin inlet (nickel mining), Richmond gulf (iron and lead mining), Wakeham bay (nickel mining), Coral harbour (airfield) and Hopes Advance bay (iron mining and concentrating). Settlements providing trading centres for Indian and Eskimo trappers exist at Fort Chimo, Port Harrison, Chesterfield Inlet, Igloolik and many other places.

Hudson strait may have been discovered by the Cabots as early as 1498, but no deep westward penetration was achieved until 1610, when Henry Hudson traced the Canadian mainland coast from Ungava bay to James bay. Two years later Sir Thomas Button mapped the west coast of Hudson bay proper. In 1631 Captain Thomas James traced much of the south coast, and Luke Foxe discovered Foxe channel. The west coast of Foxe basin was not mapped till 1821–23 by Sir William Parry; Prince Charles, Air Force and Foley islands, near the east coast, were not charted until 1948.

See also RUPERT'S LAND; HUDSON'S BAY COMPANY.

(H. R. TN.)

HUDSON RIVER, situated entirely within the state of New York, originates in several small, postglacial lakes in Essex county near Mt. Marcy, the highest point in the state. For about 108 mi. it pursues a winding course, flowing generally southeast to Corinth in Saratoga county and then northeast to Hudson Falls at the northern end of what is called the Hudson valley. From there it flows without significant gradient almost directly south for nearly 200 mi. to the Battery at the head of New York's Upper bay. As it descends from the Archean (Pre-Cambrian) Adirondack province to the younger Hudson-Champlain trough it drains an area of 13,370 sq.mi. For 150 mi. from its mouth, the Hudson is a drowned valley and as such is an arm of the sea. Tides are felt as far north as the federal dam at Troy, where the mean tidal range is 4.7 ft., with a maximum record after freshets of 33.4 ft. In width, the Hudson ranges from ¾ mi. at its mouth to 3 mi. at Haverstraw bay (between Harmon in Westchester county and Haverstraw in Rockland county), with the section to the south of this, called Tappan Zee, almost attaining this width. Upstream of Haverstraw bay to the head of navigation at Waterford, it narrows unevenly from about 1 mi. to a few hundred feet. Along its final 17 mi., where it is called North river, it forms part of the eastern boundary of New Jersey. Total river length is 306 mi.

Navigation **and** Commerce. — The most important tributary of the Hudson is the Mohawk, which enters at Waterford, north of Troy. Together these constitute one of the world's major waterways—a passage of such shallow gradient that it has long been the principal route through the Appalachian barrier. Improvement of the Hudson began in 1797, at first by the state, then jointly with the federal government and, since 1892, by the latter alone. Canalization of the Mohawk proceeded simultaneously. The controlling depth of the Hudson is 27 ft. at Albany and 14 ft. from Albany to the mouth of the Mohawk, a distance of about 155 mi. This is sufficient for deepwater navigation to Albany and for through tug-barge traffic to the Great Lakes via the canalized Mohawk and the New York state barge canal. The lower river is open year-round; and to Albany the navigation season is 12 months for ocean-going ships and 8 months for barges. Principal items in the tonnage of river-borne commerce are sand, gravel and crushed rock; petroleum and its products; coal and lignite. Passenger service has dwindled to a few excursion boats, largely because of the efficiency of parallel transportation, both highway and rail, including the New York state thruway, which follows the Hudson-Mohawk depression to Buffalo.

The addition of bridges also has led to the abandonment of ferries in many places. Important bridges south of Albany are the Rip van Winkle (1935) at Catskill; the Kingston-Rhinecliff (1957); the Mid-Hudson (1930) at Poughkeepsie; the Bear Mountain (1924) near Peekskill; the Tappan Zee (1956) at Tarrytown; and the George Washington (1931) at New York city. Two vehicular and tno rail tunnels under the river also connect New York city uith northern New Jersey.

Although the Hudson valley is famous for its scenery and is used mainly for dairying, fruitgrowing, recreation and travel, industry and commerce are noteworthy north of the New York metropolitan area in such cities as Kyack, Tarrytown, Haverstraw, Ossining, Peekskill, Newburgh, Beacon, Poughkeepsie, Kingston, Saugerties, Catskill. Hudson, Albany, Troy, Cohoes and Glens Falls.

History. — The Florentine navigator Giovanni da Verazzano sailed a short distance up the Hudson in 1524, but the river rightly bears the name of Henry Hudson, who explored it in 1609. Dutch settlement of the valley began in 1629, but for over 200 years tenants were denied title to the land under an aristocratic patroon system, which created along the river a series of large and elegant estates. The region possessed a serene scenic beauty that formed a background to the stories of Washington Irving and inspired the Hudson River school of art and architecture.

In the Revolution the Hudson was a strategic waterway and was the site of many historic events; including the decisive victory over Burgoyne at Saratoga and the naval battle of Tappan Zee, during which an enormous chain was stretched across the river between Gee's point and Constitution Island to prevent the passage of British ships. Benedict Arnold, while military commander of the forts in this locality, planned to surrender them to the British. He made his escape from his quarters on the east bank near the site of the village of Garrison to a British ship anchored in the river below. Washington made his headquarters at Newburgh in 1782 and later disbanded the Continental armies from there.

During the 19th century the Hudson traffic flourished, particularly after the opening of three canals — the Erie, the Delaware and Hudson and the Champlain — that linked New York city with the Great Lakes and with the Delaware and lower St. Lawrence valleys. The waterway was thus a key factor in the growth of New York city. (See also ERIE CANAL.) Practical American steam navigation was begun on the Hudson by Robert Fulton in 1807, and the river rapidly gained in importance as a highway for passengers and goods. Its main towns owed their early prosperity to the whaling trade, but later they became home ports for interocean merchant fleets. Local industries other than whale-processing included brickmaking, leather fabricating, lumbering, fishing, ice storage, quarrying and the excavation of native cement.

Many of the Hudson river estates have become schools or insti-

tutions, and the colourful paddle wheelers and sailing ships are things of the past; but the magnificence of Hudson valley scenery, especially in its lower portion, remains one of the great natural attractions of North America.

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HUDSON'S BAY COMPANY, or "the Governor and Company of Adventurers of England trading into Hudson's Bay," a corporation formed for the purpose of importing into Great Britain the furs and skins which it obtained, chiefly by barter, from the Indians of British North America.

In 1670 Charles II granted a charter to Prince Rupert and 17 other noblemen and gentlemen, incorporating them as the "Governor and Company of Adventurers of England trading into Hudson's Bay." and securing to them a monopoly of the trade of all lands watered by streams flowing into Hudson bay. Besides the complete lordship and entire legislative, judicial and executive power, the corporation received also the right to "the whole and entire trade and traffic to and from all havens. bays. creeks. rivers; lakes, and seas into which they shall find entrance or passage by water or land out of the territories, limits, or places aforesaid." The first settlements in the country thus granted, which was to be known as Rupert's Land, were made on James bay and at Churchill and Hayes rivers; but it was long before there was any advance into the interior. for in 1749, when an unsuccessful attempt was made in parliament to deprive the company of its charter on the plea of "nonuser." it had only some four or five forts on the coast. with about 120 regular employees. Although the commercial success of the enterprise was from the first immense. great losses were inflicted on the company by the French. After the cession of Canada to Great Britain in 1563. numbers of fur traders spread over that country and began even to encroach on the Hudson's Bay company's territories. These individual speculators finally combined into the North-West Fur Company of Montreal. In the competition which arose between the companies the Indians were demoralized, body and soul, by the abundance of ardent spirits with which the rival traders sought to attract them to themselves; the supply of furs threatened soon to be exhausted by the indiscriminate slaughter. even during the breeding season. of both male and female animals; and the worst passions of both whites and Indians were inflamed to their fiercest (see RED RIVER SETTLEMENT). At last, in 1821. the companies amalgamated. obtaining a licence to hold for 21 years the monopoly of trade in the vast regions lying to the west and northwest of the older company's grant. In 1838 the Hudson's Bay company acquired the sole rights for itself. and obtained a new licence. also for 21 years. On the expiry of this it was not renewed! and since 1859 the district has been open to all.

The licences to trade did not of course affect the original possessions of the company. Under the terms of the deed of surrender, dated Nov. 19, 1869, the Hudson's Bay company surrendered all its rights of government, subject to certain terms and conditions, including the payment to the company by the Canadian government of a sum of £300,000 sterling on the transfer of Rupert's Land to the Dominion of Canada, the retention by the company of its posts and stations, with a right of selection of a block of land adjoining each post in conformity with a schedule annexed to the deed of surrender; and the right to claim in any township or district within the fertile belt in which land is set out for settlement, grants of land not exceeding one-twentieth part of the land so set out. The boundaries of the fertile belt were fixed as follows: "On the south by the United States' boundary; on the west by the Rocky Mountains; on the north by the northern branch of the Saskatchewan; on the east by Lake Winnipeg, the Lake of the Woods. and the waters connecting them." In 1872 it was agreed that the one-twentieth of the lands in the fertile belt reserved to the company under the terms of the deed of surrender should be taken by "allotting in every fifth township two whole sections of 640 acres each, and in all other townships one section and three-quarters of a section each."

From this time little was done to develop the company until just before the outbreak of World War I. During the period 1914–18 one part of the company with 300 steamers was engaged in food and munition transport for the French and Belgian governments. From the end of the war the company began to develop rapidly; the annual reports showed a steady increase in business done. and the company opened new offices in territories previously untouched. Large stores were completed in Winnipeg, Saskatoon, Calgary, Edmonton, Vancouver, and Victoria. and agreements were made with the Cnited States for the importation of furs to special centres.

An experiment in reindeer farming in Baffin's Land failed; but efforts were made elsewhere.

See G. Bryce, *Remarkable History of the Hudson's Bay Company* (1900); and *A.* C. Laut, *Conquest* of *the great Northwest; being the story of the adventurers of England known as Hudson's Bay Co.* (1909); *Canadian Progress* (an annual publication), and the annual reports of the Hudson's Bay Company. (X.; A. N. J. W.)

HUE (officially THUA-THIEN), capital of Thua-thien province, Vietnam. on the Hué river. about 8 mi. from the China sea. Pop. (1958 est.) 90.682. Hué was for several centuries capital of the Annamite empire, covering much of modern Indochina. Hills on three sides and a river not navigable by large vessels made it relatively inaccessible. which was desired by the emperors, but after construction of the Saigon-Hanoi railway and highway Hué was no longer isolated. Flat paddy lands, traversed by streams and canals, surround the town. Glass and ivory became

BY COURTESY OF THE GOVERNOR AND COMMITTEE OF THE HUDSON'S BAY COMPANY

FACSIMILE OF A PORTION OF THE FIRST SHEET OF THE CHARTER GRANTED MAY 2. 1670. BY KING CHARLES II TO "THE GOVERNOR AND COMPANY OF ADVENTURERS OF ENGLAND TRADING INTO HUDSON'S BAY." THE FIVE-PAGE CHARTER GAVE POWER TO THE COMPANY TO RULE WITHIN ITS TERRITORY ACCORDING TO ENGLISH LAW

the basis of a thriving handicraft industry, but no large-scale manufacturing was developed. A frequent service of steam launches connected the town with Thuan-an, at the mouth of the river, and with Tourane 60 mi. to the southeast. The city walls enclose the former emperor's palace. Outside the walls is the business district. Tombs of many past emperors remind the visitor of Hué's past glory. (J. R. A.; X.)

HUE AND CRY, a phrase employed in English law to signify the old common law process of pursuing a criminal with horn and voice. It was the duty of any person aggrieved, or discovering a felony, to raise the hue and cry, and his neighbours were bound to turn out with him and assist in the discovery of the offender. In the case of a hue and cry, all those joining in the pursuit were justified in arresting the person pursued, even though it turned out that he was innocent. A swift fate awaited any one overtaken by hue and cry, if he still had about him the signs of his guilt. If he resisted he could be cut down, while, if he submitted to capture, his fate was decided. Although brought before a court, he was not allowed to say anything in self-defense, nor was there any need for accusation, indictment or appeal. Although regulated from time to time by writs and statutes, the process of hue and cry continued to retain its summary method of procedure, and proof was not required of a culprit's guilt, but merely that he had been taken red-handed by hue and cry. The various statutes relating to hue and cry were repealed in 1827 (7 and 8 Geo. IV, c, 27). The Sheriffs act, 1887, re-enacting 3 Edw. I, c, 9, provides that every person in a county must be ready and apparelled at the command of the sheriff and at the cry of the county to arrest a felon, and in default shall on conviction be liable to a fine. (See also HARO, CLAMEUR DE.)

For the early history, see Pollock and Maitland, *History of English Law,* vol. ii; *W*. Stubbs, *Select Charters.*

HUEHUETENANGO, a town in northwestern Guatemala, capital of the province of the same name, 106 mi. N.W. of Guatemala city. It is overwhelmingly Indian in population and is an important centre of the Guatemalan area known as *los altos* (the highlands). Pop. (1950) 6,187. Huehuetenango is on the river Salega, and lies at an altitude of 6,200 ft. It enjoys a semi-tropical climate and is surrounded by a fertile agricultural country raising wheat, maize, potatoes, beans, melons, fruits, etc. Sheep graze on the hills, and there is a considerable production of hand-woven woollens in ancient patterns used by the local villagers for their typical costumes and also in conventional tweed patterns which are sold in Guatemala city. Coffee, cacao, sugar cane and tropical fruits are grown in neighbouring valleys. Huehuetenango is reached by automobile from San Felipe, the nearest railway station, and from Quetzaltenango (*q.v.*) and, via the latter city, from Guatemala city. The name, Huehuetenango means "Place of the Ancients" and the town is located close to the ruins of an ancient Indian centre called Zaculeu. In Spanish times, the Dominican missionaries penetrated to Huehuetenango, and near by, at Chiantla, had a monastery richly equipped from the returns of a silver mine owned by the Dominicans and worked by the Indians; it was at one time one of the wealthiest religious communities in Central America. It was taken over by the government in 1873, and the mines were abandoned.

HUELVA, a maritime province of southwestern Spain, formed in 1833 of districts taken from Andalusia, and bounded on the north by Badajoz, east by Seville, south by the Gulf of Cadiz and west by Portugal. Population (1950 census) 369,722; area 3,907 sq.mi. The northern district is highland traversed in a southwesterly direction by the Sierra Morena, there known, in its main ridge, as the Sierra de Aracena. The south is a lowland maritime strip with flat wastelands (Las Marismas) in the southeast around the mouth of the Guadalquivir. The lower reaches of the Guadalquivir and Guadiana are navigable and form respectively for some distance the southeastern and southwestern boundaries. The Odiel and the Tinto both fall into the Atlantic by navigable *rias* or estuaries. Huelva has a mild and equable climate, with abundant moisture and a fertile soil. In the northern highlands there are many oaks, pines, beeches, cork trees and chestnut, while the lowlands afford excellent pasturage. But agriculture and stock-breeding are there less important than in most Spanish provinces, although the exports comprise large quantities of fruit, oil and wine, besides cork and esparto grass. The headquarters of the fishing trades, which include the drying and salting of fish, are at Huelva, the capital, and Ayamonte on the Guadiana. There are numerous brandy distilleries, but the great local industry is the mining of copper manganese and iron. The well-known Rio Tinto copper mines, near the sources of the Tinto, like those of Tharsis, 30 mi. N.N.W. of Huelva, were exploited from very early times and later by the Carthaginians, and Romans. Saline and other mineral springs are common throughout the province. Huelva is the principal seaport, with railway connections with Seville and Mérida, while a network of narrow-gauge railways leads to the chief mining centres. Insurgents occupied Huelva early in the civil war of 1936–39. *See* ANDALUSIA.

HUELVA (the ancient Onuba, Onoba or Onuba Aestuaria), the capital of the Spanish province of Huelva, about 10 mi. from the Atlantic ocean, on the left bank of the river Odiel, and on the Seville-Huelva, Mérida-Huelva and Rio Tinto-Huelva railways, the last-named being a narrow-gauge line. Population (1950) 58,058. Huelva is built on the western shore of a triangular peninsula formed by the estuaries of the Odiel and Tinto, which meet below the town. Huelva was originally a Carthaginian trading station, and afterward a Roman colony. The colossal statue of Columbus was erected in 1892 to commemorate the fourth centenary of his voyage which began and ended in the village of Palos de la Frontera on the Tinto. Columbus resided in the neighbouring Franciscan monastery of Santa Maria la Rábida after his original plans for the voyage had been rejected by King John II of Portugal in 1484. The present town is modem in appearance, and owes its prosperity to a transit trade in copper and other ores, for which it is the port of shipment. After 1872, when the famous Rio Tinto copper mines were for the first time properly exploited, it progressed rapidly in size and wealth. Besides exporting copper, manganese and other minerals, Huelva is the headquarters of the sardine, tunny and bonito fisheries, and of a trade in grain, grapes, olives and cork. The bulk of the imports, which consist chiefly of coal, iron and steel and machinery, ordinarily comes from Great Britain. Foodstuffs and Australian hardwood are also imported. Franco's Nationalist forces captured Huelva early in the civil war of 1936–39.

HUÉRCAL OVERA, a town of southeastern Spain, in the province of Almeria, on the Lorca-Baza railway, and between two branches of the River Almanzora. Pop. (1950) 14,020 (mun.). Huércal Overa is the chief town of a thriving agricultural district, largely dependent on the lead mining carried on among the surrounding highlands.

HUESCA, a frontier province of northern Spain, formed in 1833 of districts previously belonging to Aragon; and bounded on the north by France, east and southeast by Lérida, southwest and west by Saragossa, and northwest by Navarre. Population (1950) 237,681; area 5,849 sq.mi. The entire northern half of Huesca belongs to the mountain system of the Pyrenees, which there attain their greatest altitudes in Aneto, the highest point of the Maladetta ridge (11,168 ft.), and in Monte Perdido (11,007 ft.). The southern half forms part of the rugged and high-lying plateau of Aragon, with the Sierra de Alcubierre on the southwestern border. The whole province is included in the basin of the Ebro, and is drained by four of its principal tributaries—the Aragon in the northwest, the Gallego in the west, the Cinca in the centre, and the Noguera Ribagorzana along part of the eastern border. These rivers rise among the Pyrenees, and take a southerly course; the two last-named unite with the Segre before joining the Ebro. The Cinca receives the combined waters of the Alcanadre and Isuela on the right and the Esera on the left.

The climate is influenced locally by the cold winds of the snow-capped Pyrenees and the continental conditions of the interior plateau.

Agriculture is facilitated by a fairly complete system of irrigation, by means of which much wasteland has been reclaimed, although large tracts remain useless. There is good summer pas-

turage on the mountains, where cattle. sheep and swine are reared. The mountains are richly clothed with forests of pine, beech, oak and fir; and the southern regions, wherever cultivation is possible, produce abundant crops of wheat and other cereals, vines, mulberries and numerous other fruits and vegetables. The mineral resources include small quantities of argentiferous lead, copper, iron and cobalt, with salt, lignite, limestone, millstone, gypsum, granite and slate. The minerals are of little commercial value and there are many transport difficulties. Mineral springs are numerous. Timber, millstones, cattle, leather, and some brandy and wine are exported to France. The manufactures of Huesca are of little importance.

The Saragossa-LCrida-Barcelona railway traverses the province, and gives access, by two branch lines, to Jaca, by way of Huesca, the provincial capital, and to Barbastro. Jaca is connected with Pau (France) by rail. Huesca and Jaca are episcopal cities. Fraga was a residence of the kings of Aragon; there is a fine 12th century church and a ruined Moorish citadel. Monzon is a town on the lower Cinca, with the ruins of a Roman fortification, and of a 12th century castle of the Knights Templar. The province was contested by insurgents and loyalists until its occupation by the former in 1938. *(See* also ARAGON.)

HUESCA (anc. *Osca),* the capital of the Spanish province of Huesca, 35 mi. N.N.E. of Saragossa, on the Tardienta-Huesca-Jaca railway. Pop. (1950) 20,003 (municipio). It occupies a height near the right bank of the river Isuela, overlooking a broad and fertile plain. Strabo (iii. 161, where some editors read Ileosca) describes Osca as a town of the Ilergetes, and the scene of Sertorius's death in 72 B.C.; while Pliny places the Oscenses in *regio Vescitania.* Plutarch calls it a large city. Julius Caesar names it Vencedora; and the name by which Augustus knew it, Urbs victrix Osca, was stamped on its coins, and is still preserved on its arms. In 1096 Pedro I. of Aragon regained it from the Moors, after winning the battle of Alcoraz. Huesca is an episcopal see and has an imposing Gothic cathedral, begun in 1400, finished in 1515, and enriched with fine carving. In the same plaza is the old palace of the kings of Aragon, formerly given up for the use of the now closed Sertoria (the university), so named in memory of a school for the sons of native chiefs, founded at Huesca by Sertorius in 77 B.C. (Plut. *Sert.* 15). Huesca manufactures pottery, bricks, cloth and leather; but its chief trade is in cereals, wine, fruit and vegetables. Much fighting took place in and around Huesca in the civil war of 1936–39.

HUET (HUETIUS), PIERRE DANIEL (1630–1721), bishop of Avranches, French scholar, was born at Caen. He was educated at the Jesuit school of Caen, and also received lessons from the Protestant pastor, Samuel Bochart. In 1652 Samuel Bochart took Huet with him to Stockholm. This journey, in which he saw Leyden, Amsterdam and Copenhagen, as well as Stockholm, resulted in the discovery, in the Swedish royal library, of some fragments of Origen's *Commentary on St. Matthew,* which gave Huet the idea of editing Origen, a task he completed in 1668. He eventually quarrelled with Bochart, who accused him of having suppressed a line in Origen in the Eucharistic controversy. In Paris he entered into close relations with Chapelain. During the famous dispute of Ancients and Moderns Huet took the side of the Ancients against Charles Perrault and Desmarets. Among his friends at this period were Conrart and Pellisson. His taste for mathematics led him to the study of astronomy. He next turned his attention to anatomy, and, being himself short-sighted, devoted his inquiries mainly to the question of vision and the formation of the eye. In this pursuit he made more than 800 dissections. He then learned all that was then to be learned in chemistry, and wrote a Latin poem on salt. All this time he was no mere book-worm or recluse, but mas haunting the salons of Mlle. de Scudéry and the studios of painters; nor did his scientific researches interfere with his classical studies, for during this time he was discussing with Bochart the origin of certain medals, and was learning Syriac and Arabic under the Jesuit Parvilliers. He also translated the pastorals of Longus, wrote a tale called *Diane de Castro,* and defended, in a treatise on the origin of romance, the reading of fiction.

On being appointed assistant tutor to the Dauphin in 1670, he edited with the assistance of Anne Lefèvre, afterward Madame Dacier, the well-known edition of the *Delphin Classics.* This series was an edition of the Latin classics in about 60 volumes, and each work was accompanied by a Latin commentary and verbal index. Huet was admitted to the academy in 1674 He issued one of his greatest works, the *Demonstratio evangelica,* in 1679. He took holy orders in 1676, and two years later the king gave him the abbey of Aulnay, where he wrote his *Questiones Aletuanae* (Caen, 1690), his *Censura philosophiae Cartesianae* (1689), his *Nouveau mémoire pour servir à l'histoire du Cartésianisme* (1692), and his discussion with Boileau on the Sublime. In 1685 he was made bishop of Soissons, but after waiting for installation for four years he took the bishopric of Avranches instead. He exchanged the cares of his bishopric for what he thought would be the easier chair of the Abbey of Fontenay, but there he was vexed with continual law-suits. At length he retired to the Jesuits' House in the Rue Saint Antoine at Paris, where he died in 1721. His great library and manuscripts, after being bequeathed to the Jesuits, were bought for the royal library.

In the *Huetiana* (1722) of the abbé d'Olivet will be found material for arriving at an idea of his prodigious labours, exact memory and wide scholarship. Another posthumous work was his *Traité philosophique de la faiblesse de l'esprit humain* (Amsterdam, 1723). His autobiography, found in his *Commentarius de rebus ad eum pertinentibus* (1718), has Seen translated into French and into English.

See de Gournay, *Huet, évêque d'Avranches* (1854).

HUFELAND, GOTTLIEB (1760–1817), German economist and jurist, was born at Danzig on Oct. 19, 1760. He studied at Leipzig, Göttingen and Jena, and in 1788 was appointed to an extraordinary professorship at Jena. Five years later he was made ordinary professor. He lectured on natural law, developing with great acuteness and skill the formal principles of the Kantian theory of legislation. In 1803 Hufeland removed to Wiirzburg, and then to Landshut. From 1808 to 1812 he acted as burgomaster in his native town of Danzig. He died at Halle on Feb. 25, 1817.

Hufeland's works on the theory of legislation are marked by precision of statement and clearness of deduction. They form on the whole the best commentary upon Kant's *Rechtslehre,* the principles of which they carry out in detail, and apply to the discussion of positive laws. In political economy Hufeland's chief work is the *Neue Grundlegung der Staatswirthschaftskunst* (2 vols., 1807–13), the second volume of which has the special title, *Lehre vom Gelde und Geldumlaufe.* Hufeland was the first among German economists to point out the profit of the *entrepreneur* as a distinct species of revenue with laws peculiar to itself.

See Roscher. *Geschichte der National Ökonomik in Deutschland.*

HUGEL, FRIEDRICH VON, BARON (1852–1925), Catholic theologian, son of Karl Von Hugel (1775–1870), baron of the Holy Roman Empire, was born on May 5, 1852 at Florence. In 1867 the family moved to England, and settled at Torquay. Von Hugel later became one of the most sympathetic, resourceful and persuasive religious teachers of his age. But while he possessed a generous sympathy for all seekers after truth, he held the Catholic Church to possess the fullest, richest and deepest realization of religion. He accepted the papacy, but thought that Church government was overcentralized, believing that this tendency could be counteracted by the healthy interaction of energy between the head and the members of the whole body of believers. His relations with the Higher Criticism resulting from his Biblical scholarship led him to be classed with the Modernists, but when the crisis of Modernism was over he made it clear that he could not follow the Modernists who revolted from Rome, and that he rejected their theory of belief.

In 1873 Von Hugel married Lady Mary Herbert, a daughter of Sydney Herbert (Lord Herbert of Lea). He died in London on Jan. 27, 1925, leaving his library to St. Andrews university.

His works include: *The Mystical Element of Religion as studied in St. Catherine of Genoa and her Friends* (1908, new and rev. ed. 1923); *Eternal Life, a Study of its Implications and Applications* (1912, 2nd ed. repr. 1913); *The German Soul in its Attitude towards Ethics and Christianity; The State and War* (1916); *Essays and Addresses on the Philosophy of Religion* (1921).

HUGGINS, SIR WILLIAM (1824–1910), English astronomer who revolutionized observational astronomy by applying the spectroscopic method to the determination of the chemical constitution of stars and by his use of photography in stellar spectroscopy. He was born in London on Feb. 7. 1824, and was educated at the City of London school and under private tuition. He built a private observatory at Tulse Hill, London, in 1856 and began to apply G. R. Kirchhoff's discoveries in spectrum analysis to astronomy; this work was independent of nearly contemporary researches by L. M. Rutherfurd in the U.S. His results on the chemical constitution of the stars, obtained in collaboration with W. A. Miller, were presented to the Royal society in 1863 in a note on the "Lines of the Spectra of some of the fixed stars." In 1864 Huggins discovered the gaseous nature of the so-called "unresolved" nebulae, previously considered to be aggregates of stars too remote to be resolved by existing instruments. On May 18. 1866, in the first spectroscopic examination of a nova, he observed, superimposed on a solar-type spectrum, a number of bright hydrogen lines, suggesting that the outburst was accompanied by the emission of a shell of gas at a temperature higher than that of the star's surface. In 1868 he proved incandescent carbon vapours to be the main source of cometary light and in the same year applied Doppler's principle to the detection and measurement of stellar velocities in the line of sight. Huggins was made knight commander of the Order of the Bath in 1897, was an original member of the Order of Merit (1902) and president of the Royal society from 1900 to 1905. His *Atlas* of *Representative Stellar Spectra,* prepared conjointly with Lady Huggins (who actively cooperated in her husband's work), was published in 1899.

Huggins died in London on May 12, 1910.

See *The Scientific Papers of Sir William Huggins* (1909).

(O. J. E.)

HUGH, called THE GREAT (d. 956), duke of the Franks and count of Paris, son of King Robert of France (d. 923) and nephew of King Odo or Eudes (d. 898), was one of the founders of the power of the Capetian house in France. Hugh's first wife was Eadhild, a sister of the English king, Aethelstan. At the death of Raoul, duke of Burgundy, in 936, Hugh was in possession of nearly all the region between the Loire and the Seine, corresponding to the ancient Neustria, with the exception of the territory ceded to the Normans in 911. He took a very active part in bringing Louis IV. (d'Outremer) from England in 936, but in the same year Hugh married Hadwig, sister of the emperor Otto the Great, and soon quarrelled with Louis. Hugh even paid homage to Otto, and supported him in his struggle against Louis. When Louis fell into the hands of the Normans in 945, he was handed over to Hugh, who released him in 946 only on condition that he should surrender the fortress of Laon. At the council of Ingelheim (948) Hugh was condemned, under pain of excommunication, to make reparation to Louis who had made an alliance with Otto. It was not, however, until 950 that the powerful vassal became reconciled with his suzerain and restored Laon. But new difficulties arose, and peace was not finally concluded until 953. On the death of Louis IV. Hugh was one of the first to recognize Lothair as his successor, and, at the intervention of Queen Gerberga, was instrumental in having him crowned (Nov. 12, 956). In recognition of this service Hugh was invested by the new king with the duchies of Burgundy (his suzerainty over which had already been nominally recognized by Louis IV.) and Aquitaine. But his expedition in 955 to take possession of Aquitaine was unsuccessful. In the same year, however, Giselbert, duke of Burgundy, acknowledged himself his vassal and betrothed his daughter to Hugh's son Otto. At Giselbert's death (April 8, 956) Hugh became effectivemaster of the duchy, but died soon afterwards, on June 17, 956.

HUGH CAPET (*c.* 938–996), king of France and founder of the Capetian dynasty, was the eldest son of Hugh the Great by his wife Hadwig. When his father died in 956 he succeeded to his numerous fiefs around Paris and Orleans, and his cousin, the Frankish king Lothair, recognized him somewhat reluctantly as duke of the Franks. Many of the counts of northern France did homage to him as their overlord, and Richard I., duke of Normandy, was both his vassal and his brother-in-law. His authority extended over certain districts, south of the Loire, and, owing to his interference, Lothair was obliged to recognize his brother Henry as duke of Burgundy. Hugh supported his royal suzerain when Lothair and the emperor Otto II. fought for the possession of Lorraine; but chagrined at the king's conduct in making peace in 980, he went to Rome to conclude an alliance with Otto. Laying more stress upon independence than upon loyalty, Hugh appears to have acted in a haughty manner toward Lothair, and also towards his son and successor Louis V.; but neither king was strong enough to punish this powerful vassal. When Louis V. died without children in May 987, Hugh and the late king's uncle Charles, duke of Lower Lorraine, were candidates for the vacant throne, and in this contest the energy of Hugh's champions, Adalberon, archbishop of Reims, and Gerbert, afterwards Pope Sylvester II., prevailed. Declaring that the Frankish crown was an elective and not an hereditary dignity, Adalberon secured the election of his friend, and crowned him, probably at Noyon, in July, 987.

The authority of the new king was quickly recognized in his kingdom, which covered the greater part of France north of the Loire with the exception of Brittany, and in a shadowy fashion he was acknowledged in Aquitaine; but he was compelled to purchase the allegiance of the great nobles by large grants of royal lands, and he was hardly more powerful as king than he had been as duke. Moreover, Charles of Lorraine was not prepared to bow before his successful rival, and before Hugh had secured the coronation of his son Robert as his colleague and successor in December 987, he had found allies and attacked the king. Hugh was worsted during the earlier part of this struggle, and was in serious straits, until he was saved by the wiles of his partisan Adalberon (*q.v.*) bishop of Laon, known as Asselin, who in 991 treacherously seized Charles and handed him over to the king. This capture virtually ended the war, but one of its side issues was a quarrel between Hugh and Pope John XV., who was supported by the empire, then under the rule of the empresses Adelaide and Theophano as regents for the young emperor Otto III. In 987 the king had appointed to the vacant archbishopric of Reims a certain Arnulf, who at once proved himself a traitor to Hugh and a friend to Charles of Lorraine. In June 991, at the instance of the king, the French bishops deposed Arnulf and elected Gerbert in his stead, a proceeding which was displeasing to the pope, who excommunicated the new archbishop and his partisans. Hugh and his bishops remained firm, and the dispute was still in progress when the king died at Paris on Oct. 24, 996.

Hugh was a devoted son of the church, to which, it is not too much to say, he owed his throne. As lay abbot of the abbeys of St. Martin at Tours and of St. Denis he was interested in clerical reform, was fond of participating in religious ceremonies, and had many friends among the clergy. His wife was Adelaide, daughter of William III, duke of Aquitaine, by whom he left a son, Robert, who succeeded him as king of France. The origin of Hugh's surname of Capet, which was also applied to his father, has been the subject of some discussion. It is derived undoubtedly from the Lat. *capa, cappa,* "a cape," but whether Hugh received it from the cape which he wore as abbot of St. Martin's, or from his youthful and playful habit of seizing caps, or from some other cause, is uncertain.

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HUGH DE PUISET (*c.* 1125–1195), bishop of Durham, was the nephew of Stephen and Henry of Blois; the latter brought him to England and made him an archdeacon of the see of Winchester. Hugh afterward became archdeacon and treasurer of York. In 1153 he was chosen bishop of Durham, in spite of the opposition of the archbishop of York; but he obtained consecration only by making a personal visit to Rome. Hugh remained neutral, as far as he could, in the quarrel between Henry and Thomas Becket, but he at least connived at the rebellion of 1173 and William the Lion's invasion of England in that year. After the

failure of the rebellion the bishop was compelled to surrender Durham, Norham and Northallerton to the king. In 1179 he attended the Lateran council at Rome, and in 1181 by the pope's order he laid Scotland under an interdict. In 1184 he took the cross.

At the general sale of offices with which Richard began his reign (1189) Hugh bought the earldom of h'orthumberland. The archbishopric of York had been vacant since 1181. This vacancy increased Hugh's power vastly, and when the vacancy was filled by the appointment of Geoffrey he naturally raised objections. This quarrel with Geoffrey lasted till the end of his life. Hugh aas nominated justiciar jointly with William Longchamp when Richard left the kingdom. But Longchamp soon deprived the bishop of his place (1191), imprisoned him and forced the surrender of his castle, his earldom and hostages. Hugh was compelled to acknowledge Geoffrey of York as his .ecclesiastical superior in 1195. Combining in his own hands the palatinate of Durham and the earldom of Northumberland. Hugh held a position not much dissimilar to that of the great German princes, a local sovereign in all but name.

See Kate Norgate's *England* under *the Angevin Kings* (1887).

HUGHES, CHARLES EVANS (1862–1948), U.S. jurist and statesman who narrowly missed election to the presidency of the United States; twice a member of the United States supreme court. he led that tribunal as chief justice through its greatest crisis in the first half of the 20th century.

Hughes was born at Glens Falls, N.Y., on April 11, 1862, the only son of the Rev. David Charles Hughes and Mary Catherine Connelly Hughes. He was educated at Madison (now Colgate) university, Hamilton, K.Y. (1876–78), and at Brown university, Providence, R.I., where he was graduated (B A.) in 1881. After teaching for a year at Delhi, N.Y., and studying law in his spare time. he entered Columbia law school in 1882. Two years later he was graduated with an LL.B. degree and a three-year prize fellowship. Passing the bar examination with a mark of 99½, he began his practice in New York city. For two years (1891–93) he served as professor of law at Cornell university, Ithaca, N.Y.. and then resumed his practice in New Uork city.

Early Career. — Hughes's nork as counsel for the Stevens committee investigating the gas and electric lighting industries of Sew York in 1905 first brought him public recognition. His success in that venture resulted in his employment by the Armstrong legislative committee to investigate the corruption in which many Sew York life insurance companies had become involved, Though his methods were fair, his conscientious digging brought sensational disclosures which led to extensive life insurance reforms and to his nomination for the governorship of New York by the Republican party acting under the influence of Pres. Theodore Roosevelt. After a turbulent campaign Hughes won by 57,897 votes over William Randolph Hearst. He was re-elected in 1908. By appealing to the people over the heads of the party bosses, he succeeded in establishing two of the first public service commissions in the country. His administration was also notable for its progressive labour and welfare legislation, its administrative reforms, and for enforcement of the constitutional prohibition of race-track gambling.

Associate Justice and Presidential Candidate. — Pres. William Howard Taft named Hughes associate justice of the U.S. supreme court in 1910, and he soon emerged as an eminent judge, especially in the fields of civil rights and railaay rate regulation. In 1912 he flatly refused to be a candidate for the presidency; in 1916 he again repudiated all work in his behalf, but, uith Europe at war and the Republican party split between William H. Taft and Theodore Roosevelt, he was drafted by the Republican national convention and immediately resigned from the court. Though he campaigned vigorously as candidate of both the Progressive and the Republican parties, he lost by 277 to 254 electoral votes to Pres. Woodrow Wilson, aho was widely credited aith having kept the United States out of the war in Europe When the country was drawn into World War I in the early months of Wilson's second term. Hughes offered his services to the president and became chairman of the draft appeals board of New Uork city in 1917 and special assistant to the U.S. attorney general to investigate the sluggish aircraft industry in 1918. Between his official assignments, he again practised law in New York.

Secretary of State. — Hughes put aside suggestions that he become a presidential candidate again in 1920, partly because of the death of his daughter Helen. When Pres. Warren G. Harding was inaugurated on March 4, 1921, however, Hughes became secretary of state. His behind-the-scenes struggle to take the United States into the League of Nations. nithout art. x of its covenant, was blocked by the "Irreconcilables" in the senate. Unable to save any part of the treaty of Versailles, he negotiated a separate peace with Germany. In a spirited contest with Japan, he insisted on keeping the mandated islands of the Pacific open to international inspection.

Hughes was the chief planner of the Washington arms conference of 1921–22. His dramatic speech proposing a formula to end the naval race, aith drastic reductions in the capital ships of the United States, Britain and Japan, was applauded throughout the world and adopted with little change. Likewise he succeeded in breaking up the Anglo-Japanese alliance and substituting for it a four-power pact designed to keep the peace in the Pacific. Among the seven treaties which the conference produced were also a nine-power pact guaranteeing the integrity of China and a settlement of the Shantung controversy between Japan and China. *(See* WASHINGTON CONFERENCE.)

Secretary Hughes continued the Wilson policy of refusing to recognize the Communist government of the U S.S.R., but he applied steady pressure on Japan to end the postwar occupation of Siberia and Sakhalin. In Latin America his policy was one of removing causes of friction and of "liquidating imperialism." His patience and fairness brought about settlement of several boundary disputes between Latin-American countries and contributed greatly to the ultimate settlement of the Tacna-Arica controversy between Chile and Peru. Alarmed by mounting economic chaos in Europe, he tried to induce France to agree to an expert investigation of Germany's capacity to pay reparations. The French repeatedly refused. and the situation worsened. Finally he made his suggestion publicly in a speech at New Haven, Conn., in Dec. 1922, and after much pulling and hauling this led to the scaling down of reparations through the Dames plan. (See REPARATIONS.)

Hughes's efforts to take the United States into the world court were no more successful than his fight for the League had been. Because he was a moderate internationalist at a time of extreme isolationism, some of his favourite projects were thwarted. After his retirement in the 1940s, however. Secretary of State Cordell Hull secretly consulted him in regard to international organization to keep the peace and some of his ideas found expression in the charter of the United h'ations. His policies as secretary of state made a substantial impact on the course of international events; he pursued his principles of justice and peace with remarkable skill.

When Hughes returned to the bar on March 4, 1925, he was acknowledged to be the country's leading attorney. Yet he found time for extensive public service. In 1925–26 he headed the New York state reorganization commission, which strengthened the poners of the governor, created an executive budget system and consolidated nearly 180 bureaus and agencies into 18 departments. In 1928 he went to Havana, Cuba, as chairman of the U.S. delegation to the sixth Pan American conference. His dramatic speech in defense of the U S. occupation of Nicaragua convinced the delegates that the U.S. had no aggressive intent. A year later he again represented the U.S. at the Pan American Conference on Arbitration and Conciliation. In the same year he served as a judge of the Permanent Court of International Justice at The Hague.

Chief Justice. — Hughes let it be known that he would not accept nomination for the presidency in 1928 because he was too old, but tao years later (Feb. 3, 1930) he did accept nomination to the chief justiceship of the United States at the age of 67. The nomination was confirmed only after a spirited fight in the senate. Sen. George W. Norris and others had been seeking an opportunity to denounce some of the court's conservative opinions and to embarrass Pres. Herbert Hoover, who made the appoint-

ment. They unleashed all their fury against Hughes, but to no avail. He was confirmed by a vote of 52 to 26.

On the bench Hughes confounded his critics by a series of liberal opinions further buttressing civil rights against encroachment by the states. He also took a broad view of the power of congress to regulate interstate commerce and thus control the national economy. Though he held to the concept of a "marching" constitution, he believed that the court was obligated to hold invalid statutes for which no constitutional backing could be found.

In the dark years of the great depression of the 1930s the court ruled that congress had exceeded its powers in passing several recovery measures sponsored by Pres. Franklin D. Roosevelt. The National Recovery administration, the Agricultural Adjustment administration and the Guffey Coal act went down. The court also upset the New York minimum wage law, thus curbing state as well as national power. Its extreme conservatism brought frequent dissents from Hughes and other justices. However, it upheld the more carefully devised New Deal statutes.

In 1937 Roosevelt asked congress to give him authority to name six new members of the court if the justices over 70 did not retire. A letter from Hughes to the senate judiciary committee riddled the president's contention that this would enhance the court's efficiency. It is sometimes said that the court further contributed to defeat Roosevelt's "court-packing" bill by upholding the Wagner Labor Relations act and the Social Security acts and by changing its mind on state minimum wage laws. But Hughes always insisted that the bill had no effect on the court's rulings and that the later New Deal laws were upheld because they had been enacted with greater care. His skillful defense of the court's work and the restraint of his opinions were powerful factors in the final defeat of the bill. In 1941 he retired and on Aug. 27, 1948, he died at Cape Cod, Mass., at the age of 86.

Hughes delivered numerous addresses subsequently reproduced in pamphlet form. In addition, he published *Addresses and Papers* (1908); *Public Papers of C. E. Hughes, Governor, 1907–1910* (1910); *Conditions of Progress in Democratic Government,* Yale lectures (1910); *Addresses 1906–16* (1916); *Foreign Relations* (1924); *The Pathway of Peace* (1925); *The Supreme Court of the United States: Its Foundations, Methods and Achievements* (1928); and *Pan American Peace Plans* (1929).

See M. J. Pusey, *Charles Evans Hughes,* authorized biography, 2 vol. (1951). (M. J. Py.)

HUGHES, DAVID EDWARD (1831–1900), Anglo-American electrician, was born on May 16, 1831, in London, but the earlier part of his life was spent in America, whither his parents emigrated when he was about seven years old. In 1850 he became professor of music at the college of Bardstown, Kentucky, and soon afterwards teacher of natural philosophy at the same place, but resigned in 1854. In 1855 he took out a patent in the United States for his type-printing telegraph instrument. Its success was immediate and in 1867 Hughes brought it over to Europe. In the succeeding ten years it came into extensive use all over Europe, gaining for its inventor numerous honours and prizes. Hughes played an important part in the development of telephony; his microphone was the forerunner of the various forms of carbon transmitter in general use. Continuing his experiments with his microphonic joints, Hughes discovered the phenomena on which depends the action of the so-called "coherers" used in wireless telegraphy. Hughes, who is also known for his invention of the induction balance and for his contributions to the theory of magnetism, died in London on Jan. 22, 1900.

HUGHES, SIR EDWARD (c. 1720–1794). British admiral, entered the Royal Navy in 1735, and four years later was present at Porto Bello. In 1740 he became lieutenant, and in that rank served in the Cartagena expedition of 1741, and at the indecisive battle of Toulon (1744). From that time he was almost continuously employed on active service. He was with Boscawen at Louisburg and with Saunders at Quebec. As Commodore he commanded in the East Indies from 1773 to 1777. It was not long before he returned to the East as a rear-admiral, with an overwhelming naval force. On his outward voyage he retook Goree from the French. In 1782 he stormed Trincomalee a few days before the squadron of Suffren (*q.v.*) arrived in the neighbourhood. Five fiercely contested general actions were fought by the two fleets, neither of them gaining a decisive advantage. Hughes died at Luxborough, Essex, in 1794.

HUGHES, HOWARD ROBARD (1905–), American aviator, was born in Houston, Tex., on Dec. 24, 1905, and was educated at Rice Institute in Houston and at the California Institute of Technology. After several years in the production of motion pictures in Hollywood he built an aeroplane factory and began his career as a speed flyer. In 1935 he set a world's speed record for land planes (352 m.p.h.) and in 1937 he flew eastward across the continent in the record time of 7 hours, 28 minutes. On July 14, 1938, he completed, with four companions, his record flight around the world in 3 days, 19 hours, 8 minutes.

HUGHES, HUGH PRICE (1847–1902), British Nonconformist divine, was born at Carmarthen on Feb. 8, 1847, the son of a surgeon. He established in 1887 the West London mission. He had started in 1885 the *Methodist Times,* and rapidly made it a leading organ of Nonconformist opinion. He was a born fighter, and carried the fire and eloquence he showed on the platform and in the pulpit into journalism. He supported W. T. Stead in 1885, as he had earlier supported Mrs. Josephine Butler in a similar cause; he attacked the trade in alcohol; was an anti-vivisectionist; he advocated arbitration; and his vehement attacks on Sir Charles Dilke and Charles Stewart Parnell originated the phrase the "Nonconformist conscience." He differed strongly from a large section of Nonconformist opinion in his defence of the South African War. In 1898 he was president of the Wesleyan Conference. His energies were largely devoted to co-operation among the various Nonconformist bodies, and he was one of the founders and most energetic members of the National Council of the Evangelical Free Churches. He died in London on Nov. 17, 1902.

See his *Life* (1904) by his daughter, Dorothea Price Hughes.

HUGHES, JOHN (1677–1720), English poet and miscellaneous writer, was born at Marlborough, Wiltshire. He died on the night of the production of his most celebrated work, *The Siege of Damascus,* Feb. 17, 1720. Hughes wrote some of the libretti of the cantatas (2 vols., 1712) set to music by Dr. John Christopher Pepusch. Others of his pieces were set to music by Ernest Galliard and by Handel. In the masque of *Apollo and Daphne* (1716) he was associated with Pepusch, and in his opera of *Calypso and Telemachus* (1712) with John E. Galliard. Hughes's version of the *Letters of Abelard and Heloise* . . . (1714) is notable as the basis of Pope's "Eloisa to Abelard" (1717).

His *Poems on Several Occasions, with some Select Essays in Prose* . . . were edited with a memoir in 1735, by William Duncombe, who had married his sister Elizabeth. *See* also *Letters by several eminent persons* (2 vols., 1772) and *The Correspondence of John Hughes, Esq. . . . and Several of his Friends* . . . (2 vols., 1773), with some additional poems.

HUGHES, JOHN (1797–1864), American Roman Catholic divine, was born in Annaloghan, county Tyrone, Ireland, on June 24, 1797. He followed his father to Chambersburg, Pa., and was ordained deacon in 1825 and priest in 1826. He opposed the lay trustee system in Philadelphia where he served in several churches. In the New York diocese he was consecrated coadjutor to Bishop Dubois in 1838, bishop in 1842, and first archbishop in 1850, and worked against the lay trustee system and for State support for parochial schools. At all times he constituted himself a defender of his faith against miscellaneous attacks of Protestant clergy and the "Native American" and "Know-Nothing" agitations of 1844 and 1854. He was equally ready, however, to denounce sources of weakness within the Church as is shown by his attack in 1856 on three classes of Roman Catholic papers which he considered injurious. During the Civil War his ardent attachment to the Union resulted in his going to France to counteract the influence of the Slidell mission and was productive of good feeling towards the North both in Rome and Ireland. The establishment of St. John's college (now Fordham university) in 1841 largely with funds collected by him in Europe is one of his most constructive achievements. He died in New York city on Jan. 3, 1864. His reputation as a member of the Church militant he himself explained on the

ground that "the circumstances by which I have been surrounded, and the character of the country and people with whom I had to deal, did not allow me to use, at all times, that meek and apostolic spirit which is so appropriate and beautiful."

His works were edited by Laurence Kehoe (1864–65). Good biographies were prepared by J. G. Hassard (1865) and H. A. Brann (1892).

HUGHES, SIR SAM (1853–1921), Canadian soldier and politician, was born at Darlington, Ont. on Jan. 8, 1853. In the Fenian raids of 1870 he served with the Canadian volunteer militia, and in 1873 was gazetted to the 45th Regiment. Educated at Toronto University, he lectured at a Toronto collegiate institute until 1885, when he took up journalism, being editor and proprietor of the Lindsay *Warder*, 1885–97. In 1892 Hughes was elected to the Dominion parliament, but service in the South African War interrupted his political career. Returning to Canada after the coronation of King George V. in 1911, he became minister of militia and defence, and was chiefly responsible for the creation of the overseas force which sailed for Europe in 1914. In 1915 Hughes was created K.C.B. and promoted major-general; but in the following year disagreements with Sir Robert Borden resulted in his resignation. Hughes criticized severely the strategy and leadership of Sir Arthur Currie. In July 1921 he announced his intention of retiring from parliament, and he died at Lindsay, Ont., on Aug. 24, 1921.

HUGHES, THOMAS, English dramatist, a native of Cheshire, entered Queens' college, Cambridge, in 1571, and became a member of Gray's Inn. He wrote *The Misfortunes of Arthur, Uther Pendragon's son reduced into tragical notes by Thomas Hughes,* performed at Greenwich in the queen's presence on Feb. 28, 1588. Nicholas Trotte provided the introduction, Francis Flower the choruses of Acts I. and II., William Fulbeck two speeches, while three other gentlemen of Gray's Inn, one of whom was Francis Bacon, undertook the care of the dumb show. The argument of the play, based on a story of incest and crime, was borrowed, in accordance with Senecan tradition, from mythical history, in this case Geoffrey of Monmouth's *Historia Britonum.* Dr. *W. J.* Cunliffe has proved that Hughes's memory was saturated with Seneca, and that the play may be resolved into a patchwork of translations, with occasional original lines.

The Misfortunes of Arthur was reprinted in J. P. Collier's supplement to Dodsley's Old *Plays;* and *by* Harvey Carson Grumline (Berlin, 1900) who points out that Hughes's source was Geoffrey of Monmouth's *Historia Britonum,* not the *Morte D'Arthur.*

HUGHES, THOMAS (1822–1896), English lawyer and author, second son of John Hughes of Donnington Priory, editor of *The Boscobel Tracts* (1830), was born at Uffington, Berks. He was educated at Rugby school under Dr. Arnold, and at Oriel college, Oxford. He was called to the bar in 1848, became Q.C. in 1869, a bencher in 1870, and was appointed to a county court judgeship in the Chester district in July 1882. While at Lincoln's Inn he came under the dominating influence of his life, that of Frederick Denison Maurice. In 1848 he joined the Christian Socialists, under Maurice's banner, among his closest allies being Charles Kingsley. In Jan. 1854 he was one of the original promoters of the Working Men's College in Great Ormond Street, of which he became principal after Maurice's death. Hughes sat in parliament from 1865 to 1874, and introduced a trades union bill which, however, only reached its second reading. On one of his visits to America in 1879 he planned a co-operative settlement, "Rugby," in Tennessee, which involved him in money losses. In 1848 Hughes had married Frances, niece of Richard Ford, of Spanish *Handbook* fame. They settled in 1853 at Wimbledon, and there was written his famous story, *Tom Brown's School Days* (1857) "by an Old Boy." *Tom Brown* did a great deal to fix the English concept of what a public school should be. Hughes also wrote *The Scouring of the White Horse* (1859), *Tom Brown at Oxford* (1861), *Religio Laici* (1868) and *Life of Alfred the Great* (1869). He died at Brighton on March 22, 1896.

HUGHES, WILLIAM MORRIS (1864–1952), Australian statesman, was born on Sept. 25, 1864, in London, Eng. At the age of 20 he went to Australia. There he drove sheep and cattle across New South Wales and Queensland, worked on farms and cooked for harvesting gangs, became a sailor on coasting steamers, prospected for gold, tramped from station to station doing odd jobs, taught children in remote settlements, walked hundreds of miles organizing for the Australian Workers' union, and in the end drifted back to Sydney and gravitated to politics. He formed the Sydney waterside workers into a militant organization and entered the New South Wales parliament in 1894 as member for the Lang division of Sydney.

As a member of the Opposition Hughes was an effective debater, and devised the Labour party's caucus system of settling all internal dissensions outside the House and presenting a united front in parliament. Then in 1901 came federation, and as member for West Sydney in the first House of Representatives Hughes found wider scope for his political genius. In 1904 J. C. Watson formed the first Labour ministry, and Hughes, who in the midst of his industrial and political work had found time to qualify as a barrister, became minister for external affairs. The ministry was short-lived, but thenceforth it was clear to friends and foes alike that a new force had entered Australian politics. During the years that followed Hughes became a powerful orator, and his courage, energy, intellectual gifts and dominating personality made his succession to Mr. Fisher almost inevitable.

Hughes was attorney-general in the Fisher ministry of 1908, and revealed a breadth of view and a warm Imperialism hardly to be looked for in a party which, not so many years before, had toyed with the idea of "cutting the painter." He promoted the scheme of compulsory military service, and he was heart and soul with his leader when Fisher, who had returned to office after the Liberal defeat of 1913, made his historic offer in 1914 of Australia's last man and last shilling. In 1915 Fisher went to London as high commissioner, and Hughes succeeded him as prime minister. Hughes, by his driving force and faculty of kindling enthusiasm, gave an immense stimulus to the raising and maintenance of the Australian Expeditionary Forces; and with equal energy he set to work to eradicate German commercial influence from Australia. He secured legislation annulling German contracts, transferred control of output to the newly established Australian Metal Exchange, prevented trading with the enemy, and disinherited enemy shareholders in commercial enterprises of every kind.

In 1916 he visited England and preached a renaissance of the British race based upon a greater development of the empire's resources and a closer-knit economic system. Returning to Australia he attempted to introduce conscription. On this issue the Labour party split, and Hughes formed a Coalition Government composed of the Liberals and that section of the Labour party which followed him on the conscription issue. The conscription referendum, on which the Government was defeated, was marked by great bitterness, and there followed a period of industrial and political strife without parallel in Australia's history. Hughes was hotly attacked for his autocratic methods, for his excursions into State shipowning and shipbuilding, and for his policy of concentrating power in his own hands by means of the War Precautions Act, the establishment of boards to control industry, and the appointment of special tribunals to settle industrial disputes over the head of the Arbitration Courts. But so long as the War lasted there was no acceptable alternative leader, and the prime minister left to attend the Peace Conference with his prestige higher than ever. His assertion of Australia's right to proclaim something rather like a Monroe Doctrine for the Pacific awakened Americans and the world to the importance of Australasia; and at Versailles his dogged advocacy of the Commonwealth's right to a mandate over the former German colony of Papua, helped to make history. His quarrel with President Wilson, embittered by mutual dislike, gave rise to some of the most piquant passages in the annals of the conference.

In Australia, on his return, Hughes found grave industrial troubles disturbing a country already weighed down by an immense load of debt and the problem of reabsorbing 400,000 men into civil life. But he could not prevent discontent revealing itself in the secession of certain Liberal-Nationalists and the formation of a new Country party, and in Feb. 1923 he resigned. Offices he

later held included vice-president of the executive council, 1934–35 and 1937–38; minister for external affairs, 1937–39; and minister for the navy, 1940–41. His works include *The Price of Peace* (1934) and *Policies and Potentates* (1950). He died at Sydney on Oct. 27, 1952. (G. C. DI.; X.)

HUGH OF LINCOLN, ST. (*c.* 1140–1200), bishop of Lincoln, was born of a noble family at Avalon, in Burgundy. He entered the canons regular at Villard-Benoît and about 1160 was appointed prior of a dependent cell. Later, however, he joined the monks of the Grande Chartreuse, and rising to the important office of procurator, he acquired a reputation for energy and tact which led Henry II. of England to request his assistance in establishing at Witham in Somersetshire the first English Carthusian monastery. Hugh became the first prior, and under him the Charterhouse, a copy of the Grande Chartreuse, was completed. In 1186 Henry procured his election to the see of Lincoln There he let neither royal nor ecclesiastical influence interfere with his conduct, but fearlessly resisted any infringement of the rights of his church or diocese. Though himself an ascetic, he was noted for his kindness to the poor, to lepers and to Jews. In 1200 Hugh revisited his native country and on the return journey was seized with an illness, of which he died at London on Nov. 16, 1200. He was canonized by Honorius III. and his feast is celebrated on Nov. 17.

The *Magna vita S. Hugonis* was edited (1864) by J. F. Dimock, who also edited a *Metrical Life of St. Hugh of Avalon* (1860) and *a Vita* by Giraldus Cambrensis (1877). *See* the *Vie de St. Hugues, évêque de Lincoln* (1140–1200) *par un religieux de la Grande Chartreuse* (Montreuil, 1890, Eng. trans by H Thurston, S J , with valuable notes 1898); C. L. Marson, *Hugh, bishop of Lincoln* (1901); R M. Woolley, *St. Hugh of Lincoln* (1927). *A* complete bibliography is given in U. Chevalier, *Bio-bibliographie* (1905); *see* also A. Potthast, *Bibliotheca med. aev.*, 1380.

Another ST HUGH OF LINCOLN was a child about ten years old when he was found dead on premises belonging to a Jew. It was said that the boy had been scourged and crucified in imitation of the death of Christ, and many Jews were punished. The incident is referred to by Chaucer in the *Priorerses Tale* and by Marlowe in the *Jew of Malta*.

See J. Jacobs, *Little St. Hugh of Lincoln* (1884).

HUGH OF ST. CHER (*c.* 1200–1263), French cardinal and Biblical commentator, was born at St. Cher, near Vienne, and, while a student in Paris, became a Dominican in 1225. Later, as provincial of his order, he won the confidence of the popes Gregory IX., Innocent IV. and Alexander IV., who charged him with several important missions. Created cardinal-priest in 1244, he played an important part in the council of Lyons in 1245, contributed to the reform of the Carmelites (1247), and the condemnations of the *Introductorius in evangelium aeternum* of Gherardino del Borgo San Donnino (1255), and of William of St. Amour's *De periculis novissimorum temporum*. He died at Orvieto on March 19, 1263. He directed the first revision of the text of the Vulgate begun in 1236 by the Dominicans; this first "correctorium," vigorously criticized by Roger Bacon, was revised in 1248 and in 1256, and forms the base of the celebrated *Correctorium Bibliae Sorbonicum*. With others of his order he edited the first concordance of the Bible, *Concordantiae Sacrorum Bibliorum* or *Concordantiae S Jacobi*. His *Postillae in sacram scripturam juxta quadruplicem sensum, litteralem, allegoricum, anagogicum et moralem* was published frequently in the 15th and 16th centuries, and his exegetical works appeared at Venice in 1754 in 8 vols.

See Quetif-Echard, *Scriptores ordinis praedicatorum;* Denifle, in *Archiv fur Litteratur und Kirchengeschichte des Mittelalters,* iv. *L'Année dominicaine,* iii. (1886); *Chartularium universitatis Parisiensis,* i.

HUGH OF ST. VICTOR (1096–1141), mystic philosopher and theologian, was born at Hartingam, Saxony. After spending some time in a house of canons regular at Hamersleben, in Saxony, where he took the habit, he went to the Abbey of St. Victor in Paris. There he rose to be canon, in 1125 *scholasticus,* and perhaps even prior, and it was there that he died on March 11, 1141. Hugh initiated that mysticism of the school of St. Victor which filled the whole of the second part of the 12th century; but in reaction to the theories of Roscelin and Abelard, his mysticism was the orthodox system of a subtle and prudent rhetorician. In theology, he paved the way for the great *Summae* of the 13th century by his excellent dogmatic synthesis, entitled *De sacramentis:* Creation and restoration are the critical events in the history of the world. By the former the world was constituted, by the latter it regains its lost glory. The work of creation can be known by a study of the profane sciences; that of restoration is revealed in Holy Scriptures. His sacramental teaching clarified many points later adopted by his successors. Hugh did not profess the contempt for the profane sciences which his followers the Victorines expressed. His division of these sciences into theoretical, practical, mechanical and logical, and his moderate realism occupy a subordinate position to his interest in psychology. Like Augustine, he starts from consciousness of the self, which he believes bears witness to the existence, the substantiality, and the spirituality of the soul. Knowledge of the self is the fruit of introspection, knowledge of the external world is the fruit of the zealous exercising of natural talent, and knowledge of God the fruit of contemplation. For Hugh the existence of God is provable both from internal and from external experience, especially that of the changeability of creatures.

Besides the *De Sacramentis*, Hugh's chief works are the encyclopaedic *Didascalion*, the *De Unione corporis et spiritus*, the mystical treatises *De arca Noë morali, De arca Noe mystica, De vanitate mundi, De arrha animae, De amore sponsi ad sponsam,* etc., the commentaries on Scriptural books and on the *Celestial Hierarchy* of the Pseudo-Dionysius.

The 1648 Rouen edition of his *opera* was reprinted in Migne's *Patrol. Lat.*, vols. 175–177. *See* B. Hauréau, *Les Oeuvres de Hugues de St. Victor* (1859; 2nd ed., 1886); article by H. Deniffe in *Archiv fur Literatur und Kirchengeschichte dcs Mittelalters,* iii. (1887); A. Mignon, *Les Origines de la Scholastique et Hugues de St. Victor* (1895); J. Kilgenstein, *Die Gotteslehre des Hugo von St. Victor* (1898); Ostler, *Die Psychologie des Hugo von St. Viktor* (1906); Pourrat, *La Theologie sacrammentaire* (1907); M. Grabmann, *Die Gesch. der Scholast. Methods* (1909–11), and complete bibliography in Überweg, *Gesch. der Philosophie* (Bd. ii. 1928).

HUGO, GUSTAV VON (1764–1844), German jurist, was born at Lörrach in Baden, on Nov. 23, 1764. He became extraordinary professor of law at Göttingen in 1788, ordinary professor in 1792. In the preface to his *Beiträge zur zivilistischen Bücherkenntnis der letzten vierzig Jahre* (1828–29) he gives a sketch of the condition of the civil law teaching at Göttingen at that time. He was the founder of that historical school of jurisprudence which was continued and further developed by Savigny. His *magna opera* are the *Lehrbuch eines zivilistischen Kursus* (7 vols., 1792–1821), in which his method is thoroughly worked out, and the *Zivilistisches Magazin* (6 vols., 1790–1837). He died at Göttingen on Sept. 15, 1844.

See Eyssenhardt, *Zur Erinnerung an Gustav Hugo* (1845).

HUGO, VICTOR MARIE (1802–1885), French poet and novelist, was the third son of Captain (subsequently General) Joseph Léopold Sigisbert Hugo by his wife Sophie, daughter of M. Trébuchet of Nantes. In the autobiographical notes which the poet dictated to his wife and which were published in 1863 under the title *Victor Hugo raconté par un témoin de sa vie,* a wholly apocryphal account of the origins of the Hugo family is given. History discloses only that the poet's grandfather, Joseph Hugo, was a carpenter at Nancy, that his great grandfather was a peasant-farmer in the Vosges. His mother's family were of Breton, and indeed Celtic origin, and the fact that Victor Hugo was thus "d'un sang bréton et lorrain à la fois," may account for the curious blending in his character of imagination and insensitiveness, of recklessness and caution, of extravagance and parsimony. At the time of the poet's birth his father, who was suspected by Bonaparte of being a supporter of Moreau, had been relegated to the command of a battalion at Besançon. It was here, in the Maison Barette on the Place St. Quentin, that Victor Hugo was born on Feb. 26, 1802.

Victor Hugo's life divides itself into seven distinct though

unequal periods. There is his exciting Napoleonic childhood (1802–15); his infant-prodigy period in Paris (1815–22); his royalist period (1822–27); the three turbulent years of the romantic crusade (1827–30); the 1 j successful years under Louis Philippe (1830–45); his political period, and his 18 years of exile (1852–70); and the final apotheosis when he lived on as the bard and prophet of the Third Republic (1870–85).

Childhood (1802–1815).—The events of Hugo's childhood are important and must be recorded in some detail. It was an exaggeration on his part to say that:—

> Parmi les chars poudreux, les armes Cclatantes
> Une muse des camps m'emporta sous les tentes . . .

but it is a fact that his early years were inflamed by many journeys and excitements, and that his whole subsequent attitude towards life was much affected by the contrasts and vicissitudes, by the actual flash and jingle, of the Napoleonic era. His father had attached himself to Joseph Bonaparte and accompanied that monarch first to Naples and then to Madrid. Of the Italian journey, undertaken at the age of five, little remained for Hugo beyond some faint memories of Rome and Naples, of the snow and sledges upon the Mont Cenis, of the nut-trees among the rocks at Avellino. The Spanish journey of 1811 left an infinitely deeper impress. General Hugo was by then a count of the Empire. He was governor of Madrid, and King Joseph's confidential adviser: he was count of Cifuentes and marquis of Siguenza: he Possessed on paper large properties in Castile and a fortune of one million réals. There was no limit to the honours or prosperity which such a father could obtain, and the Spanish journey was thus undertaken in a blaze of anticipation and with all the conveniences and attentions accorded to highly important personages, Such glories left an indelible impression, but they were not of long duration. Victor and his brother Eugene were sent to the College of Nobles in Madrid, where they were supposed to consort with the Spanish aristocracy. The latter, however, regarded them as foreigners and invaders, whereas the Jesuits who were in charge of the college imagined that they were Protestants and eyed them askance. It was not a happy period; and it produced in Hugo an aristocracy-complex, a love-hatred of aristocracy, which, working on his persistent egoism, became one of the many constituents of his later demagogics. For the moment, however, his vanity reacted to these humiliations only in the form of national arrogance:—

> Chez dix peuples vaincus, je passais sans défense
> Et leur respect craintif étonnait mon enfance . . .
> Quand je balbutais le nom chéri de la France
> Je faisais pâlir l'ttranger.

By the spring of 1812 the French position in Madrid, in spite of the pallor of the inhabitants, became insecure: General Hugo felt it safer to send his wife and children back to Paris.

In the intervals of these Italian and Spanish expeditions, Mme. Hugo educated her children in Paris. She was a hard and stingy woman,——imperious, independent and cold. Her politics were anti-Bonapartist, she was royalist and Vendéenne. Her religion was Voltairean, inclining to deism. Her influence upon her children was immense and she succeeded for many years in imposing upon them her dislike of Napoleon, her very acute dislike of their own father. They were happy there, in the large garden of No. 12 Impasse des Feuillantines, where they climbed the trees, and played with little Adkle Foucher, and had pleasant discursive lessons from Père de la Rivière, and listened to the long stories of General Lahorie, an aged conspirator whom their mother was hiding from the police. With the fall of Napoleon the fortunes of the Hugo family declined suddenly: their many castles in Spain melted into the air: General Hugo was interned on an allowance of £40 a year at Blois, where he established an alternative Mme. Hugo, and became thereafter for his sons "le brigand de la Loire." Mme., no longer countess, Hugo found herself in reduced circumstances: she left the Feuillantines and took a small flat in the rue Bonaparte. And Victor Hugo, for his part, was sent to the Pension Cordier, rue Marguérite, to prepare for the Ecole Polytechnique. These circumstances of his early years have been recorded in some detail since their grandeur and their instability help to explain many outstanding faults in Hugo's genius and character. His intermittent education, the constant disagreements between his father and mother, the contrast between the splendours of his father's prospects and the meagre squalor of the result, the violent tawdriness of the whole Napoleonic system, account in their several ways for the superficiality of his knowledge and convictions, for his flashy exaggerations, for his passion for contrast, for the actual vulgarity of his character and mind. For the first 13 years of his life he was continually in a dramatic, and therefore in a false, position: a twist was thereby given to his egoism which developed into a foolish, and subsequently an embittered, form of conceit.

The Infant Prodigy (1815–1822).—His three years at the Pension Cordier, the lectures which he attended simultaneously at Louis-le-Grand, were important to Hugo as constituting the only systematic or thorough education that he ever obtained. He was excellent at mathematics, superficial in his classical studies, and a voracious reader. The tragedies of Voltaire which had hitherto been his main source of reading, were now supplemented by Ossian, by Calderon, by Chateaubriand. On July 10, 1816 we find him writing "I wish to be Chateaubriand or nothing." His literary ambition was thus aroused at the age of 14 and during his school-boy years he composed all manner of verses, odes, satires, acrostics, riddles, epics and madrigals. There was a tragedy, *Irtamène,* in the manner of Voltaire: a long poem on the flood: a melodrama entitled *Inez de Castro:* a comic opera: and a series of translations from Ossian and the classics. In 1817 he obtained an honourable mention from the Académie Française for a poem on the theme of "Happiness procured by study and application," and, thus encouraged, he embarked upon his first novel *Bug-Jargal,* which dealt with a blood curdling episode in the negro revolt at San Domingo. In 1819 he was accorded by the Academy of the Jeux Floraux at Toulouse the first prize for a poem on the restoration of the statue of Henry IV., and it was on this occasion that Chateaubriand is said to have called him "l'enfant sublime." His eldest brother Abel Hugo had by then begun to edit a short-lived journal entitled *Le Conservateur Littéraire.* To this journal Victor Hugo contributed not only the text of his novel *Bug-Jargal,* but a great mass of valueless prose and verse which poured precociously from his teeming brain. He was already secretly engaged to his early playmate Adèle Foucher; the death of his mother in June 1821, and his refusal to accept any money from his father, brought him face to face with actual penury: for a whole year he existed on 700 francs in an attic in the rue du Dragon, an experience which he subsequently exploited in the person of Marius in *Les Misérables:* and during these months he wrote with dogged perseverance, with that self-confidence which throughout his life never failed him.

The Royalist Period (1822–1827).—In June 1822, at the age of twenty, Victor Hugo published his first volume of poetry under the title *Odes et Poksies diverses.* Apart from some sentimental verses addressed to Adele Foucher (*le Vallon de Chérizy, A toi, le Regret)* the pieces collected in this volume were designed to catch the ear of the court. This design succeeded. Fifteen hundred copies were sold in four months. The little volume reached the hands even of Louis XVIII. who with tears in his eyes read the stilted odes on the death of the Duc de Berry or on the birth of the Duc de Bordeaux. Victor Hugo was accorded a pension of £40 from the privy purse, a salary which in the following year was doubled. He felt justified in pressing his suit on Adele Foucher: the parents consented: the marriage took place at St. Sulpice on Oct. 14, 1822: Victor Hugo was reconciled with his father who thereupon ceased to be the "brigand de la Loire" and became "ce héros au sourire si doux": and Eugkne Hugo, who was also in love with Adkle, went mad during the wedding and had to be confined in an asylum, where he died in 1837. Money was required to support Hugo's wife and impending family. Early in 1823 he published a second "tale of horror" under the title *Han d'Islande* and in 1824 he founded. the *Muse française.* The contributors to this journal formed the *Cénacle,* a literary club which met in the rooms of Charles Nodier, librarian of the Arsenal, and of which the leading members were Hugo, Alfred de Vigny,

Nodier, Soumet, Emile Deschamps and Delphine Gay. Of these young writers it was Nodier only who was frankly revolutionary and romantic. The others hedged: Victor Hugo himself, who had just been made a Chevalier of the Legion d'Honneur and who had personally been invited to attend the coronation of Charles X. at Rheims, was again in a false position. The year *1825,* however, marks the first definite break on his part with the classic traditions of the restoration court. He came more and more under the influence of Nodier; he visited Switzerland in the company of that romantic; he visited Lamartine at St. Pont: he read German ballads. In *1826* he published *Bug-Jargal,* and to a new edition of the *Odes* which appeared the same year he added the *Ballades* in which the transition from classicism to romanticism is clearly adumbrated. His early admiration of Chateaubriand bore a comparatively tardy fruit.

The Romantic Crusade (1827–1830).—It must be remembered that Hugo was a cautious man, and one who would have hesitated to put himself at the head of the new romantic movement had he not been assured not only of leadership but also of success. By the end of *1826* the originators of the French romantic movement, Chateaubriand and Lamartine, had retired into political life; a second and more vigorous wave of romanticism was about to overwhelm French literature; Hugo was quick to realise the tidal force of this new movement and quick to determine that he himself should ride upon its crest. The great decisions of Hugo's life were always taken under the impulse of an inspired opportunism. His convictions were adjusted rapidly to the new formula, and into the expression of this formula he flung the irresistible force of his imagination and his rhetoric. The influence of the *Cdnacle,* the influence of Nodier, the far more forceful and encouraging influence of Sainte-Beuve, all contributed to this new orientation: the affectionate relations which he now established with his father revived the excited Bonapartism of his early years: and, no less importantly, the success of Weber's *Freischütz* in *1826,* and the still greater success of Miss Smithson's Shakespearean season in *1827,* convinced him that the Parisian public were ready for something exciting, for something explosive, for something which had nothing whatever to do with complimentary odes to Charles X. His break with the court was signalized by the publication in the *Ddbats* of his *Ode à la Colonne,* a fine diatribe in uhich he championed Napoleon's marshals against the insults which had been offered them by the Austrian ambassador. By Feb. *1827* he had already written the first draft of *Cromwell,* and during the months that followed he was engaged on writing the preface to that play which constituted the "declaration of rights" of the romantic movement. The essence of this manifesto is its wholly justified attack upon the stagnation which had come over French literature owing to the tyranny of the classical formula and the rigid rules of Boileau. With impassioned rhetoric Hugo argued that art was evolutionary and dynamic, that the old formula stood only for rigidity and decay. "The object," he wrote, "of modern art is not beauty but life." This famous preface, which was published in Oct. *1827,* at once rendered Hugo the prophet and protagonist of the new school. It was less difficult, however, to formulate these new conceptions than to put them into practice. *Cromwell* itself was not suited for the stage, and an adaptation of Scott's *Kenilworth* which he produced under a pseudonym early in *1828* with the title of *Amy Robsart* was a ghastly failure. With his quick sensitiveness to public opinion Hugo abandoned drama for the moment, and adopting the then popular theme of the Greek War of Independence he composed and published *Les Orientales,* a series of poems on the Levant which, while they reflected no personal experiences, were yet so beautifully cadenced and designed that they at once achieved an immediate popularity. This volume in which he had the insight, thanks to Sainte-Beuve, to revive the forgotten metres of Ronsard and his imitators, was issued in Jan. *1829,* one of the most active, and certainly one of the most important years of Hugo's life. In this year he produced *Les Orientales, Le Dernier jour d'un Condamné,* and *Marion de Lorme*: and he wrote the whole of *Hernani,* a great portion of *Nôtre Dame de Paris* and most of the lyrics which were subsequently included in the *Feuilles d'Automne. Marion de Lorme* was banned for political reasons by the censor, but on Feb. 2j, 1830 *Hernani* was produced at the *Théatre Français* with Mlle. Mars in the part of Doña Sol. The 45 representations of this eloquent melodrama are known in French literary history as "Les batailles d'Hernani." It may be questioned whether the opposition of the classics was as determined as has been represented: but there can be no question regarding the violence of the *claque* which Hugo, Mme. Hugo and Théophile Gautier had organized. Sainte-Beuve, who was already in love with Mme. Hugo, disapproved of all this self-advertisement. "Je suis blasé," he wrote, "sur Hernani." But Hugo for his part had achieved not fame only, but fortune: the play brought him 15,000 francs: he was acclaimed by Chateaubriand as "the rising sun": he had opened the flood-gates of romanticism to Alexandre Dumas, to Alfred de Vigny, and to George Sand: and he moved with his wife and children to a larger house near the Champs Elysées. Unfortunately, however, the Revolution of July momentarily distracted public attention from Victor Hugo.

Success (1830–1845).—With the advent of the monarchy of July, under the sly complacency of Louis-Philippe, we leave the *Sturm und Drang* period of Hugo's life and pass into a phase of 15 years' success. He published *Nôtre Dame de Paris* in April of *1831* and acquired thereby great popularity in circles where poetry was unread and where controversial drama was not appreciated. In December of that year he again, and rightly, aroused the admiration of the intellectuals by his *Feuilles d'Automne.* Fortune smiled upon him: his four children, Léopoldine, Charles, Francois-Victor and Adèle were living depositaries of sentimentality: he was surrounded by friends and disciples, by de Musset, de Nerval, Alexandre Dumas and Petrus Borel: he was sufficiently in opposition to Louis Philippe to be regarded as a martyr while not actually becoming one: and he moved into another and more romantic apartment, now the Musée Victor Hugo, in the Place des Vosges. In Nov. *1832,* he produced *le Roi s'amuse,* which would have been a failure had it not been banned by the censor on the second night. On Feb. *2, 1833* he gave *Lucrezia Borgia* at the Porte St. Martin, and was accorded a public ovation: the part of Princess Negroni was taken by Juliette Gauvain, known, under the name of Juliette Drouet, as a leading courtesan. Hugo decided to redeem this woman, and for several years he confined her in a little flat which he alone was allowed to visit; she is the heroine of his most lovely lyrics and she remained his mistress for more than 50 years. Mme. Hugo, who was not allowed any similar indulgence in regard to Sainte-Beuve, acquiesced unhappily in this arrangement. *Lucrezia Borgia* was the last but one of Hugo's successes on the stage; *Marie Tudor* and *Angelo* both failed in *1833;* for a moment the triumph of *Ruy Blas* in *1838* recalled the days of *Hernani,* but a final end was put to the romantic drama by the complete collapse of *Les Burgraaes* in *1843.*

During these years, however, his reputation as one of the greatest of French lyric poets was firmly established. The *Feuilles d'Automne* of *1831* was succeeded by the *Chants du Crépuscule* of 1835, by *Les Voix intérieures* of *1837,* and *Les Rayons et les Ombres* of 1840. In 1836 Hugo presented himself for election to the French Academy: Emmanuel Dupaty was selected in his place. In *1839* he again stood as a candidate, but Count Molé was chosen. The third time, in 1840, Pierre Flourens and not Victor Hugo was elected. It was only at his fourth attempt, on June *3. 1841,* that he secured admission. These years of popular, if not official. success and adulation were not good for Victor Hugo: his temperamental egoism increased, and his former austerity was succeeded by a period of indulgence which provoked frequent scandals. The year *1843* was marked by a double tragedy: the failure of *Les Burgraves* was complete and crushing: and in the autumn of the same year his daughter Léopoldine, who had just married, was drowned in the Seine. In later years, this tragedy echoed for Victor Hugo in what are perhaps the finest of all his lyrics *(Trois Ans Après* and the Villequier series in the second volume of *Les Contemplations),* but for the moment he was stunned. He abandoned poetry for politics, and in *1845* he was created a peer of France.

Politics and Exile (1845–1870).—Victor Hugo, unlike Cha-

teaubriand or Lamartine or Byron, was not good at politics. In the tribune of the House of Peers he ranted and raved and indulged in phrases of such bombastic rhetoric that even his brother peers failed to take him seriously. After the revolution of 1848 he stood for the presidency of the Republic but obtained only a very few votes. During the *coup d'état* of December 1851, he made a scene in an omnibus, and he addressed the troops in the Place de la Bastille from a four-wheeler. He was a member of the committee of Insurrection and behaved during the two days of December with courage but without good sense. He was rescued by Juliette Drouet, and finally on Dec. 14, 1851 he escaped to Brussels in the disguise of a workman. In Aug. 1852 he proceeded to Jersey, where he lived at Marine Parade ("la roche oh j'ai ployé mon aile") and from where he published *Napoléon le Petit* (1852) and *Les Chdtiments* (1853) which, whatever its weakness and exaggeration as a satire, contains some of the most marvellous of his metrical triumphs. In 1855 he moved to Guernsey where, the next year, he bought Hauteville House. Here he resided, revelling in his martyrdom, for 17 years. In 1856, at the age that is of 54, he published *Les Contemplations* which contain what is perhaps the most durable section of his lyric verse, and two years later he composed the first section of the *Le'gende des Sidcles.* In 1862 he published *Les Misérables,* and in 1866 *Les Travailleurs de la Mer* and in 1869 *L'homme qui rit.* The last years of his exile had been saddened by the desertion of his family: his wife went to live in Brussels where she died in 1868: his daughter Adèle ran away with an English officer; only Mme. Drouet, in her cottage next to Hauteville House, remained faithful to the veteran egoist. The establishment of the Republic released Victor Hugo from exile. He returned in triumph to Paris in Sept. 1870.

Last Years (1870–1885).—His re-entry into the political life of his country was not of long duration. He was elected to the National Assembly but resigned on being unable to obtain a hearing. During the Commune he moved to Brussels where his offer to house the communist exiles led to a riot and his expulsion by the Belgian Government. On his return to Paris he was elected to the Senate, but took no part in the debates. It was easier and safer for him to remain in his house in the Avenue d'Eylau and to watch while one by one the beacons of his apotheosis were lit around him. His fame was universal: his faculties undimmed by age. In his 80th year he published those still fresh and lovely verses of the *Quatre Vents de l'Esprit:* he attended the triumphant jubilee of *Hernani;* and on his 80th birthday he was acclaimed by six hundred thousand of his fellow citizens. Juliette Drouet, faithful to the end, died in 1883: and on May 31, 1885 Victor Hugo himself was buried in the Panthéon. His body, in accordance with his last behest, had been placed in a pauper's coffin; for a night it lay in state under the Arc de Triomphe; the pomp and drama of his funeral was symbolic of his strangely histrionic mind.

The output of his last years was, in quantity if not in quality, amazing It can be catalogued as follows:—Actes *et Paroles* (1872); *L'Année Terrible* (1872); *Quatre-vingt-treize* (1874); *Le'gende des Sidcles* (second series 1877); *L'Art d'être grand-pkre* (1877); *L'Histoire d'un crime* (1877); *Discours pour Voltaire* (1878); *Le Pape* (1878); *La Pitié suprème* (1879); *L'Ane* (1880); *Religions et Religion* (1880); *Les Quatre Vents de l'Espit* (1881); *Torquemada* (1882); *Ldgende des Sidcles* (3rd series 1883). Of the many posthumous works published by his friends Paul Meurice and Auguste Vacquerie the most interesting is the volume of autobiographical notes entitled *Choses vues,* and the collection of poetry published under the name of *Toute la Lyre.* The other posthumous collections served only to harm the poet's reputation.

The idolatry with which Victor Hugo was acclaimed by his worshippers has produced an inevitable reaction. Under the influence of this reaction his bad qualities—his vulgarity, his bombast, the tenuity of his thought and feeling, his sheer blatant egoism—have obscured his remarkable gifts. It is possible perhaps to make a juster estimate. From the historical point of view Victor Hugo is unquestionably one of the greatest figures in French literature. His influence was not only very deep but also extremely wide: it is possible to find in Hugo's work the germ of practically every subsequent movement, whether Parnassian, Symbolist or Decadent; such diverse figures as Baudelaire, Verlaine and even Rimbaud owe him heavy debts; he was without doubt the greatest literary influence in 19th century France. It is true that this influence bore almost wholly on technique, but technique in French poetry is of primary importance. Victor Hugo was not quite the revolutionary ("le démagogue horrible et débordé") that he pretended: but he *did* re-introduce the lovely metres and cadences of the 16th century, he *did* break the tyranny of Boileau, and he *did* render the French ear sensitive to the delicate vowel changes and balances in which their language is so rich. Thus although his drama is dead, and his novels can scarcely be compared with those of Balzac, Sand or even Dumas, yet the great mass of his verse, whether lyric, satiric or narrative, will always retain, not only its beauty but its strength. Most of Hugo's boasts about himself, about that "ego Hugo" who was the centre of all his thoughts, are not only insufferable, but inaccurate: he was right, however, and absolutely right, when he described himself as placed "au centre de tout comme un écho sonore." His receptive faculty was unlimited: his interpretive faculty was of a high standard: it was his selective faculty which was at fault. The fact that he could, with dangerous facility, cast into beautiful and convincing form what the average person of 1840–80 felt inarticulately, accounts not only for his unequalled popularity, but for his own unfortunate conviction that he was the prophet of his country and his age.

> "Moi," he exclaims in a characteristic passage:—
> "Moi, qui me crus apôtre . . .
> "La France, dans sa nuit profonde
> "Verra ma torche flamber."

Interpretation and melody, however, are not enough. Victor Hugo possessed a trivial character and an uninteresting mind. A high quality of either mind or character are not perhaps essential to the finest poetry, but the absence of both must always reduce a poet to the second category. Hugo was a master of language: he was a great literary figure: he might perhaps have been a great mystic had he been less worldly: but as it is, when asked who was the greatest French poet of the 19th century we must reply, in the words of a recent French cynic, "Unfortunately, Victor Hugo." (H. Nr.)

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HUGUENOTS, the name given from about the middle of the 16th century to the Protestants of France. According to Henri Estienne, the word is a nickname. The Protestants at Tours, he says, used to assemble by night near the gate of King Hugo, whom the people regarded as a spirit. A monk, therefore, in a sermon declared that the Lutherans ought to be called *Huguenots,* as kinsmen of King Hugo, inasmuch as they would only go out at night as he did. This name became popular from 1560 onward.

The French reform movement has often been regarded as an offshoot of Lutheranism, and up to the middle of the 16th century its adherents were known as Lutherans. But as early as 1512 Jacobus Faber (*q.v.*) of Étaples published his *Santi Pauli Epistolae xiv . . . cum commentariis,* which enunciates the cardinal doctrine of reform and justification by faith, and in 1523 appeared his French translation of the New Testament. In 1525 Jacques Pavannes and, shortly afterward. Louis de Berquin were burned at the stake. But no persecution could stop the Reform movement, and on the walls of Paris there were found placards condemning the mass (1534). On Jan. 29, 1535, an edict was published, ordering the extermination of the heretics and resulting in a general emigration. Three years later the first French Protestant church, composed of 1,500 refugees, was founded at Strasbourg. Of all those exiles the most famous was John Calvin (*q.v.*),

the future leader of the movement, who fled to Basel. The first Protestant community in France was that of Meaux (1546), organized on the lines of the church at Strasbourg, of which Calvin was pastor.

Persecution, however, became more rigorous. The Waldenses of Cabrières and Mérindol had been massacred in 1545, and at Paris was created a special court in the *parlement* for the suppression of heretics, a court which became famous in history as the *chambre ardentc* (1549). The church at Paris was founded in 1556, and in spite of persecution the reformers increased in numbers. In 1j58 at Poitiers it was decided that all the Protestant churches in France should formulate by common accord a confession of faith and an ecclesiastical discipline. The church at Paris was commissioned to summon the first synod, which, in spite of the danger, was convened on May 25, 1559. The synod of Paris derived its inspiration from the constitution introduced by Calvin at Geneva, which has since become the model for all the Presbyterian churches. Ecclesiastical authority resides ultimately in the people, for the faithful select the elders who are charged with the general supervision of the church and the choice of pastors. The churches are independent units, and there can be no question of superiority among them; at the same time they have common interests, and their unity must be maintained by an authority capable of protecting them. The association of several neighbouring churches forms a local council (*colloque*). Over these stands the provincial synod, on which each church is equally represented by lay delegates and pastors. Supreme authority resides in the national synod, composed of representatives, lay and ecclesiastic, elected by the provincial synods. The democratic character of this constitution of elders and synods is particularly remarkable in view of the early date at which it began to flourish.

The synod of 1j59 was the beginning of a remarkable increase in the Reform movement; at that synod 1j churches were represented; later, in 1561, the number was 2,150—an increase which carried the struggle into the arena of national politics.

The conspiracy of Amboise, formed with the object of kidnaping the king (March 1560), resulted in the death of the plotters and was followed by the proclamation of the Edict of Romorantin, which laid an interdict upon the Protestant religion. But the reformers had become so powerful that Coligny, who was to become their most famous leader, protested in their name against this violation of liberty of conscience. For a moment, at the colloquy of Poissy (Oct. 1561), at which Roman Catholic and Protestant divines were assembled together, it seemed as though a *modus vivendi* would be established. The attempt failed, but by the edict of Jan. 1562 religious liberty was assured to the Huguenots. This, however, was merely the prelude to civil war, the signal for which was given by the Guises, who slaughtered a number of Huguenots assembled for worship in a barn at Vassy (March 1, 1562); and the duke of Guise, entering Paris in triumph, transferred the court to Fontainebleau by a daring *coup d'état* in defiance of Catherine de' Medici, the queen regent. It was then that Condé declared there was no hope but in God and his arms, and, with the Huguenot leaders, signed at Orléans (April 11, 1562) the manifesto in which, having declared their loyalty to the crown, they stated that as good and loyal subjects they were driven to take up arms for liberty of conscience on behalf of the persecuted saints. Until the end of the century the history of France is that of the struggle between the Huguenots upholding "the Cause" and the Roman Catholics fighting for the Holy League. The leading events only are related here (see also FRANCE: History). The war lasted, with intermissions in 1563 and 1568, until 1569, when, after the defeat of the Huguenots at Jarnac, Condé was assassinated. But Jeanne d'Albret renewed the courage oi the vanquished by presenting to them her son, Henri de Bourbon, the future Henry IV; and Coligny, whose heroic courage rose with adversity, collected the remnants of the Protestant army and by a march as able as it was audacious moved on Paris. The Peace of St. Germain followed, on Aug. 8, 1570.

Peace seemed to be assured, when, on the night of Aug. 24, 1572, there occurred the Massacre of St. Bartholomew (*q.v.*), in which Coligny and all the leading Huguenots were slain. The Paris massacre was repeated throughout France, and the Protestants were slain in thousands. The survivors resolved upon a desperate resistance. A Huguenot political party was formed at Milhau in 1573, definitely constituted at La Rochelle in 1588 and lasted until the peace of Alais in 1629. The delegates selected by the churches bound themselves to offer a united opposition to the violence of the enemies of God, the king and the state. It is a mistake to suppose that they desired to overthrow the monarchy. But it is true that among themselves they formed a kind of republic, which, according to the historian J. A. de Thou, had its own laws dealing with civil government, justice, war, commerce, finance. They had a president called the protector of the churches, an office held first by Conde and afterward by the king of Navarre up to the day on which he became king of France as Henry IV (1589). The fourth religious war, which had broken out immediately after the Massacre of St. Bartholomew, was brought to an end by the pacification of Boulogne (July 16, 1573), which granted a general amnesty. The recollections of the horrors of St. Bartholomew's night had hastened the death of Charles IX, the last of the Valois. Under Henry III, the war broke out anew. It lasted, with one briei intermission in 1576, until March 22, 1594, when Henry of Navarre entered Paris as Henry IV, successor of Henry III, who had been assassinated by a monk in 1589. The league was utterly deieated. Thus the Huguenots, after 40 years of strife, obtained by their constancy the promulgation of the Edict of Nantes (April 13, 1598), the charter of religious and political freedom. (See NANTES, EDICT OF.)

Twelve years aiterward, on May 14, 1610, Henry was assassinated. During the minority of Louis XIII, power resided in the hands of counselors who favoured the Catholic party. The Huguenots once more took up arms under the leadership of Henri de Rohan (*q.v.*). Richelieu had entered the king's council on May 4, 1624; the destruction of the Huguenots was his policy, and he pursued it to a triumphant conclusion. On Oct. 28, 1628, La Rochelle, the last stronghold of the Huguenots, was obliged to surrender, after a siege rendered famous for all time by the heroism oi its defenders and of its mayor. The peace of Alais, which was signed on June 28, 1629, marks the end of the civil wars.

Louis XIV.—The Huguenots had ceased to exist as a political party and, assured that liberty of conscience would be granted them, showed themselves loyal subjects. On the death of Louis XIII, the declaration of July 8, 1643, had guaranteed to the Protestants "free and unrestricted exercise of their religion," thus confirming the Edict of Nantes. The Roman Catholic clergy, however, had never accepted the Edict of Nantes, and all their efforts were directed to obtaining its revocation. As long as Mazarin was alive the complaints of the clergy were in vain, but when Louis XIV attained his majority there commenced a legal persecution which was bound in time to bring about the ruin of the Reformed Churches. The Edict of Nantes, mhich was part of the law of the land, might seem to defy all attacks, but the clergy found means to evade the law by demanding that it should be observed with literal accuracy, disregarding the changes which had been produced in France during more than half a century. The clergy in 1661 successfully demanded that commissioners should he sent to the provinces to report infractions of the edict, and thus began a judicial war which was to last for more than 20 years. All the churches which had been built since the Edict of Nantes were condemned to be demolished. All the privileges which were not explicitly stated in the actual text of the edict were suppressed. More than 400 proclamations, edicts or declarations attacking the Huguenots in their households and their civil freedom, their property and their liberty of conscience were promulgated during the years which preceded the revocation of the Edict of Nantes. In spite of all sufferings which this rigorous legislation inflicted upon them they did not cease to resist, and in order to compel them to accept the "king's religion," the dragonnades (1683–86) were organized, which effected the iorcible conversion of thousands of Protestants who gave way under the tortures which were inflicted upon them. It was then that Louis XIV declared that "the best of the larger part of our subjects, who formerly held the so-called reformed religion, have embraced the Catholic religion, and therefore the Edict of Nantes has become unnecessary." On Oct. 18, 1685, he pronounced its revocation. Thus under the influence of the clergy was committed one of the most flagrant political and religious blunders in the history of France, which in the course of a few years lost more than 400,000 of its inhabitants. Many emigrated to England or Prussia and became very useful citizens of their adopted countries.

Persecution had succeeded in silencing, but it could not convert the people. Despair armed the Cévennes, and in 1702 the war of the Camisards broke out, only to end in the defeat of the insurgents (see CAMISARDS and CAVALIER, JEAN). The Huguenots seemed to be finally conquered. On March 8, 1715, Louis XIV announced that he had put an end to all exercise of the Protestant religion; but on Aug. 21 there assembled together at Monoblet, in Languedoc, under the presidency of Antoine Court (*q.v.*), the "Restorer of Protestantism," then only 20 years of age, a conference devoted to the re-establishment of the church. This was the first "synod of the desert."

Year by year the churches became more numerous. In 1756 there were already 40 pastors; several years later, in 1763, the date of the last "synod of the desert," their number had increased to 6;. As the 18th century advanced, public opinion began to revolt from the persecution of the Huguenots. The torture of Jean Calas caused general indignation, of which Voltaire became the eloquent mouthpiece, and the edict of Nov. 1787, in spite oi the opposition of the clergy. renewed the civil rights of the Huguenots by recognizing the validity of their marriages. Two years later the Declaration of the Rights of Man affirmed the liberty of religion. By the law of 18 Germinal year X, the legal standing of the Protestant church was recognized, but it was denied the character of a free church, which it had claimed.

The Protestants, on the day on which liberty of conscience was restored, could measure the full extent of the misery which they had

endured. Of this people, which in the 16th century formed more than one-tenth of the population of France, there survived only a few hundred thousand. In 1626 there were 809 pastors in the service of 751 churches; in 1802 there were only 121 pastors and 171 churches; in Paris there was only a single church mith a single pastor. The church had no faculty of theology, no scho'ols, no Bible societies, no asylums, no orphanages, no religious literature. Everything had to be created afresh, and this work was pursued during the 19th century with energy and faith.

Later History.—At the fall of the empire (1815) the reaction of the White Terror once more exposed the Protestants to outrage, and again a number Red from persecution and sought safety in foreign countries. Peace having been established, attention was then focused on religious questions, and the period mas marked in Protestantism by a remarkable awakening. On all sides churches were built and schools opened. During that period were founded the great religious societies: Société biblique (1819), Société de l'instruction primaire (1829), Société des traités (1821), Société des missions (1822). On the other hand, the old union of the Reformed Churches had ceased to exist since the revolution of July. Ecclesiastical strife broke out and never entirely ceased. A schism occurred first in 1848, owing to the refusal of the synod to dram up a profession of faith. The cornte de Gasparin and the pastor, Frédéric Monod, seceded and founded the Union des Églises Evangéliques de France, separated from the state. Under the second empire (1852–70) the divisions between the orthodox and the liberal thinkers were accentuated and resulted in a separation, which followed on the reassembly of the national synod, authorized in 1872 by the government of the third republic. The old Huguenot Church mas thus separated into two parts, having no other link than that of the Concordat of 1802, and each possessing its own peculiar organization.

The law of Dec. g, 1905, which separated the church from the state, was accepted by the great majority of Protestants as a legitimate consequence of the reform principles, and its application caused no difficulty with the state. In 1907 the National Gnion of the Reformed Churches of France, consisting of ten regional unions, was founded in Paris; these unions are combined with others in the Protestant Federation of France, which convenes a general assembly of all affiliated churches every five years. The restoration of Alsace and Lorraine to France involved the inclusion oi the Lutheran and Reformed Churches of those provinces in the main body of French Protestants, increasing the membership to nearly one million. These churches are established and supported by the French state, in accordance mith the régime existing before the Franco-German War oi 1870–71.

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HUGUET, JAIME (c. 1415–1492), Spanish painter, the last important master of Catalan Gothic painting, was established in Barcelona in 1448. With the aid of assistants he produced many large composite altarpieces. The most important surviving examples are the retable of SS. Abdon and Sennen (Tarrasa). the retable made for the constable of Portugal (S. Agueda, Barcelona) and that of St. Xugustine in the Barcelona museum, where many other productions of his workshop are to be seen. His style, reflecting French, Italian and Flemish influences, is distinguished by a combination of highly individualized heads and a purely decorative treatment of costume and background, ornamented with patterned and embossed gold. He had many followers.

See C R Post, *A History of Spanish Painting,* vol. vii, part i (1938).

(E. Hs.)

HUHEHOT (formerly Kuei-sui. Kweihwa, Kuku Khoto), former capital of Suiyüan province. China; since 1954 capital of the Inner Mongolian Autonomous Region. The city lies at the northeastern end of the Kuei-sui plain, a fertile irrigated basin of the Hei river on the eastern shoulder of the Yellow river bend, and south of a break in the 4,500 ft. high Yin-Shan scarp of the Mongolian plateau. In the 11th century the city became a frontier mart. where Chinese tea and manufactures were exchanged for Mongolian horses, skins and wool. Huhehot (meaning "blue city") was more Mongol than Chinese and prior to 1664 housed the Mongolian dalai lama. Increased Chinese control eventually resulted in the erection of an administrative city one mile northeast of the old Mongol settlement, an influx of Chinese farmers in 1928. the completion of the Peking-Suiyüan railway to Pao-t'ou, go mi. W., and increased manufacture of local wares, such as rugs, clothing and leather goods. Since 1954, under the city's status of regional capital. industry has grown and plants have been built for making brick and tile. farm tools. woolen textiles, and sugar from sugar beets. It is the location of the Inner Mongolian Medical college and has six secondary technical schools. The city is go mi. W. of Chi-ning. connecting point for the railway to Ulan Bator, a location that is advantageous to its flourishing as a supply centre for the rapidly growing Chi-ning and of the new heavy industry centre. Pao-t'ou. Pop. (1953) 148,400. (Te. H.)

HUICHOL. This Indian tribe of the inaccessible Sierra Madre mountains of northern Jalisco and Nayarit is notable in modern Mexico for the degree to which its members have preserved their aboriginal speech (a Uto-Aztecan language), religion (especially the peyote cult) and customs (corn-beans-squash agriculture, selection of political officials by dreaming, curing of illness by shamans, etc.). They are closely related in language and culture to the neighbouring Cora. The Huichols number somewhat more, and the Cora somewhat fewer. than 3,000.

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(E. Z. V.)

HUILA, a department in the south central part of the republic of Colombia drained by the upper reaches of the Magdalena river. Pop. (1951) 293.692; area 7,656 sq.mi. Created in 1905 from Tolima, it is named for the snow-capped Nevado del Huila (18,701 ft.) in the central cordillera, which dominates much of the landscape. Since the colonial period this part of the upper Magdalena valley has been primarily a stock-raising area, but with the improvement of irrigation facilities. agriculture (especially cotton) became increasingly important. The capital; Neiva, is the terminus of a railroad that links it to Bogotá, Girardot and Ibagué. The San Agustín archaeological zone: with its mysterious giant stone figures, lies in the southernmost part of the department. The impressive Cuevas de los Guácharos (caves of the oilbirds) are 12 mi. S. of Pitalito, east of San Agustin. (Js. J. P.)

HUI TSUNG (1082–1135), Chinese emperor of the Sung dynasty, was famous for his calligraphy and his exquisitely com-

posed paintings. Paintings by court academicians, greatly advanced by his patronage, eventually gave rise to a new school, outstanding in art history. Politically, his reign (1101–25) was fatal to the Northern Sung dynasty. A brief attempt to reunify the bureaucracy failed to resolve the bitter factional strife between the conservatives in opposition and the postreformers who claimed to follow the new policies which had originated with the great reformer Wang An-shih. Probably disillusioned with state affairs, Hui Tsung sought comfort and pleasure in promoting Taoism (*q.v.*) at the court. in arts. in amorous affairs and in enjoying a new extravagant palace garden. His requisition of colourful stones. precious plants and exotic pets caused great hardship among the people. The administration was for many years left to Ts'ai Chin. With the persecution of the conservatives, the bureaucracy became submissive; with manipulation and corrupt practices, it became abusive. Favourite eunuchs also gained unprecedented power, including military command. The victory over the Liao in north China brought about by the alliance with the Chin Tatars from Manchuria was entirely illusory, for the Chin turned out to be the real menace. In mounting crisis. Hui Tsung abdicated in favour of his son. Ch'in Tsung. In 1127 the Chin invaders ended the Northern Sung dynasty, and both emperors suffered captivity and exile in the north under miserable conditions till their deaths. See also CHINESE PAINTING: *History: Sung Dynasty.* (J. T. C. L.)

HUITZILOPOCHTLI, the supreme being in the religions of ancient Mexico and also the god of war. He was the mythic leader and chief divinity of the Aztecs. dominant tribe of the Nahua nation. As a hummingbird Huitzilopochtli was alleged to have led the Aztecs to 3 new home. His idol was a huge block of basalt (still thought to be preserved in Mexico), on one side of which he is sculptured in hideous form, adorned with the feathers of the hummingbird.

The ceremonies of his worship were of the most bloodthirsty character. and hundreds of human beings were sacrificed annually beiore his shrine, their limbs being eaten by his worshipers. When the temple of Huitzilopochtli was dedicated in 1486. it is traditionally reported that 70.000 persons were killed.

HU-K'OU (HUKOW), a town in northern Kiangsi province, China. on the south hank of the Yangtze river. 20 mi. E.S.E. of Chiu-chiang (*q.v.*). Hu-k'ou, whose name means "lake mouth," is situated on a short canal that provides an outlet from the P'o-yang Hu (lake) to the Yangtze. In the days when Chinese waterways played a dominant role in inland transportation, Hu-k'ou was a major transportation huh and transshipment centre. Shallow-draught lake junks transferred their goods to or from the larger ocean-going vessels that plied the middle and lower course of the Yangtze. With the coming of the railroad era to China, Hu-k'ou began to decline. Its functions were largely taken over by the rising commercial centre of Chiu-chiang, linked by a railroad with Nan-ch'ang, the provincial capital of Kiangsi. (T. SD.)

HULDA, in Teutonic mythology. goddess of marriage, a beneficent deity. patroness and guardian of maidens (*see* BERCHTA).

HULL, CLARK LEONARD (1884–1952), U.S. psychologist, the most influential theoretical psychologist of the period 1930–50, was horn near Akron. N.Y., on May 24, 1884. Poliomyelitis interrupted his education in mining engineering, and studies at the University of Michigan (A.B., 1913) directed him to psychology. His doctoral dissertation (University of Wisconsin, 1918) pioneered the experimental analysis of concept formation. He remained at Wisconsin until called in 1929 to the Sterling professorship of psychology at Yale university. He died there on May 10, 1952.

By 1930 Hull had produced two research programs that resulted in the classical books *Aptitude Testing* (1928) and *Hypnosis and Suggestibility* (1933). His influence, however, resulted largely from many articles arid two books (*Principles of Behavior* [1943] and *A Behavior System* [1952]), in which he developed an explicit, quantitative theory of simple and complex forms of learning and behaviour. His theory proved to he remarkably suggestive of, and responsive to. experimental data.

Hull's autobiography appears in *History of Psychology in Autobiography,* \-01. iv (1952), and evaluations of him may be found in *American Journal of Psychology,* vol. lxv (1952) anti *Psychological Review,* vol. lix (1952). (A. W. MN.)

HULL, CORDELL (1871–1955), U.S. statesman and Nobel prize winner. was born in Overton county (now Pickett), Tenn.. on Oct. 2. 1871. He was admitted to the Tennessee bar in 1891 and elected to the house of representatives in 1893 and to a judgeship in 1903. He served in the U.S. house of representatives from 1907 to 1921—when he mas active in developing the income and inheritance taxes—and from 1923 to 1931. In 1931 he was elected to the senate. but in 1933 he was appointed secretary of state by Pres. F. D. Roosevelt, continuing in that position until he resigned Nov. 27. 1944. Hull was awarded the 1945 Nobel peace prize for his part in organizing the United Nations organization. He died at Bethesda. Md., July 23. 1955.

HULL, ISAAC (1773–1843), commodore in the C.S. navy, whose claim to fame came from his exploits in the War of 1812, was born at Derby, Conn., on March 9, 1773. Going to sea at 14 as a cabin boy on a coaster. he was master of a ship at 19. In 1796–97 he was twice captured by French privateers in the West Indies. He was commissioned fourth lieutenant of the frigate "Constitution" on March 9, 1798. In the naval war with France he distinguished himself by cutting out the French privateer "Sandwich" in the harbour of Puerto Plata, Santo Domingo. Commanding the brig "Argus" during the Tripolitan War, he gave naval support to William Eaton, C.S. navy agent for the Barbary regencies. in the capture of Derna. Hull was promoted to captain April 23, 1806, and became commander of the "Constitution" on June 1;. 1810. After taking U.S. minister Joel Barlow to France and delivering $28,000 in specie to Holland. he returned a few months beiore hostilities began between the U.S. and England.

Theodore Roosevelt regarded Hull's actions in the War of 1812 as placing him "above any single ship captain of the war." Encountering a British squadron in July 1812, off Egg Harbor, N.J., in a dead calm. Hull escaped after three days and nights in one of the most remarkable chases in naval history. On Aug. 19 the "Constitution" met the British frigate "Guerrière." In fewer than 30 minutes of close and violent action the enemy ship was dismasted and at Hull's mercy. Considered the most important single victory in U.S. naval annals, the defeat of the "Guerriere" united the nation behind the war effort and smashed forever the legend of British naval invincibility. In this fight the "Constitution" won the name of "Old Ironsicles." Relieved of his command at his own request, Hull commanded harbour defenses at New York city. Hull was one of the first three members of the board of naval commissioners and was commandant at navy yards at Portsmouth. N.H., Boston. Mass., and Washington, D.C. He was commodore of the C.S. squadron in the Pacific (1824–27) and Mediterranean (1839–41). He died at Philadelphia, Pa.. on Feb. 13, 1843.

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HULL, a city and railway junction of the province of Quebec, Can., located on the north bank of the Ottawa river, opposite Ottawa, Ont., is the county seat of Hull county and chief administrative and business centre in southwest Quebec. Pop. (1961) 56,-929; 90% French in origin. Abundant hydroelectric power and timber resources support large pulp. paper and match factories; other industries include portland cement. meat packing, foundries, clothing and iurniture. A large government printing plant has been established there.

Samuel de Champlain described the site in 1613. The community began as a lumber settlement. The first settler (1800) was Philemon Wright from Massachusetts, who named it after Hull. Eng.. from which his parents had emigrated. It was incorporated as 3 city in 1875. (GN. C. M.)

HULL (officially KINGSTON UPON HULL). a city and county of a city. municipal, county and parliamentary borough and seaport in the East Riding of Yorkshire, Eng., at the junction of the river Hull with the Humber, 22 mi. from the open sea and 166 mi. N. of London by road and ferry. Pop. (1961) 303,268. Area 22.4

sq.mi. The town stands on a level plain so low as to render embankments necessary to prevent inundations. The older portion is completely enclosed by the river Hull on the east. the Humber on the south. by docks on the west and by public gardens, known as the Queen's gardens (the site of the city's first enclosed dock) on the north.

The first mention of any town on the site occurs under the name of Wyke upon Hull in a charter of about 1160–80 by which Maud, daughter of Hugh Camin, transferred it to the monks of Meaux, who in 1279 obtained a licence to hold a market every Thursday and a fair on the eve. day and morrow of Holy Trinity and 12 days following. Shortly afterward, Edward I, seeing its value as a port. obtained the town from the monks in exchange for other lands. The king in 1293 renamed the town Kingston upon Hull. granting its first charter in 1299, making it a borough freed from the manorial system of government but under the governance of a warden appointed by the king: giving the burgesses freedom from certain tolls throughout the realm and according other privileges, including the right to hold two weekly markets. Tuesday and Friday. and a fair lasting 30 days. namely. on the day of St. Augustine and for 29 days next following. Edward III, in 1331, granted the burgesses the right to hold the borough with fairs. markets. free customs at a fee farm rent of £70 and with power to choose from among themselves to keep the borough, in lieu of a warden as previously. a mayor and four bailiffs each year. In 1440 the constitution of the borough was again altered. a charter of that year incorporating the borough, the corporate body comprising 13 aldermen elected for life. all being justices and one being annually elected the mayor. By the same charter the county of the town was created by virtue of which a sheriff was. and still is. annually elected. In 1541 the town was visited by Henry VIII, who ordered a castle and other places of defense to be built. Edward VI granted the manors of Hull. part of Sutton and of Tupcoates with Myton to the burgesses in 1552. A charter. commonly called the governing charter. was granted in 1661. and other grants of note were the conferring of the title of city in 1897 and that of lord mayor instead of mayor in 1914.

During the Civil War. although the majority of the inhabitants were said to be royalist. Kingston upon Hull was garrisoned by the parliamentarians and Charles I was refused admission by the governor. Sir John Hotham. In 1643 it was besieged for six weeks, and the new governor. Ferdinando Fairfax, 2nd baron Fairfax, obliged the royalist army to retreat by opening the sluices and flooding the surrounding country.

Holy Trinity church is one of the largest English parish churches, with Decorated style transepts and choir and a Perpendicular nave. The choir is an unusually early example of the use of brick in English ecclesiastical architecture. The church of St. Mary. Lowgate, was founded in the 14th century. Among the principal public buildings are the guildhall in Lowgate and the Feren's Art gallery (1927). The ancient grammar school was reendowed in 1485, and among its students was said to be Andrew Marvell. the poet, who represented the town in parliament from 1659 until his death in 1678; another student was William Wilberforce (1759–1833). The latter is commemorated by a column and statue at the east end of the Queen's gardens and by a museum in the house of his birth. The city hall and the first municipal art galleries were opened in 1910. The Transport museum (now restored) was partly destroyed by enemy action in World War II, when the old Charterhouse hospital was badly damaged and a great deal of the town laid flat.

With its university. grammar schools. the Hymers college and other educational establishments. the Trinity House Marine school (founded in 1787) and technical and art schools. Kingston upon Hull is the educational centre for the East Riding. The university college. founded in 1927 by the Rt. Hon. T. R. Ferens and opened in 1929, was raised by royal charter to the status of a university in 1954.

Charities and benevolent foundations are numerous. Trinity house. a charity for seamen of the merchant service. was founded by the Trinity House guild (instituted in 1369), and the present building was erected in 1; j3. It contains a noteworthy collection of paintings and a museum. The Charterhouse belongs to a foundation for the support of the old and feeble and was established in 1384 by Sir Michael de la Pole. afterward earl of Suffolk.

The corporation owns the telephone system.

The original harbour occupied that part of the river Hull which faced the old town, but in 1774 an act was passed for forming a dock on the west bank of the river. This became known as Queen's dock (now the Queen's gardens), and with Prince's and Humber docks it completed the encirclement of the old town. The small Railway dock opens from Humber dock. East of the Hull lies the Victoria dock, and west of the Humber dock basin and parallel to the Humber lie Albert and William Wright docks. Others are Alexandra dock and the St. Andrew's fish docks. The port was enlarged in 1914 by the opening of the King George dock, having a large grain silo. fine equipment and covering an area of 53 ac. with provision for future extension to 8j ac. The docks are owned by the British Transport commission and cover a water area of 200 ac. with 12 mi. of quays.

Kingston upon Hull, the third port in the kingdom, has commerce with all parts of the world. It is one of the principal ports for the handling of the manufactures of Lancashire and Yorkshire and has direct communication by canal and rail with its hinterlands. Softwood is imported from the Scandinavian countries and the Baltic, and hardwood and grain from the various sources of supply. Passenger steamship services run to the principal European ports and a ferry serves the Lincolnshire shore of the Humber. Kingston upon Hull was an early seat of the whale fisheries. and sea fishing is extensively carried on. There is a large number of trawlers in the fishing fleet which did valuable service during World Wars I and II. Kingston upon Hull is one of the two largest fishing ports in the United Kingdom.

The numerous industries include iron founding, ship repairing and engineering, the manufacture of chemicals, vegetable oils, colours, cement, starch, soap, industrial alcohol and its derivatives, surgical dressings and household requisites, tanning and brewing.

Kingston upon Hull was early represented in parliament and has sent members since 1304. The parliamentary borough returned two members until 1885, three until 1918, when it was divided into four constituencies returning one member for each constituency; but in 1954 it was again reduced to three constituencies, East, North and West.

Kingston upon Hull has a bishop suffragan attached to the diocese of York. (E. H. Bk.)

HUMACAQ, a town, founded in 1790, and municipality in the eastern part of Puerto Rico. Urban pop. (1960) 8,009; mun. 34,417.

Located at the end of a valley which opens to the sea 6 mi. E., Humacao has a delightful climate. The town is connected by excellent highways with Fajardo, Caguas and San Juan. Sugar is grown in the surrounding rural area and many small farms in the nearby foothills produce a variety of tropical fruits. The Ryder Memorial hospital is located there. The local government was successful in encouraging the establishment of several industries in the town. (T. G. Ms.)

HUMANE SOCIETIES. During the 18th century humanist; claimed that animals had rights which should be recognized. The old English common law was completely indifferent to the protection of animals from cruel treatment.

Jeremy Bentham (1748–1832), English jurist, was the first to assert the rights of animals with authority. He believed legislation should agree with the principles of private morals. and was a strong advocate for the enactment of laws to protect animals from cruel and inhuman treatment. He also claimed that if humanity to animals — the sentiment of benevolence — were inculcated in the minds of children, it would tend toward the prevention of crimes of violence.

In 1811 Lord Erskine (1750–1823), in a speech before the house of lords, portrayed the cruelties inflicted on animals at that time in Britain, and asked for legislation to protect them. In 1822 Richard Martin of Galway, a member of parliament, procured the passage of the Ill-Treatment of Cattle bill, commonly known as Martin's act. This act prohibited the cruel and improper treatment of cattle, and for persons who wantonly and cruelly beat, abused or ill-treated any horse, mare,

gelding, mule, ass, ox, heifer, steer, sheep or other cattle provided fines of not more than £5 or less than 10s., or imprisonment not exceeding three months. It was the first law to prosecute offenders for acts of cruelty to cattle and beasts of burden. The English Society for the Prevention of Cruelty to Animals was organized on June *16, 1824,* to make this law operative. Through its agency brutal sports as well as other types of cruelty were prohibited or abated. In *1840,* by command of Queen Victoria, the society was honoured with the prefix "royal."

UNITED STATES

After its establishment in Britain the movement for animal protection spread rapidly. Societies were organized in all parts of Europe and other countries. In *1866* the American Society for the Prevention of Cruelty to Animals was founded by Henry Berrh. who became its first president. This was the first society of its kind in the United States. Laws for the prevention of cruelty to animals enacted by the legislature of the state of New York were the first on the subject in the United States and were based on English law.

In *1868* George T. Angell of Boston, Mass., organized the Massachusetts Society for the Prevention of Cruelty to Animals. Other societies were organized in Pennsylvania, New Jersey and California in the same year. In *1869* Illinois and Minnesota organized societies. Laws similar to those of the parent society were enacted in these states. Details of legislation were refined and amplified until today there is not a state or territory without some statutory provision for animal protection.

Protection of Children. — Organized activity in the prevention of cruelty to children grew out of the similar work for animals and was a part of the same rising wave of humane sentiment and activity. There were no similar laws in existence for the prevention of cruelty to children. The old English common law in force in the U.S. gave no protection to children except in extraordinary cases of cruelty.

In *1874* in New I'ork a case known as the Mary Ellen case directed attention to the necessity for legislation to protect children from cruelty. A nine-year-old child was brutally beaten by her foster mother, and complaints by neighbours to the police and other law-enforcing agencies were of no avail as there seemed to be no law under which they could rescue the child and prosecute the foster mother for cruelty. The laws for the prevention of cruelty to animals were used to rescue this child on the theory that a child was an animal. The child was rescued by an officer of the Society for the Prevention of Cruelty to Animals and the foster mother prosecuted and sent to prison for one year.

Immediately after this case, steps were taken by Elbridge T. Gerry, counsel for the American Society for the Prevention of Cruelty to Animals, to have laws enacted for the protection of children from cruelty in the state of New York. After the enactment of these laws in 1875, the New York Society for the Prevention of Cruelty to Children was organized — first of its kind in the world. The society was formed to rescue children from vicious and immoral surroundings and to prosecute offenders, to prevent the employment of children for mendicant purpose or in theatrical or acrobatic performances and to provide for the enforcement of all laws for the protection of minors from abuse. Similar laws were passed and societies were organized in other states following the lead of the New York society. These societies all adopted the New York model, as did other local societies later.

From *1870* to 1877 the Illinois society had been rescuing so many children from conditions of cruelty and neglect, in addition to their work for the prevention of cruelty to animals, that the society deemed it advisable to change its name to the Illinois Humane society. This was the first society in the world to take the name "humane," indicating the dual work of prevention of cruelty to children and to animals. Other societies engaged in this dual work were later organized in the United States under the name humane societies.

In 1877 the leading U.S. societies met at Cleveland, O., and organized the International Humane society to deal with the question of the maltreatment of animals in transit between the east and the west. This society in *1878* changed its name to the American Humane association. On March 3, *1901,* it was incorporated in the District of Columbia.

Societies known as humane education societies were organized to carry humane education in all possible ways into American schools and homes.

The Juvenile Court act enacted in Illinois in *1899* was the first law of its kind, relating to children who are or may become dependent, neglected or delinquent, to define these terms and to provide for the treatment, control, maintenance, adoption and guardianship of the persons of such children. The juvenile court movement developed rapidly thereafter.

GREAT BRITAIN

In 1849 the Cruelty to Animals act had provided that "If any person shall from and after the passing of this Act cruelly beat. ill-treat, overdrive, abuse or torture, or cause or procure to be cruelly beaten, ill-treated, over-driven, abused or tortured any animal, every offender shall for every such offense forfeit and pay a penalty not exceeding five pounds." This act and the Cruelty to Animals act of *1854* contained substantially the working laws on the subject of cruelty to animals, upon which later laws were founded as they applied to domestic animals generally.

The Cruelty to Animals act of *1876* was enacted to regulate vivisection or the practice of making experiments upon living animals for scientific purposes, by extending the law relating to cruelty to animals to the cases of animals which for medical, physiological or other scientific purposes are subject, when alive, to experiments calculated to inflict pain.

In *1884* England followed the United States in enacting laws protecting children from cruel treatment, and the National Society for the Prevention of Cruelty to Children was organized. The Royal Scottish Society for Prevention of Cruelty to Children was organized in the same year and similar societies were organized in other countries.

The Wild Animals in Captivity Protection act was passed in 1900. Whereas the Cruelty to Animals acts of *1849* and *1854* protected only domestic animals, this act included almost every act of cruelty to any other animal.

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(G. A. H. S.)

HUMANISM, the attitude of mind which attaches primary importance to man and to his faculties, affairs, temporal aspirations and well-being (from Latin *humanus,* "human"; *cf. homo,* "man," *homines,* "mankind"), often regarded as the characteristic attitude of the Renaissance (*q.v.*) in western Europe. The Greek and Roman classical writers regularly distinguished the human, or humane. on the one hand from the bestial and on the other from the divine; but in making the latter contrast they usually stressed some pathetic aspect of the human. such as mortality or fallibility. Medieval Christianity, however, suggested that man's life on earth was significant only in so far as it affected his soul's expectation of God's mercy after death, and it was against this belittling of his natural condition that the humanists of the Renaissance asserted the intrinsic value of man's life before death and the greatness of his potentialities. As ecclesiastical influence waned, the protest of humanism was turned against secular orthodoxies that subordinated man to the abstract concepts of political or biological theory.

In the 20th century some new senses were given to the word humanism. F. C. S. Schiller (1864–1937) took it as the special name of his own version of pragmatism (*q.v.*), maintaining that all philosophic understanding stems from human activity and reaffirming Protagoras' contention that "Man is the measure" against what he called the "intellectualist" philosophies, whether represented by Plato, by Hume or by the idealists of his own time. The humanism of Irving Babbitt (*q.v.*) was very different, being a reaction in favour of classical order against romanticism and naturalism, not only in their literary but also in their wider aspects. *(See* also **AMERICAN LITERATURE.)**

HUMANITIES, a group of educational disciplines distinguished in content and method from the physical and biological sciences and, if less decisively, from the social sciences. The group includes language and literature in each of their principal examples (ancient and modern), the fine arts other than literature, philosophy, at least in its more traditional divisions, and, to a less clearly defined extent, history, where the boundary between the social sciences and the humanities is most debatable. These are the core of the humanities and are sometimes organized as a school or division in the modern university.

The humanities are studies which centre attention on the life of man. But this does not by itself serve to distinguish them from biology, a natural science, if it directs its attention to man; or from politics, a social science (for man, as Aristotle said, is a political animal); or even from religion (for man, as Edmund Burke added. is a religious animal). It is true, however, that as early as William Caxton (1422–91), humanity was distinguished from divinity, as the one dealt with man on the merely human level (or in the order of nature), and the other embraced the whole scheme of revealed religion (or the order of grace); and this distinction remains significant. Though the humanities stand committed to no particular philosophy or creed, they assume the possibility of distinguishing with some sharpness between man and the rest of nature, and between the human and the supernatural. These two facts, taken in conjunction, mean that at different times or by different schools the humanities may be brought into some relation with naturalism (as in the more pagan forms of Renaissance and subsequent

humanism) or with religion (as in the Christian humanists of the same and succeeding periods). Cicero's use of the term *humanitas* leads to the question of meaning in another way. In its most general sense *humanitas* signified for him the qualities, feelings and inclinations proper to mankind and was from the first not descriptive only, but normative in function. From the general it developed two special senses. It came to connote humane feelings and the conduct toward others which they dictated: gentleness, consideration, good manners — in a word, much that was to be incorporated in the ideal of the gentleman and to become, thereby, the second aim of a liberal education as formulated by John Henry Newman (*q.v.*) in *Idea of a University* (1852). *Humanitas* also came to connote intellectual cultivation and the training that produced it, or (in the language of Newman) the process and primary end of liberal education. Since: for Cicero, education reached its goal in the production of the orator, the principal acquisition and instrument of training was literature in a wide sense, and the outcome of intellectual culture was weight, precision and effectiveness of utterance. *Humanitas* was coupled with literature or study or came to stand for them, in such phrases as *literae humanitatis* and *in omni recto studio atque humanitate versari* ("to be versed in all true study and humanity"). No wonder *inhumanitas* was for Cicero a synonym for *barbaria.* For the humanists of the Renaissance, humanity, partly through the direct influence of Cicero, retained these connotations; and since for them, as for him, Greek and Latin literature was the great source of knowledge, wisdom and eloquence, the humanities meant the languages and literatures of ancient Greece and Rome (literature including of course philosophy, history and oratory, as well as belles-lettres)—the meaning preserved in such phrases as *literae humaniores* (Oxford) and professor of humanity (*i.e.,* Latin) at Edinburgh. All the meanings discussed here have left their mark on the term humanities as applied to the group of disciplines listed at the outset. The extension and differentiation of studies and the emergence of new methods, since the 17th century, have also had their influence.

In European universities language has ceased to mean Greek, Latin and the ancient languages of the near east; it has come to include the modern languages, with (as is natural) special attention to the mother tongue of the student, and has extended its territory to take in the Slavic and the far-eastern language groups. The historical and comparative study of languages and general linguistics have approximated in their aims and methods natural science and, further, have discovered common ground with such social sciences as psychology, anthropology and sociology. But in another department, the study of language continues to be treated not as science merely, but as the art of expression; and here the tradition of the humanities and the emphasis on a normative function clearly persist. The cumbersome framework of ancient rhetoric has been largely abandoned (to be replaced by new techniques), but something of the underlying belief survives that effective expression depends on a trained and cultivated intellect and sensibility and is their ultimate sign and seal.

Literature. — Literature, which is still, as all the more conservative definitions suggest, the core of the humanities, has kept pace nith the extension of the field in language since added languages have given access to additional literatures of greater or less value; and here, too, new methods of study and new affinities with other disciplines have been discovered and applied. But it is remarkable how many of the essential methods of literary study were already foreshadowed in the De *Ratione Studii* of Erasmus in the 16th century. And indeed the traditional pattern set by the study of the classics has continued to exercise its pervasive influence: in the wide definition of literature centring on, but extending beyond, belles-lettres (as in Matthew Arnold's "Literature and Science"); in the concentration upon major authors and acknowledged masterpieces so that, in one view, what extension meant was to add Dante to Virgil, Milton to Homer, Racine to Sophocles, Gibbon to Thucydides, Bacon to Aristotle, Burke to Cicero; and in the connection, fairly steadily maintained, of literature and language — sometimes reduced to the dry analysis of the grammarian but capable of being reinvigorated, as often in contemporary criticism. The training ground in literature as such has increasingly shifted from the classics to modern literature, and especially to whichever is for the student the literature of his mother tongue: with this last (which of course betokens some decline in linguistic studies, despite the extension of their range and methods) may be associated courses in ancient and modern foreign literature in translation. Such courses while sacrificing the connection with language do at least bear witness to the centrality of literature itself, as also does that other experiment of basing a liberal education, in whole or in part, on a systematic study of "great books" of literature in its widest extent, including the classics of philosophy, history, politics and even theology and science. Literature thus conceived (that is, as requiring only that it shall be addressed to the general reader and shall manifest a certain significance of content and distinction of expression) becomes a great meeting place of subject matters.

In its stricter definition as belles-lettres, literature long provided the principal or only representative of the aesthetic in liberal education. There has been added the academic (*i.e.,* the critical and historical) study of the fine arts, and especially of painting and music. The latecomers have immensely strengthened the humanities on the aesthetic side, have supplemented and reinforced the study of literature and have been able in measure to apply some of the methods of which literature has been the proving ground.

Philosophy and History. — The two remaining divisions of the humanities, philosophy and history, possess their own appropriate subject matters but are unique in also providing distinctive methods mhich can be applied to other subjects. For a century and a half, historical method has increasingly dominated all branches of humanistic study and research, though, especially in literary criticism. there is some reaction against it based on an avowed desire to contemplate the work in itself and therefore in isolation. One may question how effective and lasting this reaction can prove, since so many of the materials of humanistic study belong to the past and demand their historical settings and explanations. Historical method has, of course, been applied outside the humanities and especially in the social sciences where history, because its special subject rnatter has so often been political, holds also an important place. But history in other of its departments has close affinities with the humanities: historical biography may be regarded as a form of literature, historiography as part of the theory of literature and indeed of knowledge, and the philosophy of history, from Hegel to Arnold Toynbee, as a branch of philosophy.

In the subdivision of subjects and distinction of disciplines, philosophy has lost psychology to the social (or perhaps, rather, to the natural) sciences and has come to share the theory of government with political science and the history of ideas with literature; but a large and vastly important territory remains its undisputed possession, including metaphysics, ethics and the history of philosophy in general. Moreover, philosophy has manifold contracts nith other disciplines. Like history it includes, as well as a subject matter, a method applicable to a wide range of subjects mhich it can thus. in a sense, appropriate. Commanding as it does the theory of knowledge in general, it deals on the theoretic level with aesthetics and the kind of knowledge involved in the arts and also with logic and the kind of knowledge involved in the sciences and social sciences.

Finally, philosophy, and it alone, is equipped to synthetize, still on the theoretic level, data supplied by all the other departments of the humanities and by the sciences and the social sciences as well. There is in the modern university a need, more often recognized than adequately met, for giving to the nonspecialist some insight into the philosophy and history of science, and such a course of instruction evidently requires the techniques of both philosophy and history or, in other words, the co-operation of the humanities, since its real subject would be the bearings of science on the life and thought of man.

Well into the 19th century the humanities, still mainly represented by Greek and Latin, constituted with mathematics the staple of liberal education. The 19th century, which witnessed a great

expansion of and within the humanistic disciplines, also witnessed the inevitable loss of their monopoly before the advance of the sciences and social sciences. These disciplines have indeed brought within the scheme of formal education knowledge essential to an understanding of the world we live in and useful for various practical ends; but (as Matthew Arnold observed in "Literature and Science") science is apt to content itself with the steady accumulation of knowledge, while the humanities have failed unless, in addition, they bring some accession of wisdom, some recognizable cultivation of intellect, imagination and sensibility, and some preparation for what the Greeks called the good life. This conception of the humanities and their role is true to the tradition from Cicero onward; but it sometimes invites misapprehension.

There has been a widespread feeling in the 20th century that the retreat of the humanities in education may have gone too far and fresh demands have been made upon them. Schemes of "general education" in some C.S. universities have apportioned time and effort between the humanities, the sciences and the social sciences as distinctive areas and forms of knowledge. In these schemes there has been perhaps a tacit assumption, little supported by the tradition of the humanities, that their concern is wholly with man as an individual and not at all with man as a social being. Nor do their varied subject matters easily lend themselves to an effort of united presentation, under what is in effect a new academic subject, designated "Humanities." Though not without its possible uses in general education, this effort is also a departure from the tradition of the humanities and carries some threat to the integrity of the separate subjects.

The gravest danger in the demands made upon the humanities, and the opportunities opening before them, lies in the possible misapprehension regarding their role, hinted above, and what that role entails. This misapprehension, in a word, is to suppose that the humanities can reach their end by indoctrination concealed as intellectual discipline. If the humanities are indeed normative, if they mold the mind and sensibility of the student and bring an accession of wisdom, it is by virtue of their subject matter, of the ideas which they present or evoke and the experiences to which they give him entry; and these ideas and experiences achieve their full effect only as they are examined critically, evaluated, and by the student made his own. See also EDUCATION, HISTORY OF; HIGHER EDUCATION: UNIVERSITIES. (A. S. P. W.)

HUMAN NATURE. Man has a nature, widespread and persistent, that is obviously characteristic of his kind and notably different from the natures of other living things. Yet there is no generally acceptable account including all principal aspects of this nature as one whole. The nature of man is familiar, impressively unique and almost indescribable. Common experience meets it daily; every considered system of thought or action declares or implies some view of it; none of the scholarly or scientific disciplines presents it in terms of all that common sense recognizes in it.

Different meanings have been attached to the phrase "human nature." Most commonly it refers to an original, inborn nature characteristic of all men or of this particular man or these particular men. So understood, "human nature" is man's special form of that which is biologically inherited in any and all species. It is, of course, an abstraction or inference, for very early it combines with "environment." and from the effects of experience becomes something else. This original, inborn, never directly observed nature has been variously conceived: as composed of distinguishable dispositions to specific behaviour (reflex and instinct); as powers or faculties of the mind; as something greatly or even infinitely plastic, or empty and formless.

Of those who see man's inborn nature in this last way, some have come to identify "human natures[x]—now plural—with the particular unique manifestations of mankind in local groups; each traditional group, or culture, has its own human nature, and no nature true of all peoples in this view can be asserted.

Similar to this conception in its identification of "human nature" with what is acquired through experience is that conception which, in contrast to the foregoing, asserts the reality of an acquired nature that is widespread or even universal. "Human nature" is then taken to be a resultant of man's characteristic experiences in any and all societies so far. Everynhere he lives and has lived in groups with similar basic necessities and activities, has known intimate and personal relationships, has recognized differences between people close to him and of his own kind, and other people farther away and of another kind. And so on. Those who so think of man's nature attempt to describe the states of mind and feeling that underlie the great local differences and that are everywhere similar.

Of these three principal ways of conceiving man's nature—as defined or vague inborn potentiality or necessity; as knowable only in its locally developed special forms; as a nature universally acquired or developed and common to all—various combinations can and have been made. For example, the Freudian view of man combines the first and third.

The view adopted as to what man is, essentially and generally, is connected with the thinker's moral judgments and with his position as to the possibilities and the methods of action and reform. He who strongly believes in the power of education or of learning or of conditioned response conceives of original nature as very modifiable. He who takes a pessimistic view as to the elimination of such man-caused evils as war and crime is likely to think of these mischiefs as rooted in particularities of an unalterable inborn nature.

In the everyday experience of the ordinary person the nature of man presents itself as states of mind and feeling, and as characteristic action, in or by the people he meets and deals with. He comes to know human nature through the persons he knows, their characters and conduct. Behind what they do he comes to recognize qualities that often do not surprise him. they are what he comes to expect of other human beings and not of cows or horses. People are proud, sensitive, eager for recognition or admiration. often ambitious, hopeful or despondent, selfish or capable of sacrifice of self. They take satisfaction in their achievements, sometimes feel guilt or shame, have within them a something called a conscience, are loyal or disloyal. The common-sense view of human nature sees it not as innate and inferable from certain behaviour, but as present, however originating, in the conduct of grown people all the time. This is that kind of human nature from which Walt Whitman turned away when he said he would live with the animals because

> They do not sweat and whine about their condition;
> They do not lie awake at night and weep for their sins;
> They do not make me sick discussing their duty to God:
> Not one is dissatisfied—not one is demented with the mania of owning things;
> Not one kneels to another, nor to his kind that lived thousands of years ago. . . .

This is the common conception of human nature that has given rise to ideas—however differently defined—of the inhuman and the superhuman. It implies a probable range of conduct that is "just what you expect" of people; conduct beyond that range is held to violate or exceed the normal expectancy.

These common attributions of man's nature as human are variously made so as to include or exclude some people but not others. More remote and exotic peoples may be denied full inclusion: they are "really not quite human." On the whole, persons who have experience and acquaintance with man's nature as seen in customs and institutions very unlike their own tend to recognize in such alien peoples a humanity common with their own. On the whole. in the course of history, the popular category "human beings" has widened, including more and more people, and recognizing local variants as nevertheless only variants of common humanity.

This view of man's nature is that which is developed and deepened through experience with persons and their conduct. The acquaintance and understanding are gained in part through imaginative works of the mind: biography, letters, novels, drama. Literature is the great storehouse from which to draw experience of the human. It provides a variety and scope that direct experience cannot. In meeting human beings in literature the reader encounters that same question as to the local and special, and the widespread or universal, about which the systematic thinker,

disciplined in a science or in philosophy, feels he must consider. Do the people presented in the Greek tragedies have the same human nature as those shown us by Shakespeare? In reading *War and Peace* and *The Tale of Genji,* we seem to see a human nature that is both different and the same. Though such impressions as to the universality and the variability of humanity do not submit to the procedures of a behavioural science, for those who think about them they seem to deepen and refine opinions, however imperfectly definable, as to the nature of man.

BRITANNICA ARTICLES ON MAN

The conception of man's nature discussed in the paragraphs above, a conception robust, full of content, ill-defined, is not the conception that is presented in this encyclopaedia. For the fragmentation of knowledge as it touches on the subject "man!' appears to have gone very far. This has often been remarked: "We have discarded eternal man and cut mutable man into pieces to be enquired into by different sciences. each of which claims autonomy. The pieces fit into one another less and less. A relatively immutable remnant, called human nature. is left to the care of a biology that speaks the language of physics and chemistry, In this language the animal we call Man is meaningless to himself." (Kurt Riezler. *Man, Mutable and Immutable,* p. vii. Henry Regnery Company. Chicago; 1951.) For the most part *Britannica's* articles present knowledge as it has got itself organized in science. scholarship and the arts. The formal disciplines—and here the scientific disciplines are especially in mind—have come to deal with those aspects of man's nature which lend themselves to organized method and more or less precise formulation. The subject matter "man" is not presented to the reader in any one article that would presume to say all that is important about that topic. but in many and separated articles relating to man, most of which approach that topic in that special way in which some discipline. more or less scientific, has found itself able to deal with it. Each such article presents some aspect of man, or conceives of man, for the purpose of the work of seeking knowledge that it performs, as if man corresponded to what that discipline has found it necessary or convenient to abstract from man as a whole. Many of these articles are less concerned with telling the reader of the nature of man. even as so specially conceived, than with telling him how that science thinks and talks and perhaps observationally or experimentally acts as to that aspect of man. Thus, ANTHROPOLOGY tells mostly of the kinds of questions asked by anthropologists in doing their work and of the ways of work of anthropologists. PSYCHOLOGY is largely concerned with the fields, schools and practical applications of that science or group of sciences. The article on PHILOSOPHY AND PHILOSOPHICAL STUDIES is not a source of information on the nature of man but of information as to what philosophers have thought and said. The kind of abstraction of man made by economists is set forth in ECONOMIC MAN. Such articles are about disciplines that have something to do with man; they do not directly describe the nature of man. Even articles that by their titles suggest discussions of some perhaps characteristically human quality or activity will be found not to be such. IKTROSPECTION deals with the use of that kind of mental activity in psychological research. IXTUITION distinguishes among meanings attached to that word in the discourse of philosophers. "Reason" is mentioned in many articles telling what particular philosophers thought of reason.

The nature of man is presented in *Britannica* as aspects of it appear in one organized way or another of studying and describing some component or aspect of that nature. Cnderstanding this, one may group articles according to the component or abstraction of man's nature that is chosen or emphasized. Emphasizing numerability, and disregarding everything characteristically human in favour of a few qualities that lend themselves to sorting people in very inclusive categories, such as age, sex and marital condition, one kind of specialist achieves orderly knowledge of POPULATION. But POPULATION ECOLOGY is little concerned with man. DEMOGRAPHY briefly defines a discipline concerned with more than population—with the statistics of the life conditions of man. Related articles are BIRTH RATE; DEATH RATE; DEATH (BIOLOGICAL) ; MIGRATIOK ; VITAL STATISTICS.

The largest single grouping of articles is that of articles which attend to those aspects of man's nature which he shares with the animals: his nature as a biological organism. Various parts of the somatic (body) or neural structure underlying that nature are described in ANATOMY, GROSS; SKELETON, VERTEBRATE ; NERVE; NERVOUS SYSTEM; BRAIN; EMBRYOLOGY, HUMAN ; HORMONES; and in articles mentioned in PHYSIOLOGY. The development of the species *Homo sapiens* is the subject of MAN, EVOLUTION OF; the methods of research used in reaching knowledge of this topic are indicated in ANTHROPOLOGY. The biological varieties into which man has come to be subdivided are described in RACES OF MANKIND.

These articles, in short, present man as biological structures and functions. So are animals seen for the most part. More widely, animal or man may be seen as behaviour: as types of activity visible to the observer and describable without reference to introspection or consciousness. The article BEHAVIOURISM presents this view in the science of psychology. ANIMAL BEHAVIOUR indicates that as observation of animals from this prevailing or necessary viewpoint has proceeded, investigators have come to see in animal behaviour some kinds previously associated with man; as symbolic behaviour and insight. But other psychologists recognize consciousness and make use of introspection in studying man as mental activity: the common subject matter of psychologists often otherwise widely differing. Many of the articles about psychology deal with methods of study used by psychologists (PSYCHOLOGICAL TESTS AND MEASUREMENTS; CONDITIONING), but others identify components of human mental behaviour that may or may not be shared by animals (CONCEPT FORMATION, PSYCHOLUGY OF; EMOTION; HABIT; LEARNISG; MEMORY; SENTIMENT; INTELLIGENCE; UNCONSCIOUS; THINKISG AND PROBLEM SOLVING, PSYCHOLOGY OF). The assemblage of such particulars of mental life into a kind of portrait of mankind is not attempted in these articles. One might look for it in PERSONALITY, the concept "which embraces all the functions of the individual." but this article is concerned largely with the ways in which particular personalities are studied or classified. A generalized description of the human personality, as contrasting with whatever personality may be ascribed to, say, chimpanzees, is perhaps not possible. Yet common sense recognizes a characteristic difference.

In most of these psychological articles the "man" in view is a developed adult. especially such as psychologists encounter in their laboratories of the west. Alan is also conceivable as a characteristic course of development, a "human career" from birth to death. Such a conception is implied in CHILD PSYCHOLOGY AXD DEVELOPMENT (where again it is a western child and a western society that tend to define the generalizations reached). The place of the universal human experiences in shaping man's nature is not, however; really presented in this or in other articles; DEATH (LEGAL ASPECTS), for example, refers only to the legal aspects of that event.

From man seen as a kind of mental life, consideration may move to man conceived as the forms of thought and feeling which widely occur and characterize him everywhere. This would yield some formulation of those impressions of man which common experience with people and conduct. and literature also, suggests. Such a possible formulation is barely suggested in SENTIMENT! hinted at in SOCIAL ANTHROPOLOGY and more fully indicated, but not achieved, in ETHICS and in ETHICS! COMPARATIVE (an evolutionary treatment of men's systems of values or principles of conduct).

Man's nature—thinking of it again as something developed in the usual course of experience—may also be thought of in terms of the usual or universal products of his nature and the usual or universal arrangements of his life. There is, however, no article on society or on community although almost all men live in societies and' communities, but some principal societal forms of man (social organization, marriage, kinship. social control, etc.) are discussed in FAMILY; MARRIAGE; CITY; KINSHIP; CLASS; and are briefly distinguished in SOCIAL AXTHROPOLOGY. Accounts of particular total arrangements of human life in cultures or civilizations can

hardly find room in an encyclopaedia; meanings of these terms are discussed in CIVILIZATION AND CULTURE. Other articles that deal from specialized points of view with aspects of collective human life that are widespread or universal have something to say as to those aspects: RELIGION presents a generalized primitive religion besides a separate account of the higher religions; ART tells first of western and then of oriental art. On the whole, such articles represent or take as a basis of comparison human productions in the western world.

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HUMAN **RIGHTS.** One of the main purposes of every legal system is to protect the individual against oppression. Ordinarily the rights of individuals are protected on the local level; in federations there is, in addition, federal machinery for their protection. In some cases. if no protection can be found domestically, recourse may be had to appropriate international institutions.

History.— The first international rules and procedures for the protection of human rights were developed in order to protect foreigners against abuse by local authorities. Many international tribunals and claims commissions throughout the 19th century established certain minimum standards for all nations to follow in the treatment of aliens. If a citizen of one nation suffers an injury because of a violation of one of these standards by the government or an official of another nation, the violating nation has a duty to pay reparation to the alien's nation.

A series of treaties concluded after World War I imposed upon several European countries special obligations for the protection of racial, religious and national minorities, and authorized the League of Nations to supervise the execution of these obligations. *(See* MINORITIES.)

While international law does not usually deal with relations between a country and its citizens, this rule ceases to apply when a nation's treatment of its population violates the dictates of humanity and justice or shocks the conscience of mankind. Thus, in the course of the 19th century. trade in African slaves came to be generally condemned and following the massacre of minorities in the middle east various remedial measures were taken by western nations. It was, however, the ruthless tyranny of the Nazi regime and the wholesale slaughter by the Germans of minorities and inhabitants of occupied territories that brought about a widespread insistence that human rights must be internationally protected.

Charter of the United Nations.— At the San Francisco conference of 1945, many delegations urged the inclusion of provisions concerning human rights in the charter of the United Nations; some proposed even that a detailed declaration of essential human rights be appended to the charter. While the latter proposal was sidetracked on the ground that such a declaration required careful drafting and there was no time for it at the conference, the charter did contain seven specific references to human rights.

The preamble to the charter reaffirms faith in "fundamental human rights." and art. 1 lists among the purposes of the United Nations: "To achieve international cooperation . . . in promoting and encouraging respect for human rights and for the fundamental freedoms for all without distinction as to race, sex, language or religion"; similar provisions are contained in the additional statements of purposes in art. 55 and 76 of the charter, which deal, respectively, with economic and social co-operation and trusteeship. The general assembly was empowered to initiate studies and make recommendations for the purpose of "assisting in the realization" of these rights and freedoms; and the Economic and Social council was authorized to make recommendations for the purpose of "promoting respect for. and observance of" these rights and freedoms and to set up a special commission "for the promotion of human rights" (art. 13. 62 and 68).

Finally, all members pledged themselves "to take joint and separate action in cooperation with the organization for the achievement" of "universal respect for, and observance of, human rights and fundamental freedoms for all without distinction as to race, sex, language or religion" (art. 55 and 56).

It may be noted that none of these provisions defined in precise terms the meaning of the phrase "human rights and fundamental freedoms." and that the task of the United Nations was limited to "promoting" and "encouraging" respect for, and observance of, these rights and freedoms. Consequently, it was argued that these provisions did not create any definite obligations and that the United Nations might not enforce them until they had been properly defined by supplementary instruments. It became important therefore to prepare such a definition immediately, and the United Nations Commission on Human Rights was entrusted with the preparation of two separate instruments: a declaration of general principles and a treaty containing binding obligations (the so-called Covenant on Human Rights).

Universal Declaration of Human Rights.— The declaration completed by the commission in June 1948 was adopted, after a few changes, by the general assembly at its Paris session on Dec. 10. 1948, by unanimous vote (the six members of the Soviet bloc and Saudi Arabia and the Union of South Africa abstained). The declaration was proclaimed by the assembly as "a common standard of achievement for all peoples and all nations, to the end that every individual and every organ of society, keeping this Declaration constantly in mind, shall strive by teaching and education to promote respect for these rights and freedoms and by progressive measures, national and international, to secure their universal and effective recognition and observance."

The declaration contained general definitions not only of those principal civil and political rights recognized in democratic constitutions, but also of several so-called economic, social and cultural rights. To the first group belong such rights as: life. liberty and the security of person; freedom from arbitrary arrest, detention or exile; right to a fair and public hearing by an independent and impartial tribunal; freedom of thought, conscience and religion; and freedom of peaceful assembly and association. Among the new items in the declaration were: right to social security; right to work; right to education; right to participate in the cultural life of the community; and right to enjoy the arts and to share in scientific advancement and its benefits.

Effect of the Charter and the Declaration.— The effect of the declaration is not entirely clear. On the one hand Charles Malik of Lebanon, one of its chief draftsmen, stated that the principles embodied in the declaration represent "what my government pledged itself to promote, achieve and observe" when it signed the charter, and that "the declaration continued and in a way supplemented the charter, and could not therefore be considered a mere resolution." (United Nations. *These Rights and Freedoms,* p. 15 (1550); General Assembly, *Official Records of the Third Session,* pt. ii, "General Committee," p. 32.) On the other hand, another of its authors, Mrs. Franklin D Roosevelt (United States), expressed the view that the declaration "is not a treaty; it is not an international agreement. It is not and does not purport to be a statement of law or oi legal obligation." The middle view would seem to be that the declaration, though not a binding instrument itself, makes more precise the obligations previously contracted in the charter.

Whether the charter itself has any binding force within the nations which are members of the United Nations, and whether its effect was strengthened by the adoption of the declaration, were also disputed points. In *Sei Fujii* v. *California* (38 Cal. 2d 718, 242 p.2d 617, 1952), the supreme court of California held that the charter and the declaration were not self-executing and that they could not therefore invalidate the California Alien Land law which forbade the acquisition of land by aliens. (The court held the law invalid, however, on other grounds.)

On the other hand, the general assembly considered that the charter obliged members to "promote" human rights and condemned those who violated such rights. It held, for instance, that certain legislative acts of the Union of South Africa were "contrary to the charter and the Universal Declaration of Human Rights" (resolution 719 [viii] of 1953); and that measures taken

by the Soviet Union to prevent Russian wives of citizens of other nationalities from leaving the union with their husbands were "not in conformity with the charter" (resolution 285 [iii] of 1949).

Covenants on Human Rights.—To ensure further the enforcement of national obligations with respect to human rights, the UN general assembly requested the Commission on Human Rights to prepare in treaty form two covenants, one dealing with civil and political rights and the other with economic, social and cultural rights. While the primary purpose of both covenants was to spell out in great detail the rights outlined in the declaration, they were intended also to provide more effective enforcement. For instance, nations accepting the covenant on civil and political rights would be obliged to adopt such legislative measures as might be necessary to give effect to the rights recognized in that covenant; and to ensure that any person whose rights were violated should have an effective remedy and that the competent authorities should enforce such remedies when granted. On the other hand, a party to the covenant on economic, social and cultural rights would be bound only to take steps to the maximum of its available resources, with a view to achieving progressively the full realization of the rights recognized in that covenant. Many difficulties were encountered in the drafting of the two covenants.

Protection of Human Rights in Europe.—Enforcement of human rights does not depend solely on the United Nations. Under the auspices of the Council of Europe, for instance. the nations of western Europe put into force the European Convention on Human Rights of Nov. 4, 1950 (together with a supplementary protocol of March 20, 1952). A European court of human rights was established in 1959 to enforce this convention, and individuals were allowed to bring complaints in the form of petitions to a European commission of human rights. Effective measures were thus provided for direct international protection of human rights.

See also CIVIL LIBERTIES.

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HUMAYUN (1508–1556), Mogul emperor of Delhi, succeeded his father, Baber, in India in 1530, while his brother Kamran obtained the sovereignty of Kabul and Lahore. Humayun was thus left in possession of his father's recent conquests, which were in dispute with the Indian Afghans under Sher Shah, governor of Bengal. After ten years of fighting, Humayun was driven out of India and compelled to flee to Persia through the desert of Sind, where his famous son, Akbar the Great, was born in the petty fort of Umarkot (1542). Sher Shah was killed at the storming of Kalinjar (1545); and Humayun, returning to India with Akbar, then only 13 years of age, defeated the Indo-Afghan army and reoccupied Delhi (1555). India thus passed again from the Afghans to the Moguls, but six months afterward Humayun was killed by a fall from the parapet of his palace (1556) and left his kingdom to Akbar. The tomb of Humayun is one of the finest Mogul monuments in the neighbourhood of Delhi.

See S. Ray, *Humayun in* Persia, Royal Asiatic Society of Bengal monograph series, vol. 6 (Calcutta, 1948).

HUMBER, an estuary on the east coast of England between the counties of Yorkshire and Lincolnshire and forming the outlet of the Ouse and Trent rivers. It consists of two sections, one running east for 18 mi. and a second southeast for 19 mi. to the North sea. The first is clearly the submerged course of a river which had cut its way across the chalk ridge near Hessle and entered the sea in Bridlington bay. The lower Humber follows a channel excavated by melt water through glacial deposits at a late stage in the Ice Age. The waters of the Humber are notoriously muddy, and much deposition is taking place along its shores, material washed southward from the clay cliffs of the Holderness coast being carried inland by the flood tide and dropped at slack water. The deep-water channel swings from shore to shore through the mud shoals. and its close approach to the north bank fixed the site of Kingston upon Hull as its major port. Grimsby (on the south bank) is less well placed in this respect, as the main channel is there well offshore. It comes closer at the coal port of Immingham, a few miles farther inland but also on the south bank. Goole, at the mouth of the Ouse and west of the Trent mouth, can be reached by a 22-ft. dredged channel and is the terminal of the Aire and Calder canal system which links Goole with Leeds and other west Yorkshire centres. In 1955 a wildfowl refuge of about 20 sq.mi. of water and tidal flats was made on the Humber to protect the roosting area of the pinkfoot geese. (T. HER.)

HUMBERT I (UMBERTO RANIERI CARLO-EMANUELE GIOVANNI-MARIA FERDINANDO EUGENIO) (1844–1900), king of Italy, son of Victor Emmanuel II and Adelaide, archduchess of Austria, was born at Turin, capital of the kingdom of Sardinia, on March 14, 1844. He had some education in constitutional law from the celebrated jurist P. S. Mancini, but for the most part he received the usual severe and rigid military education of his house. All his life he was first and foremost a soldier. Ignorant and untutored in all matters of culture, his early training left him predisposed toward the authoritarian and imperialist policy of a minister such as Francesco Crispi. Entering the army on March 14, 1858, as a captain, he was present at Solferino in 1859, and in 1866 commanded a division at Custozza. In April 1868 he married his cousin Margherita Teresa Giovanna, princess of Savoy, so carrying one stage farther the unwise tendency of his family toward intermarriage. On Nov. 11, 1869, Margherita gave birth to Victor Emmanuel, prince of Naples, afterward Victor Emmanuel III of Italy.

Ascending the throne on the death of his father (Jan. 9, 1878), Humbert adopted the style "Humbert I of Italy" instead of Humbert IV. The same sensible policy of making the monarchy more Roman and less Piedmontese led him to go against his father's wishes and bury the body of the *re galantuomo* at Rome in the Pantheon and not in the royal mausoleum of Superga. He himself always spoke with a strong Piedmontese accent, and indeed preferred to use not Italian but his own northern dialect, but he did much more than his parents to visit other areas of Italy and come in contact with other classes than the narrow court aristocracy; for a time he even lived in Naples, and there his son was born. Just after his accession, on entering Naples (Nov. 17, 1878), he was attacked by a fanatic named G. Passanante The king warded off the blow with his sabre, but Benedetto Cairoli, the prime minister, in attempting to defend him, was severely wounded.

Compared with the reigns of his grandfather, Charles Albert, and of his father, Victor Emmanuel, the reign of Humbert was tranquil, at least in its early years. Despite his father's great popularity, a popularity to which the less colourful character of Humbert could never aspire, there was a strong antimonarchical opposition which was inherited by the new king. On the left were the republicans and near-republicans who derived from Mazzini and Garibaldi; on the right were the clericals who were completely unreconciled to the Italian capture of Rome and the Papal States in 1870. Humbert maintained a firm attitude toward the Vatican and repeatedly asserted Italy's right to permanent possession of the Holy City. He and Queen Margherita did their best, with moderate success, to set up a sociable court life in Rome such as had been lacking in the previous reign, and so to win over Catholic society to the new order. Margherita was a strong and ambitious personality, indeed the only uncontestably regal character in modern Italian history. Although much neglected by her husband, she had a strong influence over him, and used this influence to make the monarchy a powerful ally in politics of the conservative right.

The royal prerogative was allowed special play in foreign policy and in the appointment of a foreign minister. Humbert approved the conclusion of the triple alliance, and in repeated visits to Vienna and Berlin established and consolidated the pact. He also refused to let his governments reduce the money spent on armaments. Latterly he tried to override parliament in his choice of prime ministers and became associated with a harsh policy of ruling by martial law. At one point the premiership and five ministries were in the hands of generals or admirals who had a sworn al-

legiance to the king personally. This was met by a dangerous upsurge of republicanism, and on July 29, 1900, Humbert was assassinated at Monza by the anarchist G. Bresci. (D. M. SH.)

HUMBLEBEE: *see* BUMBLEBEE.

HUMBLE PETITION AND ADVICE. This was a constitution devised by the second parliament of the English Protectorate (1656) to replace the Instrument of Government (*q.v.*). It was inspired by resentment at the rule of the major generals and marked a further return toward the ancient constitution. In its original form (March 1657) it offered the title of king to the protector, Oliver Cromwell, but this he refused after much hesitation. In its final form, with the modifications introduced by the Additional Petition and Advice (June 1657), it left him the title of lord protector, with power to name his successor. It vested authority in the protector, a privy council and a parliament of two houses, and gave the government an annual revenue of £1,300,000 of which £1,000,000 was assigned to the upkeep of the army and navy. Parliament was to meet at least once in every three years. Those who had abetted the rebellion in Ireland, who professed the Roman Catholic religion or who had fought against parliament and had not afterward given good testimony of their affection to the commonwealth were excluded from sitting in either house and from voting in the elections for the commons. No one elected to the commons was to be excluded except by a decision of the house itself. The "other house" was to consist of from 40 to 70 members nominated by the protector. The 21 members of the privy council were to be approved by both houses of parliament, whose approval was also required for the dismissal of a councilor and for appointments to most of the great offices of state. The control of the standing forces by land and sea was shared between the protector and parliament or, when parliament was not sitting, between protector and council; and the treasury was to account to parliament for the £1,000,000 allotted to these forces. The revenue of £1,300,000 per annum was not to be altered, nor were any other taxes to be raised, without consent of parliament. Finally, protector and parliament were to agree upon and "recommend" to the people a confession of faith "according to the rule and warrant of the scriptures"; but religious toleration was promised to all, with the serious qualification "that this liberty be not extended to Popery or Prelacy or to the countenancing such who publish . . . blasphemies or practise or hold forth licentiousness or profaneness under the profession of Christ." (R. B. WM.)

HUMBOLDT, ALEXANDER (FRIEDRICH HEINRICH ALEXANDER) BARON VON (1769–1859), German naturalist and traveler, was born at Berlin, on Sept. 14, 1769, son of a major in the Prussian army. His education devolved upon his mother, who was left a widow in 1779. His researches into the vegetation of the mines of Freiberg led to the publication in 1793 of his *Florae Fribergensis Specimen;* and the results of prolonged experiments on the phenomena of muscular irritability, then recently discovered by L. Galvani, were contained in his *Versuche über die gereizte Muskel- und Nervenfaser* (Berlin, 1797), enriched in the French translation with notes by Johann Blumenbach.

In 1794 he was admitted to the intimacy of the famous Weimar coterie, and contributed (June 1795) to Johann Schiller's new periodical, *Die Horen,* a philosophical allegory entitled *Die Lebenskraft, oder der rhodische Genius.* In 1790 he visited England with Georg Forster, the companion of Cook on his second voyage. In 1792 and 1797 he was in Vienna; in 1795 he made a geological and botanical tour through Switzerland and Italy. Meanwhile he had been appointed assessor of mines at Berlin, in 1792. He rapidly rose to the highest post in his department, and was entrusted with important diplomatic missions. After the death of his mother in 1796 he severed his official connections, to fulfill his desire to travel. He left for Marseilles with Aimé Bonpland, the botanist. hoping to join Napoleon in Egypt, but the two travelers eventually went to Madrid, where the unexpected patronage of the minister d'Urquijo determined them to make Spanish America the scene of their explorations.

They sailed in the "Pizarro" from Corunna, in 1799, stopped six days at Teneriffe for the ascent of the peak, and landed at Cumana. There Humboldt observed, on the night of Nov. 12–13, that meteor shower which forms the starting point of our knowledge of the periodicity of the phenomenon; thence he proceeded with Bonpland to Caracas; and in 1800 he left to explore the course of the Orinoco. He covered in four months 1,725 mi. of wild and uninhabited country, established the existence of a communication between the water systems of the Orinoco and Amazon and the exact position of the bifurcation. On Nov. 24 the two friends set sail for Cuba, and after a stay of several months regained the mainland at Cartagena. Ascending the Magdalena and crossing the Cordilleras, they reached Quito on Jan. 6, 1802. They made the ascent of Pichincha and Chimborazo, and an expedition to the sources of the Amazon en route for Lima. At Callao Humboldt observed (*c.* Nov. 9) the transit of Mercury, and studied the fertilizing properties of guano. the introduction of which into Europe was mainly due to his writings. After a year spent in Mexico, and a short visit to the United States, they returned (1804) to Europe.

In this expedition Humboldt laid the foundation in their larger bearings of the sciences of physical geography and meteorology. By his delineation (in 1817) of isothermal lines, he suggested the idea and devised the means of comparing the climatic conditions of various countries. He first investigated the rate of decrease in mean temperature with increase of elevation above the sea level, and afforded, by his inquiries into the origin of tropical storms, the earliest clue to the detection of the more complicated law governing atmospheric disturbances in higher latitudes; while his essay on the geography of plants was based on the then novel idea of studying the distribution of organic life as affected by varying physical conditions. His discovery of the decrease in intensity of the earth's magnetic force from the poles to the equator was communicated (Dec. 7, 1804) to the Paris institute. His services to geology were mainly based on his study of the volcanoes of the new world. He showed that they fell naturally into linear groups, presumably corresponding with vast subterranean fissures; and by his demonstration of the igneous origin of rocks previously held to be of aqueous formation, he contributed largely to the elimination of erroneous views.

After a short trip to Italy with Joseph Gay-Lussac to investigate the law of magnetic declination. and a sojourn of two and a half years in Berlin. he settled (1808) in Paris for the purpose of securing the scientific co-operation required for the arrangement of the material he had collected on his travels. This colossal task occupied him for 21 years, and even then remained incomplete. With the exception of Napoleon Bonaparte, he was the most famous man in Europe. Academies, both native and foreign, were eager to enroll him among their members. Frederick William III of Prussia gave him a court sinecure. He refused the appointment of Prussian minister of public instruction in 1810. In 1814 he accompanied the allied sovereigns to London. Three years later he was summoned by the king of Prussia to attend him at the congress of Aix-la-Chapelle. Again in the autumn of 1822 he accompanied the king to the congress of Verona, proceeded to Rome and Naples and returned to Paris in the spring of 1823.

In Paris Humboldt found scientific sympathy, and the social stimulus which his mind craved. When at last he received a summons to join the court at Berlin he obeyed regretfully. He never ceased to rail against the bigotry without religion, aestheticism without culture and philosophy without common sense, which he found dominant in Berlin. At first he sought relief from the "nebulous atmosphere" of his new abode by frequent visits to Paris; but as years advanced his excursions were reduced to accompanying the monotonous oscillations of the court between Potsdam and Berlin. On May 12, 1827. he settled permanently in the Prussian capital, where his first efforts were directed toward the investigation of the nature and law of "magnetic storms"—a term invented by him to designate abnormal disturbances of the earth's magnetism. His appeal to the Russian government in 1829 led to the establishment of a line of magnetic and meteorological stations across northern Asia; while his letter to the duke of Sussex, then (April 1836) president of the Royal society, secured for the undertaking the wide basis of the British dominions. Thus that scientific conspiracy of nations which is one of the noblest

fruits of modern civilization was by his exertions first successfully organized.

In 1811, and again in 1818, projects of Asiatic exploration were proposed to Humboldt, first by the Russian, and afterward by the Prussian government; but it was not until he had entered upon his 60th year that he resumed his early role of a traveler. Between May and Nov. 1829 he with Gustav Rose and C. G. Ehrenberg, traversed the Russian empire from the Neva to the Yenesei, traveling 9,614 mi. in 25 weeks. The journey was too rapid to be profitable. Its most important fruits were the correction of the prevalent exaggerated estimate of the height of the central Asian plateau, and the discovery of diamonds in the gold washings of the Ural.

Between 1830 and 1848 Humboldt was frequently sent on diplomatic missions to the court of Louis Philippe, with whom he always maintained cordial personal relations. The death of his brother. Wilhelm von Humboldt (*q.v.*), saddened the later years of his life. After the accession (1840) of Frederick William IV, Humboldt was more and more in demand at court, and was much hindered in his own work.

The first two volumes of the *Kosmos,* the great work of his life, were published, and in the main composed, between 1845 and 1847, the third and fourth between 1850 and 1858; a fifth appeared posthumously in 1862. The idea of a work which should convey not only a graphic description but an imaginative conception of the physical world—which should support generalization by details, and dignify details by generalization—had first taken shape in lectures in 1827–28. These formed. as his biographer expresses it, "the cartoon for the great fresco of the *Kosmos,*" and cover the whole scientific knowledge of the time. The supreme and abiding value of his work consists in its faithful reflection of the mind of a great man.

In 1857 Humboldt had a stroke. He died on May 6, 1859. Humboldt's early zeal for the improvement of the condition of the miners in Galicia and Franconia, his consistent detestation of slavery, his earnest patronage of rising men of science, bear witness to the large humanity which formed the groundwork of his character. The faults of his old age are shown in his letters to Varnhagen von Ense. The chief of these was his habit of smooth speaking, almost amounting to flattery, which contrasted with the caustic sarcasm of his confidential utterances. After every deduction has been made Humboldt was a great representative of the scientific side of the culture of his country.

The *Voyage aux régions équinoxiales du Nouveau Continent, fait en 1799–1804, par Alexandre de Humboldt et Aimé Bonpland* (Paris, 1807, etc.), consisted of 30 vol., and comprised subordinate but important works. Among these may be enumerated *Vue des Cordillères et monuments des peuples indigènes de l'Amérique,* 2 vol. folio (1810); *Examen critique de l'histoire de la ge'ographie du Nouveau Continent* (1814–34); *Atlas géographique et physique du royaume de la Nouvelle Espagne* (1811); *Essai politique sur le royaume de la Nouvelle Espagne* (1811); *Essai sur la géographie des plantes* (1805, now very rare); and *Relation historique* (1814–25), an unfinished narrative of his travels, including the *Essai politique sur l'île de Cuba.* The *Nova genera et species plantarum,* 7 vol. folio (1815–25), containing descriptions of above 4,500 species of plants collected by Humboldt and Bonpland, was mainly compiled by C. S. Kunth; J. Oltmanns assisted in preparing the *Recueil d'observations astronomiques* (1808); G. Cuvier, P. Latreille, A. Valenciennes and Gay-Lussac co-operated in the *Recueil d'observations de zoologie et d'anatomie comparée* (1805–33). Humboldt's *Ansichten der Natur* (Stuttgart and Tiibingen. 1808) went through three editions in his lifetime, and was translated into nearly every European language. The results of his Asiatic journey were published in *Fragments de géologie et de climatologie asiatiques,* 2 vol. (1831), and the *Asie centrale,* 3 vol. (1843)—an enlargement of the earlier work.

The publication of his *Briefe an Varnhagen von Ense* (Leipzig, 1860) was followed by *Briefwechsel mit einem jungen Freunde* (Berlin, 1861); *Briefwechsel mit Heinrich Berghaus,* 3 vol. (Jena, 1863); *Correspondance scientifique et littéraire,* 2 vol. (Paris, 1865–69); "Lettres à Marc-Aug. Pictet," published in *Le Globe,* tome vii (Geneva, 1868); *Briefe an Bunsen* (Leipzig, 1869); *Briefe zwischen Humboldt und Gauss* (1877); *Briefe an seinen Bruder Wilhelm* (Stuttgart, 1880); *Jugendbriefe an W. G. Wegener* (Leipzig, 1896); besides some other collections of less note. An edition of Humboldt's principal works was published in Paris by T. Morgand (1864–66). *See* also Karl Bruhns (and others), *Alexander von Humboldt, eine wissenschaftliche Biographie,* 3 vol. (1872, with bibliography, Eng. trans. by Lassell, 1873); Karl von Baer, *Bulletin de l'acad. des sciences de St.-Pétersbourg,* xvii, 529 (1859); R. Murchison, *Proceedings, Geog. Society of London,* vi (1859); L. Agassiz, *American Jour. of Science,* xxviii. 96 (1859); *Proc. Roy. Society,* x, xxxix; 4. Quetelet. *Annuaire de l'acad. des sciences,* p. 97 (Brussels. 1860); J. Madler, *Geschichte der Himmelskunde,* ii, 113; J. C. Houzeau, *Bibl. astronomique,* ii, 168. (A. M. C.; X.)

HUMBOLDT, WILHELM VON, BARON (1767–1835), German philologist, diplomat and man of letters, who mas the first to state clearly that the character and structure of a language express the inner life and knowledge of its speakers and that languages differ from one another in the same way and to the same extent as those who use them. He was born at Potsdam on June 22, 1767, the elder brother of Alexander von Humboldt. After studying at Berlin, Gottingen and Jena, in the last of which places he formed a close and lifelong friendship with Schiller, he married Karoline von Dacheroden, and in 1802 was appointed by the Prussian government first resident and then minister plenipotentiary at Rome. While there he published a poem entitled *Rom.* His critical essay on Johann Wolfgang von Goethe's *Hermann und Dorothea,* published in 1799, had already placed him in the first rank of authorities on aesthetics, and, together with his family connections, had much to do with his appointment at Rome. In the years 1795 and 1797 he had brought out translations of several of the odes of Pindar, which were also held in high esteem. On quitting his post at Rome he was made councillor of state and minister of public instruction. (*See* EDUCATION, HISTORY OF: *Germany.*) He soon, however, retired to his estate at Tegel, near Berlin, but was recalled and sent as ambassador to Vienna in 1812.

In 1813, as Prussian plenipotentiary at the congress of Prague, he was instrumental in inducing Austria to unite with Prussia and Russia against France; in 1815 he was one of the signatories of the capitulation of Paris, and drafted the treaty between Prussia and Saxony, by which Prussian territory was largely increased. In 1816 he was at Frankfurt, but was summoned to London in the midst of his work, and in 1818 had to attend the congress at Aix-la-Chapelle. The reactionary policy of the Prussian government made him resign his office of privy councillor and give up political life in 1819; and from that time forward he devoted himself solely to literature and study.

In 1816 he had published a translation of the *Agamemnon* of Aeschylus, and in 1817 corrections and additions to J. Adelung's *Mithridates,* that famous collection of specimens of the various languages and dialects of the world. Among these additions that on the Basque language is the longest and most important, Basque having for some time specially attracted his attention. Wilhelm von Humboldt introduced Basque to the notice of European philologists, and made a scientific study of it possible. He visited the Basque country itself, the result of his visit being the valuable "Researches Into the Early Inhabitants of Spain by the Help of the Basque Language" (*Prüfung der Untersuchungen über die Urbewohner Hispaniens vermittelst der vaskischen Sprache,* 1821). Another work on what has sometimes been termed the metaphysics of language was published in 1828 under the title of *Über den Dualis.*

The great work of his life, on the ancient Kawi language of Java, was interrupted by his death on April 8, 1835. The imperfect fragment was edited by his brother and J. Buschmann in 1836, and contains the introduction on "The Heterogeneity of Language and Its Influence on the Intellectual Development of Mankind," which was afterward edited and defended against H. Steinthal's criticisms by A. Pott (2 vol., 1876). This essay has been called the textbook of the philosophy of speech. Other linguistic publications of Humboldt, which had appeared in the *Transactions* of the Berlin Academy, the *Journal* of the Royal Asiatic society or elsewhere. were republished by his brother in a seven volume edition (1841–52). These volumes also contain poems, essays on aesthetic subjects and other creations of his prolific mind.

Many volumes of Humboldt's interesting correspondence with his contemporaries have been published, among them: with Schiller (1830), new ed. by A. Leitzmann (1880); with Goethe, ed. by F. Bratranek (1876); with J. R. Forster, ed. by Forster (1889); with F. H. Jacobi, ed. by A. Leitzmann (1892); with A. W. von Schlegel, ed. by A. Leitzmann (1908); with Karoline von Hum-

boldt. ed. by **A.** von Sydow, 3 vol. (1906–09); and a selection of letters to various correspondents, ed. by K. Sell (1924). A new edition of his *Gesammelte Werke,* 7 vol. (1841–52) was prepared for the Prussian Academy, 15 vol. (1903–18).

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HUME, ALEXANDER (*c.* 1560–1609), Scottish poet, one of the "last of the makaris," or native Scottish poets, of the 16th century. He was the second son of Patrick Hume of Polwarth, Berwicksbire. He probably studied at St. Andrews university, spent some years in France and, after practising law in Edinburgh and trying his fortune at court, was finally ordained, becoming minister of Logie, near Stirling, in 1597. He remained there until his death, Dec. 4, 1609. He wrote a few religious tracts and published his meagre collection of poems, *Hymnes, or Sacred Songs,* "written in rude Scottish," in 1599. Although he is remembered chiefly by one poem, the evocatively descriptive "Of the Day Estivall," his autobiographical "Epistle to Maister Gilbert Mont-Crief" is an interesting early example of the genre.

See *Poems of Alexander Hume,* ed by A. Lawson for the Scottish Text Society (1902), which also contains his prose tracts; R. M. Fergusson, *Alexander Hume . . . and His Intimates* (1899). G. M.)

HUME, ALLAN OCTAVIAN (1829–1912), English ornithologist and Indian administrator, son of Joseph Hume (*q.v.*), was born on June 6, 1829, and educated at Haileybury and London university. He had a distinguished career in the Indian civil service (1849–82). After his retirement he devoted himself to furthering the aspirations of Indians. The Indian National Congress (*see* INDIA: *History*), which first met at Bombay in 1885, owes its existence to him. He was the author of several works on ornithology and presented his collections to the British museum. He died at Norwood on July 31, 1912.

See W. Wedderburn, *Allan Octavian Hume C.B.; Father of the Indian National Congress* (1913); *Allan O. Hume: a Sketch of His Life and Services to India* (1912); and **H.** V. Lovett, *A History* of *the Indian Nationalist Movement* (1920).

HUME, DAVID (1711–1776), British philosopher, historian, economist and essayist who conceived of philosophy as the inductive science of human nature. He was the younger son of Joseph Hume, the modestly circumstanced laird of Ninewells, a small estate adjoining the village of Chirnside, about nine miles distant on the Scottish side from Berwick-upon-Tweed. The family seems to have had some remote connection with the earls of Home. David's mother, Catherine, daughter of Sir David Falconer, president of the Scottish court of session, was in Edinburgh when he was born, on April 26 (Old Style), 1711. In his third year death robbed him of his father. He entered Edinburgh university when he was about 12 years old and left it at 14 or 15, as was then usual. Pressed a little later to study law (in the family tradition on both sides), he found it distasteful. read voraciously in the wider sphere of letters and, through this intensity and the excitement of intellectual discovery, had a nervous breakdown in 1729 from which it took him a few years to recover.

In 1734, after trying his hand in a merchant's office in Bristol, he took the turning-point of his life, retiring to France for three years. Most of this time he spent at La Flèche in Maine, studying and composing *A Treatise of Human Nature.* Returning to England in 1737, he set about publishing the *Treatise* (books i and ii, 2 vol., London, 1739; book iii, 1740). The negligent reception of this his first and very ambitious work depressed him, but his next venture, *Essays, Moral and Political,* 2 vol. (Edinburgh, 1741–42), won some success. Perhaps encouraged by this, he became a candidate for the chair of moral philosophy at Edinburgh in 1744. Objectors alleged heresy and even atheism, pointing to the *Treatise* for evidence. Unsuccessful, he left the city, where he had been living since 1740, and began a period of wandering: a sorry year near St. Albans as tutor to the mad marquess of Annandale (1745–46); a few months as secretary to Gen. James Sinclair (d. 1762) throughout an abortive expedition to Brittany (1746); a little tarrying in London and at Ninewells; and then some further months with General Sinclair on an embassy to the courts of Vienna and Turin (1748–49). He was earning the money that he needed to get leisure for his studies. Some fruits of these studies had already appeared before the end of his travels: namely, a further *Three Essays Moral and Political* (London, 1748) and *Philosophical Essays Concerning Human Understanding* (London, 1748), the latter a rewriting of book i of the *Treatise* (with the addition of his notorious essay "Of Miracles") and better known as *An Enquiry Concerning Human Understanding,* the title that Hume gave to it in a revision of 1758. The *Enquiry Concerning the Principles of Morals* (London, 1751) was a rewriting of book iii of the *Treatzse.*

A settled spell followed (1751–63), spent in Edinburgh, with two breaks in London. It opened with an attempt to get him appointed as successor to Adam Smith (later to be his close friend) in the chair of logic at Glasgow. The rumour of atheism prevailed again. In 1752, however. he was made keeper of the Advocates' library at Edinburgh. There, "master of 30.000 volumes," he could indulge a desire of some years to turn to historical writing. His *History of England,* extending from Caesar's invasion to 1688, came out in six quarto volumes between 1754 and 1762, preceded by *Polztical Discourses* (Edinburgh, 1752). His recent writings had begun to make him known, but these two brought him fame, abroad as well as at home: there were two French translations of the *Discourses* as early as 1754; and of the *History* a French version was begun in 1760 and a German in 1762. In this period he also produced *Four Dissertations* (London, 1757), which he regarded as a trifle, although it included a rewriting of book ii of the *Treatise* (completing his purged restatement of this work) and an able study of "the natural history of religion." In 1762 James Boswell called Hume "the greatest writer in Britain," and Rome paid him the attention of putting all his writings on the *Index* in 1761.

The most colourful episode of his life ensued: in 1763 he left England to become secretary to the British embassy in Paris under the earl of Hertford. The society of Paris accepted him, despite his ungainly figure and gauche manner. He was honoured as eminent in width of learning, in acuteness of thought and in elegance of pen, and taken to heart for his simple goodness and cheerfulness. The salons threw open their doors to him, and he was even given a distinguished reception at court. For four months in 1765 he acted as chargé d'affaires at the embassy. When he returned to London at the beginning of 1766 (to become a year later undersecretary of state there) he brought Jean Jacques Rousseau with him and found him a refuge from persecution in a country house at Wootton in Staffordshire. This pathetic genius, under one of his delusions, suspected a plot, took secret flight back to France and spread a report of Hume's bad faith (*see* ROUSSEAU, JEAN JACQUES). Hume was partly stung and partly persuaded into publishing the relevant correspondence between them with a connecting narrative (*A Concise and Genuine Account of the Dispute between Mr. Hume and M. Rousseau,* London, 1766).

In 1769, somewhat tired of public life and of England too, he established a residence (he never married) in his beloved Edinburgh again, deeply enjoying the company, at once intellectual and convivial, of friends old and new and revising the text of his writings. He issued five further editions of his *History* between 1762 and 1773 (there was also a Dublin one, perhaps without his leave) and eight editions of his collected writings (omitting the *Treatise, History* and ephemera) under the title *Essays and Treatises* between 1753 and 1772, besides preparing the final edition of this collection, which appeared posthumously (1777), and *Dialogues Concerning Natural Religion,* held back under pressure from friends and not published until 1779. His curiously detached autobiography, *The Life* of *David Hume, written by Himself* (London. 1777; the title is his own) is dated 18 April 1776. After a long illness he died in his Edinburgh house on Aug. 25, 1776, and was buried on Calton hill. Adam Smith, his literary executor, added to the *Life* a letter that concludes with his judgment on his friend as "approaching as nearly to the idea of a perfectly wise and virtuous man as perhaps the nature of human frailty will

permit." His distinguished friends, with ministers of religion among them, certainly admired and loved him, and there were younger men indebted either to his influence or to his pocket. The mob had heard only that he was an atheist and simply wondered how such an ogre would manage his dying. How he did, Boswell, who visited him in his last illness, has told us.

Place in History. — That Hume was one of the major figures of his century can hardly be doubted. So his contemporaries thought, and his achievement, as seen in historical perspective, confirms that judgment, though with a shift of emphasis. Some hints of the reasons for the assessment may be given under four heads:

As a Writer. — Hume's style was praised in his lifetime and has often been praised since; but not so much in the 20th century. It seems in retrospect to be little, if anything, more than the style of his day at a high level of competence. It lacks individuality and the pulse of variety and power. Hume's quill never becomes a wing, nor does it ever plunge into depths; and the pathetic was beyond him, for he was always proudly on guard against his emotions. The touch is light, except on slight subjects, where it is rather heavy. Yet in his philosophical works — those later than the Treatise — he gives an unsought pleasure. Here his detachment, levelness (all on one plane), smoothness and daylight clearness are proper merits. It is as one of the best writers of scientific prose in English that he stands in the history of style.

As a Historian. — Library catalogues still list Hume as "Hume, David, the Historian." Between his death and 1894 there were at least 50 editions of his History; and an abridgement, The Student's *Hume* (London, 1859; often reprinted), remained in common use for 50 years. Though now outdated, its generations of readers entitle the History to be regarded as an event of cultural importance. Moreover, in its own day it was an innovation! soaring high above its very few predecessors. It was fuller and set a higher standard of impartiality. It saw in the nation the mental interests of the educated citizens as well as the deeds of kings and statesmen, as may be seen, for instance, in the pages on literature and science at the end of ch. iii under the Commonwealth and at the end of ch. ii under James II. It was unprecedentedly readable, in structure as well as in phrasing, persons and events being woven into causal patterns that furnished a narrative with the goals and resting points of recurrent climaxes. That was to be the plan and march of future history books for the general reader. No one. however, would place Hume near to Gibbon.

As an Economist. — Hame steps forward as an economist in the Political Discourses incorporated in Essays and Treatises as part ii of Essays *Moral,* Political and Literary. How far he influenced his friend Adam Smith, 12 years his junior, remains uncertain: they have broadly similar principles and both have the excellent habit of illustrating and supporting these from history. How far he was original is also uncertain: George Berkeley's Querist (1735–37) and some of the private correspondence of the period leave the impression that there was more economic sense alive than the histories of economic thought suggest. Still, in the eliciting of general principles, in sense of evidence and in lucidity of exposition. Hume wrote ahead of his day, though. unlike Smith. whose Wealth *of* Nations he just lived to see, he did not work out a system. His level of insight can be gathered from his main contentions: that wealth consists not of money but of commodities; that the amount of money in circulation should be kept related to the amount of goods in the market (two points made by Berkeley) ; that a low rate of interest is a symptom not of superabundance of money but of booming trade; that no nation can go on exporting only for bullion; that each nation has special advantages of raw materials, climate and skill, so that a free interchange of products (with some exceptions) is mutually beneficial; and that poor nations impoverish the rest just because they do not produce enough to be able to take much part in that exchange. He welcomed advance beyond an agricultural to an industrial economy as a precondition of any but the barer forms of civilization.

As a Philosopher. — This is the essential Hume, for even outside his philosophy all his serious work is either the seed or the fruit of his conception of philosophy as the inductive science of human nature, as well as of his philosophical conclusion that man is more a creature of sensitive and practical sentiment than of reason. It is also the Hume that has been most vigorously alive since his physical death. On the continent of Europe he is seen as one of the few classical philosophers of Great Britain, with only Francis Bacon and John Locke for company. For some Germans his title to fame is that by putting the problem of causal inference devastatingly he stung Immanuel Kant into creating the "critical" philosophy. He was one of the factors that led Auguste Comte to positivism. In Great Britain he has been and remains the symbol of a cause, of a type of philosophy that must be either exalted or disgraced. The Scottish school, from its beginning in his lifetime under Thomas Reid until Thomas Brown, recoiled from his sceptical treatment of belief in causality and in a material world, and the British Hegelian idealists attacked his empiricism and naturalism generally. His positive influence is instanced in Jeremy Bentham, confessedly moved to utilitarianism by book iii of the Treatise, and more extensively in J. S. Mill. By the middle of the 20th century he was again on his pedestal, regarded by the anti-metaphysicians in England as one of the few philosophers of the past still worth reading.

PHILOSOPHY

Theory of **Knowledge.**—Hume's conclusion is that no theory of reality is possible. His way to this conclusion is in both the Treatise (book i) and the Enquiry concerning *Human Understandzng.* The custom of expositors is to follow the former. on the true ground that it is more thorough and on the questionable supposition that the latter is merely a popular version of the former. Hume himself at the end of his life vehemently repudiated the Treatzse as juvenile, avowing that only his later writings presented his considered views. A brief summary can only follow the clearer lines of the *Enquiry.*

The basis is a twofold classification of objects of awareness, both classifications being derived from Locke and the second sharpened by Leibniz. In the first place, all such objects are either "impressions." ultimate data of sensation or of internal consciousness. or "ideas," derived from the data by compounding, transposing, augmenting or diminishing. That is to say, we do not create any ideas. From this Hume. again with Locke, infers a theory of meaning: a word that does not stand directly for an impression has meaning only if it brings before the mind an object that can be gathered from an impression by one of the mental processes mentioned. In this short way he dismisses the terms of metaphysics: all talk of a realm beyond experience has no content. Secondly, all objects of awareness are either "relations of ideas" or "matters of fact." Ideas can be held before the mind simply as meanings, and their logical relations to one another can then bedetected by rational inspection. The idea of a plane triangle, for example, entails the equality of its internal angles to two right angles, and the idea of motion entails the ideas of space and time. irrespective of whether there really are such things as triangles and motions. Only on this level of mere meanings, Hume asserts. is there room for demonstrative knowledge, which (unlike Locke) he arbitrarily restricts to ideas of quantity; *i.e.,* to mathematics. Matters of fact, on the other hand, objects believed to exist, come before us merely as they are, revealing no logical relations; their properties and connections have to be accepted as they are given. That primroses are yellow, that lead is heavy and that fire burns things are facts, each shut up in itself, logically barren. Each, so far as reason is concerned, could be different: the contradictory of every matter of fact is conceivable. Therefore, any demonstrative science of fact is impossible — as Locke had said, with less crispness and less relish.

From this unoriginal basis Hume takes his own way, developing his distinctive doctrine about causality. singled out because of its importance both in natural science and in practical thinking. The idea of causality is alleged to be of a necessary connection among matters of fact. From what impression. then, is it derived? But no logically necessary relation is discoverable among matters of fact. What, then, is the nature of causal inference? The two questions are obviously intertwined.

On the first question, Hume concurs with the occasionalists, with Locke and with Berkeley in observing no causal relation among the data of the "external" senses; in his own terms, the idea of causality has no impressional source there. Locke had found this internally, in the experience of willing: here we are directly aware of putting forth power, necessitating the next event. Hume disagrees: causal power is nowhere observed, for when we regard any events as causally connected, all that we do and can observe is that they frequently and uniformly go together. Now in this sort of togetherness it is a fact that the impression or idea of the one event brings with it the idea of the other. A habitual association is set up in the mind; and as in other forms of habit, so in this one, the working of the association is felt as compulsion. This *feeling,* Hume concludes, is the only discoverable impressional source of the idea of causality: in other words, when we assert, however carefully (as in natural science), a causal connection between any two objects, the sole experience or evidenced necessitation is not in them but in the habituated mind.

The second question has already been partly answered: causal inference is not rational detection but a habit-determined movement from one object to another. But there is a residual question, namely, the movement also of belief. When we see a glass fall, we not only think of its breaking but expect and believe this, or, starting from an effect, when we see the ground to be generally wet, besides thinking of rain we believe that there has been rain. Hume claims that he was the first to investigate the nature of belief. He uses this term in the narrowed sense of belief in matter of fact, in anything as existing. Belief is not, he notes, part of the content of ideas, since if it were it would be itself an idea and could then be joined at will to any other idea. He describes it as a sort of liveliness or vividness possessed by some of the immediate objects of awareness: originally by impressions and the simple memory-images of these. How does it come to belong to certain ideas? By association. Now this is the essence of causal inference: we pass from an impression to an idea regularly associated with it. Hume confidently asserts that in the process the aspect of liveliness proper to the impression infects the idea. He is almost thinking by analogy with the communication of motion by impetus. It is an odd theory that makes belief consist in a vividness of what is thought of instead of an attitude of the thinker (one consequence of it should be that "existing" means being believed) but, taken with his view of it as transferable by association. it enables him to formulate a theory of probability. Transferred belief varies in strength with the frequency and regularity of the association. The degrees of probability are the degrees of transferred belief.

What Hume was doing falls within what we would now call the psychology of cognition: he has been trying to describe how the mind works in acquiring what passes for knowledge, or, more particularly, how it derives ideas from impressions and infers from given facts to ideas believed also to be facts. He claimed to have shown that there can be no knowledge of anything beyond experience; that reason can work only with bare meanings, not with facts. or, in other words, cannot infer anything from any facts. since no particular causal law, nor the general law of causality (that every event has a cause), nor the law of uniformity (that every cause always has the same effect) has a shred of logic in it; that causality can be known only as a feeling attending frequent and regular association; and that causal inference is merely such association. What he has not claimed to prove is that the propositions (1) that events themselves are causally related and (2) that they will be related in the future in the same ways as they were in the past are false. He firmly believed both these propositions and insisted that everybody else does, will continue to do and must do in order to survive. They are natural beliefs, inextinguishable propensities (here Hume slips back into taking belief as an attitude) of our nature, madness apart. What he has claimed to prove is that they are not got and cannot be illuminated either by empirical observation or by reason whether intuitive or inferential. Reflection shows that there is no evidence for them and shows also both that we are bound to believe them and that it is sensible or sane to do so. This is Hume's scepticism: it is an affirmation of that tension. a denial not of belief but of evidence. Some of our knowledge of what exists is merely given, the rest of it is not logically inferred, yet it is believed and deserves to be believed. He was fond of saying that we should be grateful to nature for giving us the knowledge we need through "a species of instinct or mechanical power" (association) instead of leaving us to so narrow a faculty as reason.

In the *Treatise* (book i) the arguings of the *Enquiry* had proceeded with divagations and applications which do indeed exhibit Hume's flair for seeing problems and his acuteness in following them out (making it a fertile textbook for students) but leave the reader wondering where Hume stands. The *Treatise* is badly constructed, in parts over-subtle, confusing because of ambiguity in important terms (especially "reason") and marred by willful extravagance of statement and rather theatrical personal avowals. His mature condemnation of it was only severe, not misplaced. Since, however, that single book i has been more read in academic circles than any other of his writings, a summary must be given of its treatment of some topics that are omitted from. or merely hinted at, in the *Enquiry.* First, on the relation of the impressions of the "external" senses to reality, Hume, convinced by the current doctrine that such impressions are all within the sensing mind, rejects as fruitless all attempts to argue from them to continuing material things outside the mind: the sensations are our ultimates; and the theories that pretend to justify our belief in an external world are incoherent and unverifiable, whereas the belief itself is indispensable for practice and in fact ineradicable. Secondly, he continues Berkeley's polemic against the possibility of abstract ideas and general entities and (at much length) against the infinite divisibility of space and time. Thirdly, the idea of substance, as something underlying, producing and holding together all the observable properties of a thing, is discarded. Locke had exposed the extreme thinness of the idea of material substance; Berkeley had dismissed it as empty; Hume dismissed along with it the idea of mental substance. As for a self, if there is one it should be observable, but nothing is observable except particular and momentary impressions and ideas. A mind is known only as a "bundle" of punctual experiences; we suppose it to be a unity because of the felt smoothness of the transitions which imagination effects from point to point. In an appendix published a year later (at the end of book iii) Hume frankly condemns as one-sided his treatment of the problem of the self, summarizes the opposite side as equally cogent and claims the right of a sceptic to leave the matter there. He never returned to it in print. Once more he finds critical reflection at variance with itself. Surprisingly. in book ii, on the "passions," he openly uses the idea of a self: and in book iii he seems to take it for granted.

Theory of Morals.—When Hume passes from the study of knowing to the study of living, another character seems to come into play. He is still whittling down the pretensions of reason, but no longer enjoying the business of displaying reason as divided against itself. He writes as a man having the same engagements as his fellows, anxious both to elucidate and to defend them. The subject occupies book iii of the *Treatise,* more than half of the space being given to justice. The substance of the book was re-expressed in a more balanced form in the *Enquiry concerning the Principles of Morals.* If we take his confession about this two years later, "I have a partiality for that work," and his judgment at the end of his life, "Of all my writings incomparably the best," along with many other indications in his *History,* essays and letters: we may well suspect that he regarded himself chiefly as a moralist.

The total evidence strongly suggests that the traditional view of his character (a detached scoffer, everywhere a sceptic) and of his ruling purpose (desire for literary fame) is deeply wrong. The priority of his moral interest has been shown by N. K. Smith to provide an illuminating clue to some of the glaring inconsistencies within the *Treatise* as a whole.

In ethics Francis Hutcheson is Hume's general guide, behind whom stands the 3rd earl of Shaftesbury. and the impress of

Joseph Butler is evident: but he achieves, as in his theory of knowledge, a striking originality. He keeps to his rule of studying what human nature can be observed to be. Defining morality as those qualities that are approved (1) in whomsoever they happen to be and (2) by virtually everybody, he sets himself to discover the broadest grounds of the approvals. He finds them, as he found the grounds of belief, in "feelings," not in "knowings." No single *summum bonum* or single faculty of moral reason or sense, or single moral propulsion, emerges, but four types of human merit and four corresponding "moral sentiments." Qualities are valued either for their utility or for their agreeableness, in each case either to their owners or to others.

Utility or usefulness means the fitness or natural tendency of anything to serve an end, if the end is regarded as good. Hume takes special pains to prove that justice—still taken in Locke's sense as the honouring of property-rights—owes its merit entirely to its "public utility"; *i.e.*, to its being conducive to the weal of society. It might be rhetorically, but is not scientifically ultimate: it is not to be set among the original biases which Hume is trying to track down as the general sources of behaviour and judgment. It cannot be original because property is not; because it would be unrequired if nature's bounty were so great that everybody could take what he pleased without robbing anybody else; and because it would be impossible if the weal of society were not itself desired or admired as an end. It has an external condition (the distinction of property) and an internal condition (esteem for the public good), and when these are present it arises so naturally that it is not to be classified as merely conventional. Within our nature; then, the irreducible source is concern for the good of others, of which justice is an impersonal and institutionalized form and benevolence a freer form, operating among individuals and over a sphere wider than property. This regard for others, according to Hume, accounts for the greater part of morality. He was continuing the reaction of Shaftesbury, Butler and Hutcheson against the egoism of Hobbes. Altruism is not analyzable into a covert care for oneself.

A second group of esteemed qualities is characterized by usefulness to those who have them; *e.g.*, diligence and frugality. Our approval of them cannot be attributed to self-love, since we approve them in others even when we ourselves are not beneficiaries—another stream from the spring of concern for others. True, some of them, for example honesty and truthfulness, are praised for their usefulness to others as well as to those who have them. The doubleness here of the ground for esteem is a general fact of experience, not to be argued away with a theoretical preconception that one of the grounds must be collapsible into the other: we do like a man to be industrious for his own sake. In this group Hume includes such goods as advantages of birth, wealth and figure (handsomeness), expostulating that the distinction of virtues and what he calls "talents" is merely verbal. If he is wrong here, it is because his starting-point, the qualities that we admire, is too wide for ethics.

Further, Hume records, there are some qualities, such as cheerfulness and courage, which we approve because they are felt as pleasant by their owners, again whether these be ourselves or others. Like the preceding type, this third one also benefits others, but our esteem is irrespective of this fact. Benevolence is an instance: Hume says that our chief reason for regarding it as good is its utility to others, but that we do as well find it intrinsically attractive. However, their tendency to benefit others leads Hume to refer the first and third types to a common source, which he calls "a sentiment of humanity," linking with this "social sympathy."

The fourth type consists of qualities, for instance modesty and good manners, which are approved, whether in ourselves or in others, simply because they are agreeable or attractive to others. Of this type, Hume remarks, nothing more can be said than that it "must be trusted entirely to the sure but blind testimony of taste and sentiment! and must be considered as a part of ethics left by nature to baffle all the pride of philosophy, and make her sensible of her narrow boundaries and slender acquisitions."

Hume is clearly not a utilitarian in the Benthamite sense. His system is more nearly eudaemonism—the happiness of others (without any such formula as "the greatest happiness of the greatest number") *and* the happiness of self. Like Butler: he contends that these two do not conflict. His emphasis is on altruism: of the four moral sentiments which he claims to find by inductive classification, he traces the first three to a sentiment for and a sympathy with our fellows. It is our nature, he maintains, to laugh with the laughing and to grieve with the grieved and to seek the good of others as well as our own. It is also our nature to find certain human qualities intrinsically good, and this takes him beyond eudaemonism. How is this nature to be accounted for? It cannot be, is his reply, since any attempt would take us into the vacuum of metaphysics.

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HUME, JOSEPH (1777–1855), British politician, was born on Jan. 22, 1777, of humble parents, at Montrose, Scot. After completing his course of medical study at the university of Edinburgh he sailed in 1797 for India, where he made a fortune. In 1812 he purchased a seat in parliament for Weymouth and voted as a Tory. When upon the dissolution of parliament the patron refused to return him he brought an action and recovered part of his money.

Six years elapsed before Hume again entered the house, and during that interval he adopted the doctrines of James Mill and the philosophical reformers of the school of Jeremy Bentham. He joined Francis Place (*q.v.*) and others in seeking to establish schools for them on the Lancastrian system, and promoting the formation of savings banks.

In 1818, soon after his marriage with Miss Burnley, the daughter of an East India director, Hume was returned to parliament as member for the Border burghs. He was afterward successively elected for Middlesex (1830), Kilkenny (1837) and for the Montrose burghs (1842).

Hume became the self-elected guardian of the public purse, by challenging and bringing to a direct vote every single item of public expenditure. It was he who caused the word "retrenchment" to be added to the Radical program "peace and reform." He fought the old combination laws that hampered workmen and favoured masters; he brought about the repeal of the laws prohibiting the export of machinery and of the act preventing workmen from going abroad.

Hume constantly protested against flogging in the army, the impressment of sailors and imprisonment for debt. He took up the question of lighthouses and harbours; in the former he secured greater efficiency, in the latter he prevented useless expenditure. He died on Feb. 20, 1855.

HUMIDITY, ATMOSPHERIC. The atmosphere is made up of a number of gases, of which water vapour is in many respects the most important. This importance arises from the fact

that water vapour is the only constituent of air whose state changes at the temperatures encountered in the atmosphere. Water substance occurs as a vapour (invisible), as a liquid (fog, cloud and rain droplets) and as a solid (ice crystals, hail and snowflakes). The subject of atmospheric humidity deals only with water in its vapour state.

There is an upper limit to the amount of water vapour which a given space can contain, this upper limit depending oniy on the temperature of the vapour. At low temperatures the amount is small; at high temperatures it is large. The presence of other gases does not appreciably affect this relationship. When a given space contains the maximum amount of water vapour, the vapour is said to be saturated; air containing saturated vapour is also loosely but commonly referred to as saturated. From the foregoing, it follows that the amount of water vapour present near the earth's surface is nearly always greater than that in the cooler upper air; similarly, near the surface, the amount is greater in equatorial than in polar regions. The propoftion of water vapour in air is small but variable; it ranges from a very small fraction of 1% to nearly 3%. The processes by which water substance changes from one state to another, and the influence of the variability of the concentration of water vapour in the atmosphere, form the subject matter of many studies of weather phenomena.

There are several ways of expressing the water vapour content of air:

1. The relative humidity gives the amount of water vapour present in a volume of air as a percentage of the maximum possible amount in that volume at the same temperature. For example, a relative humidity of 25% means that one-quarter of the maximum amount is present; one of 100% indicates that the air is saturated. The relative humidity depends on the temperature as well as on the vapour content, falling as the former rises, and vice versa.

2. The absolute humidity specifies the mass of water vapour in unit volume of air. It also changes mith the temperature.

3. The humidity mixing ratio is the mass of water vapour per unit mass of the dry components of the air.

4. The specific humidity is the mass of water vapour per unit mass of air.

The difference between the numerical values of the humidity mixing ratio and the specific humidity of any mass of air is slight, and for most purposes the two are used interchangeably. These two quantities are especially useful in weather analysis, for they do not change with temperature but only when water vapour is added to or removed from the air, as by evaporation or condensation. or by mixing with moister or drier air.

Related to these measures of moisture content are the dew point and the wet-bulb temperature. The dew point is the temperature at which condensation commences when air is cooled at constant pressure and constant vapour content. The met-bulb temperature may he defined as the lowest temperature to which air can be cooled by evaporating water into it, the air itself supplying the heat necessary for the process. The former quantity is useful because it remains constant as long as water vapour is neither added to nor removed from the air, and the latter because it does not change when evaporation or condensation occurs in the air. The dew point is always lower than the met-bulb temperature except uhen the air is saturated, in which case the two coincide with the existing air temperature.

Both of these quantities find numerous applications in aeronautical meteorology. especially in cloud and fog forecasting. The dew point is useful for forecasting the height of the base of certain types of clouds. For example, the height of the base of the cumulus (woolpack) clouds which often develop during a summer afternoon may be predicted approximately from the formula

$$\text{height of base (in feet)} = 225\ (T\text{-}T_d)$$

where T is the temperature and T_d the dew point of the air near the surface, both in degrees Fahrenheit. For example, if it is expected that the spread between the tuo temperatures will be 10° F. during the afternoon, a cloud base height of 2,250ft. would be forecast. The heights of the bases of some other types of low clouds may be predicted in the same way. The wet-bulb temperature aloft is especially useful for studying the vertical stability of the atmosphere, which governs the formation and vertical extent of a number of types of clouds.

The determination of the humidity of the atmosphere is known as hygrometry. The first hygrometer! invented by Leonardo da Vinci about 1500, was based on the principle that certain substances, known as hygroscopic, have an affinity for water vapour and absorb it readily. With Leonardo's hygrometer the humidity was measured by weighing a ball of wool, which absorbed varying amounts of water vapour, large when the atmospheric humidity was high and small when it was low. Other instruments were later devised, depending on various principles. Horace Benedict de Saussure, in 1783, described a hygrometer which utilized a human hair, freed from grease. The hair lengthened with increasing humidity and shortened with decreasing humidity. In 1802, C. W. Boeckmann made measurements of humidity by comparing the readings of two thermometers, one with its bulb dry and the other wet. The lower the humidity relative to that for saturation, the greater was the spread between the two temperatures. Improving on a technique suggested earlier (1822) by Johann Wolfgang Dobereiner, Henri Victor Regnault in 1845 measured the dew point. A highly polished silver cylinder was cooled until dew formed on it and the temperature of the cylinder noted when this happened, thus giving the dew point. Refinements of these basic methods were made later.

Hygrometers may be divided into five types, according to the basic principles employed:

1. The evaporation method. The wet- and dry-bulb instrument, known as a psychrometer. is essentially the same as Boeckmann's hygrometer, described above. In one type the wet bulb is covered with muslin, which is kept moist by a wick extending to a vessel containing water. A steady flow of air past the wet bulb is necessary for accurate measurements. The sling psychrometer consists of two thermometers in a frame, with muslin covering the bulb of one. The latter is dipped in water and the assembly then whirled vigorously. The relative humidity corresponding to the wet- and dry-bulb temperatures is found from tables.

2. The condensation method. The dew-point hygrometer is based on Regnault's instrument. A thermometer is set up with its bulb in the polished silver cylinder, which contains ether. Air is bubbled through the ether. which cools by evaporation. The temperature at which water vapour starts to condense on the outside of the cylinder. as read by the thermometer, is the dew point. Comparison with the air temperature from another thermometer gives, mith the aid of tables. the relative humidity. Through the use of a photoelectric cell sensitive to dew formed on the reflecting surface, it is possible to balance the temperature at the dew point through direct or induction heating, and thus provide a recording dew-point hygrometer.

3. The hygroscopic method. The dimensions of certain substances. known as hygroscopic, vary with the relative humidity. Human hair has this property, increasing in length by about 2½% as the relative humidity rises from 0% to 100%. In the hair hygrometer, the relative humidity is obtained directly as a function of the length of the hair. Many household hygrometers are of this type. Sometimes goldbeater's skin is found more satisfactory than a hair. The chief disadvantage of hygrometers of this type is the slowness of their response in changing humidity at very low temperatures.

4. The chemical method. With the chemical hygrometer, a given quantity of air is exposed to a drying agent which absorbs the water vapour present; the humidity of the air is obtained by comparing the weight of the drier after absorption has occurred with that before, or by a similar means. The weighing method is the most accurate known but is not suitable for routine meteorological observations.

5. The electrical method. The electrical resistance of certain substances varies with the amount of moisture absorbed by them; lithium chloride is one of these. In one type of electrical hygrometer, measurement of the resistance of a film of lithium chloride permits the evaluation of the relative humidity. This instrument is used mainly for studies of the upper air.

An instrument which records the humidity is called a hygrograph. Most hygrographs depend on the hygroscopic principle, for the variations in the length of a hair are readily magnified and recorded on a revolving drum.

One of the factors governing human comfort is the relative humidity of the air, for it, in part, determines the rate at which perspiration evaporates, with its resultant cooling effect. No single optimum humidity can be given, for the moisture content of the air must be considered in conjunction with its temperature and movement. It is possible, with air conditioning of buildings, to control indoor conditions for maximum health and efficiency. Estimates of the best conditions vary for different countries. Thus in Great Britain an indoor temperature of 65° F. with a relative humidity of 50% to 60% is considered ideal, whereas in the United States and Canada a temperature of 72° F. with a relative humidity from 40% to 60% is preferred. Air conditioning is also of great importance in many industrial plants. To take one example only, printing establishments find humidity control in pressrooms and paper storage rooms helpful, for the properties and dimensions of paper vary with the relative humidity of the air. Most papers are handled with a minimum of trouble when the relative humidity is between 40% and 50%.

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HUMILIATI, the name of an Italian monastic order created in the 12th century. Its origin is obscure. A group of Lombards came to Rome with the intention of obtaining the pope's approval of the rule of life which they had spontaneously chosen; while continuing to live in their houses in the midst of their families, they wished to lead a more pious existence than of old, to abandon oaths and litigation, to content themselves with a modest dress, and all in a spirit of Catholic piety. The pope approved their resolve to live in humility and purity, but forbade them to hold assemblies and to preach in public; the chronicler adding that they infringed the pope's wish and thus drew upon themselves his excommunication. Their name Humiliati ("Humiles" would have been more appropriate) arose from the fact that the clothes they wore were very simple and of one colour. This lay fraternity spread rapidly and soon put forth two new branches, a second order composed of women, and a third composed of priests. to which Innocent III granted a rule. His object was to reconcile the order with the Waldenses (*q.v.*), and, indeed. the rule reproduces several of the Waldensian propositions, ingeniously modified in the orthodox sense, but still very easily recognizable. It forbade useless oaths and the taking of God's name in vain; allowed voluntary poverty and marriage; regulated pious exercises; and approved the solidarity which already existed among the members of the association. Finally, by a singular concession, it authorized them to meet on Sunday to listen to the words of a brother "of proved faith and prudent piety," on condition that the hearers should not discuss among themselves either the articles of faith or the sacraments of the church. The bishops were forbidden to oppose any of the utterances of the Humiliati brethren, "for the spirit must not be stifled." So broad a discipline must of necessity have led back some waverers into the pale of the church, but the tradition of the independent Humiliati is confused with the history of the Waldenses throughout the later 12th century. Pius V suppressed the entire congregation in 1570–71. (P. AL.; X.)

HUMITE, a group of four related minerals consisting of basic magnesium fluosilicates: chondrodite, clinohumite, humite and norbergite. The four minerals are strikingly similar in appearance and are best distinguished by their optics and X-ray powder diffraction patterns. They are honey-yellow to brown or red in colour and have a vitreous to resinous lustre; hardness 6–6.5; specific gravity 3.1–3.2. The name humite, after Sir Abraham Hume (1749–1839), was given in 1813 to the small and brilliant honey-yellow crystals found in the blocks of crystalline limestone ejected from Monte Somma, Vesuvius; all but norbergite have since been recognized at this locality. Chondrodite (from the Greek word for a grain) was a name early in use for granular forms of these minerals found embedded in crystalline limestones in Sweden, Finland and at several places in New York and New Jersey. Large hyacinth-red crystals of all four species are associated with magnetite in the Tilly Foster iron mine at Brewster, N.Y.

The minerals have the formulas: norbergite, $Mg(F,OH)_2.Mg_2SiO_4$; chondrodite, $Mg(F,OH)_2.2Mg_2SiO_4$; humite, $Mg(F,OH)_2.3Mg_2SiO_4$; and clinohumite, $Mg(F,OH)_2.4Mg_2SiO_4$. Norbergite and humite are orthorhombic, the others monoclinic in crystallization. The lengths of the vertical axes are in the ratio 3:5:7:9, and this is also the ratio of the number of magnesium atoms present in each of the four minerals. Such a relation between the crystallographic constants and the chemical composition is known as a morphotropic relation. Structurally, the minerals consist of interleaved layers of the olivine (Mg_2SiO_4) structure and of brucite, $Mg(OH)_2$. The stacking sequence of these layers determines the compositional and crystallographic relations observed. (CL. F.)

HUMMEL, JOHANN NEPOMUK (1778–1837), German composer and pianist, was born on Nov. 14, 1778, at Pressburg, in Hungary. In 1785 his father became conductor at Schikaneder's theatre in Vienna. Schikaneder was a friend of Mozart and the librettist of the Magic *Flute*, .and introduced Hummel to Mozart who gave the boy instruction for two years. At nine years of age Hummel toured Europe with his father as a "Wunderkind"; when he was 11 he began to compose. After his return to Vienna he completed his studies under Albrechtsberger and Haydn; and at a later period he learned song writing from Salieri. From 1804 to 1811 he was Kapellmeister to Prince Eszterhazy. Beethoven's Mass in C was performed in 1810, and a remark passed by Hummel caused an estrangement between the two which was only healed just before Beethoven's death. The years 1811 to 1815 were spent in Vienna, and after the peace Hummel began to tour Europe as pianist and conductor, having enormous success everywhere. He died in 1837 at Weimar, where for a long time he had been the musical conductor of the court theatre. Hummel wrote, among other things, several operas, both tragic and comic, and two grand masses (Opus 80 and Opus 111). More important are his compositions for the pianoforte (his two concertos in A minor and B minor, and the sonata in F sharp minor), and his chamber music (the celebrated septet, and several trios, etc.). His experience as a player and teacher of the pianoforte was embodied in his Great Pianoforte School (Vienna), and the excellence of his method was attested by his pupils, Henselt and Ferdinand Hiller. Hummel continued the traditions of the earlier Viennese school of Mozart and Haydn; his style alike as pianist and composer was marked by purity and correctness rather than by passion and imagination.

HUMMINGBIRD, any of numerous small birds confined to the Americas and constituting the family Trochilidae, placed with the swifts (*q.v.*) in the order Apodiformes. They include the smallest of all birds, famous for the rainbow colours and delicate intermediate shades of the brilliant iridescent plumage of the males, which may also have striking crests, neck tufts and remarkably elongate tail feathers. Like the swifts they have short legs and small feet, narrow wings and long primaries. The extreme development of breastbone and keel is associated with rapid wingbeat, so fast as to appear a blur in smaller species. The bill is slender, usually straight, from two-fifths inches to five inches long, or curved in a third of a circle in the sicklebilled hummingbird (Eutoxeras aquila) of Costa Rica to Ecuador. The unusually developed tongue probes tube flowers for tiny insects and nectar as the bird balances in mid-air. The bird must move backward in flight to remove its bill from the flower and dart away in humming flight. The voice is weak, the song chippering, unmusical. The nest is a solidly built little cup of vegetable down, plant fibres and spider webs, in some species decorated with bits of lichens; usually less than an inch across the cavity, it contains two tiny elliptical white eggs. Parents are pugnacious in protecting eggs or young.

The smallest bird in the world is the fairy or Princess Helen's hummingbird (Calypte *helenae*) of Cuba, body two inches long and

bill two-fifths inches, its nest cavity three-fourths inches across and eggs three-tenths inches long. The vervain or verbena hummingbird (Mellisuga minima) of Jamaica and Hispaniola, also weighing less than 2 g.. has a slightly longer wing. The largest hummingbird is Patagona *gigas,* eight and one-half inches long in the Andes from Ecuador to Chile. About 325 hummingbirds are grouped in 123 genera, of which 72 have only 1 and 21 have 2 species each. The largest genus is *Amazilia,* with about 28 species from Brazil to Mexico. two (*A.* tzacatl and *A.* yucatanensis) reaching the lower Rio Grande valley of Texas. The plain-coloured hermits (Phaethornis), 22 species, range from Mexico through Brazil.

Hummingbirds range from Alaska to Tierra del Fuego, from lowlands to snowline at 16,000 ft, in Ecuador. Centre of abundance of species and numbers is in Colombia. The ruby-throat (*Archilochus colubris*) is the only one in eastern North America, the black-chinned species (*A.* alexandri) ranging the southwest to Texas and British Columbia. Six species live in California and western mountains, calliope (*Stellula* calliope) to British Columbia. rufous (Selasphorus *rufus*) to Alaska; six cross the Mexican border into Arizona and trans-Pecos Texas. (G. F. Ss.)

HUMOUR began its interesting career as a Latin word humor, meaning "moisture." In a more specialized sense "humour" meant the fluids of the body; this sense survives in part in medical usage. In the ancient physiology still current in the middle ages and later the four cardinal humours of the body were blood. phlegm, choler (yellow bile) and melancholy (black bile); the variant mixtures of these humours in different men determined their "complexions" or "temperaments." their physical and mental qualities, their dispositions: the ideal man had the ideally proportioned mixture of the four; a predominance of one produced a man who was sanguine (Latin sanguis, "blood"), phlegmatic, choleric or melancholic. Each of these complexions had specific characteristics so that the words carried much weight that they have since lost: the choleric man, for example, was not only quick to anger but yellow-faced, lean, hairy, proud. ambitious. revengeful and shrewd. Some knowledge of the four humours is helpful in reading Chaucer and Shakespeare and their contemporaries.

Renaissance Theory.— By further extension and specialization, humour in the 16th century came to denote usually an unbalanced mental condition, a mood, or unreasonable caprice, or a fixed folly or vice. As such, humour was a fit subject for the writer of comedy, whose traditional function, in Renaissance theory, was the correction of irrational or immoral conduct. The great exponent of the comedy of humours was Ben Jonson, who took for his own a word already popular and. as Jonson saw it, absurdly abused: all sorts of fools and knaves proudly insisted upon their personal humours. Jonson, at the beginning of Every Man *Out* of His *Humour,* distinguished two kinds of humour, in the sense in which the word is applied to disposition. One is true humour, in which one peculiar quality actually possesses a man, body and soul. But there is also an adopted humour, in which a man goes out of his way to appear singular by affecting certain modes of clothing, speech and social habits. This ridiculous pride in singularity Jonson scourges without mercy. Affected humours change with the years, with the fashions; they are manners, so that Jonson comes to speak of "recent humours . . . or manners of men that [go] along aith the times"; his 17th-century successors continued to find new humours, new kinds of offensive conduct, that offered material for the satiric comedy of manners.

18th and 19th Centuries.— By the end of the 17th century the English had come to be rather proud of the excellence of their comedy. claiming that it was superior to that of the ancients and of the modern French because of its humour; that is, its greater copiousness in comic characters. Moreover, they began to claim that this richness of the comic stage derived from the richness of their national life, which abounded in men of varied humours. England had long been known as the home of individualists, peculiar men, even madmen, so that when young Hamlet put his antic disposition on he was packed off to England where it would not be noticed. In that sense England had always had its "humorists" (its odd types, men with a humour). It was, however, Sir William Temple in "Of Poetry" (1690) who was the first to try to account for English eminence in humour—he claimed that the word itself was peculiar to the English language—by finding its causes: the native plenty of the soil, the ease of government and the uncertainty of the climate. These forces, he said, produce a nation of extremists and this has disadvantages, but wealth, liberty and varied weather produce a brilliant crop: health, courage, beauty, genius, goodness of nature and, among all these. humour "because every Man follows his own, and takes a Pleasure, perhaps a Pride, to shew it." When humour was seen in this light, not as an affected manner but as a natural, national expression, a distinct compliment to a race of rich and free men. its future was assured. William Congreve in "Concerning Humour in Comedy" (1695) confirmed Temple's observations on the English and analyzed closely the distinction between affectation and true humour. Temple's account was widely popular and the English variety of humours became one of the great commonplaces of the English heritage. The entire matter was regarded with much complacency. As one writer in 1725 said, "The pleasing Medley of Characters and Humours particular to Old England, make up together a very fine Scene; and the general Face of Peace and Prosperity that covers all, will well enough excuse a warm Englishman in thinking it the finest Country in the World." Another writer of 1777 summarized the history of "true humour" in a few words: "At length Commerce, and her companion Freedom, ushered into the world their genuine offspring, True Humour. To these she owed her birth; and when they expire, it will require no great sagacity to prophesy that she will follow her parents to the same grave." This was the humour of a national tradition complex in origin and expression, but one that may be described in outline as empirical, liberal and expansive, scientific, democratic and commercial, one that emphasized variety and the individual rather than conformity and the class. It was the Whig tradition of the Glorious Revolution of 1688, which made Englishmen proudly self-conscious of their liberties and wealth: and it was a legacy inherited and then independently cultivated by Americans. The continuing vitality of the tradition from which "True Humour" sprang can be seen in the 19th century, at its best, in John Stuart Mill's insistence that free scope should be given to varieties of character, that eccentricity in a society is proportional to genius, originality, mental vigour and moral courage. The major critic of its defects was Matthew Arnold, who saw its degeneration into the mere rawness of "Doing as One Likes." It drew its inspiration neither from the witty aristocracy nor the baseborn knaves and fools; it was distinctly "middle class": "the Courtier crys out for ***Wit,"*** according to George Farquhar's analysis of the public taste (1702), "the Citizen for *Humour.*"

Humour and Wit.—Wit was a form of intellectual quickness, raillery and repartee, likely to be an upper-class manner of discourse, likely to be dangerous, as are all sharp weapons that can cut good and bad alike; wit was associated with the aggressive, sexual Restoration rakes, who, in the eyes of good citizens, had used ridicule against religion and marriage and all moral and social decency. Wit was inferior, furthermore, as a literary form because it was primarily cleverness and thus without passion or heart; in comedy, therefore, it offered no cause for the action of characters; on the contrary, it was regarded as too often obliterating the distinctions between characters because some authors in their overflowing desire to display their wit tended to put their witticisms into the mouths of inappropriate characters. Congreve became the standard example of the excessively witty writer. But Congreve himself had declared that the manner of the wit should be adapted to the humour; that is. humour as a manner peculiar to one man was bound up necessarily in individual character and feeling and thus determined action and speech (including such wit as might be appropriate). Humour, then, unlike wit, was not the flash of an isolated sentence whose force was largely independent of the speaker or the time or place, but gathered its strength from a wide context, the previous life of the character, the relationships among a number of human beings in a complex specific dramatic situation. Humour was therefore more "natural," a growth of time, a freer and less restrained expression of character than wit.

Wit, like any impersonal mental skill, required books, learning, art; humour was a more universal gift. Wit surprised the mind, but humour was more delightful and appealed to the heart as well. To the more "polite" critics of the 18th century, where wit was more designed, concerted, regular and artificial, humour was more wild. loose, extravagant and fantastical, not consistent with true politeness; if humour was more diverting than wit it was only as a buffoon is more diverting than a gentleman: this was the account given by Adam Smith in 1755. Humour was therefore considered by some to be "low," but the prevalent tendency was to vindicate it. if humour is not found in the well-bred it is because they have learned to repress their feelings and adapt their manners to a rigid mold of decorum; among the lower orders, by passions and humour, nature appears in all its charming, unsophisticated diversities.

The development of the concept of humour was thus closely linked to the development of the concept of nature; humour flourished not in a nature that was a set of ideal or general norms or types in which individual variants were aberrations, but in a nature in which luxuriant variation and plenitude of forms were necessary and desirable, a "picturesque" nature in which irregularity and roughness of outline, the unusual and unexpected, even the grotesque, were admired and treasured.

By the mid-18th century humour was no longer an abnormality and a fit subject for the satirist but rather a whimsical oddity or foible, amusing and innocent. But more than that, unlike wit, which was often severe, bitter and satirical, humour very frequently exhibited generous, benevolent sentiments of heart which, though exerted in an odd manner, it was said, justly commanded our fondness and love. Benevolence, in one of its forms, giving free rein to inner impulse and trusting that spontaneous expression of personal feeling was good for both the individual and society, even if it seemed excessive or foolish or ludicrous by cool-headed standards. had a near relationship with humour. Certain free. jocund and liberal oddities and foibles might result from a generous flow of spirits and warm uncalculating benevolence, but these were amiable, even estimable failings. Humour might even be a guise to hide tender feelings.

18th-Century Humorists. — The 18th century was prolific in the creation of kindhearted "humorists," most notably Joseph Addison and Sir Richard Steele's Sir Roger de Coverley, Henry Fielding's Parson Adams, Oliver Goldsmith's Vicar of Wakefield and Laurence Sterne's Uncle Toby. The history of comic writing was reshaped so that though it may seem obvious to us that amiable humour has always existed, that Shakespeare and Cervantes and the humorous characters they created, for example, were greater than anything produced by later ages, if such is the case it is because we have inherited the 18th-century interpretations of those earlier authors. Falstaff and Don Quixote, though always highly admired as comic creations, were regarded as butts of ridicule, the one an amorous, lying, gluttonous buffoon, the other a lunatic designed to satirize chivalric romances, until well along into the 18th century; then Falstaif became a lovable, harmless rogue; Don Quixote became an enthusiastic philanthropist: even when his too ardent feelings betray him into ridiculous excesses and we are tempted to laugh at him, it is impossible to withhold our love and pity.

Thus humour, by the end of the 18th century and the beginning of the 19th, in its most exquisite moments was found to have an intimacy with sympathy and pathos. The inevitable distresses of a high-minded innocent like Don Quixote brought a tear to the eye even as the smile was upon the lip. Humour was the expression of a human nature that was, within itself and in its social and cosmic relations, a strange mixture, at once sublime and ridiculous. Humour was an essential resource of the sensitive and melancholy, a relief from and defense against the sadness of life that always weighs most heavily on those of keenest sensibilities. Sterne, with his unpredictable mingling of mirth and sentiment, laughter and tears, writing, as he claimed, against the "spleen," was tremendously popular and influential. The spleen was a nervous, depressive disorder that affected especially the finest tempers; it made men "humorists" and it made humour a necessary therapeutic. The English as a nation were notable for their spleen and their humour; the two were inseparable.

19th-Century **German** Humour. — Though the English had declared their monopoly of humour, other nations were not always prepared to acknowledge the claim. In the 19th century the Germans in particular became determined and solemn philosophers about humour. Jean Paul Richter, who was much influenced by English humour, especially Sterne's, and whose ideas on humour, in turn, were influential on Samuel Coleridge, Thomas De Quincey and Thomas Carlyle, developed in his *Vorschule der Asthetik* (1804) a theory of humour as the romantic form of the comic; in his highly complex exposition, the observer of a humorous situation must subjectively identify himself with the object of his laughter and thereby the object of his laughter is himself as well, indeed all humanity, of which both he and the object are a part. Humour destroys not the individual but the finite in its contrast with the infinite. In this universality humour finds no individual fools but only foolishness in a foolish world and is therefore tenderly tolerant. But when humour measures and connects with this little world the infinite one, there arises a laughter wherein there is still a pain of greatness, Richter says. Nor is it difficult to find later theories of humour with loftier pyramids of complexity.

Modern Humour. — In the 19th century humour was established as the highest and richest form of the comic. As such the word came also to be employed as a general term, as it usually is today, to denote anything comic, or anything that makes us laugh. By obvious extension of meaning a "humorist" is now someone consciously skilled in comic artistry, not, as the word was normally used until the 19th century, an unconscious subject of comedy himself. "Humour" is applied also to the ability to perceive or appreciate the comic. When qualified, of course, the word is used of a large variety of special areas of the comic. The word, therefore, now has little specific meaning except what it still may retain from its history in the 18th and 19th centuries, when it reached its apotheosis.

At its worst the idea of humour that developed in that period is a pudding of meaningless grotesquerie and gratuitous emotionalism. At its best it preserved a fine and difficult balance and a comprehensive conception of man and nature. It caught the enthusiasm of man's aspiring goodness and checked it with an eye for the incongruities of his concomitant weaknesses. At its best it did not identify innocence with the whole of nature or the complete virtue of man; innocence is also ludicrously short of fulfilling human capabilities. It measured reality, not as the satirist tends, by an ideal against which reality is terribly wanting, nor did it, in the manner of the sentimentalist, deny the gap of the real and the ideal. It accepted the difference with a liberal tolerance, or, unlike both satirist and sentimentalist, it found the ideal in the varied fullness of the real in all its imperfections. Its strength can be seen in the manner in which it prepared an enormous audience for the early Dickens; its weakness can be seen in the unwillingness of that audience to let Dickens get beyond *Pickwick Papers*.

In the 20th century humour no longer enjoys an unquestioned pre-eminence in the hierarchy of the comic. For one thing, increased historical study of the comic has led to the rejection of 18th- and 19th-century interpretations of earlier authors and to the understanding of modes of the comic that antedate the later idea of humour. The interest of many critics has turned also to questions of formal structural analysis, in which the emotions of the audience, essential in humour, are subordinated. And it is certainly true that one characteristic of the 20th century is an astringency (cynicism to those who do not like it, tough-mindedness to those who do) that questions sharply the liberal assumptions on which the 18th- and 19th-century idea of humour was based, regarding them as undisciplined both in intellect and emotion. It is note orthy that those critics who tend to regard the 18th and 19th centuries as unfortunate errors in the history of literature have revived "wit," using it once again, after its long eclipse by humour, in a 17th-century sense to denote the hard, bright quality of that fine fusion of intelligence and feeling found in the greatest poetry.

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HUMPERDINCK, ENGELBERT (1854–1921), German composer known for his children's opera Hansel und Gretel. Born at Sieburg. Sept. 1, 1854, he studied under Ferdinand Hiller at Cologne and Franz Lachner and Joseph Rheinberger at Munich. In 1879 a Mendelssohn scholarship enabled him to go to Italy, where he met Wagner who invited him to assist in the production of Parsifal at Bayreuth. He taught at the Barcelona conservatory (1885–87) and at Frankfurt (1890–96) where he was also music critic of the *Frankfurter Zeitung.* Early works were the choral ballads, Die Wallfahrt nach Kevelaar (1878), Das *Glück* von *Eden*hall (1879) and the *Humoreske* (1880) for orchestra. Hansel und Gretel, conducted by Richard Strauss, was produced at Weimar on Dec. 23, 1893. The libretto, by the composer's sister Adelheid Wette, was based on the folk tale made familiar by the brothers Grimm. In this work Humperdinck showed an understanding of a child's mind and a subtle sense of poetry, notably in the atmosphere of the uoodland scene at twilight and in the realistic effects in the episode of the broken milk jug. The Wagnerian harmonies, often of simple tunes, and the resourceful orchestration maintain the musical interest on a high level.

Between 1895 and 1919 Humperdinck produced six further operas, including Dornroschen (Frankfurt, 1902) and Konigskinder (New York, 1910) but none of them, nor the pantomime The Miracle (London, 1911), achieved much success. He also wrote incidental music for plays by Aristophanes, Shakespeare and Maeterlinck, a *Moorish* Rhapsody for orchestra (1898), a string quartet, piano works and songs.

Humperdinck died at Neustrelitz, Sept. 27, 1921.

See O. Besch, Engelbert *Humperdinck* (1914); H. Kiihlmann, *Stil* und Form *in* der *Musik von* Humperdincks Oper "Hansel und Gretel" (1930).

HUMPHREY (or HUMFREY), **LAWRENCE** (1527?–1590), president of Magdalen college, Oxford, and dean successively of Gloucester and Winchester, was born at Newport Pagnel. He was elected demy of Magdalen college in 1546 and fellow in 1548 He mas one of the most promising pupils of Peter Martyr, and on Mary's accession obtained leave from his college to travel abroad. He lived at Basel, Zürich, Frankfurt and Geneva, making the acquaintance of the leading Swiss ministers, whose ecclesiastical views he adopted. He returned to England at Elizabeth I's accession, was appointed regius professor of divinity at Oxford in 1560, and was recommended by Archbishop Parker and others for election as president of Magdalen. The fellows refused at first to elect so pronounced a reformer, but they yielded in 1561, and Humphrey gradually converted the college into a stronghold of Puritanism. In 1564 he and his friend Thomas Sampson, dean of Christ Church. mere called before Parker for refusing to wear the prescribed ecclesiastical vestments; and a prolonged controversy broke out, in which Bullinger and other foreign theologians took part as well as most of the leading churchmen in England. In spite of Bullinger's advice. Humphrey refused to conform; and Parker wished to deprive him as well as Sampson. But the presidency of Magdalen was elective and the visitor of the college was not Parker but the bishop of Winchester; and Humphrey escaped with temporary retirement. Parker, in fact, was not supported by the council; in 1566 Humphrey was selected to preach at St. Paul's Cross. and mas allowed to do so without the vestments. In that year, on the occasion of Elizabeth's visit to Oxford he wore his doctor's gown and habit, which the queen told him "became him very well": and his resistance now began to weaken. He yielded on the point before 1571 when he was made dean of Gloucester. In 1578 he was among those selected to attend the diet at Schmalkalden, and in 1580 he was made dean of Winchester. In 1585 he was persuaded by his bishop, Cooper. to restore the use of surplices in Magdalen College chapel. He died on Feb. 1, 1590, and was buried in the college chapel.

HUMPHREYS, ANDREW ATKINSON (1810–1883), U.S. soldier and engineer, was born at Philadelphia, on Nov. 2, 1810. Graduating at West Point in 1831, he served in the Civil War as a topographical engineer. He commanded a division, at the battle of Fredericksburg. He took part in the battles of Chancellorsville and Gettysburg and the Wilderness campaign. Toward the end of the war he commanded the famous 2nd corps. After the mar, now brevet major general, he returned to duty as chief engineer of the U.S. army and retired in 1879. He died at Washington, D.C., on Dec. 28, 1883.

HUMPHRY, OZIAS (1742–1810), English miniature painter, was born at Honiton and educated at the grammar school of that town. Attracted by the gallery of casts opened by the duke of Richmond, Humphry came to London and studied at Shipley's school; and later he left for Bath, where he lodged with Linley and became a great friend of his beautiful daughter, afterward Mrs. Sheridan. In 1766 he was in London warmly encouraged by Sir Joshua Reynolds, who was always interested in Devonshire painters. He was a great friend of the painter George Romney, with whom in 1773 he went to Italy, staying. on his way to Dover, at Knole, where the duke of Dorset gave him many commissions. In 1785 he went to India, visiting the native courts, painting a large number of miniatures and making many beautiful sketches. His sight failed him in 1797, and he died in Hampstead in 1810. (G. C. W.)

HUMUS is organic matter that has undergone extensive decomposition. It is brown to black in colour and imparts these colours to peat bogs and to many surface soils. Complex chemically, its compounds are known only in part. In addition to the nonliving organic material. to which the term "humus" is usually applied, soils contain great numbers of bacteria and other microorganisms that form humus from added organic materials and gradually decompose humus itself. Humus contains some of the phosphorus and sulfur and almost all the nitrogen of soils. It is important principally because during decomposition the nitrogen is gradually changed to simple forms that can be used by plants. Humus is valuable also because it increases the water absorption and improves the workability of soils (see also SOIL).

See C. A. Black, Soil-Plant Relationships (1957). (C. .4. BK.)

HUNALD, DUKE OF AQUITAINE, succeeded his father Odo, or Eudes, in 735 He refused to recognize the high authority of the Frankish mayor of the palace, Charles Martel, whereupon Charles marched south of the Loire, seized Bordeaux and Blaye, but eventually allowed Hunald to retain Aquitaine on promise of fidelity. At Charles's death in 741 Hunald declared war against the Franks, crossed the Loire and burned Chartres. Menaced by Pippin and Carloman, Hunald begged for peace in 745 and retired to a monastery, probably on the Isle of Ré. We find him later in Italy. where he allied himself with the Lombards and was stoned to death. He had left the duchy of Aquitaine to Waifer, who was probably his son. and who struggled for eight years in defending his independence against King Pippin. At the death of Pippin and at the beginning of the reign of Charlemagne, there was a last rising of the Aquitanians. This revolt was directed by a certain Hunald, who seems to have been a different person from the old duke of Aquitaine. (C. PF.)

HUNAN (HU-NAN SHENG), an important rice-producing province of China south of the central part of the Yangtze river (*q.v.*), bounded in the south by the Nan Ling mountains. Area 79,062 sq.mi., pop. (1953) 33,226,954. The province mostly comprises the drainage area of Tungting lake (Tung-t'ing Hu; *q.v.*). Except for the plain around the lake in the northeast and strips of river alluviums which narrow as the land rises in the south and west, much of the province consists of rough uplands of sandstone, limestone and granite. The largest river is the Hsiang Chiang (Siang Kiang) whose course is followed by the railroad from Hankow to Canton. At Heng-yang this railroad continues alongside a tributary stream almost due south, while a branch rail line runs over the Nan Ling mountains to Kuei-lin in Kwangsi province. River steamboats up to 500 tons can reach Ch'ang-sha on the

Hsiang Chiang and during flood periods may reach Heng-yang. Rainfall ranges from join. in the north to 58 in. in the south.

Rice is the leading field crop and, in the south. a growing season of up to 330 days permits two plantings on the same field each year. In the Tung-t'ing basin to the north the growing season is limited to about 300 days. Other field crops cultivated are rapeseed, broad beans, wheat, peas, barley and glutinous rice. Industrial crops include cotton, ramie, tung oil nut; tea (especially the Anhwa variety grown principally on the uplands), silk and tobacco. Oranges, tangerines, pomelo and pears are important fruits. Large quantities of sweet potatoes are grown. It was claimed in the late 1950s that the production of field crops had been raised to around 23,000,000,000 catties (one catty averages 1⅓ lb.) on 8,600,000 ac. of crop land. There is some lumber activities (pine, bamboo, fir) in the uplands.

Hunan is one of the leading mineral reservoirs of China, particularly in nonferrous metals. There are widespread coal deposits but only a few are economically significant. Hunan produces about 90% of China's antimony supplies. The province also accounts for about 10% of China's tungsten, 65% of its mercury, 90% of its manganese and much of the lead, zinc, gold, silver and sulfur. Although Hunan's population is overwhelmingly rural, a large number of industries have developed, including metals refining, dyes and fertilizer, glass, electric light bulbs, paper, silk gauze, matches, soap and cigarettes. A hydroelectric plant was started on the Tzu Shui (river) in the late 1950s. Ch'ang-sha, the provincial capital (pop. 650,600), is a market for rice, tea, lumber, ramie and metals as well as the major industrial centre and the site of Hunan university. Hsiang-t'an (*q.v.*) is an important industrial centre 20 mi. S.S.W. of Ch'ang-sha.

In the 1950s non-Chinese tribespeople in the western hill lands numbered about 400,000, of which about 320,000 were Miao and 51,000 were Yi (formerly Lolo) the rest comprised smaller ethnic groups. In the 1950s these tribespeoples were organized into national autonomous regions or districts.

The name Hu-nan means "south of the lake," referring to Tung-t'ing Hu. Before the Chinese migrated southward, this region mas inhabited by the ancestors of the Miao and Thai (T'ai) tribes. In the time of Confucius (6th century B.C.) it was part of the Ch'u kingdom. At the beginning of the Han dynasty (206 B.C.) it was in the Ch'ang-sha kingdom. During the T'ang dynasty (618–906) it formed a division of the Chiang-nan provinces; during the Sung dynasty (960–1279) part of the Ch'ing-hu provinces. The Mongols formed part of Hu-Kuang from it and this name was continued during the Ming dynasty (1368–1644). In 1665 under the Manchus. Hu-kuang was split, and one of the sections eventually became Hunan province. Strategically. the Hsiang Chiang valley has been important since the early Chinese moved south through Hunan to settle the Hsi Chiang (*q.v.*) drainage across the Nan Ling. The revolutionary Nationalist armies drove through Hunan northward from their Canton base to defeat the war lords in 1926–27. It was in this area that the Japanese were stopped in three campaigns during the Chinese-Japanese war (1894–95). In World War II the province was invaded by the Japanese who captured Ch'ang-sha in June 1944. Communist chief Mao Tse-tung started his peasants' associations in Hunan, Jan. 1927, and together with Chu Teh led various uprisings in 1928. However, the Nationalist forces drove Mao and his supporters into the Nan Ling hills from which they made their Long March to the west and north, finally ending at Yenan (Fu-shih) in Shensi province, not to return until 1949. (H. J. Ws.)

HUNDRED. In England the term "hundred" is particularly applied to an ancient territorial division intermediate between the villa and the county (*q.v.*). Such districts were also known in different parts of the country as wapentakes, wards or shires. In some parts of England a further intermediate division is to be found between the hundred and the county. Thus there is the trithing or riding (*q.v.*) in Yorkshire, the lathe in Kent, and the rape in Sussex. In Lincolnshire the whole county was divided into the three subcounties of Lindsey, Kesteven and Holland. The significance of the name hundred is a matter of some difficulty. The old theory is that the hundred denoted first a group of a hundred families, and then the district which these families occupied. According to another view the hundred was originally a term of measurement denoting a hundred hides of land, for there is good reason for considering that the hide was originally as much land as supported one family. It is important to notice that in the document compiled before the Norman Conquest, and now known as the *County Hidage,* the numbers of hides in all the counties are multiples of a hundred. and that in many cases the multiples agree with the number of hundreds ascribed to a county in Domesday Book. The hundreds of Devon, however, seem never to have contained a hundred hides; but various multiples of five, such as 20, 40 and 60. There, and in some of the other western counties, the hundreds are geographical divisions, to which a varying number of hides was attributed for fiscal purposes.

In the middle ages the hundred was chiefly important for its court of justice; and the word *hundredum* was as often applied to the court as to the district over which the court had jurisdiction. According to the compilation known as *Leges Henrici,* written shortly before 1118, it mas held 12 times a year, but an ordinance of 1234, after stating that it had been held fortnightly in the reign of Henry II, declares that its ordinary sessions were henceforth to take place every three weeks *(Dunstable Annals,* 139). Existing court rolls show that from the 13th to the 15th centuries it usually sat 17 times a year, in some hundreds in a fixed place, in others in various places, but in no regular course of rotation. Twice a year a specially full court was held, to which various names such as *hundredum legale* or *hundredum magnum* were applied. This was the sheriffs' turn held after Easter and Michaelmas in accordance with the Magna Carta of 121j. The chief object of these sessions was to see that all who ought to be were in the frankpledge, and that the articles of the view of frankpledge (*q.v.*) had been properly observed during the preceding half-year. Each township of the hundred was represented by a varying number of suitors who were bound to attend at these half-yearly sessions without individual summons. If the proper number failed to appear the whole township was amerced, the entry on the rolls being frequently of the form *"Villata de A. est in misericordia quia non venit plenarie."* All the 17 courts, including the two full courts, had jurisdiction in trespass covenant and debt of less than 40 shillings, and in these civil cases such of the freeholders of the county as were present were judges. But the sheriff or the lord of the hundred was the sole judge in the criminal business transacted at the full courts.

Because of the great fall in the value of money the hundred court began to decay rapidly under the Tudor sovereigns. They were for the most part extinguished by the County Courts act, 1867, which enacts that no action which can be brought in a county court shall thenceforth be brought in a hundred or other inferior court not being a court of record.

Until the Riot act. 1886. the most important of the surviving duties of the hundred was its liability to make good damages occasioned by rioters. (G. J. T.)

HUNDRED DAYS, the name commonly given to the period between March 20 1815, the date on which Napoleon arrived in Paris after his return from Elba, and June 28 181j, the date of the restoration of Louis XVIII. The phrase *Cent Jours* was first used by the prefect of Paris, the comte de Chabrol, in his speech welcoming the king.

See NAPOLEON, and FRANCE: *History.*

HUNDRED YEARS' WAR, THE. This name has been given by historians, not quite accurately, to the long struggle between England and France which, interrupted by two treaties and numerous truces. went on in an intermittent fashion from 1337 to 1453. Its fundamental cause was the anomaly by which the Plantagenet kings of England held an immense fief in southern France, the remains of the heritage of their ancestress Eleanor of Aquitaine. It mas natural that successive kings of France should endeavour to reunite to their crown-lands all the broad counties along the Garonne which had slipped out of the direct control of the Carolingian monarchs during the dark ages. It was equally natural that the kings of England should endeavour to cling to their ancient inheritance. Their task was made possible by the

fact that so late as the 14th century French national consciousness was still undeveloped, and most of the towns and many of the nobles of the South preferred the rule of an absentee duke of Aquitaine at London — who left them to manage for themselves for the most part — to that of the king at Paris with his grasping lawyers and tax-gatherers always on the spot.

The real character of the Hundred Years' War was disguised to a certain extent by the absurd claim of Edward III. and his successors to the crown of France — a claim adopted without sincere conviction from purely political reasons. Indeed Edward did not assume the title of King of France till the war had been running for several years (1338–40), and he sold his pretensions for solid consideration in land at the treaty of Brétigny (1360). That Henry V. almost succeeded in turning the shadow into substance for a few years in the 15th century had nothing to do with King Edward's original claim. Henry conquered half France as the head of a French political faction rather than as an English dynastic claimant, and his son was only recognized as king at Paris so long as French party-spirit was stronger than French national spirit, whose resurrection was displayed in the career of Joan of Arc. The real character of the struggle is well shown by the fact that after Paris had been recovered by the enemy in 1436, Bordeaux still held out for its English "Duke of Aquitaine" for 15 years more, and after having been once subdued, rose again in the name of King Henry VI., and fought for another year in the cause of southern particularism.

The dynastic side of the Hundred Years' War is a depressing story. Of its widespread economic and commercial effects this is not the place to speak, though they had much to do with the making of modern England. Its military aspect is most important, not only in the history of England and France, but in that of the general development of the art of war in Europe. Its opening years saw the end of the supremacy of feudal cavalry as the dominating power in battle: its last years witnessed the first instances of general actions decided by artillery.

PERIOD I. 1338–45

Friction between the king of England as duke of Aquitaine and the duke's overlord at Paris had been intermittent for the last century. In 1338 it had reached one of its not infrequent crises, but the main cause of rupture was the help given by Philip of Valois to Edward's Scottish enemies. In retaliation Edward stirred up the Flemings and other Netherland neighbours of France, and bought the help of the Emperor Lewis of Bavaria. His first attempts, however, to invade northern France with an army composed for the most part of the emperor's vassals in the Low Countries were complete failures. And no profit was got by Edward's proclamation of himself as rightful king of France — a step which he took in order that the Flemings might be able to say that they were not engaged in a treasonable attack on their suzerain. For Flanders, unlike the rest of the Netherlands, owed homage to France (1340). The only profit which Edward got out of the first period of the contest was the complete destruction of the French fleet at the battle of Sluys (June 25, 1340), which gave him the command of the sea for 30 years, — no small boon, for in the early days of the war French squadrons had raided and sacked Southampton, Portsmouth, Hastings and other seaports. But on land there was no decisive fighting — though Edward was eager to try against the French the tactics which the English had learned in their Welsh and Scottish wars, and of which he himself had given a victorious example at Halidon Hill (1333). But Philip of Valois accepted no general action, and Edward was unlucky in his sieges of Tournai and other places on the northern border of France. The Flemish campaigns were a complete failure, nor did Edward meet with much success in an attempt to attack France on another flank — the duchy of Brittany — where he supported the claimant in a contested succession who had not the approval of King Philip. With his exchequer drained dry and his parliament growing discontented, Edward consented to a two-year truce, which covered the years March 1343–March 1345.

PERIOD II. 1346–60 CRECY AND POITIERS

Very different was the course of military affairs when the two years of fitful truce ran out, and Edward invaded Normandy (July 1346) apparently with the object of drawing off the French from a dangerous attack on Guienne then in progress — but strategical objects are sometimes attributed to mediaeval generals on insufficient evidence. After wasting the whole duchy and capturing the rich town of Caen, Edward marched to the very gates of Paris; but when the whole power of France had been gathered against him, he judged that he had better not fight save under the most favourable tactical conditions. He swerved north, forced the passage of the Somme near its mouth, and then stood at bay, under the forest of Crécy, on a very cleverly chosen position, along a ridge of chalk downs, with a long easy slope like a glacis in front of him, and his flanks covered by the houses and enclosures of the villages of Crécy and Wadicourt. Edward had deliberately adopted the formation which had served the English well in their Scottish wars — central blocks of dismounted men-at-arms, with long wings of archers thrown out on each side. After a preliminary skirmish, in which Philip's advanced line of Genoese crossbowmen was shot to pieces by the English archery — who could give them six missiles for one — the cavalry charges began (Aug. 26, 1346). The fight of Crécy (*q.v.*) consisted in a dreadful slaughter by concentrated archery-shot of successive squadrons of the French knighthood; each feudal contingent pushed to the front as it came on the field, and charged up the long slope, to be riddled and finally brought to a stop by the thick flights of cloth-yard arrows which poured in from the flanks as well as the front. The futility of cavalry charges against trained archery in a favourable position was completely demonstrated, and Edward III. did not even need to put his reserves into action. Night only brought the battle to an end — and saw the wrecks of King Philip's chivalry disperse, leaving in front of the English line the bodies of John, king of Bohemia, the blind adventurer — the duke of Lorraine, ten counts and 1,500 gentlemen of coat armour — not to speak of thousands of mercenaries and retainers.

This frightful disaster to the cavalry arm shook to pieces the old theory of feudal war, which rested on the assumption that mailed knights charging in mass could ride over infantry of any sort. The English had taken to heart the results of Bannockburn, where cavalry had a severe lesson, and had gone over to the new tactics. Converging archery volleys, by highly trained professional bowmen, could prevent horsemen from closing, if the ground was favourable and steady supports of dismounted men-at-arms were in the line to give the archers confidence and flank-protection.

King Edward only utilized his victory at Crécy to carry out the siege of Calais, whose surrender after a long and obstinate defence gave him a permanent bridge-head across the Channel for further invasions of France (Aug. 4, 1347). Next summer both England and France were smitten by the awful plague of the Black Death, which swept away a fifth or a third of the population of both countries and upset all social conditions. It was no wonder that truces were concluded, which lasted for over two years; and were renewed — despite some local bickerings and raids by both sides — till 1354. Negotiation with John of France, who succeeded his father Philip of Valois, in 1350, for a permanent peace, coming to nothing, Edward resumed his policy of invasions of France, but apparently was aiming at breaking the enemy's spirit by destructive raids rather than at the reduction of provinces, for the armies made broad trails of devastation across the land, but did not linger to besiege large towns. In this spirit he wasted northern France in 1355, while his son Edward the Black Prince harried Languedoc almost as far as the shore of the Mediterranean. The French refused battle and shut themselves up in fortified places. Next year the king's second son, John of Lancaster, ravaged Normandy, while the Prince of Wales made a second great sweep through central France as far as the gates of Bourges and Tours. While returning laden with plunder, towards Bordeaux, he found himself in contact near Poitiers (*q.v.*) with John of France and an army thrice as great as his own. The king had abandoned his passive defensive policy of the last two years, and had resolved to risk a general action, despite the English archery. Twice in recent combats on a small scale, at

Saintes (1351) and Mauron (1352), the French, when facing English archery, had dismounted the main body of their men-at-arms, and kept on horseback only small detachments of picked horsemen, who tried to turn the line, or to slip in by rapid movement without meeting the full effect of the volley. John tried these same tactics, judging, truly enough, that the fully armoured knight was much less vulnerable on foot than when mounted, and might hope to close with his enemy, if the latter was distracted by preliminary manoeuvres of lightly moving horsemen.

Unfortunately for King John, the Prince of Wales had got into a position which was absolutely unassailable by cavalry, the front line being covered by a long hedge along the brow of the hill of Maupertuis, with but a single gap in it. But the dismounted knights did reach the hedge, though much thinned by the arrow-flight, and very bitter and prolonged fighting took place all along it. But the first French line was beaten back at last, the second flinched and turned away, and only the third, under King John himself, fought out the battle to the end. It finally broke up and retired, leaving King John and his younger son Philip prisoners. This was not so entirely an archery battle as Crécy, but could not have been won without the archers.

Poitiers might have been as indecisive a victory as Crécy, so far as the ending of the war was concerned, if it had not been that the French king had been captured, and naturally desired to ransom himself. It cured his subjects of any wish for general actions, and for the next four years they allowed the armies of King Edward to range about the land doing mischief to the open country, and shut themselves up in walled towns and castles, till the enemy had eaten up the countryside and was forced to move on for want of food. This destructive but inconclusive system of raids might apparently have gone on for an indefinite time, if King John had not made up his mind that captivity was intolerable, and offered to sign almost any terms of peace that King Edward chose to inflict upon him. He assented in the Treaty of London (March 1359) to conditions so humiliating that the French States General refused to ratify them. But in the following winter King Edward conducted a raiding tour all through Picardy, Champagne and the Isle de France with such ferocity that the spirit of the enemy was broken, and the regent of France and the States General assented to the terms which King John had already accepted, and preliminaries of peace were signed at the village of Brétigny, near Chartres, on May 8, 1360.

By this instrument Edward resigned his claim to the French crown in return for receiving back the whole duchy of Aquitaine, as it had been held by his ancestress, Queen Eleanor, free of vassalage to the king of France. He most unwisely reclaimed many counties which had been for a century and a half in French hands, and had quite lost all remembrance of their Plantagenet dukes—Poitou, the Limousin, Quercy, Rouergue, Marche, the Angoumois—a vast holding peopled by unwilling subjects. In addition Edward kept his conquest of Calais, and received back the county of Ponthieu by the mouth of the Somme, which had belonged to his grandmother, Eleanor of Castile, the queen of Edward I. But humiliating as were these renunciations, the French felt even more bitterly the charge of 4,000,000 gold crowns imposed as the ransom of their king. John, though a well meaning man enough, was an incapable sovereign, and, as everyone said, was not worth the money. Moreover he died only a few years after the treaty had been drawn up. Naturally only the early instalments of the ransom money were ever paid. Odd as it may seem, the complete ratification of the treaty was never put on paper, though Edward duly dropped his French title and received all the lands that he had been promised. He handed over Aquitaine to be ruled by his son, the Black Prince, as a fief of England.

PERIOD III. FROM THE TREATY OF BRÉTIGNY (1360) TO THE PEACE OF 1396

For nine years after the Treaty of Brétigny there was nominal peace between England and France, though it did not prevent English and French auxiliaries taking part against each other in the civil war of the duchy of Brittany and the kingdom of Castile. It was, in great measure, the unwisdom of the Black Prince's invasion of Spain—where he won, by force of archery, a great victory at Navarrete in 1367, but spent all his treasure and wrecked his own health—that led to the renewal of the French War. He had raised heavy sums in taxation from his unwilling subjects of the newly annexed regions, and in 1369 they rebelled, called for the aid of Charles V. as their rightful lord, and received it. There followed 11 years of unlucky war, in which the English gradually lost all the lands which had been ceded at Brétigny, and were reduced to their original holding in Guienne. The enemy, captained by the great Constable of France, Bertrand du Guesclin, always refused open battle—the terror of archery was still ever present. But while permitting the English to march unopposed in devastating raids through France, and observing a strict defensive behind walls when the invaders were in the field, the Constable worked on a deliberate plan of picking up by sudden surprises, often helped by treachery from within, outlying castles and cities where the enemy had no adequate garrisons, and from which his raiding army was far distant. The Black Prince, who might have made a good defence of his duchy, had collapsed under his Spanish fevers during the first campaign of the renewed war, and after taking the field once in a litter, and sacking the rebellious town of Limoges (1370), returned to England a broken invalid. The conduct of the war fell into the hands of John of Gaunt, duke of Lancaster, the Black Prince's younger brother. John was a convinced exponent of his father's old policy of bringing France to terms by continued circular raids and devastations. It failed completely, though the invasions themselves were sometimes of the most sweeping sort; in 1373 he marched, unfought, from Calais to Bordeaux, right past the gates of Paris. But he brought to Guienne only the wreck of an army; thousands had perished by the way from privation or in petty ambushes. Lancaster persisted in the same policy, and he and his younger brother, Thomas of Woodstock, led several more raids—almost as lengthy as the adventure of 1373 and quite as fruitless. Meanwhile region after region in the south was falling away to the French, and the command of the sea, won at Sluys in 1340, ceased to be certain after a naval defeat off La Rochelle in 1372.

Edward III. died in senile decay in 1377—his enemy Charles V. and Du Guesclin, the great Constable of France, both in 1380. After this the war slackened down. In England, and in France also, the Crown had fallen to a boy-king, oppressed with several ambitious and unscrupulous uncles, and in each country domestic politics took precedence of military adventure. It will be remembered that 1381 saw Wat Tyler's rebellion and all its wild scenes of massacre and reaction. But though there was no serious fighting after 1386, when there was much fear of a French invasion, and though the French encroachment in Aquitaine had nearly ceased, and a series of truces started in 1392, the war went on in theory till 1396. Then Richard II. having got the better of his uncles, concluded the peace of Paris with Charles VI. In form this odd document was only a truce for 30 years, on the territorial status *quo*, by which Richard kept Bordeaux and Bayonne and the Gascon lands between them, but tacitly abandoned all the other lost French dominions of his grandfather. As the agreement was technically only a truce, he was not forced to the humiliation of renouncing his vain title of King of France. But his marriage with Isabella, the young daughter of Charles VI., sufficiently showed that the 30 years' truce was really a permanent settlement of peace.

PERIOD IV. FROM 1396 TO 1414

When, three years only after the treaty of Paris, Richard II. was overthrown, imprisoned and finally murdered by his cousin Henry of Bolingbroke, it appeared at first quite likely that the fate of the French king's son-in-law would lead to war. But no open war followed—partly because Charles VI. relapsed into one of his intermittent fits of insanity, but much more because civil strife broke out in France between the Orleanist and the Burgundian parties, who were too much interested in each other's affairs to spare much attention for those of England. The Orleanist party, however, intermittently indulged in acts of hostility—sending auxiliaries to help the enemies of Henry IV.—the Scots

and the Welsh rebel Owen Glendower; and in 1403 the Constable and Admiral of France—both Orleanists—raided Plymouth and several Channel ports. In 1406, Orleanists and Burgundians, uniting for once, made attempts, the one on Guienne, the other on Calais—but both were foiled, and when in 1408, Burgundy murdered Orleans, the fight between their factions grew so much more bitter that molestations of the English coasts ceased, and civil! war became permanent in France. Henry IV. was then able to revenge himself in much the same surreptitious ways that the French had been using in his earlier years. He played a most unscrupulous game—lending troops to Burgundy in 1411 and to the Orleanists in 1412, on the general principle that it was profitable to England that the French should have plenty of trouble at home.

PERIOD V. FROM 1414 TO 1422

Henry IV., long broken in health, died on March 20, 1413, leaving his usurped crown to the most capable and ambitious of all the Plantagenets, his son, Henry of Monmouth, the conqueror of France—a model of formal piety from the moment that he came to the throne, a great soldier and a very unscrupulous politician. He very deliberately resolved to attack France, with the idea that a successful foreign war was the best means of keeping his own unruly subjects in good temper. After making a secret pact with John of Burgundy, he sent ambassadors to Paris to renew all the old claims of Edward III.; not only was all Aquitaine to be returned to him, but he was to be given the hand of one of the king's daughters with a competent dowry, and to receive the long-forgotten arrears of the ransom-money of King John, the prisoner of Poitiers. The French were in the throes of civil war, and to stave off invasion made liberal offers of restoration of lands in Aquitaine, and even prepared to discuss the marriage question. Henry professed himself shocked at their meanness and declared war (April 1415).

On Aug. 10, 1415, Henry V. set sail for Normandy with a well equipped army of 12,000 men, of whom two-thirds were archers. He was a strategist of a very different sort from Edward III. and John of Gaunt, and set before himself the splendid if tedious task of conquering France castle by castle and county by county, not that of indulging in futile raids of devastation. On landing he sat down before Harfleur, the town which commanded the mouth of the Seine (Le Wavre did not yet exist), and captured it by force of artillery and mining after a month's siege. This gave him a bridge-head in Normandy, whose conquest was his first aim. As autumn was now drawing on, he had to choose between going into winter quarters in Normandy or marching to Calais. He chose the latter course, probably with the idea that the French would try to stop him and risk a battle, which he desired most of all things. He was not wrong; after he had crossed the Somme with difficulty, he found the whole levy of the Orleanist faction in front of the village of Agincourt (*q.v.*) blocking the road to Calais (Oct. 25). Here was fought the last and most decisive of the great battles of the English archery. D'Albret, Constable of France and the duke of Orleans, used the tactics of Poitiers—an attack by a picked body of horse against the English front, followed by the advance of three solid lines of dismounted men-at-arms. And the result was the same as at Poitiers—the horsemen being shot down with ease. Henry found the French—weighed down by their heavy armour, on a front of ploughed fields sodden with October rain—lurching at a snail's pace towards him. After the archery had played upon them with good effect, he saw them flinch, and charged in upon them, knights and archers all together. They were rolled over in heaps and slaughtered miserably. The Constable was slain, the young Charles of Orleans—head of his faction—and the duke of Bourbon, taken prisoners. The Orleanist faction was for the moment almost annihilated, but finally made head under new leaders—the apathetic dauphin Charles becoming its nominal head, but the new Constable, Bernard of Armagnac, the real leader. And all such resistance as Henry was to meet was from this weakened party. The duke of Burgundy, under a secret agreement with the national enemy, held aloof from the war. Hence the renewed English invasion of France went on with steady progress—Normandy was conquered in three campaigns, 1417–1418–19, with many sieges but no open battle in the field. Henry continued to make offers similar to those which he had formulated in 1414—he must have back all the old lands of Edward III. and the hand and dowry of the mad king's daughter, Catharine.

The whole aspect of affairs then suddenly changed owing to a murder. The Dauphin lured John of Burgundy to a conference on the Bridge of Montereau, and there the duke was assassinated under circumstances of calculated treachery (Sept. 1, 1419). Wildly indignant and left without a leader, the Burgundian faction suddenly threw itself into the arms of the English, and offered to accept Henry as ruler of France; their only desire was to avenge the murder of Montereau. The young Philip of Burgundy put himself at the head of the movement. Hence the Treaty of Troyes (May 21, 1420), by which Henry, on marrying the Princess Catharine, was to be acknowledged as "heir of France," whose crown was to be entailed on their issue, the insane Charles VI. being allowed to retain the royal title till his death. The dauphin was to be completely disinherited "on account of his enormous crimes." The marriage being consummated (June 2), Henry found himself in possession of all those parts of France where the Burgundian faction was predominant—including Paris and a great part of the east and north. But everywhere towns and regions which adhered to the other faction lay in patches among the Burgundian lands. The dauphin was recognized as regent and representative of his incapable father, everywhere south of the Loire.

As head of the Burgundian party, and leading armies half of which consisted of his French supporters, Henry started on the tedious task of conquering in detail all the provinces where his title was denied. In 1420–21–22 he had taken Sens, Montereau, Melun, Dreux, Compiègne and Meaux, and was pushing ever southward, when he succumbed (Aug. 31, 1422) to an attack of fever and dysentery contracted in the trenches during the siege of Meaux. His insane father-in-law died only two months later, so that the infant Henry of Windsor, his only child by the Princess Catharine, was hailed as king of France, no less than of England, in his cradle.

PERIOD VI. 1423–53. EXPULSION OF THE ENGLISH

The next 20 years saw the slow destruction of the work of Henry V. which had been from the first a triumph of misdirected military genius, assisted by the perverse spirit of French faction. Even if he had driven Charles across the Pyrenees or the Alps, it is incredible that his two realms could have held together after his death.

There was little to rouse sympathy or loyalty in the hearts of the French when a king in his second year and an English regent replaced the formidable Henry of Monmouth. The marvel is that the struggle went on so long after his death. But John, duke of Bedford, the little king's uncle, was a soldier of merit and the dauphin's favourites were not. Hence Bedford's victories of Cravant (Aug. 1, 1423) and Verneuil (Aug. 17, 1424), won with armies which were half French in composition, kept the unnatural fabric of the Anglo-French union together, and in 1428 Bedford's advance reached the Loire and laid siege to Orleans. The high-water mark of progress had been attained. But the force before Orleans was but a few thousands strong, and northern France was sick of the English domination. The Burgundians, after ten years, were beginning to forget the murder of Montereau and to remember that they were Frenchmen.

Only on these considerations can the astounding career of Joan of Arc become comprehensible. When the prophetess, or the witch as the English called her, presented herself before the puzzled dauphin and preached her crusade to his doubting ear, she represented the spirit of outraged and indignant France. He resolved to give her mission a trial. Obeying the "voices" which bade her march straight for Orleans under her white banner, she and her company entered the city (April 29, 1429), and she directed a series of sorties which broke the English lines, and finally caused the siege to be raised. This sudden display of spirit produced surprise and then panic among the enemy. "Before that day 200 English would drive 500 French before them—

but now 200 French would beat and chase 400 English." A series of disasters followed, ending in the battle of Patay (June 19, 1429), where, at Joan's orders, the French charged in "before the archers could fix their stakes," and destroyed a third or more of the army of Lord Talbot. She then conducted the dauphin to Reims, where, as she had promised him, he was duly crowned king: every town where there was not a large English garrison threw open its gates as she passed.

Probably the insurrection wquld have spread over the whole of northern France if Joan had been properly backed by her master's ministers and captains. But they secretly derided her inspiration in which the soldiers and peasantry believed, gave her grudging support, and when she failed in a surprise attack on Paris, removed her from her position as adviser and inspirer of the army. The revolt continued, however, to spread, though Joan herself, conducting a raid for the relief of Compiègne, fell by ill-chance into the hands of the Burgundians, who sold her to the regent Bedford. He handed her over to a spiritual court composed of French clergy of the opposite faction, and after many months of captivity she was condemned as a sorceress and heretic, and burned at Rouen on May 29, 1431.

But though Joan suffered the death of a martyr, the movement which she had set going never ceased, though its progress was slow when it was no longer conducted by an enthusiast, but by politicians and captains of mercenary bands. But the basic fact in the situation was that the Burgundians were gradually dropping away from the English alliance: Duke Philip himself finally consented to make terms with his father's murderer at the Peace of Arras (1435) and in the following year Paris fell into the hands of the French—the burgher militia having refused to man their walls, and allowing the enemy to enter, while the small English garrison took refuge in the Bastille, and were starved out in a few days (April 1436). The regent Bedford was spared the humiliation of seeing his life's work undone—he had died in the previous autumn at Rouen.

The most astounding thing in the last weary period of the Hundred Years' War is that the fall of Paris was not immediately followed by the expulsion of the English from the whole of France. The struggle went on for no less than 17 years longer: The English Government in stupid national pride refused to make peace, as they might, by surrendering their boy king's French title; and contenting themselves with retaining the ever-loyal Guienne, Calais, and perhaps Normandy, where they had fortified themselves very strongly. Charles of France was apathetic and his resources ran low, on account of the general exhaustion.ot his realm; nevertheless it is surprising that those hard-fighting veterans, the earls of Warwick and Shrewsbury and the young duke Richard of York, kept Normandy practically intact, considering that the parliament at home grudged both men and money for the war, and that every French town revolted when revolt was possible. There was a long episode of truce in 1444–48, when—a peace party having at last appeared in England, led by the earl of Suffolk—an accommodation was almost secured, the young king was married to a French princess, Margaret of Anjou, and the English claims dwindled down to the retention of Normandy and Guienne. But the negotiations failed, and war broke out again in 1449.

This time the end had come; the duke of Somerset, commanding in Normandy, was an incapable general, but a much better man might have failed when the enemy came against him with overwhelming numbers and a great train of artillery which blew castle after castle to pieces. By 1450 most of the towns of Normandy had fallen, and the duke was being beleaguered in Caen. To relieve him there came over from England a small army, the last but one that crossed the sea during the Hundred Years' War. It was led by two veteran soldiers, Sir Matthew Gough and Sir Thomas Kyriel, but only numbered 3,500 men. On its way towards Caen it was encountered and annihilated by French forces under the Constable Richemont and the count of Clermont at Formigny (April 15, 1450). This was a battle on a small scale, but of high tactical import: the English had formed themselves in their usual order in a position covered by orchards and houses-dismounted men-at-arms in the centre, archers in long flanking wings. The French, instead of charging, brought up light field-guns opposite the archers and, keeping out of arrow range, played on the English line with roundshot till their opponents were goaded into advancing into the open to capture the guns. They were then charged in flank; a general hand to hand mêlée followed, and the French were completely victorious. Of all Kyriel's army only a few hundred got away. This was the end of the English in Normandy—Somerset surrendered Caen on June 24. Nothing now remained to King Henry VI. in the north save Calais.

The next year saw the French army directed against Guienne; no succour came from England; Jack Cade's rebellion was recently over and a bitter parliamentary contest between the dukes of York and Somerset was raging. The outworks of Bordeaux fell in May 1451, the city itself most unwillingly opened its gates on June 30. Bayonne, the last stronghold of Aquitanian loyalism, fell on Aug. 20. It looked as if the war had come to an end. But particularism was still strong: within six months of the fall of Bordeaux, Gascon nobles and burghers were visiting London to implore the aid of an English army and pledging themselves for revolt. The duke of York, as head of the English war party, prevailed on the king's council to make a final effort, and in Oct. 1452 the veteran Talbot, earl of Shrewsbury, the last surviving general of Henry V., came ashore in the Gironde with 3,000 men. On his arrival Bordeaux and all the minor towns rose in insurrection and expelled their French garrisons. But in the following summer the whole force of France was turned southward, and the fate of the duchy was settled. The French army, besieging the loyalist town of Castillon, had strengthened itself with trenches, palisades and guns of position against any relieving force. Talbot came against it with every man that he could raise, English or Gascon, but finding the enemy resolved not to leave his lines and fight in the open, risked an assault. Archery was of no use against entrenchments, and the relieving army tried to break through by main force in a great column. Its head was torn to pieces by a concentrated fire of artillery, and Talbot himself, overthrown by a roundshot, went down outside the trench. The assault having failed, the enemy sallied out from all sides and overwhelmed his leaderless troops. The last levy of Guienne and its English auxiliaries perished wholesale (July 17, 1453).

Yet so great was the hatred of the Bordelais for the French that they held out in despair for nearly three months after Castillon, and only surrendered when it became certain that no more help from England could be expected (Oct. 19, 1453). King Henry had just been struck with the first sudden access of the insanity uhich he inherited from his grandfather, Charles VI of France, and the Wars of the Roses were about to begin. For 20 years no English ruler had the power or the leisure to think of sending troops to continue the long war overseas. This mas the reason why secret emissaries from Guienne found no encouragement in London. It was a marvel that Calais did not share the fate of Bordeaux, and was still destined to remain English for a century, though in the stress of the Wars of the Roses, Queen Margaret of Anjou meditated selling it in exchange for a French mercenary army If Charles VII had been a man of energy, and not *"le bien servi,"* he might have mastered the last English foothold in France. But though war continued for a few years more, and the Senéchal of Normandy sacked Sandwich so late as 1457, the struggle petered out obscurely, and ended in a truce made by the Lancastrian party with Louis XI, whom they secured as their ally in English civil strife. (C. W. C. O)

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He joined the *New York Sun* in 1900, the *Times* in 1918 and the *World* in 1919. *A* man of great versatility, he frequently wrote on art and literature as well as music and drama. His pub-

lished works include: *Chopin: the Man and His Music* (1900); *Overtones: a Book of Temperaments* (1904); *Iconoclasts:* a *Book of Dramatists* (1905); *Franz Liszt: a Study* (1911); *Egoists: a Book of Supermen* (1909); and *Ivory Apes and Peacocks* (1915). He died in Brooklyn, N.Y., Feb. 9, 1921.

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HUNGARIAN LANGUAGE. Hungarian (self-designation MAGYAR) is spoken by about 12,000,000 persons. mainly in the central Danube valley, in Hungary. in Czechoslovakia, in Rumania and in Yugoslavia, and by scattered groups elsewhere (close to 500,000 in the United States).

History. — Hungarian belongs to the Uralic language family which includes the Finno-Ugrian and the Samoyed branches. Closest kin to Hungarian are the two other Ugric languages. Vogul and Ostyak. now spoken in western Siberia. From Cralic. Hungarian inherited about 250 basic words. and the Uralic portion still makes up more than three-fourths of the morphemes in a running text. Up to the conquest of present-day Hungary at the end of the 9th century A.D.. the vocabulary of Hungarian was greatly affected by old Iranian (metallurgical expressions), by Turkic (cattle breeding and agriculture) and to a minor extent by Ossetian and Caucasian. After the conquest the major influences came from Slavonic. Latin and German. The earliest occurrence of Hungarian words is in Arabic (8th-century), Greek (10th-century) and Latin (10th-century) texts; the first connected text. a funeral sermon. dates from the end of the 12th century. A major development of Hungarian took place around the turn of the 18th and 19th centuries, when in a quarter of a century 10,000 new words were introduced through neologistic formations, all in accordance with existing patterns which left the structure of the language unchanged. Dialectal differentiation is not very great.

Script. — During the 1st millennium after Christ, while they inhabited the steppes, the Hungarians acquired a script, related to the Old Turkic runes which, though not extensively used, survived until after the middle ages. The current Hungarian script was introduced in the 11th century by western Christianity and its orthography stabilized by the 16th century with the introduction of printing. The alphabet inciudes single letters and digraphs. The spelling is consistently phonetic. except that minor variations at morphological boundaries are not indicated and that remnants of historical spelling occur in family names. Of the vowels, the accentuated letters are pronounced long, the others short; thus *e* as in "bed." *á* as in "father." Of the consonants. *p, t* and *k* are unaspirated, *b*, d and *g* voiced; *y* (except at the end of family names where it stands for i) indicates palatal articulation, *ny* as in French *champagne; s* is pronounced as in "she," *sz* as in "six," *z* as in "zero," *zs* as in "rouge," *cs* as in "arch." *c* as in German *zehn*. Long consonants are written double (the first component only in case of the digraphs, in hyphenation both components: *össze* ["together"] but *osz-sze).*

Phonology. — The vowels include back vowels: *a d o ó u ú,* front rounded vowels: *o ő u ű,* and front unrounded vowels: *e é i í* (with many speakers differentiating two *e* phonemes). The consonants comprehend: stops; nasals; fricatives; affricates; and liquids: 1 (clear) and *r* (trilled). The occurrence of vowels in words is governed by vowel harmony: back vowels do not occur together with front rounded vowels. Consonant clusters are simple; initially in general no clusters occur. Stress is always on the first vowel of the word.

There is a distinction between falling intonation indicating assertion, and interrogative intonation which is rising if the utterance is not longer than two syllables and rising to the prefinal syllable and then falling if the utterance is longer.

Grammar. — The grammatical structure is transparent, and the categories clearly marked. The main morphological process is suffixation, by which words of considerable length can be produced; *e.g., verethetnélek* "I might cause thee to be beaten" *(ver* "beat," *-et* "cause," *-het* "may," *-né* [conditional], *-lek* "I thee"); *tanítványaimtól* "from my pupils" (*tanít* "teach," *-vány* [nominal derivative]: *-ai* [plural], *-m* "my," *-tól* "from"). Prefixes are rare, *legszebb* "most beautiful" from *szebb* "more beautiful." Suffixes often have two alternants, one with a front and one with a back vowel, which are added to stems with corresponding vowels *(cf.* vowel harmony), *Berlinben* "in Berlin." *Stockholmban* "in Stockholm." (This difference is sometimes employed for lexical purposes. *kever* "stir lightly," *kawar* "stir heavily," or in demonstratives, *ez* "this," *az* "that," *ide* "hither," *oda* "thither.")

Noun inflection indicates number, possessivity (reference to person and number, *emberem* "my man"), and case (there are about 25 cases, most of them indicating locality and direction, such as inessive "within"; other nonspatial relations, such as causal "for the sake of"). The cases are supplemented by postpositional constructions which do not show accommodation to the vowels of the head word, *emberben* "in man," *hdzbnn* "in the house," but *ember mellett* "besides the man," *hdz mellett* "besides the house." Adjectives have three degrees: *nagy* "big." *nagyobb* "bigger," *legnagyobb* "biggest"; there is also a degree expressing exaggeration, *legeslegnagyobb* "the very biggest." Personal pronouns have only two cases, nominative and accusative, the rest of the paradigm is supplemented by suffixed forms; *e.g., tn* "I," *engem* "me,!' but *bennem* "in me." *mellettem* "next to me."

There are two slightly different conjugational types: the so-called -ik verbs having the suffix *-ik,* and non-ik; *e.g., es-ik* "he, she, it falls," *üt* "he, she, it beats." The categories are: mood (indicative; conjunctive, indicating condition or wish; and imperative); tense (present and perfect); number and person; and definiteness: there is a reference in each verbal form to the definiteness of a third person object, or the lack of it. *lát* "he, she, it sees" (in general, something indefinite or unknown), but *ldtja* "he, she, it sees" (something definite, like the house, my house, a known person, etc.); in the first person singular there is also an inclusive form indicating an object in the second person, *látlak* "I see thee or you."

Both nominal and verbal derivation plays a great role, as a device partly for augmenting the vocabulary, as in *kot* "bind." *kottl* "rope," *kotelez* "oblige," *kotelezvkny* "I.O.U.," and partly for expressing nuances of reference, *csepeg* "drop," *csepereg* "drizzle," *cseppen* "drop (once)" from *csepp* "drop."

Syntax. — In attributive phrases adjectives are uninflected, *nagy ház* "big house." *nagy házakban* "in big houses." The article is the first element in phrases, *a* (preconsonantal) *nagy ház* "the big house," *az* (prevocalicj *ember* "the man." After numerals the "singular" form stands, *ezer ember* "a thousand men." Predicates are either verbal or nominal. and agree in number with the subject, *az ember lát* "the man sees," *az emberek látnak* "the men see," *az ember jó* "the man is good." *az emberek jdk* "the men are good." The order of phrases in a sentence is relatively free, but the stressed element which includes contrastive stress, question and negation must stand immediately before the predicate, 6 *otthon van* "he, she is at home." *ki van otthon* "who is at home?"

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HUNGARIAN LITERATURE. Nothing remains **of** the earliest Hungarian literature. Its existence can, however. be established with certainty. Through Hungarian folk tales and songs, elements have survived that can be traced back to pagan times. We also possess, unfortunately only in Latin and dating from between the 11th and 14th centuries, shortened versions of some Hungarian legends relating the origins of the Hungarian people; and episodes from the conquest of Hungary and from the Hungarian campaigns of the 10th century.

Earliest Works in Latin. — The establishment in 1001 of a Christian kingdom created the conditions for a new type of literature. Christian in content and Latin in language, which gradually ousted the older, unwritten. traditional preliterature, national in content and Hungarian in language. Up to the 13th century to write meant to write in Latin.

The first Hungarian writers in Latin appeared toward the middle

of the 11th century. They were the bishops Maur (Mór) and Nicholas (Miklós), the first the author of the first Hungarian saint's life. the second probably the author of the first Hungarian chronicle. This kind of literature centred around the royal court, the bishoprics and a Benedictine convent founded in 997 at Pannonhalma. In the second half of the 12th century the court of King Béla III (1172–96) became a centre of literati in which, besides Hungarian writers and scholars who had been studying at French or Italian universities, there were also representatives of the *Minnesang* and troubadour schools of poetry.

In the first four centuries of the new Hungarian kingdom, chronicles. lives of the saints and hymns were the principal literary products in Latin. Some of the chronicles stand out for the excellence of their form and originality of their conceptions. A notary of Ring BCla III—known as the Anonymus—wrote a *Gesta Ungarorum* in which lack of historical accuracy is counterbalanced by literary merit. Simon of Kéza. working under King Ladislas [Ladislaus) IV (1272–90), originated a theory which gained immense popularity in Hungary: that of the identity of Huns and Hungarians, which, though not warranted by historical fact, has haunted even modern research. In the 14th century Marc Kálti compiled a history of Hungary which was to serve as a basis for all later Hungarian histories.

The earliest saint's legend, dealing with the lives of St. Zoard and St. Benedict. was written *c.* 1060 by Bishop Maur. About 1100 were written the three legends of St. Stephen (the first Christian king of Hungary), the two legends of the bishop St. Gerard and the legend of St. Emeric, son of King Stephen. They were followed at the end of the 12th century by a legend of St. Ladislas. These legends are works of some individuality, and their heroes emerge as richly characterized human beings.

Hymns were mainly written in the 13th and 14th centuries for feasts of Hungarian saints. Mention should be made of a *Planctus destructionis regni Hungariac,* which gives a heart-rending picture of the destruction wrought by the Mongol invasion of 1241–42.

Earliest Works in Hungarian. — The first written traces of the Hungarian language consist of Hungarian words. mostly proper names, embedded in the Latin text of legal or ecclesiastical documents. The first connected example of the language is a short funeral oration written *c.* 1200, original and moving in its simplicity. The 13th century saw many translations from Latin, only one of nhich has come down, a free version of a poem by Godefroy de Breteuil; a complaint of the Virgin over her Son's body. This is the first poem written in Hungarian to survive. The 14th century also produced translations of the legends of St. Margaret and of St. Francis of Assisi. The so-called *Jdkai codex,* written *c.* 1440, which contains St. Francis' legend, is the oldest extant Hungarian codex.

The 1 jth century saw the first translations from the Bible. Two Hussite preachers. Thomas and Valentine. were responsible for this work. of which the prophetic Books, the Psalms and the Gospels have survived. A great part of the vocabulary, created for the purpose, is still in use. The Latin sermons of the Franciscan Pelbárt Temesvári constitute perhaps the greatest single achievement of Hungarian literature in that epoch. Though written in Latin they were intended for a Hungarian public, and became very popular in other European countries. A number of Temesvári's sermons have come down in Hungarian translations. Other translations include the first Hungarian drama. On *Three Christian Virgins,* a translation of the legend of St. Catherine of Alexandria and the beautiful translation of the Song of Solomon. There is also a Hungarian version of a Latin hymn in honour of St. Ladislas, and a hymn to the Virgin Mary by András Vásárhelyi.

Hungarian literature mas not entirely religious. The existence of a history of the Trojan war and of a Hungarian version of the Alexander romance can be inferred from their south Slavonic translations. In the 14th century, with laymen going in ever greater numbers to school, conditions for the development of secular literature greatly improved. Much of this literature mas simply occasional verse, of which very little has survived. We are fortunate enough to possess a song written in 1476 after the capture of Szabács by King Matthias Corvinus. From the 14th century onward more laymen went to study at universities abroad, and on their return tried to introduce the literary forms they had learned.

Renaissance **and** Reformation. — Even in the 1 jth century and at the beginning of the 16th Latin remained the language of serious literature. This perpetuation of Latin was a result partly of humanist influences in Hungary. In the second half of the 14th century Italian influence became predominant in Hungary through King Louis I of Anjou, a member of the royal house of Naples. In 136; the first Hungarian university was founded. In the middle of the 15th century, with the accession of King Matthias I, the court became a centre of humanism. Matthias' famous library, the Corvina. became widely known; he later founded a university in Pozsony and established in Buda the first Hungarian press. While vernacular literature was making its first hesitating steps, Latin literature reached its peak in Janus Pannonius, the greatest humanist of Hungary. Nephew of the archbishop of Esztergom, Janus Pannonius was educated in Italy. He achieved greatness only after his return to his own country, when, abandoning an earlier witty vein, he wrote a great number of elegies. The troubles of a responsible statesman, difficulties in combating the Turks, love of country, sorrow at his mother's death, his own illness, were all sources of inspiration. He also found it difficult to adapt himself to the iron discipline of Matthias' court.

The 16th century brought changes in the political, spiritual and literary life of Hungary. Politically the Turkish wars were the dominating factor. After the battle of Mohács (1526) the country was split into three parts, and the centres of humanist and literary thought were destroyed. Many distinguished humanists had to emigrate, among them Miklós Oláh (1493–1568). who belonged to the circle of Erasmus and who spent much time in the Netherlands; János Zsamboki, better known under his latinized name, Sambucus (1531–84), who worked in Vienna; and András Dudich (1533–89), who spent long periods in Poland and Silesia. The 16th century brought the dawn of a new era. The new impulse that transformed Hungarian literature was the Reformation.

In the 16th century not only Hungary but its literature was a battleground, and the aims of the writers of this period were above all practical. They wrote not for posterity but for their contemporaries. It was an age not of contemplation but of action, and it is small wonder that in such circumstances no major works of art were produced. This element of actuality had, however, an important consequence. In order to be understood by as wide a circle as possible, the writers had to write in Hungarian. Hungarian national literature really begins with the Reformation. Mention must here be made of three forerunners of this new era: Benedek Komjbthy, Gábor Pesti and Jbnos Sylvester. All three were of humble origin, were disciples of Erasmus and were active in translating parts of the Bible. With methods infinitely superior to those employed 100 years earlier by the Hussite teachers, they translated with a philological accuracy worthy of Erasmus himself. Pesti made also a very readable translation of Aesop's *Fables,* and in 1538 published a Latin-Hungarian dictionary. In 1539 Sylvester published the first Hungarian grammar and, to show the adaptability of his mother tongue to classical verse forms, wrote the first Hungarian poem in distichs. In 1541 he published a translation of the whole New Testament.

With the spread of the new religion the need for hymns in Hungarian became acute. Most of these were translations of the hymns of Luther or other German Protestant authors, or of the Psalms. Among translators must be mentioned András Batizi. also author of a world history and of several stories based on the Bible. Mihály Sztárai, who played an important role in the Hungarian Reformation, translated some of the Psalms into Hungarian verse. The most original in this group was András Szkhárosi Horvát, author of didactic poems, versified sermons and versified paraphrases of biblical stories, perhaps the greatest Hungarian satirist.

The second half of the 16th century saw the beginnings of Hungarian drama. Sztárai gave dramatic form to fictitious religious disputations: *Papok házassága* ("The Marriage of Priests") and *Az igaz papság tüköre* ("The Mirror of True Priesthood"). As plays these are primitive and have little to commend them. An-

other similar drama with an anti-Trinitarian tendency, *Debreceni Disputa* ("The Dispute of Debrecen"), is much better. *Balassi Menyhárt árulásáról irott komédia* ("Comedy on the Betrayal of Menyhbrt Balassi"), by an unknown author, is perhaps the most interesting literary achievement of the Reformation. This satirical comedy centres round a Hungarian aristocrat well known for his intrigues.

Gáspár Heltai (d. 1574) made a good adaptation of Aesop's *Fables*. A huge collection of sermons is the main product of Péter Bornemisza's (1535–84) literary activity. He gives an entrancing view of Hungarian life in the 16th century, teeming with fresh observations, vivid descriptions and original psychological comments. His volume "On the Temptations of the Devil" gives an interesting picture of sexual problems in the 16th century. A poem of farewell, written on leaving the country, is one of the gems of early Hungarian poetry.

Perhaps the greatest single literary achievement of the Hungarian Reformation was the translation of the Bible by Gáspár Károlyi (1590). This played a role similar to that played by the Authorized Version in the development of the English language.

Though contemplation and interest in religious and philosophical problems are by no means characteristic of the Hungarian mind, up to the 18th century religious literature seems to have fared better than secular literature. This was due partly, as has already been mentioned, to the fact that secular literature was not written down. The existence of secular literature is, however, well attested. The late 16th-century minstrels were men more learned than their predecessors, often driven to such a profession by the difficult economic conditions of the age. Many of their works were circulated in manuscript; many were printed. Perhaps the most important of these minstrels was Sebestyén Tinódi (d. 1556). By temperament he was more of a historian than a poet. He described the wars against the Turks with remarkable accuracy, but his verse is monotonous and shows little imaginative power. Tinódi also wrote music which assures him a place in the history of Hungarian music. Péter Ilosvai Selymes was the author of a romance, *Miklds Toldi* (1574), of little poetic merit, which achieved, however, great popularity in Hungary and served as a basis for János Arany's masterpiece in the 19th century. The hero, a man of immense strength who lived in the 14th century, is one of the most popular figures in Hungarian literature. This romance is the one piece of original conception in the steady flow of secondhand matter which characterizes the literature of the 15th century, a literature intended merely to entertain. Its principal genre is the so-called *széphistória* ("beautiful story") called after the Italian *bella istoria*. Perhaps the best is the "History of Argirus" by the otherwise unknown Albert Gergei. Though based on an Italian original, the story—written in verse—is interwoven with elements of Hungarian folklore and has a naïve charm. Most of the other *széphistória* are more or less free adaptations of western European originals.

The balance sheet of Hungarian literature in the 16th century would be depressing were it not for the figure of Bálint Balassi (1554–94). Balassi's life was a harassed one, spent in endless pursuit of lost rights, in fighting against the Turks, in wars, in adventures. He created a poetry highly original, reminiscent in many respects of that of the Cavalier poets of English literature. But if he has the dash and the frivolity of these writers, he has also a depth which they lack. Balassi calls to mind François Villon, enjoying fights, love, the good things in life, but with sudden and deeply sincere religious impulses. Unlike Villon, however, he shows a knowledge of nature. Balassi was not only a great poet, he was also a versifier of great dexterity. Technically, his verses are unmatched in early Hungarian literature.

Balassi had many imitators and followers. Perhaps the most important was János Rimay (1573–1631), a personal friend of Balassi and the editor of many of his verses.

The 17th Century.— The political situation of 17th-century Hungary makes it difficult to give a clear outline of the literature. The country was still divided into three parts. The first, under Turkish rule, played no part in the development of Hungarian literature. The second, under Habsburg rule, was open to western and Catholic influence; whereas the third part, Transylvania, was isolated from the main current of European thought. Though Transylvania had no university like that founded in 1635 in Nagyszombat by Péter Cardinal Pázmány, the Protestant college of Gyulafehérvár, patronized by the prince of Transylvania, Gibor Bethlen, played a similar role. Transylvanian intellectuals turned toward Protestant Germany, Holland and England. The most important was Albert Szenczi Molnár (1574–1634). He translated the *Institutes* of Calvin and the Geneva Psalms (1607). He also compiled a Latin-Hungarian and Hungarian-Latin dictionary, a Hungarian grammar, and wrote many sermons.

From the beginning of the second decade of the 17th century many Hungarian Protestant theologians went to Dutch universities. Some even visited England and translated the works of such puritan theologians as William Perkins and William Ames. From this epoch dates the first Hungarian travel book (*Europica Varietas*, 1620) by Márton Szepsi Csombor (1594–1623). The greatest Protestant scholar and writer of the 17th century was the puritan János Apáczai Csere (1625–59). His chief work, a Hungarian encyclopaedia in which he endeavoured to sum up the knowledge of his time, marks an important step in the development of a technical vocabulary. Protestant writers seem to have been interested more in learning than in letters. An interesting figure is that of the printer and pamphleteer Miklos Totfalusi Kis (1650–1702) who modernized Hungarian orthography.

By the end of the 16th century the Counter Reformation was gaining momentum in the western parts of Hungary. Among its representatives the vigorous personality of the Jesuit Péter Cardinal Pázmány (1570–1637) stands out. A master of Hungarian prose, he was an orator and essayist of the first order. A vigour of style, always clear though far irom simple, a use of popular expressions and a solidity of argument are the chief qualities of his work. As is to be expected, all his work is controversial, and his *Isteni igazságra vezérlő kalauz* ("Guide Leading to the Divine Truth," 1613) is a refutation of non-Catholic religious doctrines. Another Jesuit, Gyorgy Káldi, produced in 1626 the first Catholic translation of the Bible.

Under the influence of the Jesuits, many Hungarian aristocrats returned to the Catholic faith, and sent their sons to the Austrian Catholic universities and to Rome. There they became acquainted with the baroque style and introduced it into Hungarian literature Baroque influence can be seen in the work oi Miklós Zrinyi (1620–64). He belonged to a family with great traditions, and became one of the greatest Hungarian statesmen and generals of his time. Most of his prose work is an exposition of his political and strategic ideas. His greatest literary achievement is his epic *Szigeti Veszedelem* in 15 cantos. The subject is the siege in 1566 of Szigetvbr, defended against the Turks by Zrinyi's great-grandfather. Though the influence of the epics of Homer, Virgil, Ariosto and Tasso is clear, the work remains in concept and character profoundly original and Hungarian. Zrinyi succeeds in imbuing the historical facts, to which he closely adheres, with a symbolic value, which conveys his own political ideas.

Another epic poet of this time, István Gyöngyösi (1629–1704), was concerned with lesser subjects. He composed many epithalamia, was inventive and handled rhyme with great ease. His poems were much read during the 17th and 18th centuries

The works of aristocratic poets like Zrinyi and Gyongyosi form but a fraction of the poetic harvest of the 17th century, when writing poetry seems to have become the fashion among all classes. The so-called *Kuruc* songs stand out by their high artistic merit. The *Kurucs* were Hungarian partisans fighting against the Germans and the Habsburgs. Their poems—largely anonymous—give gripping descriptions of their poverty and misery, but also of their joys. Many celebrate the deeds of the great figures of the insurrection, particularly those of Francis Rákóczi, prince of Transylvania and leader of the last great rising (1703–11). Many Hungarian poets have sought inspiration in these *Kuruc* songs

Decadence.—The period between 1711 and about 1770 was a time of decadence in Hungarian literature Memoirs form what is best in the prose literature of this period. The autobiography of Miklós Bethlen (1642–1716), a leading Transylvanian politician, and the *Confessions* and *Mémoires* of Rákóczi, written respectively in Latin and French, make absorbing reading. The *Letters* of Kelemen Mikes (1690–1761), a companion in exile of Rákóczi, were addressed to an imaginary aunt. In choosing this genre Mikes was inspired by French influence, and his work stands out for its excellent style. The *Metamorphosis Transylvaniae* of Péter Apor (1676–1752) is a nostalgic reminiscence of the "good old days" in Transylvania before German customs had penetrated it.

Poetry of this epoch has little to offer. The poems of László Amadé (1703–64) are both in form and in content rococo. Amadé creates a Hungarian version of the *poésie galante*. He is matched by Ferenc Faludi (1704–79) who, however, takes his expressions from popular

language.

The middle of the 18th century saw the beginning of the "school dramas," so called because they were the Hungarian versions, prepared in schools, of foreign dramas.

This period of literary decadence produced notable works only in the fields of history and history of literature, Some of these were written in Latin. Among historians Mátyás Bél, Gyorgy Pray and István Katona are most important. The first historian of Hungarian literature, Dávid Czwittinger (1676–1743), wrote the biographies of about 300 Hungarian writers. His work was continued and improved by Péter Bod, whose *Magyar Athenás* ("Hungarian Athenaeum," 1766) deals with more than 500 Hungarian men of letters.

The Period of the Enlightenment. — The period between about 1772 and 1825 is often called that of the Enlightenment. Though immensely important in the development of the Hungarian spirit, it produced few writers of the first rank. However, this period prepared the ground for the splendid harvest of the 19th century, when Hungarian literature reached its greatest height. The Hungarian Enlightenment was more receptive of foreign (French and English) ideas than productive of original developments, and the main task of its exponents was to adapt the new ideas to the particularities of the Hungarian scene.

The first interpreter in Hungary of the ideas of the Enlightenment, György Bessenyei (1746–1811), decisively influenced Hungarian literature. It is with the publication, in 1772, of his first literary work, a translation (from the French) of Pope's *An Essay on Man,* that the new era begins. Bessenyei's aim was knowledge rather than pure art, and all his works serve a didactic purpose. From 1765 to 1782 he lived in Vienna, where he came to realize the backwardness of his own country. His best drama, *Agis tragédiája* ("The Tragedy of Agis," 1772), serves as a somewhat creaking vehicle for his antidespotic ideas. The problems touched upon in Greek guise remain recognizably Hungarian. His best work, *Tarimenes utazása* ("Tarimenes' Journey," 1802–04), the first real novel in Hungarian, remained unpublished for over a century. It is a bitter attack on everything that conflicts with the views of Enlightenment. With destructive irony, reminiscent of that of Swift, Bessenyei examines the shortcomings of human society.

The purely literary merit of Bessenyei's work is slight, but by writing in Hungarian, by trying his hand at various literary genres such as the drama and novel, hitherto practically unknown in Hungary, and by knocking at the closed door of Hungarian civilization with the new ideas of the Enlightenment he started a movement which put an end to the literary stagnation of the early part of the century. His personal influence induced several of his fellow officers—*e.g.,* Sándor Barotzi (1735–1809) and Abraham Barcsay (1742–1806)—to try to convey the ideas of the Enlightenment in Hungarian to a Hungarian public. This public was, as yet, virtually nonexistent, and works like those produced by Bessenyei were unlikely to create much desire to read.

Spurred on by new ideas, but basically traditionalists, the general of the cavalry, Jbzsef Gvadányi (1725–1801), and András Dugonics (1740–1810) achieved works of some literary merit and amusing enough to become popular. Gvadanyi's best work *Egy falusi nótárius budai utazasa* ("The Journey to Buda of a Village Notary," 1790) is a long narrative poem describing with humour and irony the adventures of a somewhat pretentious but basically sane notary who, on reaching the capital, is deeply shocked by the ioreign fashions prevailing there. The whole work is an apology for national and traditional values against encroaching foreign ideas. The novel *Etelka* (1788) by Dugonics, a sentimental love story in a historical setting, was the first Hungarian "best seller." It is a bad work by any standards, unoriginal, full of deplorable anachronisms, but its praise of the golden days of the Hungarian past and of popular tradition had a general appeal. Both Gvadanyi and Dugonics used a popular language, free from foreign influence, and this is perhaps their greatest merit. Ádám Pálóczi Horváth (1760–1820) belonged to the same group of writers representing national resistance to foreign ideas. His epic poem *Hunnias* (1787) on John Hunyadi would not justify the presence of his name in this survey. He left, however, in manuscript a collection of 450 poems (*Ötödjélszáz dnekek,* publ. Budapest, 1953), which is a treasure house of popular poetry and music and incorporates a number of poems of his own making. Those in the popular vein are still enjoyable, and his religious, psalmlike, poems are moving by their vigour and sincerity.

This period at the end of the 18th century is a period of discovery, and of experiments with language. Minor attempts at changing the traditional Hungarian verse form had been made by Bessenyei, Lorine Orczy and others, but other men were to explore the road on which János Sylvester had taken the first steps: the use of classical metre for Hungarian verse. The pioneers, Dávid Baróti Szabo (1739–1818), József Rajnis (1741–1812), Miklos Révai (1750–1807) were followed by Benedek Virág (1754–1830) who, influenced by Horace, imbued with poetic inspiration verse forms which for his predecessors were merely formal exercises. It fell to Dániel Berzsenyi (1776–1836) to show what use a really great poet could make of classical metre.

Berzsenyi is a giant of expression. What he has to say is neither particularly original in itself nor in its forms. It is the terseness and vigour of the expression, the power of conviction, that make his lines memorable. His ode to *Magyarokhoz* ("The Hungarians"), his *Fohasz* ("Prayer"), his elegy *A közelitő tél* ("On the Nearing Winter"), belong to a category beyond criticism. Berzsenyi could perceive, as few others could, the transitoriness of power, glory, friendship, of everything but God "whose existence shines like the burning sun but cannot be looked upon." He had taken irom his beloved Horace the acute perception of the ephemeral, but his *carpe diem* ("seize the day") is a mild, melancholy echo, almost a renunciation. Only the destinies of his country can really move him, "moral rectitude is every country's mainstay and foundation." He exults at the sight of groups of men abiding by their loyalties; and, looking into Hungary's past, he finds solace in the thought that "eagles engender but eagles, and the leopard of Nubia will not bear timid rabbits."

The ideas of the Enlightenment were not universally welcomed in Hungary. The traditionalist elements looked, as we have seen, with distrust on any imported ideas, and the government was increasingly distrustful of a spiritual trend which had led to the French Revolution and, in Hungary, to the conspiracy of Martinovics. László Szentjobi Szabo (1776–95), Ferenc Verseghy (1757–1822), János Batsanyi (1763–1845) went to prison—where Szentjóbi Szabó .died—for the crime of sympathy with these ideas. The most talented among them, Batsanyi, secured his place in the history of Hungarian literature by his poem *A franciaorszdgi változásokra* ("At the Changes in France"), a vigorous warning to all tyrants "to cast their watchful eyes on Paris."

Sentimentalism found its interpreters in Jbzsef Kármán (1769–9j) and Gabriel Dayka (1769–96). Kármán's only work of importance, *Fanni hagyomdnyai* ("The Papers of Fanny"), is a sentimental novel, written in the form of letters and diary entries. Very much on the lines of Goethe's *Werther,* the work nevertheless marks an important step in the history of the Hungarian novel. Dayka, a poet, died too young for the full measure of his talent to be realized.

The first really important lyric poet since Balassi was Mihály Csokonai Vitéz (1773–1805). A widely read, intelligent man, Csokonai continued the purely Hungarian poetical tradition, and his many songs to "Lilla" are a happy blend of rococo grace and thoughts less superficial than they appear. The influence of Rousseau is very noticeable in some of his longer philosophical poems which make a curious contrast to his popular drinking songs. He is an absolute master of form, and his poems, filled with subtle grace, show no trace of the acute sufferings of his life.

Pope's *The Rape of the Lock* served as a source of inspiration for Csokonai's comic epic *Dorottya* ("Dorothy"), but Csokonai's poem is original and very much Hungarian. The heroine, an old spinster, leads a revolt against men reluctant to marry. The language of the poem, not exempt from some slight vulgarity, is vigorous, the comic situations somewhat coarse but amusing. Mihaly Fazekas (1766–1828), a friend of Csokonai, won fame by his *Ludas Matyi,* a humorous narrative poem relating the clever vengeance of a serf on his cruel lord.

The place of Sándor Kisfaludy (1772–1844) in Hungarian literature is secured by his first work *Kesergő szerelem* ("Plaintive Love"), a song cycle depending on a very thin narrative thread: the hero Himfy finds no response to his love for Liza; in despair he goes to the wars, and returns to find that Liza still refuses to become his wife. Writing in a very elaborate verse form of 12 lines, devised by Kisfaludy and called the Himfy verse, the poet displays an astounding ingenuity in finding new variations on the theme of unhappy love. Though no one reading the whole cycle could escape a sense of monotony, the individual songs are often beautiful. "Plaintive Love" had an immense success, which prompted Kisfaludy to publish a second song cycle *Boldog szerelem* ("Happy Love," 1807), in which, with similar skill but less verve, he tried to find varied expressions to convey the apparently undisturbed bliss of his marriage. Among his better works must also be reckoned three tales, *Csobanc, Tdtika, Somló,* written in the romantic mood of *Rittergeschichten* ("stories of chivalry").

Few, if any, of the names mentioned in this account of the period following Bessenyei's appearance on the literary scene can be dissociated from Ferenc Kazinczy (1759–1831), a mediocre poet but an influential man of letters: for about 40 years he was the pivot of literary life. Aristocratic, cool, formal, efficient, his political conceptions were progressive, a luxury for which he paid with six years' imprisonment His aim was to purify Hungarian literature irom all vulgarity. He wanted a literature refined and limpid, neither baroque nor popular. What he hated above all was bad taste. His interest was focused on style, on presentation, on construction; the thoughts expressed were for him secondary To satisfy his desire for a more refined literature he became the head of the *neologi* who, opposed by the *orthologi,* tried to renew and enrich the Hungarian language to make it suitable to express the most elaborate thoughts. This language reform, which lasted through much of the 19th century, enriched Hungarian and made of it the most versatile instrument a poet can hope for. Kazinczy's activity. his correspondence and memoirs, his biting, satirical epigrams, his extensive translations of works, sometimes ill-chosen, but of varied nature so as to serve as stylistic exercises, and, above all, his great personal prestige and influence, leit an indelible mark on Hungarian letters.

The Early 19th Century. — The literary revival caused by Kazinczy's activity continued after his death, and even in the last years of his life the literary leadership of the country was assumed by Károly Kisfaludy (1788–1830), brother of Sándor In 1822 he iounded the literary magazine *Aurora,* the first of its kind, which achieved real popularity and to which all the important writers of the period contributed. Károly Kisfaludy's other important contribution to Hungarian literature was in the field of drama, where he was the first representative of romanticism and the first playwright to achieve con-

siclerable popular success. Among his many historical tragedies, *Iréne,* set in 15th-century Constantinople, and the Voivode Stibor are the best, though they fall short of the requirements of a really good play. His comedies are still enjoyable, and portray well a number of characters of the contemporary Hungarian society. He also tried his hand at short stories, and his satirical descriptions, still amusing and instructive, had at the time a political message which, with its mildly progressive ideas, was not unwelcome in a society basically conservative but more and more convinced of the necessity of social and political reforms.

While Kisfaludy's tragedies, often very shallow, were applauded all over the country, one of the best tragedies in Hungarian, published in 1820, remained entirely unknown. Its author, József Katona (1791–1830), a lawyer who in his student days had been attracted by the stage, translated from German a great number of dramas and wrote several original plays, all insignificant. In 1815 he wrote his masterpiece: Bank *bán* (the bdn was a high Hungarian dignitary). Set in the 13th century the play is a masterful combination of national and individual conflicts culminating in the murder of the queen by Bánk, the highest dignitary of the country, who wrongfully accuses her of having helped his brother Otto to violate Bank's wife. The queen, though responsible for many wrongful acts, had been innocent of this specific crime, and Bank realizes too late his fatal mistake. Particularly effective is the role of Tiborc, a poor peasant, whose figure has remained ever since the symbol of the oppressed. The tragedy, written in a vigorous prose, is a real work of art in content as well as in form.

Though it would be difficult to overestimate Kazinczy's contribution to the development of Hungarian letters, he himself, like his circle, produced no outstanding works of art. All the good, and many of the bad, poets were indebted to him; but the really strong talents had to break away and find, indeed create, their own forms of expression. This was the case with Berzsenyi, Csokonai, Károly Kisfaludy and another poet who had been in closer touch with Kazinczy than any of these: Ferenc Kolcsey (1790–1838). Kolcsey's poetical production was comparatively small, and his first poems belong to the somewhat anemic type which could cause no offense to Kazinczy. Later Kolcsey produced a number of striking poems, vigorous in thought and expression, grave, even sombre when they deal, as so often, with the problems of his country's situation. The most impressive manifestation of this mood, the *Hymnus* (1823) is a passionate plea to God to have pity on a people which through the bitter sufferings of the past "has already expiated the past as well as the future." The poem, set to music by Ferenc Erkel, is the Hungarian national anthem. Kolcsey was a politician of great standing, a brilliant orator; and his literary criticisms are also of very high standard, though unduly severe.

Mihaly Vorosmarty (1800–55) resembles Kölcsey in his general pessimism and his patriotic preoccupations. But unlike Kolcsey, whose manifold interests, as it were, softened his impact in any one field of his activity, Vorosmarty's whole genius was focused on literature. After Kazinczy and Károly Kisfaludy died, Vorosmarty became the central figure in literary life, but with much better claims to this role, as far as pure literary achievement is concerned, than either of his predecessors. He tried his hand at every literary genre, and in each produced works of abiding value. His first appearance on the literary scene, with a long epic poem written in hexameters, *Zalán futása* ("The Flight of Zalan," 1825), was a great success and was followed by many other historical tales, written in a romantic vein but not without an eye to contemporary political and social problems. These appear also in many of his best lyric poems, and his *Szózat* ("Appeal") is a worthy pendant to Kolcsey's *Hymnus.* Much interested in drama (he translated Julius Caesar and King *Lear*), he had little sense of the requirements of the stage. His best work, a charming and symbolic fairy tale, *Csongor és Tünde,* contrasts, in a fashion reminiscent of *A* Midsummer Night's *Dream,* the airy lightness of fable and poetry with the grotesque earthiness of men.

In Hungarian literature poetry was far ahead of drama, and the novel seemed slow in taking root. The first successful novelist, Miklós Jósika (1794–1865), a disciple of Walter Scott, made his appearance in 1836 with the historical novel *Abafi,* which marks a turning point in the history of the Hungarian novel. It remained his best work. Once the novel was well established as a literary medium, others tried it with increasing success.

József Eotvos (1813–71), who after the 1848 revolution was to become an important political theorist and at the end of his life was minister of public instruction, produced in his early years a few novels of which two, *A* falu *jegyzője* ("The Village Notary") and *Magyarország 1514-ben* ("Hungary in 1514"), published respectively in 1845 and 1847, figure among the best Hungarian novels. The first gives a depressing but not melodramatically exaggerated picture of feudal life in Eötvös' time, the second deals with Gyorgy Dózsa's peasants' revolt. Though the novels are lengthy and difficult to read, they have extraordinary qualities of characterization, both of individuals and of periods. Eotvos' vigorous realism had great evocative power; his heroes are set with a firm and knowledgeable hand against the background'of violent social clashes. His novels are political manifestos in support of the oppressed, and against the appalling injustices which lead to revolutions —of which the writer disapproves as a political means.

From the mid-1830s literature had become sufficiently appreciated to make writing attractive. Literature and politics were closely connected and their association was to become instrumental in the explosion of 1848. In the proliferation of writers and poets—if we except those already mentioned—few showed real talent. The novelists Ignác Nagy (1810–54) and Lajos Kuthy (1813–64), the playwrights Jdzsef Gaal (1811–64), Károly Obernyik (1815–55) and Zsigmond Czakó (1820–47) deserve mention.

Poetry was on an altogether higher level. Gergely Czuczor (1800–66) produced a few epic poems of a fairly high standard, but his best poems were in the style of folk songs. Many returned to the people and became a part of popular poetry. János Garay (1812–53) owes his fame, in Hungary, to his amusing tale in verse *Az* obsitos which relates the story of the mendacious braggart János Háry, immortalized in Zoltán Kodály's opera, Hdry *János.* Jdzsef Bajza (1804–58), popular in his time, lacks originality and his poems are too diffuse to be really effective. Bajza's significance lies in his activities as a literary critic. He played an important role in the organization of theatre life and became the first "administrator" of literature. His scrupulous honesty and his uncompromising rejection of complacency had a salutary influence His friend Ferenc Toldy (1805–75), a critic himself, made important contributions to the previously almost uncultivated field of the history of literature.

The folk song and folk ballad collections of János Erdélyi (1814–68) and János Kriza (1811–75) exerted great influence on the further development of Hungarian poetry.

"Popular poetry is the only real poetry" was a firmly held opinion of Sándor Petőfi (1823–49), one of the greatest Hungarian poets. The quality of Petőfi's production is uneven, but his best poems must rank among the masterpieces of world literature. He was an innovator, a revolutionary, by nature as well as by conviction. He hated convention and—not without a desire to *épater le* bourgeois—made a break with conventional subjects and with so-called poetic language. His descriptive poems are striking in the immediacy of the perception, in the directness of the language and in Petőfi's extraordinary capacity to infuse poetry into almost any subject The revolutionary violence of his patriotic poems, which are often frankly political, has a counterpart in the exquisite melancholy and tenderness of his love poems. Petőfi's thought lacks the depth of, say, Berzsenyi, Vorosmarty or Arany, but the sincerity and force of his expression brings it home to the heart of the reader, hence his great influence during the revolution in 1848. Petőfi's many songs are enchanting in their simplicity: in this genre he remains unsurpassed. In him the great popular song tradition, from the Kuruc songs and Balassi through Csokonai and Kisfaludy, reached its peak. Petőfi's epic poetry is of less value, though his naive popular epic poem Jdnos *vitéz* (1845) and his comic epic A *helység kalapácsa* ("The Hammer of the Village," 1844) are enjoyable. Petőfi's early death—he disappeared on July 31, 1849, in a battle with the Russians —was a tragic loss to Hungarian literature

The torch falling from Petőfi's hand was picked up by his friend, and in some ways his follower, Janos Arany (1817–82). Though older than Petőfi he became known only when Petőfi was already famous. They shared the same conviction of the value of popular poetry, but their approach to it was different. The difference between them is largely that between an extrovert and an introvert. Petőfi proclaims his feelings, almost carelessly, and only his genius saves him from writing bad verse. Arany, modest and retiring, is reluctant to unveil his inner self. (He never wrote a love poem.) He chooses his subject with great care, very often from history, and treats it with deep understanding of the human mind, and with impeccable artistry. His language is exquisitely chosen. He does not try to be popular but has the assurance of one who knows that what he writes is the language of the people, lifted to a degree rarely attained and never surpassed in Hungarian. His ballads, often romantic, have virile vigour, conciseness and uncommon evocative power. His great narrative poems, such as his *Toldi* trilogy and *Buda halála* ("Death of Buda"), while firmly rooted in Hungarian tradition, reflect eternal human problems. It is Arany's great merit that he is never boring to read, his philosophy appears through his characters and not in lengthy digressions, and a subtle humour brings welcome relief to mounting tensions.

The Late 19th Century.— The peaks of poetry reached by PetBfi and Arany remained inaccessible during the rest of the 19th century. The second half of the century produced a host of imitators. Even the more gifted found it difficult to get out of the rut. This does not apply to Mihály Tompa (1817–68), a contemporary and friend of Petofi and Arany, an original but mediocre poet whose popularity is today difficult to understand.

Hungary,, prostrated by the unsuccessful revolution of 1848–49, remained until 1867 under Austrian rule. The "epoch of compromise" which then followed was hardly more favourable to literature. The defeat was followed by half-hearted acceptance of the compromise and by a self-deceiving optimism which produced complacency and uninspired traditionalism. The strongest talent in this period of decadence, Janos Vajda (1827–97) trod a lonely path beset with devouring passions, gloomy visions. Solitary in his life as well as in his poetry, little recognized by his contemporaries, his influence on coming generations was great. Gyula Vargha (1853–1929), Sándor Endrődy (1850–1920), József Kiss (1843–1921), Gyula Reviczky (1855–89) and Mihály Szabolcska (1862–1921) all produced one or two poems of real beauty.

The theatre, steadily growing in popularity, could, even less than poetry, produce works of lasting value. In 1837 a national theatre was formed to produce works of merit, but the level of the plays was low.

The inexhaustible Ede Szigligeti (1814–78) wrote more than 100 plays. His tragedies are weak, but his comedies are amusing and he created a special genre, the so-called *népszinmű,* plays giving an idealized picture of village life. Szigligeti had a good sense of the stage and catered for a public delighted to watch plays presenting no problems.

Problems, social, political, religious, constituted the principal preoccupation of Imre Madach (1823–64), whose *Az* ember *tragédiája* ("The Tragedy of Man") is one of the glories of Hungarian literature. This dramatic poem, which follows man's destiny from his creation, through different stages of history into the future of a phalanstery (see FOURIER, FRANÇOIS MARIE CHARLES) and the ultimate extinction of life, shares some of the characteristics of such philosophical poems as Goethe's Faust. But it not only displays original thought incisively expressed, it is also remarkably effective on the stage. It is a play to be seen rather than to be read, and, well-produced, will hold its audience spellbound.

Gergely Csiky (1842–91), after Szigligeti the most popular and most prolific playwright of this epoch (35 plays), was a pseudo realist. The social conflicts which appear in his plays for the first time on the Hungarian stage are, to a large extent, artificial, secondhand and second-rate adaptations.

Only among the novelists can we find really outstanding achievements. Zsigmond Kemeny (1814–75) is, in many respects, a disciple of Balzac. Whether he sets the scene of his novels in the past as in Zord *idő* ("Grim Times," 1862), Rajongdk ("The Fanatics," 1858) or in his own time as in *Férj és nő* (("Husband and Wife," 1852), he displays a masterly skill in minute psychological analysis. His novels breathe tragedy; his characters are pushed toward their gloomy fate by a host of circumstances, never fortuitous but determined by their own deeds. Analysis often takes the place of action in Kemény's work and because of the effort needed to read them his novels have never known wide popularity.

The opposite is true of Mór Jdkai (1825–1904), undoubtedly the most popular Hungarian novelist. Jokai is a born storyteller, endowed with an exceptional imagination, which, although able to evoke any epoch, any milieu, remains firmly rooted in Hungarian soil. His characters are idealized, his descriptions inaccurate, but they carry the reader into a dream world, so realistic that he is tempted to forget that it is but the projection of Jókai's mind. In his works (more than 100 volumes), historical novels alternate with others centred on the problems of contemporary society, of which almost all the strata interested him. In following the hero—and a hero he is--we make acquaintance with a variety of worlds, strangely reminiscent of each other, for all owe their existence to Jokai.

Kálmán Mikszath (1847–1910) is entertaining in a different way: he observes with a keen eye his contemporaries, politicians, civil servants and their contacts with the people, and relates their doings with sly humour. The shortcomings of the society in which he lives are obvious to Mikszáth but, though a politician, he is little concerned with improvement. Mikszath is only less popular than Jókai.

Though his principal works were published early in the 20th century, Géza Gárdonyi (1863–1922) is a spiritual child of the 19th. His historical novels, well-constructed. easily read, are well meaning and harmless; *e.g., Az* egri csillagok ("The Stars of Eger," 1901), *A* ldthatatlan ember ("The Invisible Man," 1902).

During the 19th century, literary life in Hungary became, to some extent, organized, and literary societies played an important part. The Kisfaludy and Petofi societies, founded in 1836 and 1876 respectively, were particularly influential, though the authority of the Hungarian Academy, founded in 1825 by István Széchenyi, remained unchallenged. The principal literary critic of the second half of the century was Pál Gyulai (1826–1909), himself a poet and writer. Literary criticism, the history of Hungarian literature, attracted some of the best brains. Gusztav Heinrich (1845–1922) and Zsolt Beothy (1848–1922) were among the leading figures in this field.

The 20th Century.— As we have seen, with a few exceptions, such as Madách, the second half of the 19th century was an era of decline in which writers imitated Petofi or Arany, and based their work on social and political ideals which were becoming sterile. The great majority of Hungarian writers had been recruited from the ranks of the nobility which, in fact, constituted in Hungary the middle class. Only at the end of the century did some writers of lower middle-class origin come to the fore. The first important manifestation of the new era was the periodical *A Hét* ("The Week"), founded in 1890 by József Kiss, which without any definite program became the organ of a number of more or less gifted writers who brought some fresh air into a stifling fin de *siècle* atmosphere. Zoltán Ambrus (1861–1932), a disciple of Maupassant, and an outstanding theatrical expert, was the most important among them. Sándor Bródy (1863–1924) and Gyula Krudy (1878–1933) did not belong to any school and, perhaps because of that, wrote original short stories and novels.

The year 1906, when Endre Ady (1877–1919) burst into Hungarian life "with the new songs of a new epoch," marks a turning point. Ady's revolutionary political ideas, which provoked violent storms, made it difficult for some sections of society to accept that he was a poet of unusual genius. In form and content Ady is a lyrical poet of such originality that he defies comparison. He rejuvenated Hungarian language and poetical thought, and his rich production is of uniformly high quality. His poetry is infinitely varied; perhaps humour is the only note missing. Love, friendship, hatred and war, social and political problems, death, a desperate search for God, are among the chief sources of his inspiration His method of expression is symbolic. An external event—we are rarely told what it is—inspires a dream which defies any other description but that given in the poem itself.

In 1908 was founded the literary periodical Nyugat ("The West") with Hugo Ignotus (1869–1950) and Ern6 Osváth (1877–1929) as editors. The influence of this left-wing periodical, without any definite political program but strongly biased against the political fool's paradise of Hungarian life, cannot be overestimated. It brought together vigorous talents, who lifted Hungarian letters to a level remarkable by any standards.

Mihály Babits (1883–1941), an intellectual poet, master of form and a deep original thinker, was from 1929 editor of Nyugat. He was also a translator of exceptional ability; his *Divina* Comedia is probably the best existing translation of Dante Dezső Kosztolanyi (1885–1936), the greatest impressionist in Hungarian poetry, was a sensitive poet and an accomplished short-story writer On a slightly lower level Arpad Tóth (1886–1928), reminiscent of Keats, and Gyula Juhász (1883–1937) were masters in voicing the distress of the solitary and the oppressed. The delicate, reticent poetry of Lajos Áprily and Aladár Komjáthy, the deliberately childish verse of Ernő Szép, the light, chanson-like poems of Jeno Heltai (1871–1957) must also be mentioned.

Zsigmond Móricz (1879–1942) was undoubtedly one of the greatest novelists in Hungarian literature. His descriptions of provincial life are outstanding for their masterly portrayal of peasants and gentry, of the terrible conflicts between man and man, man and woman, man and misery Móricz was a realist in the true sense of the word, down to earth but perceptive, robust but capable of extraordinary tenderness. Margit Kaffka (1880–1918) was another important novelist (the first great woman writer in Hungary). Frigyes Karinthy (1888–1938), without producing "major works," exerted a considerable influence on his generation His splendid pastiches are studied in schools; his queer, inquiring mind had an uncanny ability to discover the absurd and the preposterous in human behaviour

It is always dangerous to give schematic pictures of anything as complex as literature, but for the sake of convenience it can be said that from 1908 there were three main streams discernible in Hungarian literature: the Nyugat group already mentioned which included the greatest talents; an official literature written by conservative-nationalist writers; and, lastly, a superficial boulevard literature with hardly any aim but entertainment. The principal writer of the second group was Ferenc Herczeg (1863–1954), author of many novels and some plays showing considerable theatrical skill. Cecily Tormay's historical novels gained more official recognition than their value would warrant. Of the third type, entitled, nevertheless, to literary recognition, must be mentioned playwrights The impressionist Dezső Szomory, with definite literary ambitions; Menyhért Lengyel whose Typhoon (1909) has known success all over the world; and the exceptionally gifted Ferenc Molnár (1878–1952), whose plays, imperfectly adapted to the tastes of international theatre audiences, do little justice to a talent which shows itself best in some little-known short stories on Budapest life.

The real importance of the Nyugat as the organ of a literary movement diminished considerably after World War I, the great writers and poets of the group gained official recognition and the conflict which opposed them to the traditionalist men of letters became less violent. The literary cake was in any case large enough to feed both groups. Solitary writers found it more difficult to obtain recognition. Lajos Nagy (1883–1954), a socialist short-story writer, and Jenő J. Tersbnszky, with his descriptions of vagabond life, deserve mention.

The solitary giant Dezső Szabó (1879–1945) an unsurpassed master of Hungarian prose, author of some powerful and bewildering novels and stories, alienated sympathy with his venomous. though often pertinent, attacks on almost everything. Lajos Kassbk (1887–) was the first worker to secure a place in Hungarian literature. A painful search for poetical form led him to an expressive, often pathetic, blank verse. His novels and particularly his moving autobiography (Egy ember *élete,* 1927) give a true picture of working-class life.

The period between World Wars I and II is one of extraordinary flowering in Hungarian letters. Most of the new writers of the prewar period were still active, and many new names appeared.

In poetry the greatest figure is that of Attila József (1905–37). His subjects, similar to those of Kassák, are treated with tender lyricism, changing sometimes into violent outbursts against the existing social order. Lőrincz Szabó (1900–57) was a master of fine observation, and a gifted translator of foreign poets. The Catholic priests Ladislas Mécs and Sándor Sík brought new life to religious poetry. Oszkár Gellért and Milbn Füst belong to the most talented poets reared by the Nyugat. The poetry of Miklós Radnoti (1909–44) reaches a tragic climax in his splendid poems written in a German camp and during a death-march in which he himself was to perish.

Gyula Illyés (1902–), considered by many as the greatest Hungarian poet of the mid-20th century, found inspiration in the life of the peasantry, also the subject of his many essays and semidocumentary descriptions, which exerted some influence on Hungarian opinion. Among postwar poets, Sándor Weores, Gyorgy Faludy, Ferenc Juhász, László Benjamin and László Nagy were probably the most talented.

In Hungary, as elsewhere, the novel became the principal form of

literary expression. To the writers already mentioned, who had been active before World War I, other names must be added. Between the wars Lajos Zilahy (1891–) and Sándor Marai produced good descriptions of the Hungarian bourgeoisie; Aron Tamasi and Jozsef Nyirő wrote on various aspects of Transylvanian life. The realistic novels of Pal Szabh, Janos Kodolanyi, Jozsef Darvas, the firsthand accounts of peasant life by Peter Veres, are probably among the best representatives of literature laden with a social "message." Problems of socialism had influenced some of the writers (*e.g.,* Attila Jozsef, Veres) even before World War II; later social and political considerations became overwhelming and, ior some years, they alone constituted the materials of literature. Much of this is negligible, but the novels of Tibor Déry are of literary value. Almost all the important novelists and poets (*e.g.,* Móricz, Heltai, Kodolanyi, Zilahy, Illyés) tried writing drama, but the greatest achievements in this field are the historical plays of László Németh (1901–). Centred on powerful personalities of the past (*e.g.,* Galileo, Pope Gregory VII) they excel in the evocation of historic settings and in the picturing of eternal conflicts which oppose the honest man, bent on improvements, to the incomprehension and hostility of his contemporaries.

During the 20th century literary criticism and the history of literature kept pace with growing production and an increased interest in letters. Of the older generation Aladár Schopflin (1872–1950), for many years chief critic of the *Nyugat;* of the generation between the wars, Antal Szerb (1901–45) are among the most outstanding figures. It is impossible not to mention Gyorgy Lukács (1885–), the great Marxist literary theorist, though Hungarian literature has formed but a small part of his studies. Jeno Pinter produced a number of manuals, lacking imagination, but useful compendia of facts. In János Horvath (1878–), a dignified and scholarly personality, Hungarian literary research reached a level which it would be difficult to surpass.

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HUNGARY, a country of central Europe, is bounded on the west by Austria, on the north by Czechoslovakia, on the northeast by an outlying portion of the Ukrainian Soviet Republic, on the east by Rumania and on the south by Yugoslavia, with a post-World War II area of 35,919 sq.mi.

Physical Features. — From 1920 Hungary occupied only the central portion of the middle Danube basin, all of which had previously belonged to the historic kingdom of Hungary. The Danube actually forms its northern frontier from a point just below Pozsony (Bratislava or Pressburg) to Szob, where it turns southward; it has Hungarian territory on both its banks until it passes into Yugoslavia just south of Mohács. It is a main artery of communications for the country and a dividing line of historical, economic and cultural importance between its western and eastern portions.

Western Hungary forms a rough square, bounded on the north and on the east by the Danube, on the west by the last outliers of the Austrian Alps and on the south by the Mur and the Drave rivers. The southwestern corner of this square (the Gocsej) consists of low, tangled hills, among which deposits of oil were discovered in the 1930s.

Above these hills the river Rába (Raab), issuing from the Styrian Alps, turns northwest to run into the Danube at Gyor. Its lower basin, comprising an area of about 3,861 sq.mi., is flat, open and often marshy; in its northwestern corner lies the extensive but shallow Lake Ferto (Neusiedlersee). Halfway down its course it runs under the southwestern outliers of the Hungarian central range, limestone hills of varied formations ranging from Permian to Recent and associated with basalt, andesite and other volcanic rocks. This range, beginning with the isolated volcanic hills of Badacsony and Somló, broadens into the forested Bakony area, this being continued to the northeast by the detached ranges of Vértes (1,572 ft.), Pilis (2,484 ft.) and the group of hills on one of which Buda is situated. Some lignite is found here, and important deposits of bauxite have been discovered.

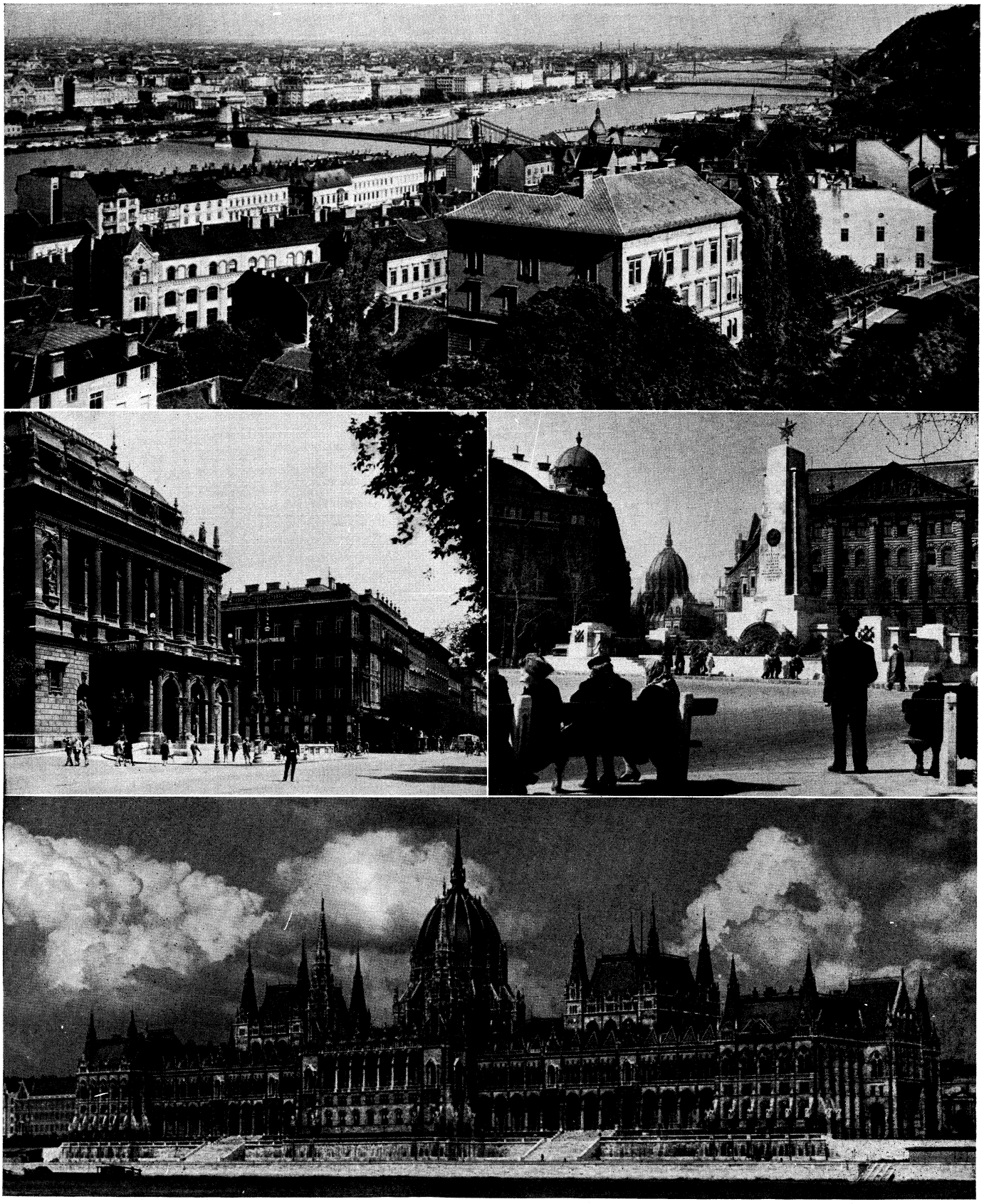
Under the southwestern slopes of these hills lies Lake Balaton (*q.v.*), south and southeast of which is a rolling downland, intersected by parallel streams whose water reaches the Danube directly or via the Sió or the Drave. Vast deposits of loess and loam make this area suitable for intensive agriculture. Rising as a mountainous island from its centre is the massif of the Mecsek hills, containing outcrops of numerous post-Carboniferous formations, Triassic and Jurassic limestones, granites, diorites and other igneous rocks, together with a considerable coal field.

Beyond the Danube the line of the central range is continued northeastward in a series of hills. The chief of these are the Borzsony (3.081 ft.) and the Cserhát (2,130 ft.) and then, between the Zagyva and the Hernád rivers, the Mátra (3,315 ft., mainly trachytes) and the Bükk (a complex of carboniferous shales, Jurassic limestones and volcanics); while beyond the Hernád to the frontier stretches part of the Eperjes-Tokaj volcanic range, renowned for the fertility of its soil and the quality of its vineyards. Below these hills is the Great Plain (Nagy-Alfold) of Hungary, an open, very flat expanse through which the Tisza (Tisa or Theiss) runs to join the Danube at a point below the frontier. Portions of this plain, especially in the south, consist of black-earth regions of great fertility. In other areas the soil is sandy and alkaline; there are also many marshy areas and lagoons. The Tisza itself was regulated only in the 19th century, and the plain is still liable to devastating floods when the snows melt in the mountains (annexed to the U.S.S.R.) in which the headwaters of the Tisza are situated. Irrigation and afforestation have only gradually reclaimed for agriculture the wilder parts of the plain, which formerly were used chiefly to maintain vast herds of horses and cattle, pastured under wild and picturesque conditions.

The climate of Hungary is transitional between oceanic and continental. The three great climatic regions of Europe, the west European, the east European and the Mediterranean, here struggle for supremacy. Mean annual temperatures range from 48° F. in the north to 52° F. in the south, and in general the country shows a positive isanomalous temperature. Temperatures may vary between 40° and 47° F. in the course of the year (in exposed districts of the Nagy-Alfold the upper limit is much higher). The distribution of precipitation over the land shows a decrease in amount eastward: the greatest quantity is received on the western slopes of the Bakony forest, where 30–35 in. fall per annum; the driest region is the middle Tisza, with less than 15 in. in dry years, though sheitered regions such as the southeastern slopes of the Hegyalja are very dry. Most rain falls in May and June (June has 13% of the year's total) with a tendency toward a secondary maximum, caused by Mediterranean influences, in late autumn (October, 10% of year's total), particularly in the Drave-Danube angle. On the Nagy-Alfold the rainfall occurs mainly during occasional storms but elsewhere it is more evenly distributed. The high summer temperatures, while excellent for wheat and maize, are dangerous when rainfall is below the average; and when this is associated with heavy winds disastrous sandstorms and crop destruction follow. One of the characteristics of the climate of most value to the people is the long autumn whereby the ripening of delicate crops (*e.g.,* grapes and other fruits) is assured. The critical feature of the climate from the agricultural point of view is the uncertainty of sufficient rainfall.

The response of natural vegetation to these climatic conditions is clear where original examples unaltered by man are found. The characteristic covering of the trans-Danubian lands is deciduous woodland, oak, beech, lime and chestnut, but these disappear rapidly toward the Nagy-Alfold, where steppe conditions prevail.

Natural Resources. — Most of the area of Hungary is mainly suitable for and devoted to agriculture. Large parts of western Hungary and the more sheltered portions of the Alfold consist of fertile land well adapted for intensive farming, including the cultivation of the main cereal and fodder crops, potatoes add sugar beet. The slopes of the hills along Lake Balaton and the Hegyalja or southern slopes of the hills running east from above Pest to Tokaj are ideally suited for viticulture. Many parts of the Alfold grow excellent fruit. The counties of Tolna and Somogy and parts of the Alfold can support a large cattle population. The treaty of Trianon left Hungary with little of its former resources in timber: only 12.7% of its acreage (chiefly in the Bakony and north of the Hegyalja) is forest, much of it of little commercial value. There is one small iron-ore field near Miskolcz, but no other minerals except a very small amount of manganese and the important bauxite deposits. These are situated in the

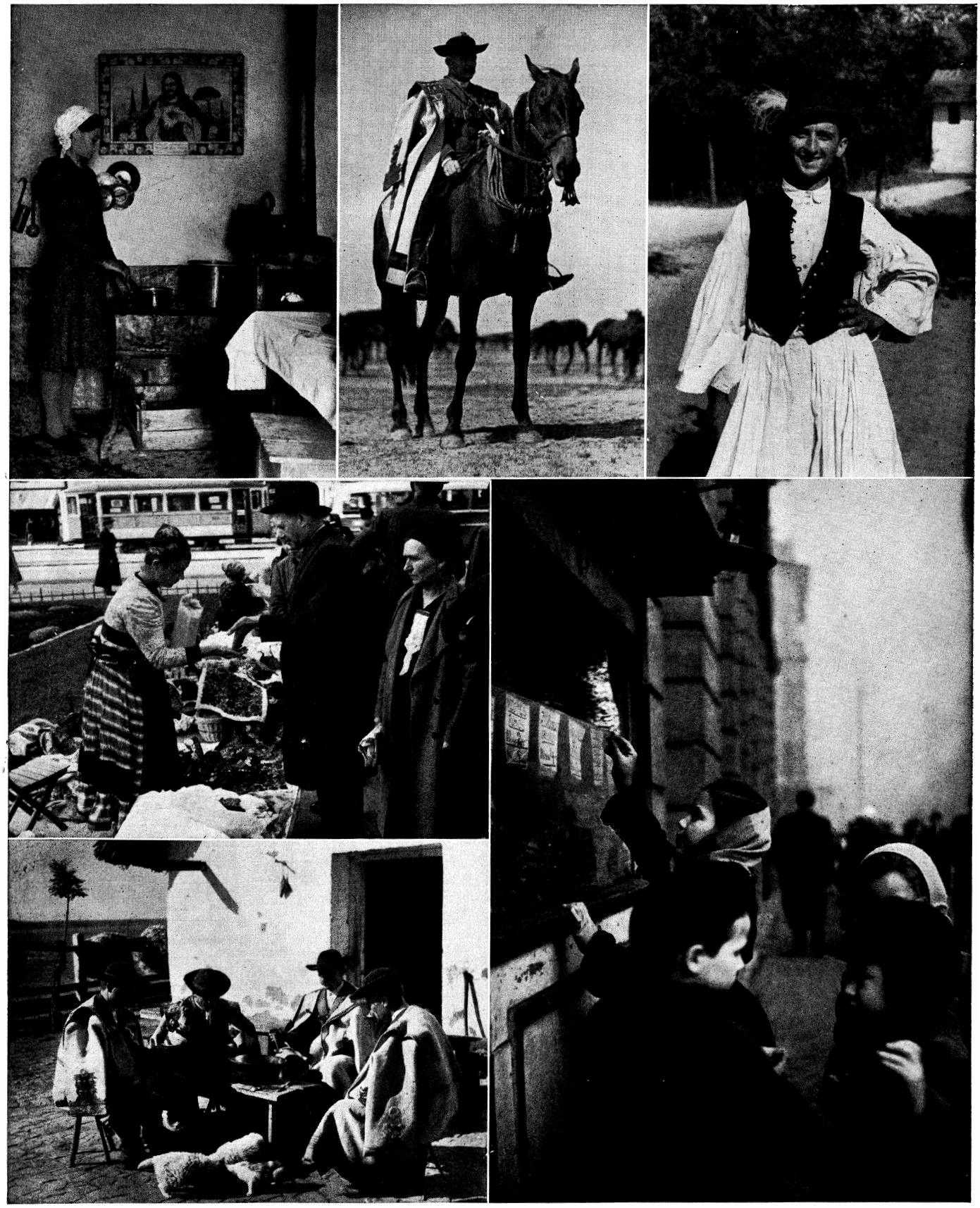


BY COURTESY OF (BOTTOM) THE AMEROP TRAVEL SERVICE, INC.; PHOTOGRAPHS, (TOP, CENTRE LEFT) EWING GALLOWAY, (CENTRE RIGHT) BLAU—PIX FROM PUBLIX

BUDAPEST

Top: General view of the city and the Danube river
Centre left: Andrassy street, showing the opera house on the left
Centre *right:* Square in central Budapest, renamed Freedom square after World War II. The monument was erected by the communist government in honour of the Soviet war dead
Bottom: The houses of parliament, one of the most imposing as well as one of the largest legislative buildings in the world

HUNGARY



PHOTOGRAPHS, (TOP LEFT) BLAU—PIX FROM PUBLIX, (TOP CENTRE) SCHUFF—PIX FROM PUBLIX, (TOP RIGHT) MAURITIUS FROM BLACK STAR, (CENTRE LEFT, BOTTOM LEFT) PIX FROM PUBLIX, (RIGHT) MUNIC—PIX FROM PUBLIX

HUNGARIAN PEOPLE

Top left: Farm woman preparing dinner on her oil stove
Top centre: Chief of the horsemen on the steppes of Hortobagy, cattle-raising area west of Debrecen
Top *right:* Peasant in traditional costume
Centre left: Peasant woman selling handmade embroideries in Budapest
Right: Children of Budapest at a sweet shop
Bottom left: Shepherds of the steppes eating supper outside their hut

Vértes mountains, in the Bakony and near Villány, in southern Hungary., and reserves have been estimated at 500,000,000 tons. The best estimates of coal and lignite reserves vary from 700,000,000 to 1,000,000,000 tons. Hard coal is mined near Pécs. The lignite deposits lie in a belt extending from the Vértes mountains northeastward to the Borsod mountains. Neither coal nor lignite exists in sufficient quantity or quality to meet the needs of a highly developed industry. Oil is found near Lispe, on the southwestern frontier. There is practically no water power. (X.)

HISTORY

The history of the countries which were later to constitute the kingdom of Hungary, up to the close of the Roman period, will be found under PANNONIA and DACIA. The Romans were succeeded by Germanic tribes, and these in turn by the Huns (*q.v.*). After the death of Attila (453) his kingdom declined, and Germanic (Gothic) tribes again entered Pannonia and Dacia. The 6th century A.D. found the Lombards established in Pannonia, the Gepidae in Dacia. In 567 the Avars (*q.v.*), allying themselves with the Lombards, crushed the Gepidae, and in the following year they occupied Pannonia, the Lombards migrating to Italy. As the Avar kingdom declined, the western and northern portions of Hungary recovered independence under Slavonic rulers. In 791–797 Charlemagne crushed the Avars and established the first Ostmarks (*see* AUSTRIA), which probably occupied all the land between the Danube and the Save. North of the Danube, the important Slavonic kingdom of Moravia (*q.v.*) was founded about 828, while the heritage of the Avars east of the Danube is believed, on slight authority but with great probability, to have been under the suzerainty of the Bulgars.

THE KINGDOM, TO 1526

The Arpáds.—The Magyars, the founders of the Hungarian state, were by origin a Finno-Ugrian people from beyond the Urals; but they were driven into the steppes about the beginning of the Christian era, and there mingled with Turki peoples. From the 5th to the 9th century A.D. they lived round and behind the mouth of the Don in a federation known as the On-Ogur (Ten Arrows), from the Slav pronunciation of which the name "Hungarian" is derived. In the early 9th century they were vassals of the Khazars (*q.v.*). They were then organized in seven hordes or tribes. under hereditary chieftains. The chiefs of the most powerful single horde were also hereditary overlords of the entire nation. Under pressure from their eastern neighbours, the Petchenegs (*q.v.*), the nation migrated westward. accompanied by three dissident hordes of Khazars, known as the Kavars or Kabars, and some other minor Turki tribes. Some of them arrived at the mouth of the Danube in A.D. 889 and took service with the Greek emperor against the Bulgars, who, however, allied themselves with the pursuing Petchenegs. Meanwhile the emperor Arnulf had enlisted the help of other contingents in his war against Sviatopluk of Moravia; and, seeing in the middle Danube basin a place of refuge from its pursuers, the entire nation, under its leader Árpád, migrated across the Carpathians (896). They easily subjected the scattered populations of the central plain, destroyed the empire of Great Moravia in 906 and, in 907, defeated German forces gathered to meet them. They were then firmly established in what was now Hungary; but its mountainous and trackless periphery was only gradually brought under effective control, and in these areas the earlier, non-Magyar populations, although subjugated. lived on.

The Magyars proper settled chiefly in western Hungary; the Kavars on and east of the Tisza. During the early part of the 10th century the invaders repeatedly raided Germany, Italy, the Balkans and even France in search of booty and slaves. The turning point in their history was the crushing defeat inflicted on them by the emperor Otto I on the Lechfeld, outside Augsburg (Aug. 10, 955). Forced onto the defensive, they began to consider the necessity of entering the European political and religious community. Some of their chieftains had already adopted Byzantine Christianity; but Árpád's great-grandson, Géza, who succeeded to the chief leadership in 972 and was able to reestablish its authority after a period of near anarchy, turned to the west. An embassy was sent to Otto II at Quedlinburg in 973, and in 975 Géza and his family were baptized into the western church.

Stephen *I.*—Géza made little headway against the popular opposition, which resented particularly stubbornly the pope's insistence—which would, indeed, have undermined the whole national economic system—that no Christians might be kept in slavery. But he married his son Stephen to Gisela, daughter of Henry II of Bavaria and sister of the future emperor Henry II, in 996; and Stephen, when he succeeded his father in 997, crushed the leading representatives of the old regime with the help of armoured Bavarian knights. In A.D. 1000 (or 1001) Pope Silvester II bestowed on Stephen a kingly crown, Silvester's relations with his former pupil Otto III enabling Hungary to enter the western religious community without admitting the political suzerainty of the empire. Stephen now crushed the last ruler of the Kavars, who had hitherto remained independent, and reorganized his state as a political and religious unit on a system which remained for many centuries the essentially unaltered basis of Hungary's entire social and political structure.

The subdivision into tribes disappeared, as did the separate status of the Kavars and other associated elements, although the social subunit of the clan remained. The freemen, descended from the old Magyar and Turki warriors, retained their personal freedom, which was inalienable except on conviction for proved crime. They were entitled to meet in general assembly, and their lands (which, since the economy was still mainly pastoral, were largely held by each clan as common property) were inalienable and free of any obligation except that of military service. All land not occupied by the freemen (a substantial proportion of the whole) became crown property and its occupants tenants of the crown. Adopting the Frankish model, Stephen divided Hungary into 46 (later, when the effective frontiers were pushed forward, 72) counties (*vármegyek*), each under a count (comes), who was a nonhereditary official of the crown. The comes exercised jurisdiction over the inhabitants of the county, free or unfree. He collected rents and dues from the unfree tenants. two-thirds of this he transmitted to the royal treasury, keeping one third for administrative purposes. In war he led the freemen of his county. An impoverished freeman who took service with the comes paid dues for any crown land cultivated by him, and an unfree tenant cultivating a freeman's land paid dues to the owner.

The unfree population could not acquire technical membership of the Hungarian "nation" (*i.e.*, the status enjoyed by the descendants of the old conquerors) except by royal grant; but it was no longer enslaved. The immigrants, who now entered the country in large numbers, could often make advantageous terms for themselves amounting to personal freedom. They were often governed, in minor matters, by their own personal law, and no effort was made to magyarize them.

The frontier zone (gyepii) was under a special dispensation, its inhabitants usually forming free communities subject to no liability except that of defending the marches. As the effective frontiers were advanced, these areas were absorbed in the county systems. Large parts of Transylvania retained the *gyepü* organization for many centuries.

The king's representative and head of the whole administrative system was the palatine.

Ecclesiastically, Stephen divided Hungary into 10 (later 12) dioceses, of which that of Esztergom and later also that of Kalocsa, were archiepiscopal. The church was entitled to tithes from all taxable land, and Stephen bestowed large estates on the sees and on the monastic orders, among which the Benedictines were prominent. This order was the main civilizing and Christianizing agent in Hungary. Its foundation of Pannonhalma (1001) was an "archabbey," exempt from episcopal jurisdiction.

The *11th* Century.—Stephen (who was to be canonized in 1073) enjoyed immense personal prestige. His rule at home, once established, was unquestioned. He fought few foreign wars and his long reign was thus a period of consolidation and growing

prosperity during which, incidentally, the national economy moved over a long way toward agriculture from stockbreeding. But when Stephen died, in 1038, the country refused to accept his designated successor Peter (his half-Italian nephew by marriage) and in 1041 put up a rival king, Aba. With the help of his kinsman the emperor Henry III, Peter drove out Aba (1044), then doing homage to Henry for Hungary and introducing foreign officials and clerics. The Hungarians brought back from Poland three brothers. Stephen's cousins. One of these, Andrew (1046–60), expelled and slew Peter but then married his own infant son Salomon to Henry III's daughter Judith and had him crowned king in his own lifetime. The accepted law of succession entitled the eldest male member of the ruling family to succeed, and this act inaugurated a long struggle. Andrew's brother Béla I (1060–63) evicted Andrew with Polish help, but on his death the emperor installed Salomon. Béla's sons Géza and Ladislaus, representing the national party, revolted in 1074 and expelled Salomon, defeating a German army sent to his aid. It was the moment of the investiture conflict and Géza I (1074–77) appealed to Pope Gregory VII for help, accepting his kingdom from him as a fief of the Holy See. The emperor now abandoned his attempts to subjugate Hungary. On Géza's death Ladislaus I (1077–95), a heroic and beloved figure who was to be canonized in 1192, re-established internal order and reaffirmed the position of Christianity, which had been shaken by two great pagan revolts in 1046 and 1061 respectively. By intervening in the affairs of Croatia, he established a claim to the crown of that country. His nephew and successor Koloman (Kálmán; 1095–1116) made the claim effective; in 1102 Croatia (later part of Dalmatia) was united with the lands of the Hungarian crown, while retaining its own diet and laws. It was ruled, for the crown, by a viceroy or ban.

The 12th Century.—Koloman revised and modernized Hungary's laws but, although an enlightened and capable man, he was cruel and treacherous. To make the throne secure for his son Stephen, he blinded his own brother Almus and the latter's infant son Béla. Stephen II (1116–31), Hungary's worst king, died childless, and the blinded Béla II ruled (1131–41). His son Géza II (1141–62), a capable ruler, completed the organization of Transylvania by settling German immigrants, the "Saxons," behind its southern passes; the eastern passes were already guarded by the Szeklers (*q.v.*), a magyarized race of Turki origin. Both Saxons and Szeklers were privileged communities, self-governing under the crown, and all Transylvania was governed as a unit under a voivode. Hungary was now little molested from the west, where neither the Austrian nor the Bohemian dukes could threaten its independence, but was involved throughout the 12th century in an intermittent struggle with the rejuvenated Eastern Roman empire, which disputed its position in Dalmatia, contested its claims in the Balkans and supported rival claimants to the crown: thus the reign of Stephen III (1162–72) was disputed by his two uncles Ladislaus II and Stephen IV, acting as clients of Constantinople. Béla III (1172–96) had himself been brought up in Constantinople and designated to marry the emperor's heiress, when Hungary would have become a vassal of the Eastern Roman empire, but on his accession he married a French princess and reconstituted Hungary's position. Under him the country achieved great wealth and power, extending its influence far and wide in eastern Europe: Galicia was made a feudatory of Hungary and Serbia a satellite. At home the royal authority was re-established. Urban life developed and western cultural influences penetrated the national life.

The Golden *Bull.*—Béla's good work was mostly undone by his younger son Andrew, who disputed the succession of his elder brother Imre or Emeric (1196–1204), expelling the latter's infant son Ladislaus III (1205). Both Imre and Andrew bought adherents by lavish grants of crown land. The recipients exercised feudal rule over the crown tenants and even over the local freemen. When Andrew became king as Andrew II (1205–35) he continued this and other abusive practices in order to pay for an extravagant court and a foreign policy of personal ambition and adventure including the crusade on which he set out in 1217. In 1222 the freemen or "nobles" reacted and forced Andrew to promulgate the famous "Golden Bull," to which every Hungarian king had thereafter to swear. as the basic charter of the national liberties. It was, in fact, essentially a reaffirmation of earlier rights—for the nobles, of those agreed between their forefathers and St. Stephen; for other communities, such as the Saxons, of their charters, fortified by safeguards against abuse on the part either of the king and his officials or of individuals. But the nobles also modernized their rights: thus, as war was no longer a co-operative profit-earning enterprise, they were not to be forced to serve abroad, except for pay. They took the control of the counties into their own hands. The famous *jus resistendi* gave them the right to resist infringements of the bull.

The Later *Árpáds.*—Hardly had Andrew's son Béla IV (1235–70) succeeded his father when the Mongols (*q.v.*) invaded Hungary (1241–42), frightfully ravaging and depopulating the country. To reconstruct and defend it, Béla had to invite many new colonists and—out of undesired necessity—to build fortresses and to confer extensive near-feudal rights on their seneschals, thus, after all, promoting the power of a new oligarchy. Some of these great "barons" achieved semi-independent status during the troubled times that followed.

Much disorder was caused also by the wild, pagan Cumans (*q.v.*) who had fled to Hungary in great numbers before the Mongols and molested the country. To bind these unruly elements closer to his dynasty, Béla married his son Stephen V to a Cumanian princess. After a short reign (1270–72) Stephen was succeeded by his son Ladislaus IV "the Cumanian" (1272–90), a wild youth who cared only for his Cumanian companions, refused to beget lawful issue and so favoured his pagan friends that Pope Nicholas IV preached a crusade against him. He died without issue, leaving Hungary in turmoil. Local magnates ruled as de *facto* sovereign princes, and rival European dynasties claimed succession to the throne. His partisans succeeded in putting on the throne the last of the Árpáds, Andrew III (1290–1301), the Italian-born son of Andrew II's posthumous son by his third wife; but Andrew too died young, leaving no issue.

With him the house of Árpád became extinct. Some of its members had been weak and foolish, but they had enabled the Magyar nation to blend its ancient traditions with the newer ones of western civilization in a synthesis which was at once European and national. Their foreign policy had never been purely individual or dynastic, or at least never foreign-based; so that Hungary was still essentially a national state and subject of its own policy. Although it had good kings thereafter, few of them wholly identified their own interests with those of Hungary.

The Angevins and **Sigismund.**—The crown was now claimed by Wenceslaus II of Bohemia for his son Wenceslaus III, by Otto III of Bavaria and by the papal candidate, Charles Robert of Anjou, of the house of Naples, then still a child. After a confused struggle, Charles Robert was left in possession as Charles I of Hungary (1308–42). After growing to manhood, he gradually established his authority, and peace and prosperity returned. Under his reign and that of his son Louis I the Great (1342–82), who in virtue of a compact with his father-in-law Casimir III the Great of Poland, also ruled over Poland after 1370, Hungary enjoyed great power and prosperity. The newly born Rumanian principalities of Moldavia and Walachia were at first under Hungarian suzerainty. **A** chain of banats was organized in the northern Balkans, and Bosnia and Serbia made vassals.

It is true that during the latter years of Louis' reign Hungary was increasingly threatened by the advance of the Turks, before which threat Louis had to acknowledge the independence of the king of Bosnia. But Hungary itself was hardly yet directly menaced so long as Serbia stood. In Italy the Angevins followed an ambitious dynastic policy that for a time brought their house splendid successes, although it cost the nation a disproportionate price in blood and wealth. However, the exploitation of the gold and silver mines of the Szepes area (the yield of which fell to the royal treasury) brought the Angevin kings immense resources. Their domestic rule was rather despotic. as they seldom convoked the diet, but they respected the acquired rights of the various

classes of the population. Imbued as they were with the ideas of western feudalism. they did not seek to abolish the "magnate" class, only replacing the turbulent oligarchs who had disputed their rule with new men loyal to themselves: in this era, indeed, the "prelates, barons and notables" appear as a constitutional factor distinct from that of the "common nobles," but membership of it was ex-officio, not hereditary. As, however, the great landowners were now made to supply contingents (*banderia*) of their own tenants for war, to supplement the noble *levée* en *masse,* the structure of Hungary became partially feudal.

When Louis died his daughter Mary was crowned. A rival, Charles of Naples, was crowned in 1385 but assassinated next year. Mary survived to marry Sigismund of Luxembourg (1387) who ruled with her until her death in 1395, then alone until 1437. His first years were greatly disturbed by his struggles with the partisans of the Neapolitan dynasty and by the Turkish danger, which had become pressing after the annihilation of the Serbian power at Kossovo (1389). Sigismund led a crusaders' army into the Balkans but was heavily defeated at Nikopoli (1396) and barely escaped with his life. After this he followed a defensive policy in the south, converting Belgrade into a large fortress. But Serbia was lost to the Turks, and elsewhere also Sigismund was unfortunate. Bosnia, Walachia and Moldavia renounced their allegiance; Dalmatia was lost to Venice; the Szepes mining towns were pledged to Poland.

Sigismund's frequent and prolonged absences from Hungary after he became Roman emperor and king of Bohemia were unfortunate for the country. The oligarchy recovered its power. There was much social unrest, partly occasioned by the spread of Hussite doctrines from Bohemia. The nation felt itself sacrificed to foreign interests.

John **Hunyadi.**—Consequently, although the estates accepted Sigismund's son-in-law Albert V of Austria (1437–39) as his successor when he died. they did so only with the stipulation that he should not accept the imperial title or reside outside Hungary without their consent: in his absence he was to be represented by the palatine, who was to be elected jointly by the king and the estates. Crowned king of Hungary on Jan. 1, 1438, Albert was in fact elected German king as Albert II in March 1438 but died in Oct. 1439, leaving his widow Elizabeth with child.

To avoid an interregnum, the estates elected Wladyslaw III of Poland king (Ulászló I) but when he fell in the disastrous battle of Varna (1444) they accepted Albert's posthumous son as Ladislaus V, appointing as his guardian and governor of Hungary the great hero John (János) Hunyadi (*q.v.*), who had been successfully defending Hungary and, in particular, Transylvania against the now constantly repeated attacks of the Turks. He kept up the defense under increasing difficulties, being constantly thwarted by the jealous magnates and harassed by the Czech mercenary Jan Jiskra, while the emperor Frederick III encroached on the western provinces. Ladislaus himself had been brought up in Austria; his supporters were identified in the national eyes with the Austrian-based and feudal Habsburg rule. Hunyadi died in 1456, immediately after winning a last great victory over the Turks at Belgrade. Ladislaus' partisans, led by Ulrich of Cilli, instigated tbe murder of Hunyadi's elder son Ladislaus: but soon afterward the young king himself died, whereupon the common nobles, asserting their ancient claim—never yet formally abandoned—that the monarchy had been elective since the extinction of the male line of the Árpáds, proclaimed as king Hunyadi's surviving son Matthias Corvinus (see MATTHIAS I).

Matthias Corvinus.—The only national king to reign in Hungary after the Árpáds, Matthias Corvinus (1458–90) has been much lauded by the historians of Hungary. He was in truth a brilliant figure, an enlightened despot in advance of his age: a strong ruler, an efficient administrator, a patron of the cities and of the arts and letters. He reformed the administration, reorganized justice, founded a new university, curbed the oligarchy, protected the peasants. But although he began by buying off the emperor (whom a party of nobles had elected antiking), cultivating friendship with George of Bohemia and carrying on his father's work in the Balkans, he soon dropped or at least postponed the idea of serious offensive operations against the Turks (although conducting further successful but limited campaigns in 1463 and 1475) and engaged in ambitious schemes in the west. He dreamed of uniting central Europe under his own rule and of acquiring the imperial crown. He attacked Bohemia in 1468 and was crowned king by the Catholic party there; under the peace of Olomouc (Dec. 7, 1478) he had to allow George's successor Vladislav (Wladyslaw, son of Casimir IV of Poland) to share the royal title and rule over Bohemia, but kept Moravia, Lusatia and Silesia under his own rule. In 1477 and again in 1485 he besieged Vienna, taking it in the latter year, whereupon he annexed Austria, Styria and Carinthia. To help him achieve his ambitions, he organized a standing mercenary force, known as the "Black army," largely drawn from Silesia and Moravia, for the upkeep of which he forced even the Hungarian nobles to pay. He retained his popularity to the last among the small nobles and was deeply beloved by the peasants, but earned the bitter hatred of the privileged classes: when he died suddenly in 1490, not only did his Czech and Austrian possessions at once break away from Hungary (which had benefited little by his conquests) but a strong internal reaction set in.

The Jagiello Kings, **1490–1526.**—The throne was now claimed by two Jagiello brothers—Vladislav, king of Bohemia since 1471, and his younger brother John Albert—and by Maximilian of Habsburg, while the lesser nobles favoured the succession, which Matthias himself had been trying to secure, of his illegitimate son John Corvinus. The magnates favoured Vladislav, precisely because he was notoriously weak. Hiring the Black army for the coup, they got Vladislav crowned (he reigned as Ulászló II, 1490–1516). John Albert stood down in favour of his brother, and John Corvinus did not press his own claim. Maximilian, by the treaty of Pressburg (Nov. 7, 1491) agreed to recognize Vladislav in return for the restoration of the Austrian provinces, an indemnity and a promise of the succession for himself or his issue if Vladislav died without male heirs. The Habsburg connection was very unpopular in Hungary, and the diet refused to ratify the treaty; but Vladislav considered it binding on himself and soon slipped into the position of Maximilian's friend and client. He had got himself into a complicated matrimonial tangle which long prevented him from begetting lawful issue. At last he succeeded in marrying lawfully the French princess Anne de Candale, but her first child was a daughter. Anne. The national party, led by John (*q.v.*) Zápolya, voivode of Transylvania, extracted from the diet of 1505 a resolution never again to accept a foreign king. But now a son, Louis, was born (1506). Zápolya's Polish ally, King Sigismund I, changed his anti-Habsburg policy in return for renunciation by the Habsburgs of their claims on Poland, and agreement was reached in Vienna (1515) whereby Louis married Maximilian's granddaughter Anne, while his sister was betrothed to Maximilian's grandson Ferdinand. A double link now joined the Hungarian crown with the Habsburg dynasty.

Meanwhile the magnates, having used the Black army to achieve their purposes, had stipulated that it should be disbanded and Matthias' other "innovations" cancelled. Vladislav was a powerless puppet. He had to consent to strict limitation of the royal prerogatives: thus in 1507 the principle was established that no royal decree was valid unless confirmed by the council of state. His resources were so diminished by the extravagance and peculations of his entourage that at times he was literally dependent on charity for his personal upkeep. With the king out of the ring, the magnates and the small nobles fought bitterly for control. The latter strengthened their constitutional rights, on paper, considerably. They secured the passage of many laws safeguarding their position both in the central and in the local government and also the great codification of Hungarian customary law produced in 1514, under the name of the Tripartitum, by the jurist István Verboczi (himself a member of the lesser nobility). This work, although it never received legal sanction. was universally taken. up to 1848. as the authoritative handbook to the Hungarian constitution, reaffirming all the cardinal liberties of the Hungarian nobility and laying down the principle of the equality in law

of all nobles. In practice, however, the magnates could take advantage of the near anarchy to direct the affairs of state and to acquire enormous individual fortunes.

As everywhere in central Europe at the time, the position of both the towns and the peasants declined rapidly. Many oppressive decrees were passed against the peasants. Then in 1514 the cardinal Tamás Bakócz collected about 100,000 of them for a crusade against the Turks. Their commander, Gyorgy Dózsa, instead turned them against the lords. They were put down after atrocious fighting, and Dozsa was tortured to death in horrible fashion. The diet of 1514 condemned them to "real and perpetual servitude" and greatly increased their burdens.

When Vladislav died on March 13, 1516, his son was proclaimed king as Louis II, being then only ten years old. Rival cliques squabbled for control, and the nation's interests were ignored. Defense, in particular, had been totally neglected since Matthias' death.

The Turks had been quiet for 30 years, but in 1521 the sultan Soliman the Magnificent suddenly sent Louis a demand for tribute. It was refused, whereupon Soliman assaulted and reduced the fortresses of Sabac and Belgrade. Granted a respite by the sultan's decision to proceed first with the conquest of Rhodes, the Hungarian nation, now suddenly alive to its danger, voted the reestablishment of a standing army; but little was done to raise the force, as each party tried to put the burden of its upkeep on the other. Appeals for help from abroad met with only a small response.

In the summer of 1526 Soliman renewed his advance. Péterváraḍ (Peterwardein) fell at the end of July. The general *levée* had been proclaimed and Louis, having gathered a few thousand men round him, moved slowly down the right bank of the Danube, to give time for the local contingents to join him. But there was disorganization, delay and contradictory orders. The most important forces—Zápolya's from Transylvania and Frangepan's from Croatia—failed to appear. On Aug. 28 Louis made contact with the Turkish army in front of Mohács and, although his force consisted only of about 16,000 Hungarians and 2,000 mercenaries, decided, on the advice of Archbishop Paul Tomori of Kalócsa, to give battle. On Aug. 29 the Hungarians attacked; the king and his whole government led the centre of the line. The little army was utterly routed; Louis, one of the few survivors of the fighting, was drowned on his flight. The sultan could not believe that this pitiful array which he had so easily overcome could be the national army of Hungary. Advancing with extreme caution, he occupied Buda on Sept. 10, but speedily returned across the Danube, taking with him 105,000 captives. By the end of October the last Turkish regular had left Hungary; but where the armies had been it was as utterly destroyed as if a flood had passed over it. (C. A. M.)

PARTITION

The Turks having retired, one party elected as king John Zápolya, voivode of Transylvania (Oct. 14, 1526). A second diet in 1527 elected Louis' brother-in-law, Ferdinand I, archduke of Austria (emperor 1556–64). Soliman supported Zápolya, and an internecine struggle went on till 1538, when by the secret treaty of Nagyvárad, Hungary was divided: Ferdinand took Croatia, Slavonia and the western counties, Zápolya the remaining two-thirds, with the royal title and Buda as his capital; Ferdinand was to succeed on Zápolya's death. However, when Zapolya died (1540) his adherents elected his infant son John Sigismund (1540–71). Ferdinand then asserted his right and laid siege to Buda in spite of the remonstrances of George Martinuzzi (*q.v.*), Zápolya's able adviser, who knew that Soliman would not allow the emperor to reign at Buda.

This brought a new Turkish invasion that lasted till 1547, when the exigencies of a war with Persia induced Soliman to grant a truce. -Hungary was partitioned: Ferdinand kept his former share, subject to payment of an annual tribute; Transylvania and some adjacent counties were assigned to John Sigismund, with the title of prince; southern and central Hungary was annexed to the Turkish empire. This settlement lasted with some changes for 150 years. Throughout this time the history of Turkish Hungary is almost a blank. It was rendered practically uninhabited and uninhabitable: its population was reduced by plague and starvation or carried into slavery. The surviving Magyars clustered into the great village-towns of the plain, which afforded them a partial protection, while in the open country seminomadic Serbs or Vlachs (Rumanians) took their places. The national sentiment and what remained of national liberties found their best expression in Transylvania, where Turk and Habsburg were equally hated. The efforts of the Habsburgs to conquer Transylvania led to fresh Turkish invasions in 1552 and 1556, the latter being Soliman's last descent on Hungary, and memorable for the heroic defense of Szigetvár by Miklós Zrinyi. The truce of Adrianople suspended hostilities from 1568 to 1593, but frontier warfare was incessant and Habsburg relations with Transylvania were almost always bad. The Habsburgs, ruling over other states and regarding Royal Hungary (*i.e.*, their own portion of that country) as an unimportant border province, were constantly wounding Magyar sentiment. The office of palatine was suspended; and the country was governed from Vienna.

Before long the political conflict was reinforced and embittered by a religious one. Even before Mohacs the tenets of Protestantism had conquered nearly all Hungary, its Calvinist form ultimately prevailing among most of the Magyars (the Transylvanian Germans and some Slovaks remained Lutheran). The Turks tolerated all creeds, although least favourable to the Catholics; in Transylvania, religious equality between Catholics and Protestants was proclaimed in 1557. During the "Long War" (1593–1606), a confused, triangular struggle, Sigismund Báthory (*q.v.*) was victorious over the Turks, but the imperial armies under Georges Basta occupied Transylvania and initiated a violent persecution of the Protestants until Istvan Bocskay (*q.v.*), calling the Turks to his aid, expelled them and, by the peace of Vienna (June 23, 1606), obtained for all Hungary a promise of religious liberty and political federation and for himself recognition as sovereign prince of an enlarged Transylvania. He strengthened his position further under the truce of Zsitvatörök (Nov. 1606).

For the next 50 years a series of very able princes of Transylvania ruled as independent Transylvanian sovereigns and protectors of Hungary. Gabriel Bethlen (*q.v.*; 1613–29) was three times at war with the emperor Ferdinand II and twice crowned king of Hungary. George Rákóczy I (1630–48) forced Ferdinand III to grant full autonomy and religious liberty to Catholics and Protestants in Hungary and further enlarged and strengthened Transylvania, which during this period enjoyed something of a golden age, politically, culturally and economically. In Royal Hungary, meanwhile, the Counter-Reformation gained strength. Péter Pázmány, primate from 1616 to 1637, reconverted most of the nobles to Catholicism and founded a great Catholic university at Nagyszombat in the Slovak north (1635). Under Leopold I (1657–1705) religious persecution, led by the Hungarians George Szelepesényi and Leopold Kollonić, became intense. A rebellion led by Nicholas Zrinyi was crushed in 1671. Many Hungarian nobles were executed, and recalcitrant Protestant ministers were condemned to slavery in the Neapolitan galleys.

The Turkish power, after decline, revived when Mohammed Kuprili (*q.v.*) became grand vizier in 1656. After defeating George Rákóczy II he re-established Turkish suzerainty over Transylvania. The imperial general Raimondo Montecucculi, by the victory of Széntgothard (Aug. 1, 1664) repelled the Turks from the frontiers of Austria; but a new Hungarian rebellion, led by Imre Thököly, broke out in 1678. The imperial forces were driven back, and the grand vizier Kara Mustapha saw an opportunity: he invaded Royal Hungary and laid siege to Vienna (1683). Now, however, the tide turned. Vienna was saved by the intervention of John III Sobieski of Poland. The Turks were driven slowly back. Buda was recaptured in 1686. The last big battle of the war was the great victory won by Prince Eugene of Savoy at Zenta in 1697. The peace of Karlowitz (1699) left the emperor in possession of the whole of historic Hungary, except the banat of Temesvar.

THE HABSBURG MONARCHY, 1699-1918

Leopold's objective was finally to crush Hungarian separatism and Protestant heresy. He forced a diet, convoked in 1687, to accept the hereditary title of the Habsburg dynasty, in the male line, to the Hungarian crown; the possibility of modification of the national rights and liberties, by agreement between the king and the estates; and the abolition of the *jus resistendi*. Transylvania, while remaining a part of the lands of the Hungarian crown, was to be governed separately, as was the Military Frontier, a defense belt along the southern frontier of Hungary. Other areas left desolate by the Turks or rendered so during the wars of liberation were declared "neoacquistica," or at the disposal of the crown. The former owners, if they had taken the wrong side, were declared to have forfeited their estates, which were bestowed on imperial adherents, Hungarian or foreign, or kept as crown property. In the latter case many were largely colonized with immigrants. A particularly important element among these were the Serbs, of whom (besides others) 36,000 families had entered Hungary en bloc, led on by their patriarch in 1691–92. They were to have returned to their homes when liberated, but as the liberation did not ensue they remained in Hungary and at the disposal of the emperor. There was also a large further immigration of Rumanians, already the most numerous nationality of Transylvania.

The country was seething with discontent. Its opportunity to break out came when the emperor, involved in the War of the Spanish Succession, withdrew almost all his troops from Hungary. There was an immediate rebellion, which found a leader in Francis Rákóczy II (*q.v.*; 1704–11), elected prince by the diet on July 6, 1704. The armies he raised were numerous but ill-equipped, and without artillery. Louis XIV aided him with money, but the defeat of the French at Blenheim enabled the emperor to send an army into Hungary, and in 1705 Rákóczy was badly defeated. In 1707 two Rákóczian diets deposed the Habsburgs and formed an interim government with Rákóczy at its head, till a national king could be elected; but Joseph I (1705–11), who succeeded Leopold as emperor, refused to come to terms with his subjects, though pressed to do so by his allies.

In 1708 Rákóczy was again defeated at Trenčin, this time decisively, though a guerrilla war still went on. But in 1711 Joseph died and was succeeded by his brother Charles VI (1711–40), a man of different stamp. A congress met at Szatmár (April 27, 1711), and peace was restored on the basis of a general amnesty, full religious liberty and the inviolability of Magyar rights and privileges. This general understanding was elaborated in the following years in detailed agreements which formed the basis of Hungary's relations with the house of Habsburg up to 1918. Charles promised in 1715 and again in 1723 to respect the rights of the estates and of the Hungarian nobility; to rule Hungary through its diet, which was to be convoked regularly and only in accordance with its own laws, existing or to be legally enacted and not "after the pattern of other provinces"; to defend its integrity; and not to incorporate any part of it in his other dominions. In return the diet of 1723, following the initiative of the Croat delegates, accepted the Pragmatic Sanction providing for the female succession of the Habsburgs: so long as this lasted, Hungary would regard itself as united "indivisibly and inseparably" with the king-emperor's other dominions, this union being valid "for all events and also against external enemies."

At the same time, it accepted, and even begged for, the institution of a standing army for the national defense, quartered in Hungary but to be composed up to two-thirds of "foreigners"; it consented to pay for the upkeep of this force (by taxation levied from the socage peasants), provided only that the money and contingents must be voted by itself. This was a move necessitated by Hungary's exhaustion and depopulation, but it proved very detrimental to the national cause: a separate Hungarian war council should have been set up, but this was never done, so that a mainly non-Hungarian force, controlled from Vienna, became a powerful instrument of centralist rule.

In many other respects Charles interpreted his undertakings somewhat loosely. The diet was seldom convoked; Transylvania was kept separate, as was the Military Frontier. When the banat of Temesvár was recovered under the peace of Passarowitz (July 21, 1722), which concluded another war with the Turks, it also was kept as a "neoacquistica" under military administration and colonized with non-Hungarians, mainly Germans. The promised independence of the Hungarian chancellery and other central organs was only nominal; and a religious settlement imposed by Charles in 1731, after the diet itself had failed to agree, left the Hungarian Protestants in a position hardly better than that of their Austrian co-religionists. Considerable improvements were, however, introduced into the administration and the judiciary.

Maria Theresa.—When Charles was succeeded by Maria Theresa (1740–80), the famous agreement between the young queen and the diet was in fact reached only with difficulty and after hard bargaining. Yet the Hungarian nobles undoubtedly saved Maria Theresa's throne, and she was grateful to them. Although seldom convoking the diet she respected the nation's privileges and made no attempt to impose her new centralism on Hungary. She won the higher aristocracy to her side by favours, creating, especially in these quarters, some real attachment to Habsburg rule; she also did much to improve the condition of the peasantry. The country benefited above all by the long peace which it now enjoyed: prosperity increased and civilization returned.

This was partly due to the great increase of population which took place in the 18th century. The accepted calculations (which may be too low) put the total figure for the whole country, including Transylvania, at only about 2,500,000 in 1715. By the end of the century this figure had been trebled. The increase was due largely to colonization by non-Magyars, while it was also the Magyar areas that had suffered most severely under the Turkish occupation. Thus, whereas in the 15th century the Magyar-speaking population of Hungary had been at least 75% of the whole, by 1790 it was less than 40%. Slovaks, Ruthenians and Rumanians formed a majority in the mountainous areas of the north and east and even encroached into the plain. The south was largely Serb or German. Magyars were in a safe majority only in the centre of the country, and even here there were many German and other colonists. Among the non-Magyars the Serbs, in particular, formed an alien and hostile element. Another shadow on the picture was that, so long as the Magyar nobles clung to their privilege of exemption from taxation, Hungary was left out of the industrialization being promoted in Austria and was kept as the agricultural complement to Austrian industry. Thus the great and growing wealth of the country remained almost entirely agricultural. Industry hardly rose above the handwork level. The towns were no more than little market centres, themselves half agricultural: the small burgher class was, incidentally, mainly German-speaking. The gold and silver mines were no longer worked. But even agriculture could not be commercially profitable, except under exceptional conditions. Since a noble's land was inalienable, he could not raise mortgages on it. Communications were so bad that only estates near the frontier or near a waterway could export bulk objects such as wheat. And although the country was still half-empty, so that the centre and south lay fallow for lack of labour, the northern districts were already becoming congested; yet the landlords, fearing that all their labour would desert if free migration were once allowed, clung obstinately to the restrictions binding the villeins to the soil.

Joseph II and Leopold II.—Joseph II (1780–90) thought the moment proper to weld all his dominions into a unitary state. Postponing coronation (so that he need not swear to the Hungarian constitution), he attempted to enforce numerous measures, some salutary in themselves, in furtherance of his ideas. He enacted religious toleration and improved the condition of the peasants. But he also abolished the self-governing institutions of Hungary and introduced a bureaucratic rule with German as the official language. The national resistance grew so threatening that he had to revoke many of his measures on his deathbed, and Leopold II (1790–92) was forced to restore the status quo and recon-

firm the fundamental compacts made between the crown and the nation after the peace of Szatmár.

The National Revival.—The opening half of the reign of Francis II (Roman emperor 1792–1806; emperor of Austria as Francis I 1804–35) was quiet; the "Jacobin conspiracy" of Ignaz Martinovics was the work of a few men. But it made Francis distrust any political movement; the crown—the great reforming factor of the 18th century—was now the chief prop of reaction. The great landlords, who were making big fortunes out of the continental blockade during the Napoleonic wars, at first acquiesced readily enough, but Joseph II's attempted germanization had aroused a new nationalism. This at first took the shape of a linguistic, literary and romantic revival, but when the wartime prosperity was followed by a slump, aggravated by monetary depreciation, the movement widened into one for political, economic and social reform, largely directed against the "dead hand" of Austria. When in 1823 Francis tried to raise money and recruits by unconstitutional means the resistance was such that the diet had to be convoked in 1825 and regularly thereafter. It thus took the lead in the entire monarchy; and within it the reformers steadily pressed back the conservative elements.

The chief figures in the new movement were Count István Széchenyi, Francis (Ferencz) Deik, Baron József Eotvos and Louis (Lajos) Kossuth (*qq.v.*). They differed on many points. Széchenyi, who was entirely loyal to the crown, thought that social and economic reform should come first and should be worked out by the Magyars themselves: he himself set the example by personal sacrifices and was in fact responsible for many reforms. He strongly urged the emancipation of the serfs and the abolition of the old socage system, which had ceased to be profitable even to the landlord, but solemnly warned the nation against tampering with the link with Austria or alienating the non-Magyars. The fiery demagogue Kossuth, while agreeing with Széchenyi on many points, including the need to liberate the serfs and to encourage industrialization, argued (with some reason) that it was the political control of Vienna that was holding up reform. His agitation turned more and more against the foreign connection. He and the other enthusiasts were anxious to assert the claims of the Magyar language. The first legal concessions which Hungary extracted in this field were few indeed and concerned with the use of Magyar in the relations between Hungary and the central authorities; but the enthusiasts soon passed to preaching the doctrine that the cause of the Magyar race was identical with that of freedom and progress and that the duty of Hungary's non-Magyar inhabitants was to magyarize. Some of the "nationalities," especially the German burghers and the Jews (who since Joseph II's edict of toleration had begun entering the country in large numbers from Galicia), accepted this doctrine wholeheartedly enough; but similar national revivals were taking place among the Slovaks, Rumanians and Southern Slavs, and with these it clashed. These peoples looked to Vienna for protection. An acute conflict broke out with the Croats when the diet decreed that its own official language was henceforward to be Magyar instead of the neutral Latin. Ljudevit Gaj was now preaching the doctrine of "Illyrianism" (*i.e.*, the unification of all Southern Slavs, at first under the Habsburg sceptre), and this presented a real danger to the integrity of Hungary.

The diets of 1830 and the following years enacted certain reforms In the social field, but the progress was slow. Francis had taken the precaution of having his son Ferdinand (1835–48) crowned in his own lifetime, so that there was no bargaining on Ferdinand's succession; but his advisers took alarm and had Kossuth imprisoned (1837). Released in 1840, Kossuth intensified his agitation in the Pesti *Hirlap*, the first Hungarian political journal. New concessions were won from the government: mixed marriages were legalized and the nobles lost their monopoly of official positions. There was then some disintegration in the reformers' ranks, the moderates being frightened by Kossuth's radicalism. The moderates formed a Centre party, and Széchenyi even joined the government. However, just before the election of 1847, Deák succeeded in reuniting all liberals on the common platform of the "ten points," afterward known as the March laws: responsible government; popular representation; the incorporation of Transylvania; right of public meeting; absolute religious liberty; universal equality before the law; universal taxation; the abolition of serfdom with compensation to the landlords; abolition of the aviticum—an obsolete land tenure. The elections gave the Progressives a complete victory, all efforts to bring about a compromise with the government were fruitless and it was proposed to dissolve the diet.

The Revolution of 1848.—But in Feb. 1848 tidings reached Pressburg (Pozsony; now Bratislava) of the revolution at Paris and its repercussions throughout Germany, where every government was threatened with overthrow. Kossuth's motion for the appointment of an independent responsible ministry was accepted by the lower house. The emperor hesitated, but on March 13 the Vienna revolution broke out and Prince Metternich fled to England; yielding to pressure or panic, the harassed monarch appointed Count Louis Batthyány premier of the first responsible Hungarian ministry, which included Kossuth as minister of finance and Széchenyi as minister of home affairs. The March laws were enacted at Pressburg and received the royal assent (April 10), and Hungary became a virtually independent state.

Ferdinand's Slavophile minister Franz Anton Kolowrat-Liebsteinsky had, however, before his forced retirement, secured the appointment of Josef Jellačić (*q.v.*) as ban of Croatia. Jellačić now repudiated the authority of the Hungarian diet, declaring that he accepted that of Vienna only, replaced Magyar officials by Croat ones and proclaimed martial law. The Hungarian Serbs demanded complete autonomy (May 13) and, when Kossuth refused this, made contact with the Croats; analogous, although less far-reaching demands came from the Slovaks and Rumanians. At first Count Batthyány, who was even prepared to send Hungarian troops to Italy, secured the emperor's support; Jellačić was disavowed and dismissed. But the Hungarians lost the support of the crown by setting up their own national army (a measure necessitated, they said, by the threat from the Southern Slavs) and refusing to vote supplies for the Italian campaign. Meanwhile the revolutionary stirrings in Galicia had been crushed; the Czechs were seeking alliance with the crown; and, although the Germans of Vienna remained semirevolutionary and sought to make common cause with the Hungarians against the Slav danger, the provinces had reverted to conservatism and the danger presented to the monarchy by Pan-German liberalism was dwindling. When Josef Radetzky's victory at Custozza (July 25) set free the imperial armies in Italy, the court reinstated Jellačić in all his honours, and he invaded Hungary on Sept. 11. Further efforts at mediation having failed equally (the mob of Buda lynching the intermediary, the Austrian minister of war), the court placed Hungary under martial law and appointed Jellačić commander in chief (Oct. 3). The Hungarian ministry resigned, leaving Kossuth in charge at the head of a committee of national defense.

Repression and Reaction.—At first the Hungarians, helped by a further revolutionary outbreak in Vienna, defended themselves successfully, but Alfred Prince von Windischgratz reduced Vienna. The court camarilla replaced Ferdinand by his young nephew, Francis Joseph (Dec. 2), who issued a proclamation declaring his intention of "uniting all lands and peoples of the monarchy in one great state." Kossuth declared the change illegal and called on the nation to resist it. Windischgratz' armies entered Hungary; those of Jellačić re-entered it; Buda fell (Jan. 5, 1849); the Hungarian government retired to Debrecen. On March 4 the new Austrian constitution was issued; while paying lip service to Hungary's separate institutions, it abrogated all of those which were contrary to its own provision; it also treated Transylvania and Croatia as separate "crown lands" and promised a separate status to the Hungarian Serbs. The Hungarian diet retorted by declaring Hungary an independent state and the Habsburgs forfeit of the throne. Kossuth was made "governor" (April).

Meanwhile the Hungarian armies, under Arthur Gorgei (*q.v.*), Moricz Perczel, Henryk Dembin'ski, Gyorgy Klapka and Josef Bem, were winning considerable successes; the capital was reoccupied on May 25. Nicholas I of Russia now offered Francis

Joseph his help, in the spirit of the Holy Alliance. A Russian army under Gen. I. F. Paskevich invaded Hungary from the north; an Austrian, under J. J. Haynau, from the west. Dissension broke out among the Hungarians: between Kossuth and Görgei and between the moderates and the extremists. The government retired to Szeged, then to Arad. Kossuth fled to Turkey. After the main Hungarian army had been heavily defeated by overwhelming forces at Temesvár (Aug. 9), Gorgei surrendered to the Russians at Vilagos (Aug. 13).

Haynau began by having Batthyány executed in Budapest and 13 senior officers, thereafter known as the "martyrs of Arad," executed at Arad (Oct. 6). Many other persons were executed or imprisoned. On Oct. 17 a provisional administration was introduced, which cut off from Hungary Transylvania, an enlarged Croatia-Slavonia (with Fiume), the Military Frontier and a "Serb Voivodina" in the south; the rest of the country was divided into five districts. The old autonomy of the counties and municipalities was suspended, and the whole country ruled through a mainly non-Hungarian bureaucracy (popularly known as the "Bach Hussars"), assisted by a newly created gendarmerie. The various nationalities inhabiting Hungary were declared equal, and their languages equal also; but in practice German was the sole language of administration and education on all except the lowest levels.

In all this, the military were gradually replaced by civilians, but the "provisorium" became a "definitivum" in Jan. 1852, a year after the Austrian constitution had been suspended.

The principles on which Alexander, Freiherr von Bach (the *spiritus rector* of all this) worked were in many respects enlightened, but the oppressive and absolutist character of his regime united the nation against him; even the non-Magyars and the peasants declined to regard it as a change for the better. At first the nation pinned its hopes, fostered by Kossuth and the other *émigrés*, on foreign intervention. Meanwhile, Deik, leader of the moderate party, counselled passive resistance, in particular the nonpayment of taxes. This policy proved very successful, and the burden of keeping so many administrators, as well as soldiers to guard against a possible rising, with so little return grew almost intolerable to the Austrian exchequer. When its difficulties were brought to a head by the Italian war of 1859, Francis Joseph dismissed Bach and introduced various constitutional experiments; but in spite of the attempted mediation of the "Old Conservative" party, the nation refused to collaborate, and a series of concessions — including the abolition of the quinquepartite division (1859) and the restoration of the court chancellery and of Magyar as central official language (1860) — had no effect. When elections were allowed again (1860 also) they only brought a flamboyantly nationalist majority.

Dualism. — After the armistice of Villafranca (1859) it was, however, clear that the monarchy was not about to disintegrate. Both the crown and the nation came increasingly to wish for compromise. Negotiations, in which Deik and Julius (Gyula) Andrássy (*q.v.*) took the lead on the Hungarian side, were initiated. They dovetailed in with the parallel negotiations in the Austrian half of the monarchy, and an unwritten alliance, similar to that of 1848, emerged between the Hungarians and the liberal German centralists at the expense of the Slavs in each half of the monarchy. In June 1861 the centralist constitution of 1861 was suspended and a provisional government formed in Hungary. A committee was set up to work out a constitution based on the Pragmatic Sanction. The March laws were recognized as valid, but to be modified in practice where this seemed desirable; the Hungarians consented to treat with representatives of the Austrian lands on matters recognized under the Pragmatic Sanction as concerning other of the monarch's dominions, besides Hungary. The Seven Weeks' War of 1866 caused another interruption, but Deák did not raise his demands after Austria's defeat. In Feb. 1867 a responsible independent Hungarian ministry was formed under Andrássy, and in March the new constitution was adopted by 200 votes to 89. On June 8 Francis Joseph was crowned king of Hungary.

Hungary recovered her full independence and her integrity: the Voivodina had already been dissolved and Transylvania was now incorporated, the Military Frontier following. Fiume and the Murakoz returned to Hungary, but the Slavonian counties remained with Croatia, with which, in 1868, a separate agreement was concluded, doing full justice to Croatia's historic rights. For the "nationalities," under law 44 of 1868, the equality of languages was stipulated insofar as was consistent with the practical needs of administration. Non-Magyars were to be allowed the use of their language in private life, in the press, etc., in the courts and in administration and in county and municipal diets, in which records could be kept also in such languages when desired by one-fifth of those concerned. The government was obliged to provide facilities for any person to receive secondary education in his own language, and communities, churches and individuals were free to found and maintain schools which enjoyed equality of status with state schools. The army and foreign affairs remained common to Hungary and Austria, each under a joint minister (alternately from Austria and Hungary); a third joint minister was in charge of the finance for these portfolios. Delegations from the Austrian and Hungarian parliaments discussed the subjects. The respective quotas which each half of the monarchy was to pay were rediscussed every ten years, as were the Austro-Hungarian customs tariffs, Austria and Hungary forming a customs union.

In Hungary itself many elements were hostile to dualism and to any community of existence with Austria. They listened to the voice of Kossuth, the leader of 1848, now living in voluntary exile. Shortly before Francis Joseph's coronation, Kossuth, in his open "Cassandra letter," had accused Deák of treachery to the rights of the nation. The pure Magyars of the Alfold supported Kossuth and elected a parliamentary opposition that took its stand on the so-called "1848 constitutional basis" and called for revision or revocation of dualism and a pure personal union with Austria. The 1848 politicians adopted a negative attitude toward all demands of the state throughout the period of dualism, voted against the budgets and military estimates and attempted to discredit the dualist governments as traitors to the nation.

Threatened at once in Vienna and in Hungary and supported solely by the emperor-king, who throughout his life remained strictly loyal to his coronation oath and upheld the law 12 of 1867, the Hungarian minister-presidents, from Andrássy on, were often forced to employ subterfuges to secure the majorities necessary for the conduct of affairs. As the 1848 ideas were most prevalent in the poorer classes, the franchise was from the first so restricted as to confine all political influence to educated circles. The maintenance of dualism was secured, first and foremost, by enlisting the "gentry," who had lost the greater part of their estates through the agrarian reform decreed under art. 9 of the law of 1848 and executed during the period of absolutism of 1852–53 with the deliberate purpose of breaking the Hungarian aristocracy. As state officials and deputies, this class now became the chief supporters of the dualist governments. After Andrássy had become common minister for foreign affairs in 1871, his successors in the premiership of Hungary ruled with the help of the gentry and the new Jewish capitalists.

The rich natural resources of Hungary had begun to be exploited, railways had been built, mines and factories started, and the profits increased the solidity of the '67 governmental party, while the '48 party was, where possible, excluded from it. It was, however, only after the death of Deak, a puritan who refused to take any office, that this was developed into a regular system by Kálmán Tisza. whose prolonged period of office (1875–90) made the government party resting on the landed gentry and capital (the "Liberal" party or "Free Principle" party) into a permanent institution. He introduced strict discipline into his party, which was most necessary, since the government was forced year by year, in the interests of dualism, to pass unpopular laws, such as the military estimates for the "common" army, with its headquarters in Vienna and German word of command. The German-speaking army in Hungary was the occasion of continual conflicts; there were repeated students' riots and patriotic demonstrations against army decrees, these flames being vigorously

fanned by old Kossuth from Turin. Kálmán Tisza fell over a bill affecting Kossuth's rights of Hungarian citizenship.

His successors, Count Julius Szápáry (1890–92), Sándor Wekerle (1892–95), Baron Dezso Bánffy (1896–99) and Koloman Széll (1899–1903), had still greater difficulties to face. Resistance was increasing, both in Austria and in Hungary. In the decennial revision of the Austro-Hungarian customs tariff parliamentary discussions were stormy, and the differences between agrarian Hungary and industrial Austria grew acute: the Hungarians complained that their country was treated as a colonial market for the Austrian factories, and they increasingly demanded an independent customs territory. Similar difficulties arose over the commercial treaties with foreign states, which had also to be concluded in common with Austria, and over army questions, in the latter case mainly because of the preference shown to German and Slav officers for high positions. Thus dislike of dualism grew more acute in Hungary; not only the Kossuth party worked against it, but also other politicians who, while remaining loyal to the compromise, yet looked on it as elastic and aimed at altering its provisions by constitutional methods: creating an independent customs territory, giving the Hungarian element in the army its due and creating an autonomous national bank. Among these were Count Albert Apponyi and, later, the younger Count Julius Andrássy (*q.v.*). The number of malcontents increased after the Wekerle government introduced a reform of the marriage law on liberal lines in 1894; a new opposition party, the Catholic Peoples' party, came into being, led by Count Ferdinand Zichy (1829–1911) and supported by wide circles of Hungarian, German and Slovak peasantry. The minister-president, Bánffy, was only able to break the power of this party in the elections of 1896 by the most extreme means, forcible intervention by the gendarmerie. In the same year the nation and its king celebrated together its jubilee, the millenary of the occupation of Hungary by the Magyars. Yet events were shaping toward a rupture with the sovereign and the compromise. When Count Istvin Tisza, as minister-president, attempted to make parliamentary discussion possible in the interests of the army estimates by changing the standing orders and was defeated at the elections (1905), Francis Joseph first tried the expedient, attempted in Austria, of reforming the franchise, to put the nationalist gentry and middle classes in a minority against the workmen and national minorities. When this attempt (Baron Géza Fejerváry's ministry, 1905–06) broke down on the resistance of the counties, he entrusted the power to the united parties of the opposition (Wekerle's ministry, 1906–10), who promised to respect the compromise. This coalition ministry included Apponyi, Andrássy and Francis Kossuth, son of the old revolutionary, now dead. Public opinion, however, failing to receive from this ministry the anticipated changes in the compromise, soon abandoned it. At the next elections the old '67 party returned in triumph; it remained in power till World War I after being reorganized by István Tisza, who was minister-president for the second time, 1913–17.

It was only with great difficulty, however, that Tisza succeeded in carrying the army estimates in the last years preceding World War I. In the '48 party the influence of the leaders compromised in the Wekerle ministry was now superseded by that of Count Mihály Károlyi (*q.v.*), who introduced extreme tendencies into the Party of Independence. At the same time, symptoms of social unrest appeared. The Socialist party, which was Marxist in creed, made several unsuccessful efforts to find new followers among the agricultural labourers; but in the first decade of the 20th century it found an ally in the Radical party, composed of semi-Socialistic bourgeoisie, doctors, lawyers and merchants, mainly Jewish in origin, which aimed at a complete remodelling of social conditions with the assistance of general suffrage.

At the same time the question of the national minorities also became acute. The law of 1868 allowed considerable scope for educational development, unhampered by the state, to those nationalities which controlled churches: the Greek Orthodox Rumanians and Serbs and the Saxon Lutherans. The Roman Catholic, Calvinist and state schools were overwhelmingly Magyar; the state, however, fostered them in non-Magyar districts with the hope of magyarizing the pupils--sometimes with success but in other cases with the opposite effect. For some time after the compromise the leaders of the nationalities retired into passivity, but about the turn of the century the new generation became actively oppositional. Many of the Rumanians and some of the Serbs were already almost openly irredentist: others sought the support of the heir to the throne, the archduke Francis Ferdinand (*q.v.*), whose interest in the unity of the army also led him to wish to break the supremacy of the Magyars. He advocated replacing dualism by trialism, creating a third Slavonic state out of the southern Serbo-Croat parts of Austria and Hungary, with Bosnia, and thus putting Hungary in a minority of one to two. The situation was further complicated by the irredentist agitation conducted by the fellow countrymen beyond the frontier of the various nationalities. Even Count Tisza, who in his second term of office made several attempts to reach an understanding with the nationalities, especially the Rumanians, was obliged to the last to oppose general suffrage, because he feared that it would have meant the supremacy of the nationalities, assisted by the Hungarian Socialists (the Magyars numbered 54.5% of the total population), and therewith a federalization of the state. To prevent this, the abortive Andrássy draft of 1908 had attempted to combine general franchise with plural voting for the educated classes.

World War I.—World War I found Hungary in the throes of a parliamentary struggle conducted by all shades of the opposition, from Albert Apponyi to Mihály Károlyi, against Tisza's attempt, supported by the crown, to maintain the compromise intact. Tisza's voice was the only one raised in the crown councils of July 7 and 19, 1914, after the murder of the heir to the throne, against war and for giving the ultimatum to Serbia such a form as to make the avoidance of war possible. When, on the death of Francis Joseph (Nov. 21, 1916), the archduke Charles succeeded him as Charles I of Austria and Charles IV of Hungary, Tisza's obstinate fidelity to the prosecution of the war at Germany's side displeased the new sovereign. At the outbreak of the war, the parties of the opposition had sworn a Truce of God; but by 1917 they had forgotten it. Losses, privations and increasing food shortage, together with the absence of any prospect of final victory held out by the Austrian and German generals, kept the population in continuous unrest. On April 25, 1917, the Socialists, Károlyi's patty and Oszkar Jászi's Radicals founded the democratic electoral bloc. Charles called on Tisza to submit a draft for an extension of the suffrage, whereupon Tisza resigned. The cabinets of Count Moricz Esterházy (June 15–Aug. 20, 1917) and Sándor Wekerle (Aug. 20, 1917–Oct. 31, 1918) attempted, without real success, to meet the increasing desire for a division of the common institutions of 1867, especially of the army, which was still under Austrian leadership. The nationalist discontent was accompanied by agitation for general suffrage, largely the result of propaganda by Jászi's Radicals which, after Tisza's fall, was subject to no restraint. In the last two years of World War I the masses, especially in the capital, moved further to the left than they had in the preceding 50 years. (C. A. M.; X.)

THE REPUBLIC, 1919-20

When, in Oct. 1918, it became clear that the war was lost, the opposition took the offensive. On Oct. 25 a "national council" was formed under the presidency of Mihály Károlyi, with the program of dissolving parliament, introducing general suffrage and concluding immediate peace. Popular demonstrations demanded the appointment of Károlyi to carry through this program. After hesitation the king allowed the appointment and Károlyi took office with a Radical-Socialist government (Oct. 31). The Slovaks, Rumanians and Serbs were threatening to secede, and in the hope of saving the integrity of Hungary Károlyi travelled to Belgrade to meet the French commander, L. F. M. F. Franchet d'Esperey, but had to accept from him (Nov. 8) an armistice under which the Hungarian troops evacuated all southeastern Hungary. Serbian troops entered the southern areas; subsequently a Rumanian army entered Transylvania and Czech troops Slovakia. The king having renounced "participation in the con-

duct of state affairs" (Nov. 13), the national council proclaimed a republic and dissolved parliament (Nov. 16).

The government prepared to introduce a democratic political system and social reforms, including land reform, but hesitated and procrastinated. Having disarmed the returning soldiers in an attempt to document its pacifist nature, it had no force with which either to keep internal order or to resist the continued encroachments of the Rumanians, Czechs and Serbs, who were consolidating their positions in the peripheral areas. Within the government coalition the bourgeois elements had to retreat continuously before the Social Democrats; but the latter were now themselves threatened by Communist propaganda spread by Béla Kun (*q.v.*), a soviet agent of Hungarian-Jewish origin. When the entente's representative in Budapest, Colonel Vyx, sent a note ordering the Hungarian troops and authorities to withdraw still farther west, far into purely Magyar territory, and indicating that the new military demarcation line would form the future political frontier, the government, now headed by Dénes Berinkey since Károlyi had become president of the republic, resigned (March 21, 1919). The Social Democrats had already agreed to fuse with the Communists and to establish a dictatorship of the proletariat in alliance with Soviet Russia, who, Kun promised, would help against the Rumanians. Many bourgeois and professional soldiers at first supported Kun in this hope, but the help never materialized. Kun attacked the Czechs with some success, but was forced by the Allies to withdraw. At home his methods, which began by being doctrinaire and ended by being terroristic, alienated the bourgeoisie, the leading members of whom fled abroad and formed *émigré* committees in Vienna and Szeged (now under French occupation), the peasants and even the industrial workers. In an attempt to restore his position Kun attacked the Rumanians, but was defeated. He and his chief lieutenants fled to Vienna (Aug. 1).

The Rumanians occupied Budapest (Aug. 4), in which various nondescript governments failed successively to maintain themselves. On Nov. 14 the Rumanians, who meanwhile had looted the capital very thoroughly, were induced to retire. The *émigrés* had by now formed a counterrevolutionary government with a national army, the latter commanded by Admiral Horthy (Nicholas Horthy de Nagybanya, *q.v.*). This force entered Budapest. The Allies attempted to bring into being a broad, democratic coalition government, recognized (Nov. 25) the appointment as minister-president of Károly Huszár and insisted on the holding of elections under a secret suffrage (Jan. 25, 1920). Already, however, counterrevolutionary detachments had taken violent and indiscriminate reprisals against the workers' leaders and the Jews. The Social Democrats abstained in protest from the elections, which returned two almost equal parties: Christian Nationals and Smallholders. Only a fraction of the latter, however, represented the peasants. The government now restored the legal continuity by cancelling Károlyi's and Kun's changes and formally dissolved the link with Austria. Hungary remained a kingdom and, pending the future settlement of the constitutional issue, Admiral Horthy was elected regent (March 1, 1920).

THE REGENCY

The Treaty of Trianon.—On June 4 Hungary had to sign the treaty of Trianon, which gave to its neighbours 192,000 sq.km. of its area of 283,000 (Croatia-Slavonia excluded) and 10,649,416 of its population of 18,264,533. Almost all its non-Magyar-speaking populations were separated from it, and more than 3,000,000 Magyars, many of them living in immediate juxtaposition to the frontier. Its armed forces were limited to 35,000 men, lightly armed, and it was required to pay a sum, to be determined subsequently, in reparations. The treaty incidentally disrupted its entire economic structure. Hungary's determination to secure revision of it thereafter governed its whole foreign policy and in particular its relations with the three main beneficiaries of the treaty, Czechoslovakia, Rumania and Yugoslavia. Its relations with Austria were also at first disturbed by that state's claim to the German-speaking areas of western Hungary. Part of these were in fact ceded, but the protocol of Venice (Oct. 12, 1921) provided for a plebiscite in the city of Sopron (Oedenburg), which remained with Hungary after the vote.

Reconstruction.— The ministries of Huszár (Nov. 24, 1919–March 15, 1920), of A. Simonyi-Semadam (March 1j–July 19, 1920) and of Count Pál Teleki (July 19, 1920–April 14, 1921) had to face many difficulties. There was much economic and financial disorganization, in the course of which wild inflation set in. The workers' leaders who had fled abroad conducted a vigorous agitation against the excesses of the "white terror" that had followed Kun's "red terror." The peasants demanded land reform. The middle classes were embittered and impoverished by the inflation. The distress of the large numbers of officials and other middle-class elements who had been expelled by the successful states and had now arrived with their families in Budapest, completely destitute, was particularly acute. These elements, which were strongly nationalistic, formed the backbone of a radical undercurrent which was at once revolutionary against the Habsburgs and the feudal system associated with them and counterrevolutionary against the ideas of 1919. It was by playing these various discontents off against each other that Count Stephen (István) Bethlen (*q.v.*), while remaining in the background, was able to negotiate a general internal settlement. The Socialist leaders signed a regular treaty agreeing to give up agitation abroad or in the country districts and to support the government's foreign policy, in return for an amnesty, the secret ballot in the towns and certain other concessions. The Smallholders were pacified by a land reform which took 1,300,000 hold from the largest estates (a further distribution was to follow later) and by the promise of partnership in the government. They agreed that the open franchise should be reintroduced in the rural districts as a safeguard against Socialist agitation and in the faith that the government would not favour a Habsburg restoration. King Charles in fact attempted to return to Hungary on March 7, 1921, but was forced by domestic and foreign opposition to leave. After this Bethlen succeeded Teleki (April 14). The king made a second attempt to recover his throne on Oct. 29. This time government troops actually fired on him. He was removed, and under pressure from the powers the Hungarian parliament enacted a law declaring the Habsburgs forfeit of the throne. Next spring, having passed through his new franchise bill by emergency legislation (against strong obstruction from the Legitimists) Bethlen dissolved parliament and held new elections. These and all subsequent elections of the period between World Wars I and II, gave a safe majority to what was always popularly known thereafter as the "government party," against relatively weak minorities of Socialists and Liberals on the one side and Legitimists on the other. The Legitimists became a declining force after the death of the king in exile.

Bethlen now completed the liquidation (begun by Teleki) of the right-wing extremists, who were quite impotent during his regime, which they declared bitterly to be one of subordination to the forces of feudalism and big capital. In 1924 Bethlen succeeded, after prolonged negotiations, in raising a reconstruction loan, with the help of which the inflation was stopped and the pengö, a new stable currency based on gold (1 pengö = 0.263 g. of fine gold), introduced. In connection with this, a new, independent Hungarian bank of issue was set up on June 24, 1924. Under the new and more peaceable conditions, money, somewhat recklessly lent, poured into the country. The national economy was readapted and reconstructed: much industrialization carried through—sufficient to counteract, though not perceptibly to diminish, the rural overpopulation that was Hungary's biggest internal problem (and that although U.S. legislation had now closed the outlet of emigration). Industrial employment was good. The middle-class refugees were supplied with posts in an elastic state service, or pensioned off. Abroad, Hungary's relations with the west were good. There were a few not explicitly official escapades, such as an attempt made in 1925 to finance propaganda by forged French francs, but revisionist agitation was damped down, although Hungary's relations with its chief neighbours—now firmly linked in the little entente—could not seriously improve. Bethlen did, however, draw Hungary out of its isolation, partly by winning sympathy for her in the west and notably by concluding a treaty

of friendship with Italy (April 1927).

The weak point of the structure was that the balance of payments was invariably passive. The gap was closed by further borrowing, but the continued success of the operation depended entirely on the maintenance of satisfactory prices for Hungary's main exports, especially wheat. When the world economic crisis broke out in 1929, Hungary was not immediately involved. In April 1930 Bethlen secured the settlement of the reparations question and the lifting of the League of Nations' financial control. In May-June 1931 he held new elections which returned him to parliament at the head of another large majority. Immediately after, however, the full force of the financial crisis hit Hungary. Payments had to be suspended, and revelations of the real financial position caused a bitter outbreak of popular feeling against the government. Bethlen resigned (Aug. 19, 1931) in favour of the puritan Count Gyula Károlyi who, strictly pressed by Hungary's creditors, set himself to carry through a policy of retrenchment and budgetary reform. He initiated settlements with Hungary's foreign creditors, but the internal agitation against the "system," led on the one hand by the indebted farmers (who now founded a new Smallholders' party) and on the other by the middle-class elements in the state services and professions was too strong for him. On Sept. 21, 1932, he resigned.

The Gombos **Ministries 1932–36.**—The new minister-president was Gyula Gombos, former minister of defense, the leader of the "Right Radicals", notorious for his fascist, anti-Semitic and militarist views and, in foreign policy, the prophetic adherent of an "axis" to consist of Hungary (within its historic frontiers), Italy and Germany. By an immediate visit to Italy, Gombos committed Hungary to a "dynamic" foreign policy, thereby also consolidating his position at home against either "democratic" or "feudal" forces. The axis, however, could not be formed, as Italy and Germany were at loggerheads over Austria. Moreover, on a visit to Berlin (June 1933) Gombos learned that Adolf Hitler, while willing to let Hungary share in the partition of Czechoslovakia, was opposed to its aspirations in Rumania and Yugoslavia. All Hungary could do was to link itself with Italy and Austria under the Rome protocols (March 17, 1934), which relieved it from the economic pressure of the little entente but also committed it to an anti-German line over Austria. At home Gombos was largely under the tutelage of a parliament "made" by Bethlen (which the regent refused to allow him to dissolve) and in the continued grip of the financial crisis, international, domestic and personal. Perforce he postponed all the revolutionary measures promised by him, even declaring publicly that he had "revised his views on the Jewish question," and settled down to a sober program of technical and orthodox reconstruction. In March 1935 he forced the regent's hand and carried through elections which gave him a parliamentary majority of his own followers, but internal opposition was still holding him in check when he fell fatally ill in June 1936. He died on Oct. 6, and the regent appointed the more conciliatory Kálmán Darinyi to succeed him.

Darányi, Imrédy and **Teleki.**—Meanwhile renewed intimacy with Italy had brought Hungary into further conflict with the little entente over the murder (Oct. 1934) of King Alexander of Yugoslavia, for which it was partly responsible and openly blamed. After the Franco-Italian negotiations of 1935 for a Danubian settlement had borne no fruit, and Hitler had occupied the Rhineland and concluded the agreement of July 11, 1936, with Austria, Hungary felt itself directly threatened by Germany. Hitler now began to exercise pressure on Hungary's internal affairs; but Hungary did not dare seek agreement with the little entente even if concessions had been offered in return, which they were not. Hungary negotiated with its neighbours in the hope of securing from them consent to its rearmament, now a question of extreme urgency in view of the patent imminence of war; but tried while so doing to detach Yugoslavia, with which it was now willing to bury the hatchet, by a separate agreement.

Darányi at first made considerable concessions to anti-German opinion; during his term of office, also, a new franchise was enacted which, while restricting the number of voters, restored the secret ballot in the rural districts. But he was hard pressed by the right wing of his own party and by extremist groups even further to the right. He and his foreign minister, K. Kánya, visited Berlin in Nov. 1937 and there acquired the conviction that Hitler meant soon to incorporate Austria and attack Czechoslovakia. These reports strengthened the hand of the military party, which urged the necessity for uncompromising rearmament and, in connection therewith, for a more active policy against the Jews. In March 1938 Darinyi announced a rearmament program and a law limiting the participation of Jews in certain walks of life. He also offered concessions to Ferenc Szálasi, the leader of the principal extremist movement, the Arrow Cross. For this he was dismissed by Horthy in favour of Béla Imrédy, formerly Gombos' minister of finance (May 1938). Imrédy had Szálasi imprisoned, took other measures against the extreme right and made several last-hour attempts to win support from the western powers—which, in the view of himself, Horthy, Bethlen and Teleki (who had returned to office as minister of education) were certain to win the coming war. When Horthy, Imrédy and Kánya paid a state visit to Kiel in Aug. 1938 they, pleading Hungary's unarmed condition, rejected overtures made to them by the Germans to co-operate against Czechoslovakia; and when the Munich crisis broke out they limited Hungary's demands to the ethnically Magyar area and made every effort to get them satisfied by the general consent. It was not by their wish that—Britain and France having shown them little sympathy—they had to fall back on Italy's support. Eventually an arbitral decision, rendered by Germany and Italy on Nov. 2, 1938, awarded Hungary an area of 12,012 sq.km. with a population of 1,048,537, preponderantly Magyar but containing also Slovak minorities.

The hostility that Hungary had encountered from Germany during the negotiations, together with the impression of the feebleness and indifference of the west, had convinced the government that it must follow a more definitely pro-axis policy. In Dec. 1938 Kánya, who had personally offended both Hitler and Joachim von Ribbentrop, was dropped for István Csiky. The latter visited Hitler (Jan. 11, 1939) and promised full co-operation, to be documented by Hungary's signing the Anti-Comintern pact (which it did on Feb. 2, 1939) and leaving the League of Nations. Imrédy announced his intention of introducing authoritarian methods and further anti-Jewish legislation. A revolt of the conservative elements in his party put him in a minority. Horthy refused to accept his resignation, but his enemies discovered a Jewish strain in his ancestry and he resigned (Feb. 16, 1939). Teleki, a man fundamentally opposed to the Germans, took office and put up what resistance he could to Germany at home and abroad. Seeing the breakup of Czechoslovakia imminent, he planned to annex Ruthenia without Germany's consent, although a last-moment invitation to act came from Germany before Hungary could move. Hungarian troops then occupied this area (12,061 sq.km., pop. 664,226, mainly Ruthenian), thus securing a long-desired common frontier with Poland. When, however, Teleki visited Berlin with Csáky in April he did not dare go back on Hungary's previous promises to follow an "axis policy," only stipulating that Hungary would not participate, directly or indirectly, in an attack on Poland. In May Teleki held elections, under the secret franchise, but with the disconcerting result that the Arrow Cross and similar parties secured 42 mandates out of 281 and the right wing of the government party was as strong as ever.

World War II.—When Hitler attacked Poland, Hungary refused a request to allow German troops transit across its territory. Both groups of belligerents wished southeastern Europe to remain out of the war, and this suited Teleki well enough as he wished to realize his further claims by general consent when the war should be over. Hungary proclaimed itself nonbelligerent. Meanwhile, while maintaining its claims against Rumania, it sought the friendship of Yugoslavia more pressingly than ever. At first this patient policy was very popular in the country, but after Hitler's successes in the spring of 1940 Teleki was strongly attacked by the right for having backed the wrong horse; when, therefore, on June 26, the U.S.S.R. sent its ultimatum to Rumania, he decided that he could wait no longer. Against the wishes of Germany and Italy he raised Hungary's claims on Transylvania. Before his threatening

insistence the axis powers agreed to mediate and finally, Rumania having asked for their arbitration, rendered an award (Aug. 30). This took the Hungarian claim as basis but scaled it down and gave Hungary 43,104 sq.km. (about two-fifths of the total) with a population of 2,577,260, including about 1,000,000 Rumanians. After this Hungary made some further concessions to the right and adhered to the Tripartite pact (Nov. 20) but, in an attempt to counteract the effect of this and to strengthen its rear against Germany, signed a "Pact of Eternal Friendship" with Yugoslavia (Dec. 12). Since September, however, it had been allowing German troops to cross its territory into Rumania. Germany now prepared to use these troops to attack Greece. Then, in March 1941, a coup d'état in Yugoslavia overthrew the government that had signed the Tripartite pact, and Hitler prepared to attack Yugoslavia. The Hungarian government was thus caught on the horns of a dilemma: it refused to join in the attack, but did not attempt to deny Germany the use of its territory and decided to move into the vacuum of the Voivodina if Croatia declared its independence. Great Britain having shown strong disapproval of this plan, Teleki committed suicide (April 2-3). His successor, László Bárdossy, carried out the program. The reannexed area comprised 10,619 sq.km. and the population 1,030,027. Great Britain now broke off diplomatic relations.

Originally Hitler had not meant Hungary to participate in the war against the U.S.S.R.; but a party in the country, fearing to be left behind by Rumania in the race for Germany's favour, was anxious that it should do so. After aircraft had dropped bombs on Košice (Kassa) (June 26, 1941; an incident not wholly explained) Bárdossy, accepting the version that the aircraft were Russian, declared a state of war to exist between Hungary and the U.S.S.R. Only a small expeditionary force was sent out at first, and it was recalled in the autumn. It was then still thought that the war would be short and easy and not involve Hungary in complications with the west. But on Dec. 6 Great Britain declared war on Hungary, and on Dec. 12 Hungary itself, under strong German pressure, declared war on the United States. In Jan. 1942 Germany demanded a serious military effort of Hungary and extracted a promise to send out about 200,000 men, some of whom Germany undertook to equip., Just at this time a lamentable incident occurred in Novi Sad (Ujvidék), the largest town in the reoccupied Yugoslav territory. There had been partisan activity, and the officer sent to restore order rounded up and massacred several hundred persons, some Serbs, others Jews, others even Magyars who had been taken as hostages. Horthy was further irritated by Bárdossy's handling of a bill to make his son István Horthy deputy regent (in reality, successor presumptive to the regency) and replaced him on March 9, 1942, by Miklos Kállay, a politician of the so-called "Conservative-Liberal" school.

Like Horthy, but unlike Bárdossy, Kállay believed not only in an Allied victory but also in the possibility of splitting the east from the west. He allowed the troops to go out, although insisting that Hungary's struggle was purely defensive, but avoided any hostile acts of even words toward the west. He and the veteran minister of the interior, F. Keresztes-Fischer, gave the Jews a measure of real protection almost unparalleled on the continent and allowed the press and parties of the left much freedom. Under their protection an independence front began to take shape. Its members were the Social Democracts (with the crypto-Communists in the background); the Smallholders' party, now professing strongly democratic ideals; "progressive intellectuals," who either remained unorganized or (since the leader of the Liberal party, K. Rassay, refused his co-operation) attached themselves to the Smallholders' party; and a small group of intellectuals who formed a National Peasant party.

In Jan. 1943 the ill-equipped and spiritless Hungarian army suffered a grave defeat at Voronezh, losing a large part of its effective and nearly all its equipment. The survivors of the fighting units were now brought home, but some second-line divisions left as occupation troops. Kállay now sent several emissaries to make secret contact with the Allies in August; one of these actually signed with the British ambassador at Ankara, Turk., an instrument of unconditional surrender, to take effect when the Allied troops reached Hungary. But no such agreement could have immediate effect. Pending developments, the Allies persisted in demanding from Kallay "deeds," notably sabotage of war production and withdrawal of the remaining troops from Russia. Kállay protested that sabotage would involve the immediate occupation of Hungary by Germany, which was growing openly suspicious and hostile, while the troops were almost literally prisoners in German hands. He made, however, repeated requests for their withdrawal, which in fact exacerbated the Germans to a high degree. On March 17, 1944, Hitler called Horthy to Bavaria and presented him with an ultimatum: either to co-operate fully or to submit to the occupation of Hungary by German, Slovak, Croat and Rumanian troops. Horthy accepted the former alternative, but before his train had returned, German forces had entered Hungary and gestapo units, armed with long-prepared lists, were arresting prominent liberal and left-wing politicians, legitimists and Jews.

A collaborationist government under Dome Sztojay sent another army to the front and promised co-operation at home. The Germans took advantage of the occasion to round up and deport, for slave labour or the gas chambers, the Jews of Hungary. Although nearly all the Jews of the country districts, about 400,000 in number, suffered this fate, the government seems really not to have been aware of the exterminations until June, when this was reported to Horthy. He ordered the deportations to stop and, although two more country districts were "cleared" after the order, the Jewish population of Budapest was saved. It had to submit to the full rigour of the Nuremberg laws. however.

When Rumania surrendered (Aug. 23, 1944) Horthy decided to extricate Hungary from the war. It was no easy operation, for its only properly armed forces were now at the front, whereas Hungary was full of German troops. To make things worse. Horthy insisted, as a point of honour, on giving Germany notice of his intention. Finally, he still hoped to keep the Russians at bay and to open the frontiers to Anglo-American troops: only after some weeks, when the Russians were long across the Carpathians, did he send a mission to Moscow, which on Oct. 11 concluded a preliminary armistice. The whole affair was shot through with mutual misunderstandings. On Oct. 15 Horthy issued a proclamation of intention to surrender; but the few officers prepared to obey him failed to get back to Budapest, or their troops refused to follow them. German troops occupied Buda and removed Horthy as a prisoner. Szálasi assumed nominal power but in fact authority was in the hands of the German and Hungarian military in western Hungary, of the Russians in eastern.

The German-Hungarian armies left Buda — heroically defended by Gen. I. Hindy — as a "hedgehog" and retreated slowly, taking with them the ministries, skilled workers and equipment from the factories and supplies of all kinds. More than 1,000,000 persons left Hungary, with much of its portable wealth. Fighting on Hungarian soil went on until April 4, 1945.

Meanwhile a new provisional government had been formed at Debrecen on Dec. 23, 1944. This consisted nominally of a coalition of the parties of the independence front (Communists, Social Democrats, Smallholders, National Peasants and, for a while, Bourgeois Radicals) with some individuals who had been in Moscow (the members of the mission that had concluded the preliminary armistice) and, as minister-president, Béla Miklos, the general commanding the 1st army. This government had to sign an armistice with the Allies (Jan. 20, 1945) which *inter alia* imposed on Hungary the obligation to pay in reparations to the U.S.S.R., Yugoslavia and Czechoslovakia a sum equivalent to $300,000,000, to reduce its armed forces to eight divisions and to withdraw its military and civilian authorities to within the Trianon frontiers. The definitive peace treaty. signed in Paris on Feb. 10, 1947, restored the Trianon frontiers, with the further aggravation that Czechoslovakia obtained an extended bridgehead opposite Bratislava that cut the main direct line between Budapest and Vienna

The government had to face a situation of extraordinary difficulty. The country had been ravaged by war and stripped by the retreating Germans; it was subsequently denuded still more effectively by the huge Soviet occupying forces, whose conduct aroused bitter resentment Economically, financially and politically there was disorganization. The history of the subsequent years is that of partial recovery; but at the same time Hungary was being gradually but remorselessly transformed into a powerless satellite of the U.S.S.R. (C. A. M.)

THE PEOPLE'S REPUBLIC

The deliberations and the program agreed upon at the provisional assembly oi Debrecen were not iree from Communist pressure. This program contained, however, some of the genuine aims of the parties represented, a radical land reform among them. This was started immediately but it met with the distrust of the peasantry who would have preferred a transfer of agrarian property rights in conditions of undoubted legality and backed by state credit in solid currency and not in inflated money. Unqualified socialization was not envisaged at Debrecen, and a coalition government was taken for granted.

The general elections of Nov. 4, 1945, were conducted by secret ballot and without apparent compulsion, but considerable sections of Hungarian opinion went unorganized to the polls; already the adjectives "antifascist" and "democratic" were used with great elasticity, and opinion called "undemocratic" was excluded. Out of 409 seats 245 went to the Smallholder party. Zoltan Tildy formed a coalition government. Upon the proclamation of the republic (Feb. 1, 1946) he became president and handed over the premiership to Ferenc Nagy, a deputy of the same party. The Smallholder leaders were increasingly coerced to sever links with their firmer and more outspoken followers and colleagues who were grouping themselves round Dezso Sulyok and later formed the Freedom party. At the beginning of 1947 large-scale arrests took place under the pretext of a conspiracy led by Gen. Lajos Veress. Numerous Smallholder politicians were implicated, among them Béla Kovacs, secretary-general oi the party, imprisoned in February. Ferenc Kagy was persuaded by a ruse to leave the country. He signed his resignation under protest in Switzerland, in order to liberate his son, aged four, who was retained as a hostage in Hungary (May 31, 1947). A nominal Smallholder, Lajos Dinnyes, took his place.

New elections were held on a revised iranchise (Aug. 31, 1947), this time under pressure. The Communists increased irom 17.1% to 21.6% of the votes cast, the Social Democrats decreasrd from 16.9% to 15.1%; the Smallholders were down irom 57% to 14.6%; there was a considerable (39.7%) opposition vote of the right. These latter parties, however, were successively reduced to silence and their leaders imprisoned or driven into exile. Meanwhile, the new government again consisted of a nominal coalition of "progressive parties," in which the Communists were in fact the only important figures. All but its crypto-Communist members had now left the Kational Peasant party, which was kept in being only in order to mislead the Hungarian peasants. The Social Democrats now suffered the same fate as the Smallholders. Their leaders were denounced as fascists, and the survivors fused with the Communists in June 1948 into a Hungarian Workers' party. Tildy was disgraced and forced to resign on July 30, 1948, and was succeeded as president of the republic by Árpad Szakasits, a vacillating Socialist, later arrested and tried in a "people's court."

Further elections, this time farcical, were held on May 15. 1949. Again a nominal coalition took office, but Communist dictatorship was now undisguised. The subsequent struggles between politicians were of Communists against each other. Among others the minister of the interior, Laszlo Rajk, who was accused of "Titoism," was hanged on Oct. 15, 1949. The chief centre of resistance to the regime was now the Roman Catholic Church, which, unlike the other denominations, had refused to come to terms with it. The cardinal primate, Archbishop Joseph Mindszenty, was tried for "espionage" on Feb. 8, 1949, and sentenced to life imprisonment.

In an unexpectedly candid speech made on Feb. 29, 1952, Matyas (Roth) Rákosi (1892–), deputy premier from Nov. 1945 and first secretary of the Workers' party, described how the Hungarian Communists entered into coalitions in order to dispose of their partners. Summarizing the history of seven years, he referred to the gradual slicing off of his allies and potential victims as "salami tactics," declaring that these necessary tactics nevertheless succeeded only because the presence in the country of the Soviet army. On Aug. 14, 1952, Istvan Dobi, a Peasant figurehead, resigned as premier and was promoted chairman of the presidential council of the national assembly (head of state), while Rákosi became chairman of the council of ministers.

On May 17, 1953, there was another election, in which the government list received 96.2% of a poll that was 98% of those on the electoral register. But, as an effect of the changes in the U.S.S.R., where after Stalin's death a "collective leadership" was proclaimed, Rakosi on July 4 resigned as premier. His successor, Imre Nagy, announced a "new course" in the government's economic policy. Admitting that the industrial development plan had placed too heavy a burden on the country's resources, Nagy declared that the government's aim in economic policy should be to cut its coat according to its cloth. The "new course" was abandoned in the spring of 1955, and in Xpril Nagy had to resign and was dismissed from the party central committee.

In May 1954, at the time of its third congress, the Hungarian Workers' Communist party (Magyar Dolgozók Partja) had 810,227 members and 54,380 "candidates" grouped in 21,551 cells or basic organizations. The Youth league (D.I.Sz.) totalled 577,000 members.

Under Communist leadership Hungary's part in foreign affairs was integrated with that of the U.S.S.R. and its satellites under the general policy laid down in Moscow.

The rehabilitation of Béla Kun and Rajk (spring 1956) merely exposed Communism to ridicule. The "new line" of de-Stalinization only hastened the moral bankruptcy and disintegration of the Communist party. Liberalizing measures were accepted but were felt to be insincere and inconsistent, especially as in April 1956 Imre Nagy, the only Communist leader who had achieved some national standing since 1945, was expelled from the party. Moreover, the collective treaty of mutual assistance signed in Warsaw on May 14, 1955, was felt to be an indication that the Soviet Union was strengthening its grip.

Rákosi's resignation (July 18, 1956) brought some relief but made Hungarians no more amenable to a new "national" form of communism. The public reappearance of discredited politicians of the old parties (Tildy, Szakasits) did not lessen the tension. Writers were in open revolt by September; university students rejected the Youth league as their organization. On Oct. 23 street demonstrations by students began. The movement spread spontaneously, within hours, and eventually led to a unanimous and firm national resistance. Events quickly outstripped simple plans for reform or for a peaceful transition; it seemed that dismay, hatred and bitterness had broken through, after years of repression.

Imre Nagy was called back to power on Oct. 24. This did not stop the movement. Despite his promises of Soviet withdrawal, iree elections, the restoration of agrarian property rights and impartial justice, the insurgents, joined by the majority of the Hungarian army, went on to occupy public buildings and centres of production. None of the four governments announced between Oct. 27 and Nov. 4 had a chance of consolidation or actual administration. Béla Kovacs, announced as a minister, was believed to have reiused every office in a coalition with the Communists; the other names — with the possible exception of Anna Kethly, released from prison shortly before these events — seemed to reassure no one. Students, workers, peasants and soldiers shared in the fighting in the teeth of violent repression by Soviet units. Cardinal Mindszenty was liberated. Imre Nagy repudiated the Warsaw treaty and asked for an immediate international recognition of Hungary's status of neutrality (Oct. 31–Nov. 1).

The insurgent army commanded by Maj. Gen. Pal Maleter came nearest to an established authority in a confused situation. The Soviet command began negotiations with him which were alleged to hasten the withdrawal of Soviet troops. On Nov. 4, however, the Russians counterattacked. For about a week fighting was again intense, especially in industrial and mining centres. Subsequently the resistance was mainly passive and took the form of a general strike. Deportations to the U.S.S.R., food shortage and destruction compelled more than 150,000 Hungarians to leave the country.

After Nov. 4 an administration was formed by the Soviet command, under the nominal premiership of the dissident Communist Janos Kadar. He visited Moscow in March 1957. Henceforth, "the traitor Nagy" was denounced and a neu enemy, named "revisionism" (*i.e.*, of Marxism-Leninism), began to be pursued. On May 27 an agreement was signed in Budapest legalizing the prescnce oi Soviet armed forces in Hungary. From June 28 to 30 the reorganized Hungarian Socialist Workers' (Communist) party held its congress: its membership was given as 345,733. In Sept. 1957 the UN general assembly endorsed the report of its committee of five (Austria, Ceylon, Denmark. Tunisia and Uruguay) which stated that the Kadar government "came into being solely as the result of military intervention." Kadar resigned in Jan. 1958 and was succeeded by Ferenc Münnich. (B. Mr.)

POPULATION

Before World War I Hungary or Magyarorszag (the state of the Magyars) covered, as part of the Xustro-Hungarian empire, a total area of 125.631 sq.mi. The blood of the original invaders must soon have become heavily diluted with Slavonic, Rumanian. Turkish. German and other strains, but in 1910 about half the total population of 20,886,500 was listed as Magyar-speaking.

The treaty of Trianon. cutting off the provinces with Slovak, Ruthenian, Rumanian and Serbo-Croat majorities, reduced Hungary to an area of 35,935 sq.mi. The population of the new state was 7,990,202 in 1920 and 8,688,319 at the 1930 census, and it was estimated at 9,082,400 in 1939, within the Trianon frontiers. The 1941 census revealed a population of 9,314,323 within the same frontiers. After the reannexation of territories awarded to Hungary on four successive occasions (see above). the country's area increased by April 1941 to 66,271 sq.mi. with an estimated population of 14,669,000. In 1945 Hungary found itself reduced to its Trianon size. By the Paris peace treaty of Feb. 10. 1947, a bridgehead facing Bratislava, on the right hank of the Danube. was ceded to Czechoslovakia, reducing Hungary's area to 35,911 sq.mi. The Jan. 1, 1949, census showed that the area was 35,905 sq.mi. and the population was 9,204,799. The 1960 census reflected a population of 9,976,530 in an area of 35,919 sq.mi.

Both before 1938 and after 1945 Hungary was predominantly Magyar-speaking and, as a result of World War II. the Magyar-speaking proportion of the population rose from 92.1% to 96.6%.

The German minority was in fact larger than the Hungarian sources admitted, and by 1939 it was estimated at 530,000. Many Germans left the country early in 1945 with the retreating German armies, and others were transferred according to the Potsdam

three-power agreement of Aug. 2, 1945.

The Jewish minority also was larger than the 1930 census according to religion suggested (see Table I), for many Jews mere converts to Catholicism or to Calvinism. It was estimated that the Jews who remained in Hungary after R'orld War II represented about one-third their prewar number and that more than 300.000 were exterminated during the war.

TABLE I.—Population According to *Religion*

Religion	1920		1930		1949*	
	Number	Per cent	Number	Per cent	Number	Per cent
Roman Catholic	5,105,37j	63.9	5,634,003	64.9	6,500,000	70.6
Greek Catholic (Uniate)	175,655	2.2	201,093	2.3		
Calvinist	1,671,052	21.0	1,813,162	20.9	2,100,000	22.8
Lutheran	497,126	6.2	534,165	6.1	300,000	3.3
Orthodox	50,918	0.6	39,839	0.5	40,000	0.4
Jewish	473,358	5.9	444,567	5.1	170,000	1.9
Other	16,721	0.2	21,490	0.2	94,000	1.0
Total	7,990,202	100.0	8,688,319	100.0	9,204,000	100.0

*Estimated.
Source: *Annuaire Statistique Hongrois, 1939* (Budapest, 1940)

The tonns were relatively numerous but small, having mostly originated as market centres. Budapest, originally two cities (the fortress Buda and the market Pest opposite it, on the left bank of the Danube), is a case by itself, having concentrated within its boundaries not only the administrative services required by the capital of a state (of a state, moreover, much larger than post-1920 Hungary) but also much of its industry. In Dec. 1949 Budapest's boundaries were extended to bring in the industrial satellite towns of Pestszenterzsebet, Cjpest and Kispest, raising its population to 1,589,065. (See Table II.)

TABLE 11.—Population *of Major* Towns

Tonn	1920	1930	1941	1949	1960
Budapest	929,690	1,006,184	1,164,963	1,589,065	1,807,299
Pestszenterzsebet	40,549	67,907	76,894		
Ujpest	57,464	67,400	76,072		
Kispest	51,064	64,512	65,139		
Miskolc	56,982	63,913	109,433	97,667	143,364
Debrecen	103,186	117,275	125,933	95,177	129,671
Szeged	123,565	135,071	136,752	83,207	99,061
Pecs	47,556	61,663	73,000	66,907	114,713
Gyor	50,036	50,881	57,190	50,583	70,812
Kecskemet	73,109	79,467	87,267	33,330	66,819
Hodmezovasarhely	60,922	60,342	61,776	34,734	53,505

Education.— All education was state conducted and given on a basis of dialectical materialism, two hours a week, however, being allowed for optional religious education. In 1954–5j there were 6,185 primary schools with 1,208,000 pupils and 46,100 teachers. and 405 secondary schools with 162,500 pupils and 7,500 teachers.

There were also 21 institutions of higher education, including four universities (Budapest, Debrecen, Pecs and Szeged) and four colleges of engineering (one old. Budapest, and three new, Szeged, Miskolc and Veszprem), with a total of 47,500 students and a teaching staff of 7,200.

GOVERNMENT AND ADMINISTRATION

Constitution.—Hungary was declared a republic on Feb. 1, 1946. A new constitution was adopted on Aug. 20, 1949. This was an almost exact copy of the constitution of the U.S.S.R., except that provisions safeguarding the rights of the national minorities replaced the federal provisions in the original. The highest organ of state authority is (in theory) the national assembly, elected by universal, direct, equal and secret adult suffrage.

Under the electoral law of 1953 the qualifying age for franchise was lowered from 20 years to 18 years, and the number of deputies was reduced from 395 to 298 elected in 20 constituencies from single lists presented by the Communist-controlled Patriotic People's front. The front was composed of the three parties which nominally governed the country in coalition (the Workers' party, the Smallholders' party and the National Peasant party) and of mass organizations of which the Trade Union federation was the largest.

The national assembly enacts legislation and appoints or dismisses ministries and ministers. Between its meetings its work is carried out by a presidential council, which consists of a chairman, two vice-presidents, a secretary and 17 members and can initiate legislation and issue orders in council having legislative force; it also performs the functions of the head of the state. Current administration is under a council of ministers who are appointed by and responsible to the parliament and may not be members of the presidential council. In practice it is this latter body that (under Moscow) controls Hungarian affairs; it consists of active Communists, whereas the presidential council consists of figureheads.

The arms of Hungary consist of a crossed hammer and sickle bordered with wheat ears and surmounted by a Soviet star.

The main geographical unit of local administration remains the old county (megye), of which, after a rationalization carried through in 1950, there remained 19. The municipal cities, 11 in number, enjoy a status roughly equivalent to that of the counties. Budapest has a special position and organization. The counties are divided into jmnsok, or rural districts (two to four to each county). which are in turn divided into communes (kozsegek), as the larger towns are divided into *keruletek* (boroughs or wards).

The judiciary is elected and responsible to its electors. Its functions would appear to be largely political. The various legal codes are those of the U.S.S.R.

Defense.— The peace treaty of 1947 limited Hungary's defense forces to a land army of 65,000 and an air force of 5.000 with 70 combat aircraft. By 1948 Hungary had only four poorly equipped divisions.

It was in that year, however, that the government under Soviet direction decided to reorganize the armed forces. Military service was made universal and compulsory between the ages of 20 and 50; active service was two years in the army, three years in the air force and 27 months in the forces of the interior, comprising security troops and frontier guards.

It was estimated that by April 1957 there were 205,000 men in the armed forces; there were nine infantry and three armoured divisions. There were also five air divisions with a total of 550 aircraft. Hungary was a member of the mutual defense treaty signed in Warsaw on May 14, 195j, by the U.S.S.R. and its six other satellite states.

ECONOMY

Agriculture.— By the mid-20th century agriculture was still the largest single industry of Hungary. In 1945 about 78% of the country's area (i e., 12,603,400 *hold* or 17 896.800 ac.) was listed as agricultural land (arable land. pastures. gardens and vineyards) Before World War II 1,382.800 smallholders owned 24.6% of agricultural land, uhile 3,870 large estates together covered 32.2% of agricultural land (5,748,100 ac.). By a decree of March 15, 1945, the government decided to parcel out the large estates. When the reform was carried out. about 6,752.000 ac., 30% of the country's area, changed hands (see Table III). The number of smallholders increased to 1,790,824 and by 1948 they owned betneen them 9,072,444 ac.; that is. 49% of all agricultural land. The Hungarian Smallholders' party, like every Peasant party in eastern Europe. stood for a democratic political system and land reform. It rejected Socialism or Communism because the system meant nationalization of land; it stressed, however, the necessity for setting up co-operatives for specific purposes or for

TABLE III.—*Hungarian* Land Reform of *1945*

Holdings by size	Number	Per cent	Total area (in *hold*)	Per cent
Before land reform				
Fewer than 20 hold*	1,382,800	85.6	3,092,900	24.6
20–50 *hold*	213,541	13.2	4,077,000	32.4
50–200 hold	16,245	1.0	1,385,500	10.8
More than 200 *hold*	3,870	0.2	4,048,000	32.2
After land reform				
Fewer than 20 hold.	1,790,824	87.6	6,248,200	49.0
20–50 hold	215,198	10.7	1,472,988	34.5
50–200 *hold*	21	...	...	11.5
More than 200 *hold*				...

*One *hold*=1.42 ac. or 0.575 **ha.**

embracing the whole life of a village community. Immediately after World War II the Hungarian Communist party was too weak and too insecure in the saddle to challenge openly the peasants' way of life. But on March 5, 1949, in a speech in Budapest. Jozsef Revai, a prominent Hungarian Communist, confirmed that the Communist parties had allowed the eastern European nations to believe that a people's democracy was to be merely a plebeian and popular form of bourgeois democracy and that the land reforms of 1945 were made in defense of small landowners, and he justified subsequent political developments by recalling that both Lenin and Stalin had insisted that all power had to be in the hands of the proletariat and that it could not be shared with peasants or any other class of the population.

At first the number of agricultural small holdings had been allowed to multiply, but, when these were shown to be uneconomic, they were made to give place to planned agricultural production along lines of collectivization. By 1949 collectivization was still in its initial stage, but by Jan. 1953 the country had 5,315 producers' co-operatives grouping 413,000 small holdings and covering 3,425,890 ac. or 19.1% of all agricultural land. State farms occupied another 1,753,700 ac. of the agricultural land, or 10%. The so-called "new course" introduced by mid-1953 represented some concession to private farming and halted the progress of large-scale collectivization. Rakosi revealed in May 1954 that more than half fhe total collectivized peasants had seized the opportunity of leaving the producers' co-operatives and that many co-operatives had been dissolved. Nevertheless, by Oct. 1956 there were 5,191 producers' co-operatives comprising 25% of the agricultural land. By Jan. 1957, after the October revolution, the number of co-operatives fell to 2.700 covering about 12% of all agricultural land.

No increase of agricultural production followed the Communist land reform and the attempt at collectivization. Table IV shows

TABLE *IV.— Agricultural Production*
(in ooo metric tons)

Crop	1920–25	1926–30	1934–38	1948–50	1955
Wheat	1,624	2,234	2,220	1,817	2,131
Rye	682	743	697	775	544
Barley	483	605	608	674	794
Oats	328	362	270	261	...
Maize	1,482	1,628	2,306	2,862*	2,912
Potatoes	1,549	1,872	2,133	2,018†	2,467
Sugar beets	984	1,482	960	1,765	2,241

*1948. †1948–49.

that the average wheat crop in 1948–50 was 17.4% less than that of 1934–38. It also shows the tendency to concentrate upon crops of value to the export market, such as sugar or bacon and ham (therefore an increase in production of maize used to feed pigs). While pigs increased in numbers, other achievements in the domain of animal husbandry fell below the standards fixed *(see* Table V).

TABLE V.—*Livestock*

Livestock	1914	1939	1949	1955
Cattle	2,149,750	1,882,000	2,070,000	1,983,000
Pigs	3,322,400	3,886,000	5,200,000	5,800,000
Sheep	2,406,000	1,868,000	579,000*	1,032,000
Hones	896,500	939,000	569,000	550,000

*1948.

Industry. — The 1941 census revealed that while 48.7% of the population was engaged in agriculture, 25.4% derived their living from industry, including mining. These figures reflected the continuous increase in industrialization which had been proceeding from 1867, The process had been accelerated after 1920 when Hungary was forced to develop new industries in order to replace those lost under the treaty of Trianon and to absorb the surplus rural population.

After World War II, when the country became a part of a centrally planned Soviet system, the pace of industrialization was greatly increased with emphasis on heavy industry. In this connection, all private industry and banking and practically all private trade were nationalized. In 1947 a three-year plan was initiated with the aim of raising industrial production by 27% as compared with 1938.

On May 17, 1950, the national assembly passed a revised five-year plan under which far greater importance was assigned to industry than had been originally intended. Hungary was to be "a country of steel and machines." The total capital investment was increased from 50,900,000,000 forints to 85,000,000,000 forints. The volume of all industrial production by 1954 was to represent 310% of that of 1949, instead of 186%.

TABLE VI.—*Industrial Production*
(in ooo metric tons; electricity in 000,000 kw.hr.)

Product	1933	1938	1946	1949	1955	1956	1960 (plan)
Coal	800	1,042	722	1,380	2,690	2,376	29,400
Lignite*	5,907	8,306	5,631	10,438	19,620	18,216	
Crude oil	—	43	685	503	1,590	1,200	1,900
Electricity	830†	1,280‡	...	2,500	5,430	5,194	8,350
Pig iron	93	335	160	428	854	744	1,410
Crude tee	72	648	353	860	1,623	1,425	2,240
Cement	181	540	101	560§	1,290	893	...
		343	133	550	1,175	995	1,860

*The thermic coefficient for Hunearian lienite is three tons of lignite per ton of coal. †1932. ‡1937. §1947.
Sources: U S *Statistical Yearbook* for the years 1933–49; *Statisztikai Havi Kozlemenyek* (Budapest, 1957).

Table VI shows that up to 1955 industrialization made steady and considerable progress. Industrial production in 1956 fell somewhat as a result of the October revolution. In 1954 the first blast furnace and two open-hearth furnaces at Sztalinvaros (formerly Dunapentele), a new centre of iron and steel production, were inaugurated. Under the 1950–54 five-year plan the iron and steel works of Diosgyor were modernized. A big hydroelectric power station was being built at Tiszalok. on the Tisza river. Between 1937 and 1956 the installed capacity in power stations rose from 854,000 kw. to 1,269,000 kw.

On Nov. 6, 1954, in Moscow, was signed an agreement transferring to Hungary the Soviet shares of all Magyar-Soviet mixed companies formed in 1945, namely those concerned with exploitation of crude petroleum, bauxite, aluminum, Danube navigation, civil aviation and the Soviet Bank for Trade and Industry in Budapest. The number of industrial workers rose between 1949 and Sept. 1956 from 520,000 to 939,000.

Currency and Finance.— To finance long-term development plans it was necessary to restrict consumer purchasing power and reinvest an ever-growing share of the national income in industrial production.

Civilian consumption was reduced by various techniques previously adopted in the U.S.S.R. First, by raising production "norms" and at the same time stabilizing wages, the worker was made to produce more without an increase in wages. Second, the pay packet was further reduced through taxation, compulsory savings and forced contributions. generally equal to a month's pay, to the yearly state loans. Third, because production had been concentrated on heavy industry and because consumer products were scarce, the regime brought buying power in line with the available supply of goods by manipulating prices. This aim was achieved in a variety of ways, by rationing with controlled and "free market" prices, by derationing with one set of prices always nearer the previously "free" one, by insufficient wage increases and by monetary reforms which greatly reduced both consumer savings and consumer purchasing power.

On July 31, 1946, the forint superseded the pengo, victim of the postwar hyperinflation. The official exchange rate of the new currency was 11.74 forints to the U.S. dollar, as compared with 115.5 octillion (+ 26 zeros!) pengo, probably the highest exchange ratio in the history of money.

On March 1, 1950, when the rouble had been put on a gold basis and its external value raised from 5.30 to 4 roubles to the dollar, the exchange rate of the forint to the rouble was proportionately reduced; thus the prices of Hungarian imports from the U.S.S.R (22.7% of the total in 1950) rose, while the prices of Hungarian exports to the U.S.S.R. (22.7% of the total in 1950) fell correspondingly

The Hungarian budget is of a Soviet type, and so includes invest-

ments in the nationalized economy. (See Table VII.)

TABLE VII.—*Budgets and Investments in Sational Economy*
factual, in 000,000 forints*)

Item	1950	1951	1952	1953	9	1955†	1956
Revenue .	25,500	33,900	42,500	49,900	45,300	46,961	43.300
Expenditure .	25,300	, 6 0 0	41,500	49,000	44,000	45,458	42,100
Investments .	11,600†	18,000†	26,200†	29,500	28,700†	25,200	22,439
Percentage invested .	46.4	3 . 6	63.1	60.2	65.2	55.4	53.4

*11.74 forints=$1; 2.935 forints=1 rouble. †Estimates.

Foreign Trade.—In 1957, after nine years of almost complete secrecy, Hungary published a comprehensive picture of its foreign trade. (See Table VIII.)

TABLE VIII.—*Foreign Trade*
(in 000,000 forints)

Item		1952	1953	1954	1955	1956
Total trade . . .	Imports	5,207.8	5,331.1	6,018.9	6,274.0	5,359.8
	Exports	5,197.8	5,904.2	6,163.6	7,147.9	5,785.4
Trade with the Socialist camp	Imports	3,769.6	4,050.1	4,094.2	3,444.8	3,331.2
	Exports	3,814.6	4,644.9	4,538.1	4,753.5	3,598.8
Trade with the U.S.S.R.	Imports	1,386 6	1,663.5	1,718.7	1,163.7	1,238.4
	Exports	1,740.6	2,198.2	2.018.0	1,794.9	1,413.7

Source: *Statisztikai Havi Kozlemenyek* (Budapest, 1957)

Table VIII shows that while in 1952 the so-called Socialist countries supplied 72.5% of Hungarian imports and took 73% of Hungarian exports, in 1956 the respective proportions were 63% and 62%. The U.S.S.R. was the most important single source of imports: it supplied 26.6% in 1952 and 23% in 1956. It also was the most important destination of exports as it took 33.5% in 1952 and 24.4% in 1956.

Communications — In 1956 there were 7,100 mi. of railways and 39.569 mi. of roads. All the seven bridges over the Danube at Budapest were rebuilt, and in May 1955 a new railroad bridge at Ujpest was opened to traffic. By the end of 1954 the restored road and railway bridge at Komarno, linking Hungary to Slovakia, was inaugurated.

It was estimated that in 1953 Hungary had 120,000 telephones. In 1954 it had 1,236,000 radio sets.

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HUNGERFORD, WALTER HUNGERFORD, BARON (d. 1449), English soldier. belonged to a Wiltshire family. His father, Sir Thomas Hungerford (d. 1398), became speaker of the house of commons in 1377, through the influence of John of Gaunt, and is the first person formally mentioned in the rolls of parliament as holding the office. Walter Hungerford also served as speaker. He fought at Agincourt and was an envoy at the council of Constance and the congress of Arras. An executor of Henry V's will and a member of the council under Henry VI, Hungerford became a baron in 1426, and he was lord treasurer from 1426 to 1431.

HUNGERFORD, a town of Berkshire, Eng., near the Wiltshire border 8 mi. W. of Newbury. Pop. (1951) 3.020. It is an agricultural and market town lying on the Dun where it joins the Kennet (trout and crayfish streams). in a valley in the Berkshire Douns; the Kennet and Avon canal also passes through it. John of Gaunt gave to the citizens manorial rights, including common pasture and fishing, in memory of which a red rose of Lancaster is still presented to a reigning sovereign first passing through the town. On Tuttiday or Hockney day. the second Tuesday after Easter. the burgesses, summoned by a horn blown from the town hall, attend their Hocktide court to elect the constable and other officials for the year. The two tuttimen with garlanded poles collect the "head penny" from each house enjoying common rights.

At Lambourn. to the north, are well-known racing stables.

HUNINGUE, a town of France, department of Haut-Rhin (Alsace), on the left bank of the Rhine and a branch of the Rhine-Rhône canal. 3 mi. N. of Basle by rail. Pop. (1954) 4,162. The town grew round a fortress at a Rhine crossing. The duke of Lauenburg took it from the imperialists in 1634 and Louis XIV of France later bought it. Sébastien le Prestre de Vauban fortified it (1679–81), and a Rhine bridge was then built. The fortress was dismantled after 181j. The town makes chemicals, molasses, watches and cigars.

HUNKERS AND BARNBURNERS, in U.S. political history. the popular names of two factions into which the Democratic party in New York state split during the 1840s. Both groups played an important part in the presidential election of 1844. The Hunkers, said to be named after the Dutch hunkerer, referring to a person who seeks office for himself, and led by William L. Marcy (*q.v.*) and Daniel S. Dickinson, were the conservative urban group. The Barnburners, whose name was supposedly derived from the act of a farmer who set his barn afire to rid it of rats. were the radicals, led by Martin van Buren (*q.v.*) and his supporters.

The factions had their origin in canal politics. The Hunkers advocated the use of canal revenues to complete the canals, whereas the Barnburners insisted they should be used to pay the state debt. Later, when the Hunkers supported and accepted the annexation of Texas and the Barnburners supported the Wilmot proviso, the split became irrevocable.

The Hunkers, advocates of the chartering of state banks, opposed the Barnburners on that issue, and the factions also disagreed on the distribution of patronage. The Hunkers supported James K. Polk and were violently opposed to antislavery agitation, The Barnburners opposed slavery in the territories, or, more precisely, opposed the extension of slavery into newly opened territories. In 1848 they left the Democratic national convention, nominated Van Buren for president, and joined the Free Soil party (*q.v.*), which also nominated him. The coalition won no electoral votes. however. Later some of the Barnburners returned to the Democratic party. but when the Republican party was organized the younger Barnburners joined it.

HUNNERIC (d. 484), king of the Vandals, was a son of King Gaiseric, and was sent to Italy as a hostage in 435 when his father made a treaty with the emperor Valentinian III. After his return to the Vandal court at Carthage, he married a daughter of Theodoric I, king of the Visigoths; but when this princess was suspected of attempting to poison her father-in-law, she was mutilated and was sent back to Europe.

Hunneric became king of the Vandals on his father's death in 477. Like Gaiseric he was an Arian, and his reign is memorable for his cruel persecution of members of the Orthodox Christian Church in his dominions. His second wife was Eudocia, a daughter of Valentinian III and his wife Eudocia. (See VANDALS.)

HUNNIS, WILLIAM (d. 1597), English musician and poet, was as early as 1549 in the service of William Herbert, afterward earl of Pembroke. In 1550 he published *Certayne Psalms . . . in Englishe Metre,* and shortly afterward was made a gentleman of the chapel royal.

During the reign of Mary he was implicated in plots against the queen, and was imprisoned for some time. In 1566 he was made master of the children of the chapel royal. No complete piece of his is extant, perhaps because of the rule that the plays acted by the children should not have been previously printed. In his later years he purchased land at Barking.

Hunnis's extant works include *Certayne Psalms* (1549), *A Hive Full of Hunnye* (1578), *Seven Sobbes of a Sorrowful Soule for Sinne* (1583), *Hunnies Recreations* (1588), 16 poems in the *Paradzse of Dainty Devices* (1576) and two in *England's Helicon* (1600). See Mrs C. Carmichael Stopes's tract on William Hunnis, reprinted (1892)

from the *Jahrbuch der deutschen Shakespeare Gesellschaft.*

HUNS, a name given to at least four peoples, whose identity remains obscure. (1) The Huns, who invaded the East Roman empire from about A.D. 372 to 453 and were most formidable under the leadership of Attila. (2) The Hungarians or Magyars who crossed the Carpathians into Hungary in A.D. 898 and mingled with the races they found there. (3) The White Huns (Ephthalites), who troubled the Persian empire from about 420 to 557 and were known to the Byzantines (see HEPHTHALITES). (4) The Hûnas, who invaded India during the same period. It is most probable that the last two are identical and although it cannot be proved that the Magyars are descended from the horde which sent forth the Huns in the 4th century, it is possible that they were originally Ephthalites. Our present knowledge of the history and distribution of the Huns tends to support this view. In the 1st century A.D. the Chinese drove the Hiung-nu westward, and while one division of the Huns remained in Transoxiana and Afghanistan, another pushed further west and rested near the southern Urals. From this point the Huns invaded Europe, and when their power collapsed, after the death of Attila, many of them may have returned to their original haunts. Possibly the Bulgarians and Khazars were offshoots of the same horde. The Magyars may very well have gradually spread first to the Don and then beyond it, until in the 9th century they entered Hungary. Authorities are not even agreed as to the branch of the Turanians to which the Huns should be referred; the physical characteristics of these nomad armies were very variable and there is no certain ethnic or linguistic identification. Hiung-nu seems not to be a particular but a general term for warlike nomads. The warlike and vigorous temper of the Huns has led many writers to regard them as Turks. The Turks were perhaps not distinguished by name or institutions from other tribes before the 5th century, but the Huns may have been an earlier offshoot of the same stock. Apart from this the Hungarians may have received an infusion of Turkish blood not only from the Osmanlis but from the Kumans and other tribes who settled in the country.

History. — The authentic history of the Huns in Europe practically begins about the year A.D. 372, when under a leader named Balamir (or, according to some mss. Balamber) they began a westward movement from their settlements in the steppes lying to the north of the Caspian. After crushing, or compelling the alliance of various nations unknown to fame (Alpilzuri, Alcidzuri, Himari, Tuncarsi, Boisci), they at length reached the Alani, a powerful nation which had its seat between the Volga and the Don; these also, after a struggle, they defeated and finally enlisted in their service. They then proceeded, in 374, to invade the empire of the Ostrogoths (Greutungi), ruled over by the aged Ermanaric, or Hermanric, who died (perhaps by his own hand) while the critical attack was still impending. Under his son Hunimund a section of his subjects promptly made a humiliating peace; under Withemir (Winithar), however, who succeeded him in the larger part of his dominions, an armed resistance was organized; but it resulted only in repeated defeat, and finally in the death of the king. The representatives of his son Witheric put an end to the conflict by accepting the condition of vassalage. Balamir now directed his victorious arms still farther westward against that portion of the Visigothic nation (or Tervingi) which acknowledged the authority of Athanaric. The latter entrenched himself on the frontier which had separated him from the Ostrogoths, behind the "Greutung-rampart" and the Dniester; but he was surprised by the enemy, who forded the river in the night, fell suddenly upon his camp, and compelled him to abandon his position. Athanaric next attempted to establish himself in the territory between the Pruth and the Danube, and with this object set about heightening the old Roman wall which Trajan had erected in the north-eastern Dacia; before his fortifications, however, were complete, the Huns were again upon him, and without a battle he was forced to retreat to the Danube. The remainder of the Visigoths, under Alavivus and Fritigern, now began to seek, and ultimately were successful in obtaining (376), the permission of the emperor Valens to settle in Thrace; Athanaric meanwhile took refuge in Transylvania, thus abandoning the field without any serious struggle to the irresistible Huns. For more than fifty years the Roman world was undisturbed by any aggressive act on the part of the new invaders, who contented themselves with over-powering various tribes which lived to the north of the Danube. In some instances, in fact, the Huns lent their aid to the Romans against third parties; thus in 404–405 certain Hunnic tribes, under a chief or king named Uldin, assisted Honorius in the struggle with Radagaisus (Ratigar) and his Ostrogoths, and took a prominent part in the decisive battle fought in the neighbourhood of Florence. Once indeed, in 409, they are said to have crossed the Danube and invaded Bulgaria under perhaps the same chief (Uldin), but extensive desertions soon compelled a retreat.

About the year 432 a Hunnic king, Ruas or Rugulas, made himself of such importance that he received from Theodosius II. an annual stipend or tribute of 350 pounds of gold (£14,000), along with the rank of Roman general. Quarrels soon arose, partly out of the circumstance that the Romans had sought to make alliances with certain Danubian tribes which Ruas chose to regard as properly subject to himself, partly also because some of the undoubted subjects of the Hun had found refuge on Roman territory; and Theodosius, in reply to an indignant and insulting message which he had received about this cause of dispute, was preparing to send off a special embassy when tidings arrived that Ruas was dead and that he had been succeeded in his kingdom by Attila and Bleda, the two sons of his brother Mundzuk (433). Shortly afterwards the treaty of Margus (not far from the modern Belgrade) was ratified; this treaty provided for Roman tribute to Attila, the surrender of fugitives, the institution of free markets and regulations as to alliances with other powers. The Romans held to the treaty and during the ensuing eight years the Huns made their extensive conquests in Scythia, Media and Persia.

In 445 Bleda died, and two years afterwards Attila, now sole ruler, undertook one of his most important expeditions against the Eastern empire; on this occasion he pushed southwards as far as Thermopylae, Gallipoli and the walls of Constantinople; peace was cheaply purchased by tripling the yearly tribute (which accordingly now stood at 2,100 pounds of gold, or £84,000 sterling) and by the payment of a heavy indemnity. In 448 again occurred various diplomatic negotiations, and especially the embassy of Maximinus, of which many curious details have been recorded by Priscus his companion. Then followed, in 451, that westward movement across the Rhine which was only arrested at last, with terrible slaughter, on the Catalaunian plains (according to common belief, in the neighbourhood of the modern Chblons, but more probably at a point some 50m. to the south-east, near Mery-sur-Seine). The following year (452) that of the Italian campaign, was marked by such events as the sack of Aquileia, the destruction of the cities of Venetia, and that historical interview with Pope Leo I. which resulted in the return of Attila to Pannonia, where in 453 he died (see ATTILA). Almost immediately afterwards the empire he had amassed rather than consolidated fell to pieces. His too numerous sons began to quarrel about their inheritance, while Ardaric, the king of the Gepidae, was placing himself at the head of a general revolt of the dependent nations. The inevitable struggle came to a crisis near the river Netad in Pannonia, in a battle in which 30,000 of the Huns and their confederates, including Ellak, Attila's eldest son, were slain. The nation, thus broken, rapidly dispersed, exactly as the White Huns did after a similar defeat about a hundred years later. One horde settled under Roman protection in Little Scythia (the Dobruja), and others in Dacia Ripensis (on the confines of Serbia and Bulgaria) or on the southern borders of Pannonia. Many, however, appear to have returned to what is now South Russia, and may perhaps have taken part in the ethnical combinations which produced the Bulgarians.

The chief original authorities are Ammianus Marcellinus, Priscus, Jordanes, Procopius, Sidonius Apollinaris and Menander Protector.

See also Gibbon, *Decline and Fall of the Roman Empire; H. H.* Howorth, *History of the Mongols* (1876–88); J. B. Bury, *History of the Later Roman Empire* (1889); *J.* Hodgkin, *Italy and her Invaders* (1892); *E.* H. Parker, *A Thousand Years of the Tartars* (1905).

(C. El; A. N. J. W.)

HUNSDON, HENRY CAREY, 1ST BARON (*c.* 1524–1596), English soldier and courtier, was a son of William Carey (d. 1529): his mother was Mary (d. 1543), a sister of Anne Boleyn, and he was consequently cousin to Queen Elizabeth. Member of parliament for Buckingham under Edward VI. and Mary, he was knighted in 1558, was created Baron Hunsdon in 1559, and in 1561 became a privy councillor and a knight of the Garter. In 1568 he became governor of Berwick and warden of the east Marches, and he gained a decisive victory over the northern rebels under Leonard Dacre near Carlisle in February 1570. In 1583 he became lord chamberlain, but he did not relinquish his post at Berwick. Hunsdon was one of the commissioners appointed to try Mary queen of Scots; after Mary's execution he went on a mission to James VI. of Scotland, and when the Spanish Armada was expected he commanded the queen's bodyguard. He died in London, at Somerset House, on July 23, 1596.

HUNSTANTON, a seaside town and urban district in the King's Lynn parliamentary division of Norfolk, Eng., on the east shore of the Wash, 47 mi. N.W. of Norwich by road. Pop. (1951) 3,419. Area 1.7 sq.mi. Behind the sands is a promenade ($1\frac{1}{4}$ mi.) rising up on to the cliffs to the north, and behind this is the "Green." Sailing is one of the many summer activities. The royal residence of Sandringham is 8 mi. S.

HUNT, ALFRED WILLIAM (1830–1896), English painter, son of Andrew Hunt, a landscape painter, was born at Liverpool on Nov. 15, 1830. Most of his pictures are in private ownership; but, his "Windsor Castle" is in the Tate gallery, "Working Late" in the Walker art gallery, Liverpool, and others at South Kensington. He died in London on May 3, 1896.

See *Exhibition of Drawings in Water Colour by Alfred William Hunt,* Burlington Fine Arts Club (1897); H. C. Marillier, *The Liverpool School of Painters* (1904).

HUNT, HENRY (1773–1835), English reformer, was born at Upavon, Wilts., on Nov. 6. He was for many years the most prominent among the more extreme English reformers under the oppression of Sidmouth and Castlereagh: indeed, after the defection of Burdett he had a position which was almost that of recognized leader. In person. training and character, he much resembled William Cobbett (*q.v.*). He was tall, florid and bulky; a typical English farmer both in occupation and appearance; he was as pugnacious, as unreasonable, as devoted and as vain as his more famous rival; he was possibly more courageous. But *littera scripta manet:* Cobbett wrote magnificent English which has preserved him a growing fame; Hunt is forgotten because we can no longer hear the voice and eloquence which gave him the name of Orator Hunt. He first adopted radical principles in 1806 and continued his agitation at a persistent series of public meetings and dinners until Aug. 1819 when he presided at the great meeting at St. Peter's fields, Manchester, which was attacked by the yeomanry (*see* PETERLOO). The white hat, which he wore on that occasion and which was stated to have been stove in by a sword cut, became the badge of reform, and for several years to wear a white hat was as symbolical as later it was to wear a red tie. He was sentenced to imprisonment for two and a half years; from his prison he sent out *A peep into a jail,* an exposure of Ilchester gaol which had its share in promoting prison reform. He took a great share in causing the *crescendo* of indignation which eventually overturned the oligarchy in 1832. In 1830 he was himself elected M.P. for Preston, a borough which, by virtue of a scot-and-lot franchise, was one of the very few with a working class electorate. In Parliament he presented a petition for women's rights, and moved (despite his farming connection) against the Corn Laws. But the Reform Act of 1832, in granting the vote to the middle class and standardizing the franchise, necessarily disfranchised the mass of the electors at Preston. Hunt lost his seat in the election of 1833 and died on Feb. 15, 1835.

See *Memoirs of Henry Hunt Esq.,* by himself (1820–22); R. Huish, *Life of Hunt (1836).* (R. W. P.)

HUNT, HENRY JACKSON (1819–1889), American soldier, was born in Detroit, Mich., on Sept. 14, 1819, and graduated at the U.S. Military Academy in 1839. He served with great gallantry in the Mexican War, became captain in 1852, and major in 1861. His professional attainments were great, and in 1856 he was a member of a board entrusted with the revision of light artillery drill and tactics. He took part in the first battle of Bull Run in 1861, and soon afterwards became chief of artillery in the Washington defences. As a colonel on the staff of General M'Clellan he organized and trained the artillery reserve of the Army of the Potomac. Throughout the Civil War he contributed more than any officer to the effective employment of the artillery arm. With the artillery reserve he rendered the greatest assistance at the battle of Malvern hill, and soon afterwards he became chief of artillery in the Army of the Potomac. On the day after the battle of South Mountain he was made brigadier-general of volunteers. At the Antietam, Fredericksburg and Chancellorsville, he rendered further good service, and at Gettysburg his handling of the artillery was conspicuous. When the U.S. army was reorganized in 1866 he became colonel of artillery and president of the permanent artillery board. In 1883 he retired to become governor of the Soldiers' Home, Washington, D.C. He died on Feb. 11, 1889. He was the author of *Instructions for Field Artillery* (1860).

HUNT, JAMES HENRY LEIGH (1784–1859), English essayist and poet, was born at Southgate, Middlesex. His father had been a lawyer in Philadelphia, and had left the United States because of his loyalist sympathies. The son, who was educated at Christ's Hospital, began writing verse as soon as he left school, and soon became a constant contributor to the newspapers. In 1808 he became editor of the *Examiner,* a clever journal owned by his brother John. The brothers were sent to prison for an attack in the *Examiner* on the prince regent. The offensive phrase was "a fat Adonis of 50." Leigh Hunt's imprisonment had compensations, for it brought Byron, Moore, Brougham and other friends of liberty to see him in prison. Another joint enterprise of the Hunt brothers was a quarterly, the *Reflector.* The essays published as *The Round Table* (2 vols., 1816–17), conjointly with William Hazlitt, appeared in the *Examiner.*

In 'S~' Leigh Hunt wrote his *Story of Rimini,* which established his fame as a poet. Though few read it now, the poem is important in the history of English poetry because in it Hunt went back to the rhythms of Chaucer and Spenser and thus became one of the pioneers of the new romantic school. In 1818 appeared a collection of poems entitled *Foliage,* followed in 1819 by *Hero and Leander,* and *Bacchus and Ariadne.* In the same year he reprinted these two works with *The Story of Rimini* and *The Descent of Liberty* with the title of *Poetical Works,* and started the *Indicator,* in which some of his best work appeared. Both Keats and Shelley belonged to the circle gathered around him at Hampstead, which also included William Hazlitt, Charles Lamb, Bryan Procter, Benjamin Haydon, Cowden Clarke, C. W. Dilke, Walter Coulson, John Hamilton Reynolds and other men of liberal sympathies. After Shelley's departure for Italy Leigh Hunt's financial situation became desperate. Marianne Hunt (*née* Kent), his rather unattractive wife, wrote to Mrs. Shelley, with the result that Leigh Hunt was invited to go out to meet Shelley and Byron at Pisa. Byron provided the Hunts and their family (there were seven children) with a lodging in the Villa Lanfranchi, and Leigh Hunt was to publish a liberal paper. But Byron was annoyed when he learned that Leigh Hunt had no longer a share in the *Examiner,* and the connection proved an unhappy one. Nevertheless, though Byron was not always gracious, he made substantial payments to Hunt, and before he left for Greece made over to John Hunt exceedingly valuable copyrights. The ill-starred *Liberal* existed through four quarterly numbers. The Hunts remained in Italy until 1825. After his return to England Hunt revenged himself for the slights he had received from Byron in the ill-judged *Lord Byron and some of his Contemporaries* (1828), which brought down on him the scorn of Moore.

From that time onwards Leigh Hunt's life was a constant

struggle with sickness and poverty. He edited various papers, and published many admirable volumes of criticism, but was often dependent on Mrs. Shelley's kindness until in 1847 he received a Civil List pension. Hunt was a generous critic, and had a fresh open mind which recognized genius before it was acknowledged elsewhere, He had been one of the first to recognize a great poet in Keats, and he lived to welcome the early poems of Tennyson. He died at Putney on Aug. 28, 1859. His most important later works were two excellent selections (1844 and 1846) from the English poets, A Book for *a* Corner (2 vols., 1849), Autobiography (3 vols., 1850), Table Talk (1851). His narrative poems, original and translated, many of the shorter of which are minor classics, were collected as Stories in *Verse* (1855). Leigh Hunt excelled especially in narrative poetry, of which "Abou ben Adhem" and "Solomon's Ring" are excellent examples on a small scale.

Leigh Hunt's other works include: *Amyntas,* A *Tale* of *the Woods* (1820), translated from Tasso; The Seer, or *Common*-Places *refreshed* (2 pts., 1840–41); three of the Canterbury Tales in *The Poems* of *Geoffrey Chaucer,* modernized (1841); Stories *from the Italian* Poets (1846): *Men, Women and* Books (2 vols., 1847); *The* Old Court *Suburb* (2 vols., 1855; ed. A. Dobson. 1902): selections from Beaumont and Fletcher (1855); and, mith S. Adams Lee. *The* Book of the Sonnet (Boston, 1867). His Po*etical Works* (2 vols.), revised by himself and edited by Lee, were printed at Boston. U.S.A., in 1857, and an edition (London and New York) by his son, Thornton Hunt, appeared in 1860. Among volumes of selections are: Essays (1887), ed. A. Symons; Leigh *Hunt* as *Poet and* Essayist (1889), ed. C. Kent; Essays and *Poems* (1891), ed. R. B. Johnson for the "Temple Library"; Prefaces by Leigh Hunt-, *Mainly to his* Periodicals, ea. R. Brimley Johnson (1928).

His *Autobiography* was revised by himself shortly before his death, and edited (1859) by his son Thornton Hunt, who also arranged his Correspondence (2 vols.. 1862). Additional letters were printed by the Cowden Clarkes in their Recollections of *Writers* (1878). The *Autobiography* was edited (2 vols., 1903) with full bibliographical note by R. Ingpen.

See bibliography of his works compiled by Alexander Ireland *(List of the Writings of William Hazlitt and Leigh Hunt,* 1868) ; short lives of Hunt by Cosmo Monkhouse ("Great Writers," 1893) and by R. B. Johnson (1896).

HUNT, SIR (HENRY CECIL) JOHN (1910–), British soldier, mountaineer and explorer, was the leader of the expedition which made the first ascent of Everest (29,028 ft.). Born on June 22, 1910, and educated at Marlborough and the Royal Military college, Sandhurst, he was commissioned to the 60th Rifles and served in India and Burma. partly on police work. From there he made acquaintance mith the Karakoram (1935) and the Sikkim Himalaya (1937, 1939). He served with his regiment during World War II. and took part with distinction in the north African and Italian campaigns. For his command of the 11th Indian brigade during the Greek rebellion (1944–46) he was awarded the commander of the order of the British empire.

In 1952 he was recalled from an army post in Germany to lead the 1953 British Everest expedition. His leadership was characterized by thorough planning and by the personal part he took in every job. On the mountain, he finally went up with one Sherpa in support of the first summit pair, leaving loads at 27,300 ft. on the southeastern ridge. The success of the expedition was in great measure the success of its planning and esprit de corps. He wrote The Ascent of *Everest* (1953) and in 1956 left the army to become the first secretary of the Duke of Edinburgh's award, a scheme to foster the idea of adventure and service among boys.

(C. W. F. N.)

HUNT, RICHARD MORRIS (1828–1895), U.S. architect, who introduced 19th-century French traditions into American architecture. was born in Brattleboro, Vt., on Oct. 31, 1828. He studied in Europe (1843–54), mainly in the École des Beaux Arts at Paris, and in 1854 was appointed inspector of works on the buildings connecting the Tuileries with the Louvre. Under Hector Lefuel he designed the Paviilon de la Bibliothèque, opposite the Palais Royal.

In 18jj he returned to New York, and was employed on the extension of the Capitol at Washington. He designed the Lenox library (now torn down) and the Tribune buildings in New Tork; the Theological librsry, and Marquand chapel at Princeton; the Divinity college and the Scroll and Key building at Yale; the Vanderbilt mausoleum on Staten island, and the Yorktown monument. For the administration building at the World's Columbian exposition at Chicago in 1893 Hunt received the gold medal of the Institute of British Architects. Among the most noteworthy of his domestic buildings were the residences of W. K. Vanderbilt and Henry G. Marquand in New York city; George W. Yanderbilt's country house at Biltmore, and several of the large "cottages" at Newport (R.I.), including "Marble House" and "The Breakers."

Hunt was the leader of a school that established in the United States the manner and the traditions of the Beaux Arts. He took a prominent part in the founding of the American Institute of Architects, and from 1888 was its president. His talent was eminently practical; and he was almost equally successful in the ornate style of the early Renaissance in France, in the picturesque style of his comfortable villas, and the monumental style of the Lenox library.

He died on July 31. 189j.

HUNT, THOMAS STERRY (1826–1892), U.S. geologist and chemist. was born at Norwich, Conn., on Sept. 5, 1826. He became interested in natural science, and in 1845 he was elected a member of the Association of American Geologists and Naturalists at Yale (1849). In 1848 he read a paper in Philadelphia On Acid Springs and Gypsum Deposits of the Onondaga Salt Group. At Yale he became assistant to Prof. B. Silliman, Jr., and in 1846 was appointed a chemist to the geological survey of Vermont. In 1847 he was appointed to similar duties on the Canadian geological survey at Montreal under Sir William Logan, and this post he held until 1872. In 1859 he was elected F.R.S., and he was one of the original members and president of the Royal Society of Canada. He died in New York city on Feb. 12, 1892.

His publications include *Chemical* and *Geological Essays* (1875, ed. 2, 1879); *Mineral Physiology and Physiography* (1886) ; *A New Basis for Chemistry* (1887, ed. 3. 1891) ; *Systematic Mineralogy* (1891). *See* an obituary notice by Persiior Frazer, *Amer. Geologist* (xi. Jan. 1893), with portrait. A complete bibliography of his work is given in *Bulletin* of *the Geol. Soc. of America,* vol. 4, p. 379.

HUNT, WILLIAM HENRY (1790–1864), English water-colour painter. was born in London, on March 28, 1790. He was apprenticed about 1805 to John Varley, the landscape painter, with whom he remained five or six years, exhibiting three oil pictures at the Royal Academy in 1807. He exhibited regularly at the Society of Painters in Water-colour, of which he became a full member in 1827. He died on Feb. 10, 1864.

Hunt was one of the creators of the English school of water-colour painting. His subjects, especially those of his later life, are extremeiy simple; but, by the delicacy, humour and fine power of their treatment, they rank second to works of the highest art only.

HUNT, WILLIAM HOLMAN (1827–1910), English artist and principal member of the Pre-Raphaelite Brotherhood, to whose tenets he remained faithful throughout his career. He was born in London on April 2, 1827, the son of a city warehouse manager. At first discouraged in his artistic ambitions, he worked as a clerk to an estate agent, but in 1843 began studying in the National gallery and British museum. The following year he entered the Royal Academy schools where he met his lifelong friend John Everett Millais, two years his junior. His first Academy picture) "Hark!" was exhibited in 1846, followed by a subject from Walter Scott, "Dr. Rochecliffe Performing Divine Service in the Cottage of Joceline Joliffe at Woodstock" (1847), and another from Keats's "Eve of St. Agnes," "The Flight of Madeline and Porphyro," in 1848. In August of that year D. G. Rossetti began working with Hunt. To the Academy exhibition of 1849 Hunt sent his picture "Rienzi" (Mrs. M. E. Clarke collection) on which appeared the initials "P.R.B." after his surname. The works of

these three men, Hunt, Millais and Rossetti, with their clear hard colour, brilliant lighting and careful delineation of detail heralded the new movement (*see* PAINTING: *Great Britain*). Also in that year, Hunt accompanied Rossetti on a visit to Paris and Belgium.

Public opinion, at first unreceptive, became actively hostile toward the Brotherhood when in 1850 Hunt showed his "Christians Escaping From the Druids" (Ashmolean museum, Oxford). John Ruskin praised "Valentine Protecting Sylvia From Proteus" (1851) and it gained a prize at Liverpool, while in 1852 "Strayed Sheep" (Tate gallery, London) was similarly honoured at Birmingham. Religious subjects, foreshadowed by "The Hireling Shepherd" (1853; later version in Manchester), henceforth dominated Hunt's attention, and in 1854 "The Light of the World" (Keble college, Oxford), an allegory of Christ knocking at the door of the human soul, was championed by Ruskin and brought the artist his first public success.

In Jan. 1854 Hunt began a two-year visit to Syria and Palestine to glean firsthand knowledge of the Holy Land. After considerable difficulties and adventures he completed in July 1855 "The Scapegoat" (Lady Lever Art gallery, Port Sunlight), a solitary outcast animal on the shores of the Dead sea, the subject being inspired by Isa. liii, 4–6, and Lev. xvi, 20–22. Painted in part at Usdum on the Dead sea, and in Jerusalem, the work was rightly criticized by Ruskin for atmospheric inconsistencies and inadequate anatomical verisimilitude. Artistic qualities suffered at the expense of religious symbolism, and this defect recurred in the elaborate "The Finding of the Saviour in the Temple" (1854–60; Birmingham), sold to Gambart for a record sum of 5,500 guineas. Hunt paid two more visits to Jerusalem, in 1869 and 1875, and "The Shadow of Death" (1870; Manchester) contains a view of Nazareth seen through the windows of the carpenter's shop. Among the most important of his later paintings are "The Triumph of the Innocents" (two versions: 1884; Tate gallery, London; 1885; Liverpool), "May Morning on Magdalen Tower" (1889; Lady Lever Art gallery) and "The Miracle of the Sacred Fire" (1898)—finished just before his sight began to fail.

In 1905 Hunt succeeded G. F. Watts to the Order of Merit and received a doctorate of civil law from Oxford university. He died in London on Sept. 7, 1910, and was buried in St. Paul's.

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HUNT, WILLIAM MORRIS (1824–1879), U.S. painter, most important for the French influence he brought to America, was born at Brattleboro, Vt., on March 31, 1824. He attended Harvard, but his real education began when he studied with Couture in Paris and then came under the influence of Jean François Millet. The companionship of Millet had a lasting influence on Hunt's character and style, and his work grew in strength, beauty, and seriousness. Through the Boston society circles in which he moved, he introduced the works of Millet, Rousseau, Corot and others of the French Barbizon school, and he more than any other turned the rising generation of American painters toward Paris. On his return in 1855 he painted some of his best pictures, reminiscent of his life in France and of Millet's influence. Such are "The Belated Kid," "Girl at the Fountain," "Hurdy-Gurdy Boy," etc. But the public called for portraits, and it became the fashion to sit for him.

Among his best paintings of this kind are those of William M. Evarts, Mrs. Charles Francis Adams, the Rev. James Freeman Clarke, William H. Gardner, Chief Justice Shaw, and Judge Horace Gray. Unfortunately many of his paintings and sketches together with five large Millets and other art treasures collected by him in Europe, were destroyed in the great Boston fire of 1872.

Among his later works American landscapes predominated. They also include the "Bathers" (twice painted) and the allegories for the senate chamber of the State capitol at Albany (N.Y.), now lost by the disintegration of the stone panels on which they were painted. Hunt was drowned at the Isles of Shoals on Sept. 8, 1879. He wrote *Talks about Art* (London, 1878).

HUNTER, ROBERT (d. 1734), colonial governor of New York, New Jersey and Jamaica, was the son of James and Margaret (Spalding) Hunter of Hunterston, Ayrshire, Scotland. Forsaking his apprenticeship as an apothecary, Hunter joined the British army and fought at Blenheim (1704) under Marlborough, with whom he seems to have been personally acquainted. In 1707 Hunter was chosen lieutenant-governor of Virginia, but on the way to America he was captured by the French, remaining as their prisoner until exchanged for the bishop of Quebec. Hunter was commissioned as governor of New York and the Jerseys in 1709. Accompanying the new executive to America in 1710 were 3,000 Palatine refugees who were ordered to undertake the production of naval stores. This Hudson river venture proved to be a failure despite the governor's intense interest and expense in the project. Hunter's career in America was characterized by a series of political and religious entanglements, but he was one of the best loved administrators ever selected by England. He played an important rôle both at the New London congress (1711) and at New York in preparing the colonial contingents for the last campaign of Queen Anne's War. In 1719 Hunter returned to England, and for several years was consulted as an authority on colonial affairs by the board of trade. His last commission was the governorship of Jamaica which office he held until his death on March 31, 1734. (R. L. BE.)

HUNTER, SIR ROBERT (1844–1913), English lawyer and philanthropist, who devoted much of his time to safeguarding the rights of the public in regard to open spaces and the preservation of rights of way, was born on Oct. 27, 1844. In 1882 he became solicitor to the general post office. One of the principal promoters of the Commons Preservation society, founded in 1865, he became in 1868 its solicitor and successfully conducted suits for preserving Wimbledon and Wandsworth commons and for recovering a portion, wrongfully enclosed, of Epping forest. Ashdown forest, Hampstead heath, Hindhead and the New forest also were safeguarded by him. He was made a knight commander of the Order of the Bath in 1911, and died at Haslemere on Nov. 6, 1913.

HUNTER, ROBERT MERCER TALIAFERRO (1809–1887), American statesman, was born in Essex county, Va., on April 21, 1809. He entered the University of Virginia in his 17th year and was one of its first graduates; he then studied law at the Winchester (Va.) law school, and in 1830 was admitted to the bar. From 1837 to 1843 and from 1845 to 1847 he was a member of the National House of Representatives, being speaker from 1839 to 1841; and from 1847 to 1861 he was in the Senate, where he was chairman of the finance committee (1850–61). He is credited with having brought about a reduction of the quantity of silver in the smaller coins; he was the author of the Tariff Act of 1857 and of the bonded-warehouse system, and was one of the first to advocate civil service reform. In 1853 he declined President Fillmore's offer to make him secretary of State. At the national Democratic convention at Charleston, S.C., in 1860 he was the Virginia delegation's choice as candidate for the presidency of the United States, but was defeated for the nomination by Stephen A. Douglas. Hunter did not regard Lincoln's election as being of itself a sufficient cause for secession, and in Jan. 1861 he proposed an elaborate but impracticable scheme for the adjustment of differences between the North and the South, but when this and several other efforts to the same end had failed he quietly urged his own State to pass the ordinance of secession. In 1861–62 he was secretary of State in the Southern Confederacy; and in 1862–65 was a member of the Confederate senate, in which he was, at times, a caustic critic of the Davis administration. He was one of the commissioners to treat at the Hampton Roads conference in 1865, and after the surrender of General Lee was summoned by President Lincoln to Richmond to confer regarding the restoration of Virginia in the Union. From 1874 to 1880 he was treasurer of Virginia, and from 1885 until his death near Lloyds, Virginia, on July 18, 1887, was collector of the port of Tappahannock, Virginia.

See Martha T. Hunter, *A Memoir of Robert M. T. Hunter* (1903) for his private life, and D. R. Anderson, *Robert Mercer Taliaferro Hunter,* in the John P. Branch Historical Papers of Randolph Macon College (vol. ii. No. 2, 1906), for his public career. *See* also "Correspondence of Robt. M. T. Hunter, 1826–1876," ed. by Charles Henry Ambler, *Amer. Hist. Assoc. Ann. Report, 1916,* vol. ii.

HUNTER, WILLIAM AND JOHN, brothers, were among the most distinguished and influential of British medical teachers and practitioners. Both brothers excelled particularly. although in different ways, in the teaching of anatomy. William was preeminent in the practice of obstetrics and John was outstanding as a surgeon. John, in addition, carried out many highly original and important studies and experiments in many areas of comparative biology, anatomy, physiology and pathology.

William and John Hunter were both born at Long Calderwood, in East Kilbride, Lanarkshire, William on May 23, 1718, and John on Feb. 13, 1728. They were the seventh and tenth children, respectively, of John and Agnes Hunter, and were descended on their father's side from the Ayrshire family of Hunter of Hunterston. Their brother James, the fifth child, showed great promise of success in medicine before his early death at the age of 30. Their sister, Dorothea, the eighth child, married James Baillie and became the mother of the distinguished pathologist Matthew Baillie and of the dramatist Joanna Baillie (*qq.v.*).

William's education and training were considerably more formal than were John's. William matriculated in 1731 at the university in Glasgow. then began his medical study late in 1736 or early in 1737 by taking up residence with William Cullen in Hamilton. After having attended medical lectures in Edinburgh in 1739 and 1740, he went to London in 1740 residing first with William Smellie and later with James Douglas. He became a surgical pupil at St. George's hospital in 1741 under James Wilkie, and was admitted to the Corporation of Surgeons in 1747. He received the degree of doctor of medicine from Glasgow in 1750, and, becoming disfranchised from the Corporation of Surgeons, was admitted a licentiate of the College of Physicians in London in 1756. William became surgeon-man-midwife to the Middlesex hospital in 1748 and to the British Lying-in hospital in 1749, but presumably, since he abandoned surgery by 1756, the tenure of neither of these positions was of long duration.

William first began to teach in 1746. It is often claimed that his first lectures were delivered to a society of navy surgeons, but this is incorrect, since the society was not founded until after Hunter had begun to teach. He continued to lecture throughout his life. His lectures dealt principally with surgery or anatomy; they were erudite. extremely polished and always well attended. His most distinguished pupil was his brother John. Through his teaching he revivified the teaching of anatomy in Great Britain, which was badly in need of reform. He had traveled in France in 1743–44 and also in 1748 and introduced to Great Britain the Paris method of providing each student with a cadaver to dissect for himself. In 1766 he purchased a house in Great Windmill street, began to teach in it in 1767 and later took up residence there, having had it rebuilt to contain an amphitheatre, dissecting rooms and a fine museum. He amassed a splendid collection of anatomical and pathological preparations for use in his teaching; he was an avid collector also of ancient coins and medals, of minerals. shells and corals, and especially of books. His library mas outstanding for any age. Ultimately after his death these collections became the property of the University of Glasgow. When the Royal Academy was founded in 1768 Hunter was appointed professor of anatomy and lectured on anatomy to artists.

William Hunter's practice, after 1756, was devoted principally to obstetrics, and he was the most successful specialist in this field in Great Britain during his day. Among his many distinguished patients the most distinguished of all was Queen Charlotte. She first consulted him during her first pregnancy in 1762, and he was named physician extraordinary to her majesty the same year. He attended her also during two subsequent pregnancies. He was influential, in the history of British obstetrics, through his opposition to the use of the forceps. But further than this, by virtue of his high standards of teaching and practice, obstetrics was removed from the hands of the midwives to become an accepted branch of medicine itself.

William Hunter published three books. One, *Two Introductory Lectures,* published posthumously (1784). illuminates the character of his teaching Another. *Medical Commentaries* (1762; *Supplement,* 1764) is of principal interest in that it contains details of his controversies with the Monros over priority for the injections of the testicular tubules and for the discovery of the absorptive functions of the lymphatics. and with Percivall Pott over credit for the elucidation of the nature of congenital hernia. But he was really a man of one book, and his great masterpiece was the *Anatomy of the Human Gravid Uterus, Exhibited in Figures,* an elephant folio published in 1774 as the only medical publication to be issued by the famous Baskerville press. William spent 30 years in its preparation. Jan van Riemsdyck made many of the drawings for the 34 plates, Robert (later Sir Robert) Strange prepared some of the engravings. and the book has rarely been excelled as an anatomical monograph. William published in addition to his books a small number of scattered essays or case histories, dealing principally with the circulatory. the skeletal or the reproductive organs. Other subjects covered were emphysema. the cellular membrane, the pupillary membrane, signs of murder, the lacrymal ducts, a description of an animal from India, and so forth.

John Hunter, in contrast to his brother, never completed a course of studies in any university, and, as was often customary for surgeons during the 18th century, he never attempted to become a doctor of medicine. He first went to London in 1748 to assist in the preparation of dissections for the course of anatomy which William had begun to teach two years before, and for 11 minters he continued to learn anatomy in his brother's dissecting rooms. In the summers of 1749 and 1750 he learned surgery from William Cheselden at Chelsea hospital, and when Cheselden became ill may have become a pupil at St. Bartholomew's in 1751. He is said to have become a surgeon's pupil at St. George's in 1754. In the spring of 1755 he entered as a gentleman commoner at St. Mary's hall. Oxford, but apparently remained for less than two months; his interest was in nature, not books. He seems to have become house surgeon at St. George's in 1756, and nas admitted a member of the Corporation of Surgeons in 1768.

Like William, John devoted great energy to teaching. During his second year in London he is said to have superintended some of his brother's pupils in practical anatomy, and he is reputed to have assisted him in lecturing after 1754. In 1753 he was elected a master of anatomy at Surgeon's hall, with the duties of reading lectures. He started his own private lectures on the principles and practice of surgery in the early 1770s and continued them until 1790. In addition, he had teaching duties from 1768 at St. George's (to which he had been elected surgeon in 1758), and these included taking house pupils. His various students included many who were later to become famous in their own right: Edward Jenner, John Abernethy, Anthony Carlisle, Henry Cline, Astley Cooper and William Blizard were among the British, and Philip Syng Physick, John Morgan and John Shippen among the Americans, who profited from his teaching. As a lecturer, he mas far less fluent than William. His ideas spilled from his mind faster than the nords from his tongue or his pen, and his use of language was far less elegant than his brother's. Yet the range of his interest and knowledge in widely various aspects of medicine and natural history, his lively curiosity and his penetration of thought were such that he could not fail, no matter what the manner of his style or delivery, to be highly stimulating to his students. Like William, he became a collector, and amassed a collection of well over 10,000 anatomical pathological and biological specimens. By his will, his collection was after his death offered for sale to the government. The government purchased it in 1799; the Corporation of Surgeons became its custodian, and when the corporation was constituted as the Royal College of Surgeons in 1800 the Hunterian collection was among its most important assets. The specimens were unfortunately mostly destroyed by enemy bombing during World War II.

From the time of his appointment in 1756 as house surgeon to St. George's. John excelled in surgery. In 1760, after an illness,

he accepted a commission as surgeon on the staff of the army, and accompanied the expedition against Belle-Île-En-Mer in 1761. He returned to London in 1763 and practised surgery there until he died. He was the leading surgeon in London and, like William, had many distinguished patients. In 1776 he was named surgeon extraordinary to George III; he was appointed deputy surgeon general to the army in 1786, and surgeon general and inspector general of hospitals in 1790. His services to surgery were to some degree similar to those of Williams's to obstetrics. He not only made specific contributions of great importance, as for instance by the introduction of the high operation for aneurism of the popliteal artery; he attained for surgery the dignity of a scientific profession, basing its practice on a vast body of general biological principles.

The range of John's accomplishments was very different from that of his brother. He published three books before he died: *The Natural History of the Human Teetlz, A Treatise on the Venereal Disease,* and *Observations on Certain Parts of tlze Animal Oeconony; the Animal Oeconomy,* like William's *Medical Commentaries,* was not a unified book but represented a collection of separate articles. These had either been previously published in periodicals or would have been appropriate for such publication. In addition. a fourth book, *A Treatise on the Blood, Inflammation and Gun-shot Wounds* was published posthumously in 1794, the year after he died. The books on the teeth, the venereal disease and on the blood would each of them alone have sufficed to bring him fame as an investigator and thinker. illustrating, as each did, his faculties of searching deep into principles to the benefit of practice.

In addition, John published a number of shorter communications describing some of his other discoveries. dealing with such topics as post-mortem digestion of the stomach (1772). air sacs in birds (1774), production of heat by animals and vegetables (1775), apparent transmission of smallpox from mother to fetus (1780), organs of hearing in fishes (1782), descent of the testis (1786), structure of the placenta (1786), secretion by the crop of the breeding pigeon (1786), extirpation of one ovary (1787), structure and economy of whales (1787), introsusception (1789), horny excrescences of the human body (1791), bees (1792), fossil bones presented to the Royal society (1794, posthumous) and so forth.

These reflect only a fraction of the diversity of John Hunter's interests. He expended apparently boundless energies on anatomical, pathological, biological and even geological investigations. His first anatomical studies were made when he was still in William's school. When he was on the military expedition to Portugal he acquired considerable knowledge of gunshot wounds and inflammation, but also studied digestion during hibernation in reptiles. After 1772, when he moved to a house at Earl's Court, he kept a small menagerie at his residence for the purposes of study and experimentation: hedgehogs, bees, leopards, blackbirds, to name only a few of his varied animals. He did not confine his experimental studies to lower animals; in an attempt to demonstrate that gonorrhea and syphilis are manifestations of a single disease he inoculated himself and contracted syphilis, and there are some who believe that this caused much of the illness that he sufferedduring his later years.

He enjoyed due recognition for his discoveries. He was elected a fellow of the Royal society in Feb. 1767, three months before William. He was Croonian lecturer at the Royal society from 1776 to 1782; he received the Copley medal, the highest honour in the Royal society's anard. in 1787. and was elected to membership in the American Philosophical society in 1787.

The full diversity and depth of John Hunter's investigations will never be known. Only a small proportion of his work was published during his lifetime, and after his death the major part of his manuscripts was destroyed by his brother-in-law, one of his executors. Everard {later Sir Everard) Home, who claimed that he destroyed the papers on Hunter's directions. They were not burned. however. until 1823, and there are many who believe that Home plagiarized their contents before destroying them.

The accusation of plagiarism was first made by William Clift, Hunter's amanuensis at the time of his death. Clift copied a number of the original notes between 1793 and 1800, and his copies are published in John's *Essays and Observations on Natural History, Anatomy, Physiology, Psychology and Geology,* which appeared in 1861 under the editorship of Richard Owen, Clift's son-in-law.

There are fine portraits of both brothers, including one of William by Johann Zoffany,and one of John by Sir Joshua Reynolds of which an equally fine engraving was made by William Sharp.

William remained a bachelor, his fiancée, Jane Douglas, having died in 1744. John in 1771 married Anne Home, a poetess of no mean merit, who published her poems and wrote words for some of Haydn's English Canzonets.

Four children were born to Anne and John Hunter. Two died young; the other two, Agnes Margaretta and John Banks, survived, but both died without issue.

The various differences already alluded to in the lives and accomplishments of the two brothers reflected very real differences in their personalities. William was in many ways a restrained person, scholarly in outlook, frugal and very nearly ascetic in his habits and probably somewhat vain in regard to his social and professional position. John, in contrast, was unconstrained, unbookish, sometimes crude though often vivid in his expression, and honest, unself-conscious and generous perhaps even to a fault. His warmth and vitality found little counterpart in his brother.

While the association between William and John was close during their early years in London, the brothers later, perhaps in part because of their differences in temperament, drifted apart. William was not invited to John's wedding in 1771, and relations between the brothers were finally completely ruptured during 1780 as a result of a public controversy between them over priorities for the discovery of the nature of the utero-placental circulation. They never again met except once when John gave surgical attention to William during the latter's final illness. John did not attend his brother's funeral and was not mentioned in William's will.

Yet for all their differences, they shared in common what was probably the key characteristic for their total accomplishment, their complete and utter devotion to their work. They both died at work, William! on March 30, 1783, having ten days before arisen from his sickbed to lecture, John, on Oct. 16, 1793, during a board meeting at St. George's. William was buried in the vaults of St. James's, Piccadilly, and John in those of St. Martin-in-the-Fields. In 1859, through the efforts of F. T. Buckland. John's remains were reinterred in Westminster abbey on the north side of the nave. William had reformed and refined the teaching of anatomy in Great Britain, and had raised obstetrics to the rank of a respected medical discipline. John had not only established the principles of surgery soundly on a broad biological basis, but had also enriched many fields of natural history through his indefatigable study and experimentation. The legacy of both brothers remained not only in their museums and their writings, but also in their vitalizing influence on anatomy, obstetrics and surgery, which is still felt.

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W. R. LeFanu, "The Writings of William Hunter F. R. S.," *The Bibliotheck* 1:3–14, (1958), presents a bibliography of William's writings. LeFanu, in *John Hunter, A List of his Books* (1946) presents a bibliography of those of John's works which were printed in book form. No such accurate bibliography has been compiled for John's articles, but LeFanu in the *List of Books* gives references to the available lists of them. (J. M. O.)

HUNTER RIVER, a river of New South Wales, Austr. It is 340 mi. long, rising in the Liverpool range behind the main crest of the eastern highlands. A longitudinal stream to near Denman, it there joins and continues to the sea the transverse course of its main tributary. the Goulburn. This transverse valley leads inland to the Cassilis gap. the lowest crossing point of the highlands between southern Queensland and western Victoria. Below the junction the valley widens and at Branxton gap near Singleton enters

the coastal lowland, there much wider than elsewhere in New South Wales. Through this breach in the highlands, Pacific influences penetrate westward and vegetation types from the inland slopes approach the coast. The climate of the valley is both warmer and more humid than that of neighbouring territories. With generally good soils, the valley naturally favoured farming and especially fruit growing; vineyards were formerly more widespread but today specialize in the production of fine light wines. The rough country of the upper valleys is mainly devoted to the grazing of cattle, sheep and horses, and there is much timber cutting on the forested slopes. The scattered sawmills along the streams provide hardwood timber for furniture making and for constructional work. Dairying is the main agricultural pursuit in the middle and lower valley; wheat growing has given way to the cultivation of forage crops—maize, hay and lucerne.

The Hunter has eroded its valley in a structural basin of coal measures of Permocarboniferous age! and rich coal seams outcrop in many places. When John Shortland discovered the river in 1797 he reported an exposure of coal near where Newcastle (*q.v.*) now stands. Working of these upper or Newcastle seams began as early as 1800, and coal export was well established by 1850. The richer lower or Greta seams were discovered in 1856 and have long provided the greater part of the output. The most important mines lie along the eastern outcrop of the Greta coals; south of the lower river between Maitland and Cessnock. Open-cast working is carried on to the northwest near Muswellbrook on the upper Hunter. The seams are generally thick and relatively easily worked and the coal is of good quality, though often with a rather high sulphur content. Proximity to a good harbour (Newcastle) at the river mouth made coal shipment easy to oversea and Xustralian coastal markets. Labour troubles frequently checked development. but output increased steadily after World War II. Greater internal consumption. in industry and on the railways, and the growing use of oil fuel in ships caused a considerable falling off in exports overseas and in the supply of bunkers. Though the Hunter is navigable for 35 mi. upstream it is little used for transport because of erratic changes of level. (T. HER.)

See J. H. Abbott, *The Newcastle Packets and the Hunter Valley* (Sydney, 1943); F. R. Mauldon, *A Study in Social Economics: The Hunter River Valley* (Melbourne, 1927).

HUNTING is the seeking. pursuing and taking of game and wild animals for subsistence, profit or sport. Hunting for sport is defined in Great Britain and western Europe as the taking of any wild animal by the aid of hounds that hunt by nose. In the United States and elsewhere, hunting refers also to the field sport of shooting small and large game. For bow and arrow hunting *see* ARCHERY. *See* also FALCONRY. For zoological information on various animals see articles under their common names, as ANTELOPE; DEER; for occurrences *see* articles on continents, countries and states and provinces.

The present article deals with the sport of hunting in its various aspects throughout the world, and is arranged as follows:

I. INTRODUCTION

1. History. — To early man, hunting was a necessity. It was not only a means of obtaining food, but provided many of the other necessities of life such as clothing and tools (*see* HUNTING AND FISHING, PRIMITIVE). As a civilization advanced, certain animals were domesticated and new breeds developed to serve the needs of man. Hunting then became a privileged sport, primarily indulged in by the landed aristocracy of Asia and Europe

As new areas were opened up in America and Africa, hunting again became a principal means of survival, and has remained so in remote parts of the world. In the new areas. such as those in North America from the end of the 16th century until into the 20th, there seemed to be an unlimited game supply and there was much unnecessary waste. As populations increased so did the amount of hunting, and wild animal populations were reduced at a correspondingly quicker rate. When hunting was no longer necessary people turned to it as a sport, hunting some species to extinction; the quagga, for example, once plentiful on the African plains. is extinct. The bison, once innumerable in America, exists only because a fen survivors nere formed into a breeding herd and carefully preserved. Among birds the passenger pigeon. also an American species and once common. has entirely ceased to exist. The process is continuing, notably in Africa.

2. Controls. — Because game was being slaughtered indiscriminately by market hunters and sportsmen. Ians were passed in nearly every country to protect wild game. Limits were put on the number of animals mhich each hunter was entitled to kill, and licences. which bring in a substantial revenue. became part of modern game management. In the United States, for example, the federal government controls migratory game birds within the U.S. borders since these migrate not only from state to state, but between Canada and Mexico. Other game comes under the jurisdiction of the individual states, all of which have highly developed programs and trained staffs to enforce regulations covering hunting seasons and game-in-season bag and possession limits. Game again became relatively plentiful and even abundant in many areas where it had formerly become scarce. Similar game conservation schemes began to be implemented in India in 1860, in Africa at the end of the 19th century and in eastern Europe in the years after World War II. In Britain, Scandinavia and the rest of western Europe the right to hunt is generally attached to the ownership of land, and the preservation of wild life is a function exercised or delegated by landowners.

See also WILDLIFE CONSERVATION. (E. P. B.; W. S.)

II. BIG GAME HUNTING

The pursuit of large game (often at great risk to the hunter) and the search for gold probably share the credit for drawing the majority of explorers into the unknown. and there can be no doubt that big game hunting has always exercised great fascination for mankind.

1. Planning. — The sportsman should ascertain the best time of pear for hunting. Quite apart from the question of health, should he visit the country at an unfavourable season he may stand small

chance of sport because of some peculiar local condition, for example, high grass nhich may prevent him from seeing anything. Another factor is water: as a rule this is fairly plentiful in any district nhere game is abundant, but at some seasons remains only in certain localities round ahich the game concentrates. Information on these points will be given by the game department of the country concerned, and the following information should also be obtained: (1) what stores and equipment can be obtained locally; (2) what means of transport is generally used between the proposed base and the actual shooting grounds; (3) whether this transport is easily obtained, and how; and (4) whether trackers are available Good maps of the country are another essential item.

The question of the mast suitable firearms is largely a matter of personal preference built upon experience, but generally speaking the best weapon for stalking (see *Method*, below) is a rifle of the "magnum" small calibre type which develops a very high muzzle velocity and so gives a flat trajectory. thus eliminating the difficulties of judging distance. It is always a mistake, however. to select a rifle which does not fire a fairly heavy bullet. as very light bullets are liable merely to wound without killing, and 150 grains is a fairly safe minimum weight. For dangerous game which is shot at close quarters the inexperienced hunter will be well advised to use a heavy double-barreled rifle of a calibre of about .470. Many experienced hunters use nothing but small calibre but the beginner can adopt such methods when he has gained experience for himself. Nearly all big-game territories possess, in addition to their conservation departments, private firms of safari organizers. Their services. and advice on local conditions and technical matters. are generally relied upon by visitors.

2. Methods.—The methods of hunting depend on the type of country in nhich the game is found, and on the size and habits of the creatures themselves. In open country free from trees, game can be viewed from afar; in these conditions a slow and stealthy approach is necessary, use being made of every tuft of grass. rock or hollow as a means of concealment and attention being paid to the direction of the wind. This is known as "stalking."

In dense bush or scrub it is impossible to see more than a few yards Game in these conditions is come upon suddenly and the best chance of getting a shot is to walk slowly and cautiously. ever on the alert. This form of hunting has been described by different names but none is so graphic or realistic as the North American "still hunting."

Some animals cannot be stalked or still-hunted. for instance big beasts mhich herd together, as do elephants. They leave well-defined tracks, or spoor, in soft ground and a skilful hunter can follow their trail even on hard ground. This method is called "tracking."

Other animals inhabit, or retire to, patches of dense jungle so thick that it is impossible for a man to advance silently within shooting distance. Tracking and still hunting are out of the question and there the best chance of success is to drive the animal out into the open or along some path where the sportsman is waiting. This is done with the help of a number of men or dogs. or, in certain parts of India, with a line of elephants—methods universally known as "driving" or "beating." If, however. no form of help is available in circumstances such as these. the only course for the sportsman is to wait in hiding over some spot where the animal will probably pass or return. Such a place may be a water hole, game trail, crossing point or a salt lick; in the case of beasts of prey. it may be a half-eaten kill. This waiting method is known as "sitting up," or "sitting." It should, however, be noted that sitting up over water or a salt lick is not generally considered a sportsmanlike procedure and it is prohibited by law in some localities.

Another form of hunting which is commonly practised in pursuit of deer is known as "calling." It consists of waiting in hiding and making noises in imitation of the call of a female during the rutting season or else of the challenge of a male. In either case a male will answer and will gradually come right up to the sportsman believing him to be a possible mate or a probable antagonist. Calling deer is one of the oldest European hunting techniques, dating back long before the introduction of firearms. It is much used by hunters of roebuck in Germany and Austria, and has been successfully adopted by moose hunters in North America.

(G. Bu.; X.)

A. North America

North America offers many opportunities for hunting, and the sport is popular. There are many types of hunting there, depending on the type of game, the terrain, the climate, and the preferences of the hunter. He may depend solely on his own devices and pursue his game on foot, and without the aid of dogs. He may travel by horseback, jeep or other motor vehicle; in some of the vast and remote hunting areas of North America a horse or jeep is practically a necessity. Airplanes are increasingly used to reach nilderness areas. Most hunting, however, is done within a mile or so of roads because of the difficulty of getting game out of remote country. This is unfortunate in a way because in a number of inaccessible areas game. such as deer, for example, becomes too plentiful for the food supply and the animals grow poor or die of starvation.

1. Deer.—Deer are the most widely hunted big game animal, since they are widely distributed and thrive in areas close to civilization. The term is usually used to cover three species, white tail, mule and black tail. Moose, elk (wapiti) and caribou are also members of the deer family (Cervidae); they are discussed below under their popular names.

The white tail deer are distinguished by their antlers; the main beams first grow upward and then project forward horizontally and the spines grow off them at the vertical; the mule deer and black tail deer have much in common and there is disagreement as to nhether they represent one or tno separate species They are distinguished by the fact that the mule deer has a white rump and a black tip on the tail which is held down when running. The black tail deer raises its tail nhen running but the tail appears all black nhen it is down. Both have forked antlers, and the ears of the mule deer are particularly large.

White tail deer are generally considered an eastern deer. while mule deer or black tail deer inhabit the far nest, but the ranges overlap in most of the western United States and northern Mexico Mule deer are called black tail deer along the west coast nhere they are found from California northnard through British Columbia.

In the east, deer are usually found in thick pine growth, brush or dense forest undergrowth "Jumping" a deer and placing a telling shot in this kind of country is difficult even for an experienced hunter. Still hunting is one of the most successful methods employed. but "sitting" (see Methods, above) offers other good opportunities—the saddle between two mountains. for instance, makes a natural crossing point for deer as well as other game. The successful hunter must always be conscious of the wind direction, for a deer may come aithin range if it does not scent the hunter and if it sees no movement. Hunters sometimes form themselves into groups, one group taking stands near known crossing points, while the other drives toward them. In a few areas in the east where there are swamps, or where hunting is for other reasons difficult, the law permits driving deer with dogs, though this is generally illegal.

The same methods are used for hunting mule deer in the west, but there is more open country where the hunter can observe a great area with the aid of a telescope or binoculars, and there are greater opportunities for long-range shooting. When disturbed, deer seldom run straight and are inclined to circle. It is not uncommon for a hunter, who has put up a deer in front of him, to find it later behind him.

2. American Elk (Wapiti).—The American elk, a member of the deer family, at one time roamed most of the United States and southern Canada. Elk are now found primarily in the Rocky mountain region of the western United States, where in the fall they come down from the high mountains for wintering. A few have been reintroduced in the east. as in Virginia, but the numbers are small and there is no open season for them. Elk are hunted much in the same way as deer. A large bull elk may stand 60 in. at the shoulder and weigh from 800 to 1,000 lb. Any of the high-

powered medium calibre rifles (.25 cal. or above) are adequate for taking elk

3. Moose.—The moose is the largest of the deer family; an unusually large bull will weigh from 1.100 to 1.600 lb . stand about 75 in. at the shoulder and have an antler spread of up to 75 in. Moose are now found in a few of the western states of the United States and in Canada and Alaska. The Alaskan moose are the largest and darkest in colour, and one of the popular hunting grounds for these animals is the Kenai peninsula. Moose are not easily found, they travel fast and over long distances. Many are taken with medium-powered cartridges.

4. Pronghorn Antelope.— The pronghorn antelope (*Antilocapra americana,* a group distinct from that to which the African antelope belongs) are plains animals which at one time inhabited much of the plains area of the United States and parts of Mexico They became very nearly extinct and were reintroduced in many areas. where they remained fully protected until the herds increased to the point where hunting could be permitted. They multiply rapidly and are a popular game animal in the far western United States and north-central Mexico.

The male antelope averages about 100 to 120 Ib. and stands about 24 to 36 in. at the shoulder. They are exceedingly swift and offer a difficult target when running. At 100 yd. range a hunter will have to lead a crossing antelope by 10–12 ft. A good stalk will permit a standing shot at reasonable range, but without one a hunter needs an accurate, long-range rifle.

5. Caribou.— In the 1850s the caribou (the name by which the North American species of the reindeer genus is known) were found not only in Canada, Alaska and Greenland but also in the northern part of the United States, including New England. Since then the southern limit of their range has moved northward and their numbers have decreased. There are several subspecies of caribou. depending largely upon geographical location.

The caribou and the reindeer differ from other genera of deer in that the female bears antlers. They are also the most gregarious, roaming in herds as large as 1,000 or more. A large mountain caribou may weigh 600 or 700 Ib., the woodland caribou a little less and the barren ground caribou of the far north only about 300 lb. Caribou are hunted in Canada and Alaska, the woodland and mountain caribou being the most interesting to hunt and providing the best trophies.

6. Bear.—North America has the two largest carnivorous animals—Alaskan brown bears and polar bears. As the name might imply. the range of the Alaskan brown bear is limited to the Pacific slope in Alaska and the offshore islands. Brown bears are not only the most impressive of the Xorth American big game animals but they are also the most dangerous, particularly when wounded. They may attack without provocation, and have great powers of recovery, so the hunter should be equipped with a powerful rifle. Alaskan brown bears come out of hibernation in May and the spring is generally the best time to hunt them. Kodiak Island is famed for its particularly large brown bears. A brown bear may stand 10–12 ft. tall on his hind legs and weigh in the neighbourhood of 1,500 lb. The claws may be four inches long.

The only rival of the brown bear in size is the Arctic polar bear. An average male weighs nearly 1,000 lb.. but individuals may be as heavy as 1.600 Ib. In the 20th century hunting polar bears in Arctic America has become an increasingly popular sport, although it is an expensive one.

During recent years, big game experts have come to the conclusion that the only difference between the brown bear and the grizzly bear is geographic. What is known as the brown bear lives near the coastal regions where a more bountiful food supply, and possibly other conditions, result in larger growth.

The bears that are found inland in Alaska (75 mi. from the coast) have been classified as grizzly bears for purposes of Boone and Crockett measurements. These bears are smaller: and a very large one would weigh not over 1000 lb. and measure not over 8½ ft. in length.

The grizzly hear has sometimes been referred to as the "silver tip" because some of them have grayish tips on the long hair of the upper parts. Like the brown bear, however, the grizzly varies greatly in colour. Some are almost black while others are light tan. In most of the United States they have become almost extinct, but a few are left in the Rocky mountain region and on the western coast of Canada. British Columbia is one of the favourite areas for sportsmen in search of these animals.

The most common and most widely distributed bear on the North American continent is the American black bear, which is not as aggressive as its larger cousins Its weight varies from 200 to 500 lb In spite of its size and the fact that it sometimes lives close to civilization, the black bear is not easy to find, for it has a good nose and sensitive ear. The best time of the year to hunt the black bear is in the spring, during the early berry season. Because of the difficulty in finding them, hounds are frequently used for tracking

7. Sheep.—Mountain sheep, of which the Rocky Mountain bighorn is probably the most nidely distributed, are found in the western North America mountain regions from blexico to the Arctic circle The white Dall sheep is found primarily in Alaska, and the dark-coloured Stone sheep ranges from British Columbia northward into the Yukon.

8. Predators.— Common predators include coyotes, foxes and bobcats. Dogs are sometimes used to hunt them, but calling is also employed; in the latter case, a sound akin to that of a wounded or snared rabbit is made.

On rare occasions jaguar and mountain lion (also known as cougar, panther, catamount and puma; *q.v.*) have been called. but the surest way of hunting these large cats is with well-trained hounds. The animals customarily take to a tree when the hounds track them down. They are both formidable enemies of dogs, however, and a too aggressive dog is apt to be hurt if he closes in on one of these animals. The jaguar, one of the highly prized trophies in America, is occasionally found in the southwestern region of the United States but more often in Mexico where it is known as el *tigre.* It is hunted successfully on the west coast of Mexico and on the eastern gulf coast in the region of Tampico and is also found in southern Mexico in the states of Campeche, Tabasco and Chiapas The jaguar is also hunted in South America. Good hunting is to be found in Colombia. Brazil, Peru and Bolivia. The Lest time to hunt jaguar is during the winter months.

At one time mountain lions were found in many parts of North America but they are now extinct throughout much of their former range. They are found in greatest numbers in the Rocky mountain region, from the southern part of the continent up into Canada. Vancouver Island seems to have a particularly high concentration and it is there that they have been known occasionally to attack humans, although they are generally considered to be somewhat cowardly When one is cornered, or treed, it is advisable for the hunter to maintain a safe distance.

9. Wild Boar.—Although the European boar, sometimes called the Russian boar, is not native to America, there are some in the United States since they were imported for hunting on large private estates and later escaped to the wild; they can be hunted in the area of Newport, N H.. in Monterey county, Calif , and in Graham county. N.C., and Monroe county, the adjoining area in Tennessee. There are closed seasons in Tennessee and North Carolina, where hunts are closely regulated, but none in California and New Hampshire. Locating a wild boar is difficult without the aid of dogs or of a guide who knows the country. Wild boars are largely nocturnal, and during the day retreat into cover. At dawn they are sometimes found feeding in the open. In California they are hunted from horses or jeeps, or on foot. A hunter sometimes walks or rides along the ridges in the early morning looking into canyons on either side. If he sees nothing before 9 A.M. the hunt is finished for the day, for by that time the boars have sought cover. An unusually large boar may weigh as much as 500 lb. Boars are formidable beasts and can be dangerous at close quarters.

10. Peccary.— The peccary, known also as the javelina, wild pig or musk-hog, is not a member of the swine family although it resembles a pig in many ways, roots with a piglike snout and grunts like a pig. It is small in comparison with the wild European boar, and is native to America. There are two subspecies, the

collared peccary of the southwestern United States and Mexico, and the white-lipped peccary of the Central and South American jungle regions. A good-sized collared peccary will weigh about 50 lb., while the white-lipped peccary may weigh closer to 75 lb. Collared peccaries have been considered primarily a desert animal and they thrive under desert conditions. However, they have been noted ranging up into the pine region of Arizona.

Peccaries live primarily in caves and are gregarious creatures. With their sensitive noses and ears they are difficult for the hunter to find. The collared peccary travels in herds of about ten, but the white-lipped peccaries are customarily found in great numbers and it is not unusual to find 50 or more in one group. If the wind is right the hunter may smell or hear them before sighting them, and can then stalk them.

11. Musk-Ox.—The musk-ox is a shaggy wild ox of Arctic America. The Eskimos have hunted it intensively for food and clothing and it is feared that the herds face extinction, although rigid protective measures have been instituted. (E. P. B.)

B. Europe

1. Great Britain.—Great Britain's only true big game animal is the red deer. The hunting of stag with hounds by mounted hunters (see *Hunting with Hounds,* below) was formerly called "hunting at force." and in the 20th century it continues in parts of England. On the open mountains of the Scottish highlands red deer are stalked with the rifle. The stalking season begins at the end of September and lasts three weeks, ending when the rut (mating season) begins, since it is not customary in Great Britain to take game at any season of the year when mating or breeding occurs. In woodland areas of the British Isles fallow deer and roebuck are stalked with the rifle. The method generally used is similar to American "still hunting," but since World War II some British sportsmen have adopted the German *hochstand* technique. in which the hunter waits on a platform erected in a tree to ambush animals passing below.

2. Northern Europe.—In Scandinavia the game to be found includes reindeer, red deer, roe deer. European elk and bear. Of these the elk is probably the most important and, in Norway, it is more widely distributed than any other species of big game. Its habitat includes all the larger areas of coniferous forest, but it is a great wanderer-and will on occasions invade districts where it has been previously unknown. Elk are hunted either by still hunting or with special hounds which run them to bay.

The European reindeer is of the barren-ground type, being smaller in the body than the woodland types of Canada and Alaska and carrying long, slender horns which show less palmation than those of the North American caribou. In former times reindeer were very widely distributed throughout the whole of Scandinavia, but after mid-20th century it was found only on the mountain plateaus above timberline; in summer it prefers those mountains where there are plenty of snowfields.

Red deer are not very widely distributed in Scandinavia, existing only along the western coast of Norway from Bokn fjord in the south to Namdal in the north, and in a few other scattered areas. The only localities where they are found in any numbers are the two islands of Tustna and Hitra. Bears still exist, but in such small number that they are negligible from a sporting point of view. Polar bears, however, are hunted on the Arctic icefields of northern Norway.

Much of the big game of central and southern Russia has been exterminated. but some of the best hunting grounds of the future may lie in northern Russia in Europe and Siberia in Asia. From Scandinavia to the eastern coast of Siberia, elk and reindeer are to be found. Farther north reindeer exist everywhere on the tundra and they are particularly common on the Kola peninsula and the island of Novaya Zemlya.

Other species of game to be found in Russia are lynx and hear, both of which are plentiful, while big grey timber wolves are ubiquitous and follow the elk. Polar bears are fairly common in the northern parts of the island of Novaya Zemlya and walrus may sometimes be encountered on the ice floes.

3. Central an a Southern Europe.—The magnificent red deer, brown bear and roebuck that formerly inhabited the reserved forests of central Europe have been sadly depleted. In the Carpathians game still exists in considerable numbers. Chamois, red and roe deer run large in these mountains and it is probable that better heads are to be found there than anywhere else in Europe. Similarly Tirol has been less affected than the lower lands. Chamois are to be found in the Alps in fair numbers, although all the best districts are preserved.

In Spain the big game are brown bear, red deer, chamois and Spanish ibex. the latter a magnificent creature very strictly preserved. Red deer are found in the forests of the Sierra Morena and Andalusia. Bear are very scarce and are confined almost entirely to the Pyrenees and Cantabrian mountains in the north, as are the chamois or izards. These are somewhat. smaller than the chamois of Tirol. both in size of bodies and heads.

In the Balkans game has been carefully preserved. Yugoslav red deer are probably the finest in the world, and possibly the most expensive to shoot. The country also supports fallow and roe deer, ibex and bear.

The Sardinian mouflon offers the sportsman of moderate means an opportunity to hunt big game. It inhabits the higher mountains. especially the Gennargentu mountains. and good heads may still be obtained although they are becoming more scarce every year. This handsome wild sheep is also found in Corsica.

In the Federal Republic of Germany hunting is strictly controlled both by statute and custom. The chief big game animals are red, fallow and roe deer and wild boar in the forests, and ibex above the snow line. The regard in which such animals are held, and the ceremony which attends all hunting in Germany. ensures that sport of a high order is maintained, although it is necessarily limited. Similar comments apply to the Belgian Ardennes and the undulating woodlands of Maastricht., Neth. France and Italy possess the same types of game as Germany but have failed to conserve it. In Italy progress is being made on a code of conduct designed to eliminate undesirable competition among sportsmen for the necessarily restricted game stock. (G. Bu.; W. S.)

C. Asia

Asia contains greater variations both in climate and physical features than any other continent and, although its big game may not be quite so numerous either in species or actual numbers as those of Africa, it offers unique attractions to the big game hunter.

1. Western **Asia.**—Mouflon, similar to the Sardinian species but larger, are to be found in the mountains of Asia Minor, while the Russian Caucasus provides some of the most difficult yet splendid sport in the world. In the higher ranges lives a fine wild goat, the West Caucasian tahr (tur), which in the east gives way to the East Caucasian tahr, an animal which carries horns very similar to those of the Himalayan bharal, or wild blue sheep, but which has a short beard and is a true goat. In the wooded valleys may be found the maral, a magnificent specimen of the red deer species almost as large as the American wapiti. The pasan, or Persian wild goat, inhabits the Caucasus, the ranges of northern Iran down to Baluchistan, and the hills on the Indian frontier in Sind. where it is known as the Sind ibex.

In Iran, tigers live in the low-lying forests to the south of the Caspian sea and probably farther east as well, while the maral of the Caucasus extends well into Iran. The mountain ranges hold at least one variety of wild sheep, which is very similar to the Indian urial but slightly larger in body and with a much finer head, and the plains carry several varieties of gazelle. Leopards are common in many parts. Mesopotamia offers little hunting, although gazelle are found in the desert. A species of ibex inhabits the mountains of the Sinai peninsula, and possibly extends farther inland, while specimens of the Arabian oryx can be obtained from Aden. The Arabian tahr inhabits the mountains of Oman and gazelle are found in the desert.

2. Central Asia.—The whole of this vast area is a good hunting ground. In the higher ranges are wild sheep with widely sweeping horns. Of these the *Ovis poli* (Marco Polo's sheep) of the Pamirs is probably the best known and certainly carries the longest horns, although they are not so massive as those of the ***Ovis*** *Karelini* of

the Tien Shan, or of the *Ovis ammon* of the Altai, which has the most massive horns of all. The range of these central Asiatic wild sheep is large, extending right through Manchuria to Kamchatka, and different species and subspecies exist throughout the mountains and hills of Manchuria and northern China. Southward, on the plateau of Tibet, they are represented by the *Ovis ammon hodgsoni* (Tibetan argali), the ammon of the Indian sportsman and the nyan of the Tibetans. Ibex range from the northern bank of the Sutlej river through the Himalayas, Karakorum and Pamirs, to the Tien Shan, the biggest heads being found in the north.

3. China. — In the mountains of northern China wild sheep are found, and tigers extend throughout the forests of eastern China from Manchuria to the extreme south. There are strong grounds for belief that Manchuria is the original home of the tiger and that it later extended its range southward. At birth tiger cubs are woolly, indicating a natural protection against cold, and although tigers are found in the hottest jungles of India they dislike heat and their pads will blister when they are forced to cross open ground in the hot weather. The tiger is found in China, Thailand, Burma, India: Malaya and Indonesia. In southern China the forests and cultivation give way to uncultivated higher lands which culminate finally in mountains where game typical of southern Tibet, the bharal and the takin, are to be found.

4. Southeast Asia. — Indochina holds, in addition to tiger, leopard and is probably the eastern outpost of the Indian elephant, gaur and rhinoceros. These animals all also exist in Thailand and there, too, may he found the curious Schomburgh's deer with its widely spreading and many-pointed antlers, as well as a small representative of the Indian sambar. This grand deer probably originated in India, for it is in that country that it attains the greatest size of both body and horn. but it has a very wide habitat, being found throughout the Malay peninsula, Indonesia and Borneo as well as in Ceylon.

5. Tibet and the Himalayas. — South of the Kunlun mountains lies the Tibetan plateau, the highest and most extensive in the world. Only one animal seems to be almost ubiquitous throughout Tibet and that is the bharal, or wild blue sheep of the Himalayas, regarded by some naturalists as the connecting link between sheep and goats. Tibetan antelope roam the Chang Thang, the desert of northern Tibet which has an average altitude of 15,000 ft., and there, too, are to be found herds of wild yak. Farther south the Tibetan argali and Tibetan gazelle may be obtained: while in the lower districts to the east of Lhasa there are forests which hold Thorold's deer, a large deer very few specimens of which have ever been obtained by European sportsmen. Also in Tibet are small bluish bears and numerous wolves while in the west, bordering on the Himalayas, the snow leopard (ounce) and Tibetan lynx exist but are rarely encountered.

The Himalayas provide magnificent stalking, the quarry being, in addition to those Tibetan animals already mentioned, ibex, tahr, markhor and urial, while other game animals are goral, serow and two species of bear, one black and one brown. The latter exists only in the higher ranges near the snow line and is a variety of the brown bear of Europe. In the western Himalayas are to be found specimens of the Kashmir stag, a deer very similar to, but larger than, the red deer of Scotland, while in the east there is an isolated pocket of territory in the Chumbi valley which is the home of a still larger stag, the shou.

6. India, Ceylon and Burma. — India contains the oldest and best-known hunting grounds of all. Sportsmen had been accustomed to shooting tigers there long before any big game hunter had set foot in Africa. The principal game fields are the Terai, a narrow belt of tropical jungle which runs along-the foot of the Himalayas from the Jumna river to Assam and which holds tiger, elephant, rhinoceros, sloth (or honey) bear, black Himalayan bear, sambar. or Ceylon elk, cheetah, swamp deer and other smaller varieties; the jungles of central India in which tiger, gaur (commonly called the bison), sambar and sloth bear are the most important big game; the damp and intensely thick jungles of southern India and the Mysore plateau where elephant. gaur and tiger are found; and the Nilgiri hills where there is a species of wild goat locally known as the "ibex" which is really a variety of tahr. Assam and Sundarbands, the semiflooded delta of the Ganges, are the home of the buffalo, which was also common at one time in Madhya Pradesh. but which has become almost extinct in that district. In India there are some firms and government agencies which make a business of conducting visiting sportsmen on hunting tours.

Burma is the best ground for elephant, gaur and tsine (banteng; *q.v.*), a wild ox akin to the gaur. Leopard abound in all the areas mentioned while the Indian antelope. or black buck, and gazelle exist in large numbers on the plains, especially in the deserts of Bikaner and the Punjab. The big game of Ceylon is very similar to that of India except that tigers do not exist on the island and all the horned or antlered game carry much smaller heads. while the elephants are almost invariably tuskless. (G. Bu.; **S.**)

D. Africa

1. General Considerations. — Although the game fields of the African continent were the last to be discovered they have suffered from the attacks of hunters more than those of any other part of the world, except some parts of North America. Such attacks. however, have not been delivered by the man who shot for sport, and if sport alone had been the object of pursuit it is doubtful whether the number of game would have decreased very materially. The settlers shot for the sake of meat and hides, and wherever commercialism entered into the question the fate of wild game was sealed. The Dutch settlers must be held responsible for the complete extinction of the quagga (a kind of zebra) and the general extermination of game from the greater part of the country which lies to the south of the Limpopo river. Similarly the early elephant hunters had much for which to answer. However, shooting alone has not been responsible for the elimination of big game from huge areas of Africa. Colonization by European settlers drove the wild animals into country that was unsuitable for them, and this advance of civilization has been the most serious menace to the African fauna. The spread of industry and agriculture, accelerated by modern methods of forest clearance, have opened up Africa at unexpected speed. and a further element is the presence of a native population newly possessed of opportunities to destroy wild animals on a large scale. and in places eager to do so for motives of profit. .There are. however, gigantic tracts of country quite unsuitable for colonization and in these areas the game should flourish for many years if the game lams existing in most parts of the continent can be efficiently administered.

The real wealth of Africa as far as big game is concerned lies in its wonderful variety of antelopes and gazelles. There are more than 60 different species, but no specimen of the deer tribe seems to be indigenous to the continent. A few red deer exist in northern Africa in the neighbourhood of Tunis, but it is probable that these were either imported or else are the descendants of some that migrated from Spain before the formation of the Strait of Gibraltar. Africa shares with Asia the rhinoceros and the elephant, but both African varieties of rhinoceros (black and white) are different from any variety of Asiatic rhinoceros. The giraffe and okapi are quite distinctive and peculiar to Africa, while the African buffalo, with all its varieties, is as distinctive as is the African elephant. The leopard is distributed throughout,the continent and is similar to the Asiatic species, although an experienced sportsman can usually detect the difference in the skins. The lion reigns supreme among the wild creatures throughout the whole of Africa.

Legal codes have been drawn up for the protection of wild life, but these are more easily devised than enforced. Several factors. apart from the vast distances common to most African countries, combine to make enforcement difficult. There are, for instance, different game codes in different territories and, except in those instances where major rivers or mountain ranges separate one national territory from another, migrating game herds crossing the frontier may be in double peril because of conflicting regulations on either side of it. These regulations define hunting areas. closed seasons and numbers which sportsmen are permitted to kill, hut they necessarily vary from year to year.

The lion, the leopard, the buffalo, the rhinoceros and the elephant have long dominated the imagination of hunters. They are

raised to a class by themselves by the fact that to shoot them the hunter must risk his life. All of these animals are aggressive when threatened: and well able to take care of themselves. The lion, which traditionally has been the hunter's most desired quarry, exists in diminishing numbers. Some ecologists believe that in the Africa of the future the lion may be in danger of extinction as a wild animal. The spread of farming communities has meant that lions, though they seldom become man-eating, have nevertheless become regarded as a menace to human life, and they are hunted down over ever-widening areas. Elsewhere, tribesmen have freely employed their newly acquired means of destruction. Simultaneously, the general contraction of game areas has reduced the number of beasts on which lions prey, also restricting their habitat. The consequence is that few heavy-maned lions remain outside the Masai tribal areas (where, it is worth noting, the spearing of lions is a tribal custom and test of manhood). Lions remaining elsewhere are generally of inferior type, and of less interest to the sporting hunter. Licences to shoot lion have been issued on a reduced scale by several African administrations.

Much the same is true, and for similar reasons! of rhinoceros, except that the situation has been even more serious and for some years the decline in rhinoceros numbers has accelerated to a serious and even grave degree. Two further causes were the susceptibility of the rhinoceros to drought, which in the 1950s repeatedly affected rhinoceros-inhabited areas, and the market in powdered rhinoceros horn as an aphrodisiac for which high prices continued to be offered.

Leopards are now unevenly distributed over Africa but remain a much-sought quarry of big game hunters eager to pit their skill against the most cunning, and perhaps the most resolute, of the major cats. In European and native farming areas where leopards have become extinct the local populations of baboons have increased to a point at which they constitute a constant hazard to agriculture. Cheetah are nearly extinct. Elephants maintain their number where their habitat remains undisturbed, though such areas are decreasing. With the same reservations, buffalo also maintain their strength and being most formidable. do not invite much attention from poachers. The remaining African animals which by tradition rank as game were in the past sought for the trophies provided by their heads, rather than the hazards which their taking involved. Of the trophy game which inhabited the forests, both the greater and the lesser kudu seem safe from the danger of drastic reduction. The hunt for the greater kudu continues to be perhaps the most challenging of all safari enterprises. Sable antelope are rarer since they can be captured or killed more easily and their meat is valuable, especially that of the bulls. Roan antelope have suffered greatly through efforts to combat the tsetse fly by destroying game over wide areas, and have also suffered from poaching. The ecological position of the wary, forest-dwelling antelope, the bongo (*q.v.*), remains obscure.

Of .the plains game, common giraffe have remained plentiful though some varieties have been reported to be growing rare. Populations of eland rise and fall periodically because the species is subject to rinderpest, but where their habitat remains their numbers are expected to be maintained too. Hartebeeste and wildeheeste (gnu) remain in great numbers. So do impala and Thomson's gazelle, though there are fewer Grant's gazelle. Zebra are much poached but the herds remain large. Fewer wart hogs were reported by the 1960s. Other animal life, such as apes and the lesser buck (bushbuck, reedbuck, steinbock and klipspringer) are not of interest to hunters who are principally interested in seeking trophies.

The trophy motive has been much reduced since in modern households large rooms are seldom available for the display of heads, and in recent decades there has been a tendency for the big game hunter to use a camera instead of a gun. However, this in itself cannot be expected to have much effect on animal populations. since it is not the sportsman but the poacher and the spread of civilization that are reducing the wildlife population in most African territories. (W. S.)

2. Principal Hunting **Grounds.**—*Northeast* and East Africa. —Most northerly of the major game territories is the Sudan which has a great variety of hunting grounds. On the east the hills hold ibex. while gazelles and oryx are found in the deserts of Kordofan and Dongola and Barbary sheep in the barren hills. But the chief hunting grounds of the Sudan lie in the south, up the Blue and White Niles. There may be obtained specimens of the giant eland (Lord Derby's) and the white rhinoceros, an animal which was once common in South Africa but is now unknown except in southern Sudan, northern Congo and Uganda. Elephants and buffalo are both common but the tusks of the former and horns of the latter are not big in the Sudan.

In Kenya, the most popular of the African big game fields, game may be seen in numbers to be encountered nowhere else in Africa in spite of the fact that the herds are not nearly so large or numerous as they once were. Every kind of country and climate is encountered in Kenya and each has its own fauna. Starting from the Indian ocean the first district is the coast belt, where game is plentiful but not so easily obtained as in other parts. The bag, however, may include elephant, buffalo, rhinoceros, eland. lion, bushbuck and some of the smaller antelopes. The next, and by far the most popular district, is the highlands which consist of great rolling plains interspersed with patches of bush and situated at an elevation of from 5,400 to 7,000 ft., in places reaching 9.000 ft. A great part of this area has been settled by Europeans but nearly 11,000,000 ac, are permanently reserved for the Masai tribe. The eastern half of this area is a game reserve but the western half is the most popular hunting ground, and specimens of almost every variety of East African game may be obtained there. A very large portion of Kenya is taken up by desert, to the north of the highlands. where the game is confined to oryx, Grévy's zebra, dikdik and Grant's gazelle. which gives place to Sömmerring's gazelle in the Jubaland region of the Somali Republic.

Southeast Africa.—The real tropical African country is not found much in Kenya but covers an extensive part of Tanganyika, where there is nearly as much possibility of varied sport as in Kenya. Here is the land of the sable antelope, which extends right down through Nyasaland. Northern and Southern Rhodesia to the frontiers of the Kalahari desert, but for really big sable antelope Angola is the best district. Rhodesia, both north and south, formerly was a fine hunting ground and still offers a chance of big kudu and roan antelope. Mozambique is heavily poached, but in the big swamps around the mouth of the Zambesi buffalo roam in great herds. South Africa now has little to show in the way of big game, although the region of Zululand probably still offers the best chance for nyala and the Kalahari is the only place where gemsbok exists (see ANTELOPE).

Western, West *Central* and *North* Africa.—The west coast holds plenty of game but not nearly in such profusion as the east, and this fact combined with the doubtful climate prevent its attracting sportsmen in numbers. Further, the heads of animals run smaller as a rule than they do in the east, while elephants carry lighter tusks. The West African buffalo, or bush cow, is, however, a distinctive type which is found nowhere else. The immense tracts of Gabon and the Republic of Congo, the Central African Republic and the Republic of the (former Belgian) Congo are seldom visited by sportsmen other than professional elephant hunters. but bordering on the eastern boundary of the Republic of the Congo lies Uganda which is the district par excellence for elephant and buffalo, as well as that shy and retiring water antelope, the sitatunga (see ANTELOPE). To the north the great Sahara desert is the home of gazelles, and in the hills of Morocco and near Algiers the sportsman who does not have time for a long journey has a chance of finding Barbary sheep. (G. BU.)

3. Safaris.—Reliable safari organizations can be employed to make all arrangements for a safari into east or west Africa. Some short duration safaris (about ten days' hunting) into equatorial Africa have also been established. Costs, on an all-expense basis out of New York. for example, range from about $2,000. Safaris into east Africa are generally set up for a minimum of about 30 days of hunting. If the customer wants an all-around take of game or desires to go into the more remote areas, the safari organization will probably ask that he allow more hunting time. Hunting time may run to 60 or 90 days depending on the territory to be hunted

and the game desired. There are no standard rates. but a safari into east Africa may cost the individual about $100 per day if there is one client per white hunter, less if there are two.

With the exception of all-expense safaris, licences are an extra expense. The cost of both general and special licences varies, and regulations change from time to time. The safari organizations furnish information about the costs and the white hunters serving as individual guides assist in procuring licences and gun permits. The organization will also recommend, and often supply, guns of the special large calibre used for large and dangerous game. Camping equipment, cooks, gun bearers, trackers, skinners and other services are generally covered by the fee. (E. P. B.)

E. Other Game Fields

South America has little in the way of attractions to the big game hunter, the jaguar being the only animal worthy of pursuit. In Australia the only indigenous large animal is the kangaroo which is scarcely big game for the sportsman's rifle; but in the Northern Territory there are herds of buffalo, the descendants of domesticated animals which escaped into the bush and have been wild for many generations. Some of the bulls carry quite good heads.

New Zealand is very different and is a country of peculiar interest in that all its game has been imported. These experiments in importation have been most successful with the result that magnificent red deer heads have been obtained, and the following animals seem to have become acclimatized: red deer (to such an extent that it has become a pest); North American moose and wapiti; chamois; Indian sambar, cheetah, tahr and bharal: and mule deer. (G. Bu.; X.)

III. SHOOTING SMALL GAME

The field sport of hunting small game and game birds with a gun is known as "hunting" in the United States and Canada and as "shooting" in Great Britain. It is practised in most countries of the world, although what is regarded as game map vary from country to country. Sometimes game is defined as a product of the wild that is killed for meat; sometimes as an animal or bird that is hunted for sport or that state or other law specifies as legitimate quarry.

1. North America.— In North America game usually is classified as those animals and birds that can be hunted for sport, but which are protected with a closed season for part of the year and on which there is a definite bag limit. In some places certain fur-bearing animals are similarly protected but hunting or trapping these animals for commercial use technically removes them from the small game category. Animals or birds that may legally be hunted for sport but are not classified either as game or as fur bearers are usually known as predators or vermin.

Rabbits and hares probably are the most popular small game animals in North America and the cottontail, the common U.S. name for several species of rabbit (*q.v.*), is the most popular of these, in part because many hunters value its meat and in part because it is relatively plentiful. Some states in the United States do not even class the rabbit as a game animal, and those that do allow relatively long open seasons. Dogs often are used to hunt rabbits and shotguns usually are the preferred weapon. Hunters should be aware that rabbits are the most important source of human infection with tularemia (*q.v.*).

In some parts of North America the brush rabbit and the swamp or marsh rabbit are popular game. Among the hares are included the snowshoe rabbit (varying hare), several jack rabbits and the large arctic hare.

In many areas of North America gray and red squirrel rank second to the cottontail in popularity among hunters. A shy and elusive target, the squirrel tests the sportsman's marksmanship and woodcraft. A .22 calibre rifle is preferred but shotguns also are commonly used.

Other North American small game include the prairie dog of the western plains, opossum, raccoon and woodchuck. Dogs are used to tree opossom and raccoon. both of which are hunted at night. In some states of the United States the raccoon is considered a predator and is unprotected. Both animals also have been trapped and hunted as fur bearers.

The woodchuck, groundhog or whistler (French-Canadian *siffleur*), the North American representatives of the European marmots, and the somewhat similar but smaller prairie dog require superior stalking and shooting skill. Many are bagged with .22 cal. rifles but often longer range guns are used; high-velocity cartridges are preferred and telescopic sights recommended.

North American small fur-bearing animals include badger, beaver, fisher, marten! mink, muskrat, otter and weasel; all have beer? trapped commercially for their fur and all have been hunted as small game or as predators.

Common predators include bobcat or North American bay lynx, sometimes called wildcat, Canadian lynx, coyote, gray and red fox, skunk. wolf and wolverine. They are not classed as game but both the wolf and wolverine are protected in certain parts of Alaska. R?inged predators include crow: owls and hawks, although many owls and hawks are protected. The great horned owl. the goshawk (largest of the hawks), the Cooper's hawk and the sharp-shinned hawk are not protected in all states because of their destruction of poultry.

Upland Game Birds.—Upland game birds provide some of the most popular sport for hunters (U.S.) or shooters (British). The ruffed grouse is a favourite, as are prairie chickens (sharp-tailed grouse and sage hen), spruce grouse and blue grouse (sooty grouse). Other popular game birds include chukar and Hungarian (European gray) partridge, pigeons and doves, ptarmigan and American woodcock. Quail, including bobwhite quail. mountain quail. valley quail and others, are widespread and attract many sportsmen. The ring neck pheasant. successfully introduced to North America, ranks high as a sporting bird. It is especially popular in the grain-belt area of the north central United States and Canada west of the Great Lakes into British Columbia. Perhaps the most highly regarded game bird in North America is the native wild turkey. which conservation measures have preserved in sufficient numbers for restricted shooting in most of the southern United States.

See also *Game Shooting* With *Dogs*, below. (E. P. B.)

Migratory Waterfowl Shooting.—The population of ducks and geese frequenting the U.S. flyways has varied greatly in the 20th century. yet. with the exception of rabbit shooting, more persons in the U.S. hunt wild ducks and geese than any other species of game.

Curtailment of legal limits and shortening of gunning seasons did not diminish the numbers of duck hunters, and there continued to be great pressures on the waterfowl populations. As in hunting upland game birds, however, the size of the bag should not be the gauge by which shooting success is measured; to the sportsman the number of birds secured is secondary to the pleasure of taking game in a sporting manner.

Wild ducks were formerly sold in the commercial market, and spring shooting (when waterfowl were on the return flight from the south to breeding grounds) was legal. Widespread slaughter of ducks to supply the market, especially in the spring when it prevented natural reproduction that might maintain flocks, threatened to bring about their extermination. The imposition of protective measures, however, was complicated by the fact that migration extended across international borders. The great bulk of the wild ducks and geese nest north of the 40th parallel. The population of these birds, therefore, depends to a great extent on conditions found in the northern United States and also in Canada during the breeding, hatching and rearing seasons, and on the protection of the ducks during these seasons.

On March 14, 1913, the U.S. government passed a law forbidding return-flight or spring shooting of waterfowl. and on Dec. 8. 1916, a treaty was entered into with Great Britain providing for similar protection of the birds in Canada. A law mas enacted on July 3, 1918, to put the treaty into effect. From that date both spring shooting and the sale of wild ducks and geese were illegal. The act of 1918 was declared constitutional by the United States supreme court on April 19, 1920. A similar convention with Mexico was concluded in 1937.

Responsibility for carrying out provisions of the Migratory Bird treaty in the U.S. was vested in the fish and wildlife service of

the department of the interior. This agency checks waterfowl populations to determine length of seasons and bag limits. Ducks Unlimited. an organization of sportsmen, and other groups also promoted measures devoted to the conservation of waterfowl.

Wildfowl travel over well-defined flyways, and four such routes in the U.S. are designated as the Atlantic flyway, Mississippi valley flyway, Central flyway and Pacific coast flyway. Certain shooting seasons are assigned each of the states on these flyways. Bag, possession limits and dates of open seasons, as well as hours of shooting, all of which may vary, are fixed by the U.S. department of the interior. State game administrators have some options in the application of regulatory measures, such as acceptance of split seasons. Wildfowl hunting regulations for each flyway have been announced annually since 1948.

Wildlife refuges established by the federal government in every section of the U.S. proved effective minter resting places for the wildfowl population. These sanctuaries, where no shooting is permitted. aid greatly in the conservation of wild ducks and geese, and provide future hunting opportunities.

Different ways of hunting wild ducks are pass shooting, jump shooting. timber shooting and shooting from a blind, a boat or a pit. with or without decoys. On the Canadian prairies, in the grain provinces, there is shooting in the stooks (stubble fields). The most popular form of duck hunting is over decoys from a blind. The shooter is concealed in a blind which may be in a lake or pond, along a shoreline or in shallow water. Before the blind are placed decoys of wood, rubber, canvas or other material. Wild birds, passing over, notice the flock of "feeding ducks" and swing in to alight. When the decoyed birds come within range, the hunters fire. Some wildfowlers are extraordinarily skilful in using a duck call to entice the wild birds into gun range. It is recommended that a retriever be in the blind with the gunners. There are various types of blinds. all of which are made to appear as natural as possible so as to lull the suspicions of the ducks. Boats may be disguised with rushes or otherwise camouflaged. Tidal water duck hunters use a battery or sink box. Movement frightens waterfowl. and experienced duck shooters are more careful about remaining perfectly still and having their companions and dogs do so than in having their apparel and cover blend with the surroundings. Some claim a sedge or golden coloured dog is not so noticeable as a black dog; most experienced hunters. however, agree that stillness, rather than coat colour. is of greatest importance.

Wild geese are more wary than ducks. They are hunted most successlully from pits or blinds with decoys. Along the Mississippi valley flyway, the pit blind is used almost exclusively, and is required in some localities. Some of the finest goose shooting on the American continent is available in the wheat fields in the Horseshoe lake area of Illinois. (W. F. Bn.)

2. British Isles.—Grouse Shooting.—The best-known branch of the sport in Britain is undoubtedly grouse shooting. Red grouse inhabit the high heather-covered hills of Scotland. northern England. Wales and Northern Ireland. Their presence made sporting rights over the moors an important commercial asset, and large sums are paid for shooting tenancies by sportsmen from many parts of the world. By systematically burning off old heather to encourage younger and more vigorous growth, the birds' chief food supply can be greatly increased and the stock correspondingly multiplied. Large bags have been made as a result. Two examples are 2.929 grouse to eight guns in a day in Lancashire in 1915 and 1.070 in a day by Lord Walsingham alone in Yorkshire in 1888. Such performances are unlikely to be repeated. or indeed attempted, again.

There are two main methods of shooting grouse: driving and "dogging." In driving, teams of beaters maneuver the birds over shooters u-ho wait in camouflaged butts. or shooting stands. In dogging. the shooters walk across the moor in line, preceded by dogs which mark the birds. Driving is considered to give the more difficult shooting and also has an advantage in that the older birds. which tend to become sterile after their first breeding season, are normally killed first and "birds of the year," being less strong on the wing and therefore slower over the guns, are left to form a rigorous parent stock for the following season. Dogging remains, however, the accepted method of shooting grouse in many districts in which beaters are not readily available.

Partridge *Shooting*.—The same two methods are used in the shooting of partridges, but this bird mainly inhabits the grain-growing areas and sport takes place over farmland instead of moor. After World War II the mechanization of farming reduced the land labour force, and therefore the supply of beaters, with the result that more shooting has been done over dogs. As in the United States and Canada, many changes in farming practice proved to be to the disadvantage of partridge and other game, especially the early plowing-in of stubbles, which removes winter food supply. The partridge population was thus much reduced in many areas. It seemed likely that gamekeepers. who hitherto did no more than protect partridges from attack by natural enemies and poachers, would need to rear some birds artificially. This was long believed impossible. but it was successfully accomplished in Denmark. By the 1960s a remarkable recovery had been achieved in the numbers of British partridges.

Pheasant Shooting.—In Great Britain, some sportsmen have felt that pheasants can supply sporting chances of shooting only under more or less artificial conditions. Preservation and artificial rearing are necessary to provide a concentration of birds. and. since gun dogs are not used in the same manner as they are in North America, the services of beaters are employed to put the birds over the guns at a height and pace to test the shooter's skill. Pheasants were introduced to Britain by the Romans, and the British, in their turn, took them to North America. The pheasant is the one bird which is now common to all countries where shooting is a recognized sport.

Black *Grouse, Ptarmigan* and *Capercaillie*.—Most of the shooting of other game in Great Britain is corollary to the sport to be had with grouse, partridges and pheasants. Black grouse, or blackcock (*q.v.*), for example, are to be found in most places where there are grouse. and the methods of shooting the two species are identical. Ptarmigan. on the other hand, belong only to the higher ranges of grouse country or to deer forests. They provide uninteresting shooting because of their tameness. Capercaillie. or capercailzie. may be found only in the neighbourhood of trees; the name is derived from the Gaelic "cabhar coille," or cock of the wood, and it is in the heart of pine and fir woods that this grouse makes its home. The birds are driven in winter, and give opportunities for remarkably high and fast shooting.

Snipe Shooting.—Snipe are to be found on most grouse moors, but snipe shooting is a sport by itself, enjoyed wherever there is suitable bogland. The bird rises from the ground like a flash. twisting this way and that, and to hit so elusive a mark needs a quick eye and hand. Snipe shooting is a sport of the winter months in Great Britain, for the home-bred birds are joined by the migrations from the continent in November. The largest bags of snipe have been made in the Hebrides, but Ireland and Wales, especially the former. provide some of the best snipe ground, and in England there are possibilities of good shooting in Norfolk.

Woodcock.—Woodcock shooting belongs principally to certain iocalities on the line of the birds' migration. As with snipe. large numbers of woodcock from the continent pass through the British Isles every autumn in a general direction from northeast to southwest. The shooting at Ballykine and its neighbourliood on the shores of Lough Mask in the Republic of Ireland is possibly the best in the world. Large bags are obtained in Cornwall. the limit of the line of flight in England. and in the west of Scotland, particularly the Isle of Islay. The difficulty of the shooting arises from the erratic movement of the bird when flying among trees. A woodcock in the open is a comparatively simple mark.

Hares and Rabbits.—Ground game provides shooting which is variously regarded as sport according to the standards of the shooter. Hares, which are destructive to crops, have to he shot down but hare driving produces few opportunities for interesting work with a gun. (See *Hunting With Hounds:* Have *Hunting*, below.) Rabbit shooting. however, may afford considerable tests of hand, eye and brain. for a rabbit gets to its top speed in an amazingly small space of ground. and takes every advantage of cover and obstacle. The European rabbit, unlike the North American

cottontail which normally nests above ground, lives in burrows and the main British methods of shooting rabbits are ferreting and laying out. In the former, ferrets are put to ground in the rabbits' burrows or "buries," and the animals are shot as they bolt from the holes. If the second method, that of laying out, is adopted. a day or two before the shoot, the gamekeeper goes the round of the buries nith some sort of evil-smelling mixture, such as paraffin (kerosene) and tar, which he sprinkles into each hole. The rabbits leave their holes at night to feed but do not return to them, objecting to the smell. On the day of the shoot the rabbits are found lying out in the undergrowth from which they are dislodged by beaters with sticks. or by spaniels.

Wildfowl.—Sport with wildfowl (ducks and geese) must always be of an uncertain nature, depending largely on the weather. The worse the weather the better, so far as the wildfowler is concerned; gales bring the fowl in from the sea to shelter, and frost confines the spaces of water where they can feed by night and rest by day. The shooter waits at dawn and dusk at certain points over which he knows the ducks will pass when flighting to and from their feeding grounds. A retriever is used to pick the birds in the dark or from the water into which they may fall. Duck hunters may use a "hide" or blind. Before World War II punt-gunning on the sea or in river estuaries was practised by a few amateurs and by professional hunters supplying birds for market. A flat-bottomed boat carrying a heavy swivel gun was used. The fowl were shot sitting, or just at the rise from the water.

Because little individual expenditure is involved in the conservation of the stock. wildfowl shooting is widely followed on both sides of the Atlantic ocean. (W. S.)

3. Game Shooting With Dogs.—Sporting dogs have been used to find, point and retrieve game for centuries. The development of gun dogs to suit the needs of hunters, however. has covered a wide range of breeds and divergent hunting activities, embracing fox. deer. bear and rabbit hounds, the pointing breeds, spaniel varieties and the recognized retrievers. (See also Dog.)

Only the Chesapeake bay retriever and the American water spaniel are distinctively U.S. breeds: the various other gun dog types have emanated from the British Isles or other countries. chiefly in Europe. Through selective breeding, adaptation and training, the dogs have been developed for. and have become proficient in, hunting. (*See* also *Hunting with Hounds*, below.)

Gun dogs are generally classified according to the specialty of the breeds. The group of pointing dogs includes the pointer and English setter. the most popular of these breeds; also the Brittany spaniel, German short-haired pointer. Gordon and Irish setters, the wire-haired pointing griffon, Weimaraner, Vizsla and Spinoni. The sporting spaniels are headed by the English springer. the cocker (both English and American breeds), clumber, field. Sussex and Welsh springer spaniels. The retriever breeds include the Labrador. Chesapeake bay, Irish water spaniel. curly-coated, flat-coated and golden retriever and American water spaniel.

In the United States gun dog in the main implies one of the breeds adapted to finding. pointing and retrieving game from upland and marsh. Pointers and setters unquestionably are most prominent. but all of the pedigreed sporting breeds have their advocates. Thousands of dogs are bred and registered each year to supply demands as more and more hunters realize the effectiveness of a good dog. Under modern hunting conditions a dog is essential to find game and to avoid tiresome tramping in fruitless quests.

Choice of a Gun Do,?.—Breeds are developed especially for certain work. Though such labels as "all-purpose" or "every-use" are applied to some hreeds. these do not compare in performance with the specialized pointing dogs, the hunting spaniels and the recognized retrievers.

If a hunter concentrates on upland game bird shooting—quail, ruffed grouse, pheasant. woodcock, prairie chicken. Hungarian partridge and valley quail—a pointer or setter is his best choice, followed by such less popular but warmly admired breeds as the Brittany spaniel (the only pointing spaniel breed), the German short-haired and the Weimaraner. If ducks are hunted in addition to pheasants and rabbits, a spaniel may best serve the purpose, preferably an English springer or a cocker. If waterfowl shooting is preferred, with perhaps an occasional foray for ring-necked pheasants, the retriever breeds. expert in water work and able to do a satisfactory job on land as well, should serve effectively. The Labrador, Chesapeake and golden retrievers are the most popular of there varieties.

The excellence of U.S. gun dog breeds may be attributed to the field trial sport—competitions for sporting dogs held under actual or simulated hunting conditions. Field trials enable breeders to evaluate the natural qualifications and refinements of a performer and select for breeding purposes individuals that can contribute to breed improvement. Accurate ancestries are on record in public stud books. and authentic information on a dog's winning and producing record in field trials is readily available.

The ultimate purpose of field trials is breed improvement, or development of improved gun dog performance in the shooting field. The best shooting dogs, those which work in a manner highly satisfactory to the average hunter, are bred from the finest field trial stock.

While the type of gun dog preferred for various kinds of hunting may differ. the important natural qualities to look for. whatever the breed. are instinct to hunt. good nose, intelligence, good constitution, nervous energy. good eyesight and hearing. tractable disposition, courage, and good conformation, style and appearance. In the case of the pointing breeds, the instinct to point is an important qualification.

The hunting dog must possess bird sense and hunt to the course chosen. should search upwind for hody scent of game, locate quickly and accurately. be well-mannered and steady to wing and shot. A pointing dog is expected to be staunch and to back a brace mate on sight or at command. He should not false point, potter (waste time) on foot-scent. blink birds (point but leave before the flush) or trail another dog with which he may he hunting.

Pointing dogs are versatile performers. They are efficient in hunting bobwhite quail in its native habitat; pheasants in meadowland. cornfield or swale; prairie chickens or Hungarian partridges in stubble; even ruffed grouse. characteristically found in woodlands or brush country; and, in Great Britain. red grouse. The accepted standards of performance for these various game birds differ. but this does not preclude a smart gun dog's being able to handle each satisfactorily. For example, the experienced quail dog can select objectives that are the most promising concealments, knows the habits of the game quested. and searches likely places depending on the time of day, character oi cover and weather conditions.

The various pointing hreeds differ in their methods. Pointers and setters hunt at greater speed and wider range than the close-working types like the German short-haired. Brittany, Weimaraner and kindred types. Retrieving is an acquired art with these breeds, although predisposed, and for short-haireds and Weimaraners adeptness at water work is a desirable attribute.

Individuals in the different hunting breeds naturally vary in ability. It has been said the setter is relatively slow in learning but improves steadily with experience, whereas the pointer learns more readily and is usually more easily trained. Such generalizations, however. are refuted by many individuals of both breeds. It is true that the setter can take the cold and wet and punishing briars more unflinchingly than the pointer, thanks to his long-haired coat, but in burr-laden areas the same coat picks up the stickers.

Most upland game bird hunting is done on foot. Consequently extreme range is impracticable and dogs are required to be subservient to the gun. In the U.S. south, however, quail hunting from horseback continues to be popular. though the number of places where it may be enjoyed has dwindled. For quail, the wide-ranging dog is referred to as a covey clog; the close-searching, keen nosed. adjustable single-bird dog is preferred in some situations.

The use of spaniels in U.S. game coverts became popular in the late 1920s. The rise to popularity of the springer and cocker was coincident with the flourishing of the pheasant. for the methods of the spaniels proved particularly suited to hunting these birds. The pheasant's trick of fleeing afoot. running off from the point of a setter or pointer, is circumvented by the spaniel's method of

quartering the ground ahead of the gun, covering all territory within ordinary shooting range at a fast. snappy pace. The spaniel springs his quarry and after flushing should immediately stop, assuming a sitting position. He is expected to retrieve only on command. It is essential that the spaniel be under control at all times. Most spaniels take to water readily and are what may be termed natural retrievers.

The retrievers are specialists. The Labrador, golden, Chesapeake and other retriever breeds have been bred, developed and trained to function in an important phase of bird shooting—the recovery of dead and crippled game. Although the retriever can be used in spaniel fashion ahead of the gun, his proper work is always after the shot. When hunting feather or fur, the retriever walks at heel, sits upon order and, when game is flushed, goes to retrieve when ordered to fetch. The dog is expected to mark the donned game. and should seek the fall in a brisk, quiet manner, thoroughly quartering the immediate area around the fall without unnecessary disturbance off the line. He should have a tender mouth and retrieve readily to hand.

When working on waterfowl, the retriever's place is in the blind or boat until actually ordered to go out. The fall of ducks should be noted and retained. for a requirement is the ability to mark several dead or wounded ducks. then deliver each in turn.

(W. F. BN.)

IV. HUNTING WITH HOUNDS

In the British Isles, some parts of the United States and elsewhere. hunting with hounds is a communal pastime which arouses much local enthusiasm.

1. Stag Hunting.— In Great Britain the sport of stag hunting, formerly called "hunting at force," entails the chase of deer by horsemen with a pack of hounds. It has been practised in this manner for more than 700 years. That it had its inception as a recreation of royalty seems obvious. and once orthodox rules were put into effect. stag hunting became the most fashionable of noble sports, although fox hunting superseded it early in the 19th century. It may be presumed that the first pursuit of the stag with "running" hounds was initiated in France. As a sport of the chase. it was brought to England by the Normans. who had adopted the French tongue and manners. The monks and clergy had a passion for the chase, hunting in great style with large retinues of servants. Because of the extent of their hunting proclivities, they were severely criticized and rebuked by moralists for neglecting their teachings. They were later prohibited from owning hounds under penalty of imprisonment. William Twici, huntsman to King Edward II, wrote about stag hunting in *Art de venerie (c.* 1314), as did Count Gaston de Foix in *Le Livre de Chasse* in 1387. Edward III, while engaged in a war with France, maintained 60 couples of staghounds, which he took with him to the battlefields. The modern method of chasing the stag. buck and hind was developed in the reign of Queen Elizabeth I. The queen's privy buckhounds were kept by Lord Leicester at Kenilworth (1575), and. under the supervision of Ranger Pollard, the royal Devonshire staghounds were kennelled at Simonsbath in 1598 and continued to hunt until 1825. Of the 20th-century packs, their successors, the Devon and Somerset staghounds have the most distinguished continuous history. including the period of World War II. When hunting returned to normal after that war, there were five packs of English staghounds and one of buckhounds (the distinction being that staghounds hunt red deer while buckhounds hunt fallow), two of staghounds in Ireland and five in France. French conditions differ from those in Great Britain in that most of the hunting there takes place inside the forest, whereas in Great Britain pursuit involves galloping across open moorland. Some British packs hunt carted stag, which is never caught but returns in a horsebox to the hunt's headquarters at the end of the day. This is in contrast with British fox-hunting tradition, which insists that the fox shall be genuinely wild and on its own familiar ground.

When World War II began, the British government encouraged the stalking and shooting of deer for food. This method. however. could not be followed in the well-populated west country, and hunting with staghounds was resorted to in order to save farm crops from depredation by deer. The stag-hunting season opens on Aug. 10 and continues until Oct. 10, at which time the rut is due to begin and hinds (female red deer) are hunted instead of stags. Stags are again hunted for six weeks from the beginning of April. when they have regained their full strength. Only warrantable stags, judged from the evidence of their antlers to be five years old or more, are considered fair quarry. The method of hunting, unchanged for four centuries, begins when the harbourer (a hunt servant) locates a warrantable stag in covert. A few hounds with special scenting pcwers, known as tufters, then hunt the stag into the open. where the main body of the pack joins in and the chase commences.

2. Hare Hunting.—-Hare hunting, in which hounds track by scent; is not to be confused with coursing (*q.v.*), in which pursuit is by sight. With mounted followers and hounds known as harriers, hare hunting ranked second only to stag hunting in Great Britain until fox hunting displaced both; until World War II it still took precedence in the hilly west of England. James I (1566–1625) followed the sport keenly, if unethically by modern standards, "live hares in baskets being carried unto the Heath." In a letter to his son Henry, prince of Wales, he had this to say about hare hunting:

> I cannot omit heere the hunting. namely, with running houndes, which is the most honourable and noblest sort thereof; for it is a thievish forme of hunting to shoote with gunnes and bowes; and greyhound hunting [coursing] is not so martial a game.

William Somervile (1675–1742), poet of the chase, referred to the joys of hunting hare, and keynoted its fascination in describing the tactics of the quarry—"a thousand shifts she tries." Somervile was an early advocate for "a diff'rent hound for ev'ry diff'rent chase." In the France of the Bourbons. the grandeur of the chase was unparalleled. An example of lavishness is cited by records of sport in the preserves at Chantilly, the residence of Prince Louis Henry de Bourbon. There, between 1748 and 1779. registered game accounted for in the chase totaled 77,750 hares, 3.363 stags and hinds and one fox. The prince maintained 240 horses and many packs of hounds.

Because of the multitudinous maneuvers of the hare, ali followers of this sport are able to see a large proportion of what goes on. Whether a man rides hard or little, "or not at all." hare hunting is considered a fascinating sport and an excellent school of horsemanship for its followers. In addition, this sport is much cheaper to conduct than other chasing sports and requires smaller areas over which to hunt.

3. Beagling.—The chase of the hare with hounds by foot followers is the oldest form of scent hunting organized as a sport. Xenophon wrote of it in Greece in 400 B.C. almost exactly as it is practised in Great Britain, where the word "beagle" is thought to derive from the Gaelic *beag* meaning "small"—the beagle being only about 14 in. tall. In the 20th century beagling increased rapidly in popularity both in Great Britain and the United States. Mechanization, resulting in the partial disappearance of horses, is doubtless an underlying cause. A contributory factor is its relative cheapness. Since the hare is capable of much greater speed than the hounds, and is the wiliest of quarries, its successful foot hunting is the art of venery at its highest. In Great Britain when hare is the object of the chase, whether by harriers or beagles, hunt uniforms are green, not scarlet as for the fox.

4. Otter Hunting.— Otter hunting is a sport particularly followed by enthusiastic fanciers of hounds who, when the fox-hunting and hare seasons are over, can enjoy the tracking of otter up and down the many streams in the British Isles. The season begins in mid-April and extends until about the middle of September. Because of the wandering propensities of the otter, the greatest difficulty encountered by the otter hunter lies in locating it. The otter starts its travels about midnight, and the earlier the hunter is afoot the more certain he is of being able to mark his quarry. It is necessary to strike his drag, or scent, and put hounds in the direction of his couch. a hole at the riverbank into which he may dive upon hearing the hounds. The scent is usually several hours old. and once hounds strike, there is the danger of their taking a line heel way, that is, going in the opposite direction to that

which the otter was traveling when it made its trail. Terriers are used to bolt (uncover) the otter if it is marked in a holt (temporary refuge). Otter hunting is an arduous sport. and in spite of the otter's strong scent it often escapes hounds. The otter's scent seems to be an unwanted one for unentered (young) hounds. and there is often difficulty in getting them to take it. Otter hunting, as an organized sport with packs of hounds, is more than 800 years old.

5. Fox Hunting in Great Britain. — England is the home of fox hunting as a sport. and a lasting tradition has been established. Opinion varies as to when fox hunting first became a recognized sport. In its inception, it was tried as an adjunct to stag and hare hunting. with the same hounds used to chase each quarry. The fox mas looked upon as a lowly creature and hardly an object of high sport. But once fox hunting took hold. the fox had few enemies except hounds and became a cherished object of the chase. Authentic and complete hunting diaries depicting the true situation prior to the 18th century are nonexistent. Honours for maintaining the first pack of hounds used exclusively for hunting the fox seem to be divided between Viscount Lowther. Lord Arundel and Thomas Boothby, with respective dates 1660, 1690 and 1698. In 1726 Squire William Draper devoted much of his time to fox hunting. with the express purpose of reducing the number of "lamb killing" foxes in Yorkshire. The form of modern fox hunting took shape in the 19th century shortly after Hugo Meynell—"the father of the modern English chase[x] — started hunting; and it soon developed into a national pastime. Whether in England or elsewhere, the traditional procedure is still observed and the proper kit worn. A fox hunt is conducted by the master. and, in theory. all who take part in it do so at his invitation even when they pay for the privilege. The hounds. generally 15–20 couple. are controlled by the huntsman, who may be the master himself but who is generally the senior paid servant of the hunt. He has two or three whippers-in to assist him in reconnaissance and in keeping the hounds together as a pack. Master, huntsman and whippers-in take precedence over all other riders to hounds. The huntsinan controls hounds by voice: his calls being known as cheers, and by his horn — a copper tube about eight inches long. the two notes of which, though not loud, have a peculiar carrying and penetrating quality. A day's hunting begins with a meet, at which the followers join the hounds, acknowledge the master and are frequently offered hospitality by one of their number who acts as host for the occasion. On the command of the master, hounds move off to draw (search) the covert, which may be woodland, patch of gorse or field in which it is suspected that a fox may he. When the fox is found, the fact being signalled by the cry of hounds and notes of the horn, the hunt begins and ordinarily proceeds to the stage where the fox is viewed. a moment which is signalled by a holloa, a high-pitched cry. If a kill follows. the brush (tail). mask (head) and pads (feet) of the fox may be given as trophies by the master to any followers whom he considers to have acquitted themselves so as to deserve the honour. The body of the fox is then thrown to the hounds.

Fox-hunting uniform is usually a scarlet coat with white stock (cravat) and black velvet cap for the master, huntsman and whippers-in. Followers of sufficient prestige are invited to wear scarlet. with the individual buttons of the hunt, and top hat (the velvet cap being strictly the prerogative of those actively engaged in the control of hounds, though by modern usage women also wear it). Other followers wear black coats. with top hats or bowlers. In the case of some ancestral hunts run by noble families the uniform may be green. yellow or gray instead of scarlet.

The entourage of a hunt includes among its lesser functionaries grooms, second horsemen (who ride relief horses for the master. his staff and leading followers), terrier men and earth stoppers. Of the last two, the former convey, either on horseback or foot. terriers which are sent down to bolt the fox should it escape into an earth (a fox's underground den) or drain; the duty of the latter is to ensure that the earths are temporarily closed on a hunting day to give the hounds the best chance of a kill. The most fashionable hunts operate in the midland counties lying around Leicester, but hunting takes place all over England, Wales, Ireland and parts of Scotland from November, when the harvest is gathered, until April, when new crops begin to grow. Cub hunting. when the young entries (hounds new to the sport) are taught to hunt with the pack, is carried on in September and October.

Just prior to World War I. fox hunting reached a zenith of popularity as an English field sport. Horse and hound breeding had arrived at a highly developed state, and hunting itself was well organized and regulated by the Master of Foxhounds association. While the sport undoubtedly lacked the golden flavour of hunting as it was enjoyed during the Victorian era, it nonetheless attained certain other compensating attributes. When the country was mobilized for war in 1914, many nonsympathizers felt that the death knell of this amusement had been tolled. but by judicious and drastic measures. which included reduction in the number of hounds, hunting weathered the storm.

An upsurge in interest following the war did not put an end to hunting difficulties. The changes in patterns of ownership and use conditions of rural England. begun prior to 1914, were accentuated. Great landowners and their tenant farmers began to be replaced by numerous small holders, and barbed wire became a menace. These threats to the sport were handled by the Master of Foxhounds association, whose members promoted the benefits of hunting to both the countryside and the community.

The experiences of World War I helped fox hunters to combat some of the problems of World War II. In spite of the scarcity of feed and other hardships. the government took the position that hunting on a vastly reduced scale served a useful purpose. Consequently, with the assistance of the many sporting farmers, with hunt staffs consisting of men ineligible for service, and also with the aid of women, establishments able to do so continued on a skeleton basis.

With the end of the war a section of the urban population of Great Britain initiated a campaign to prohibit fox hunting. Their efforts encountered vehement opposition in the countryside. and this was strongly reinforced with the return from military service of the more active hunters. It soon became evident that feeling on the subject was running high, but the anti-fox-hunting party promoted a bill to secure the abolition of the sport. When the measure was debated in the house of commons in 1949 the bill was defeated. Thereafter fox hunting rapidly re-established itself after its wartime difficulties. By the 1960s there were about 230 recognized packs of foxhounds in Great Britain and Ireland, approximately the same number there had been in 1939 on the eve of World War II; in 1885 there had been 191. (W. S.)

6. Fox Hunting in the United States. — Early *History.*— Contrary to general belief, fox hunting began awakening in North America at about the same time it did in England. A number of early settlers brought hounds. horses and hunt servants from England to Xmerica to carry on the type of sport in vogue at the time they left home. Authentic information as to when the first pack of hounds was devoted exclusively to fox is not more available in the U.S. than it is in England. There is evidence, however, that fox hunting of sorts was carried on in the colonies as early as 1650, following the arrival in Maryland of Robert Brooke. This man came from England in his own private ship with a pack of hounds, accompanied by his family and 28 servants. On the record, Brooke can be designated as the first known master of a pack of hounds in colonial America. His most important contribution to fox hunting was the Brooke hound. which has remained an entity and formed the basic breeding stock for such famous American hound strains as the Trigg and Walker. Whereas England developed fox hunting as a sport — its style, finesse and science — American fox hunters were the first to ride straight cross country while following hounds. In England, hunting at the outset was the pastime of royalty and the landed aristocracy, who considered the sport a personal hobby requiring the finest of clothes, good hunters, well-bred hound.: and skilfully trained servants. Also, because the dictates of etiquette required a certain amount of dignity and restraint. all hunting procedure was conducted according to rule. In America, while all was unsettled. untamed and unrestricted. the country and its customs not as yet having been defined, almost everything was done in individual and uninhibited fashion.

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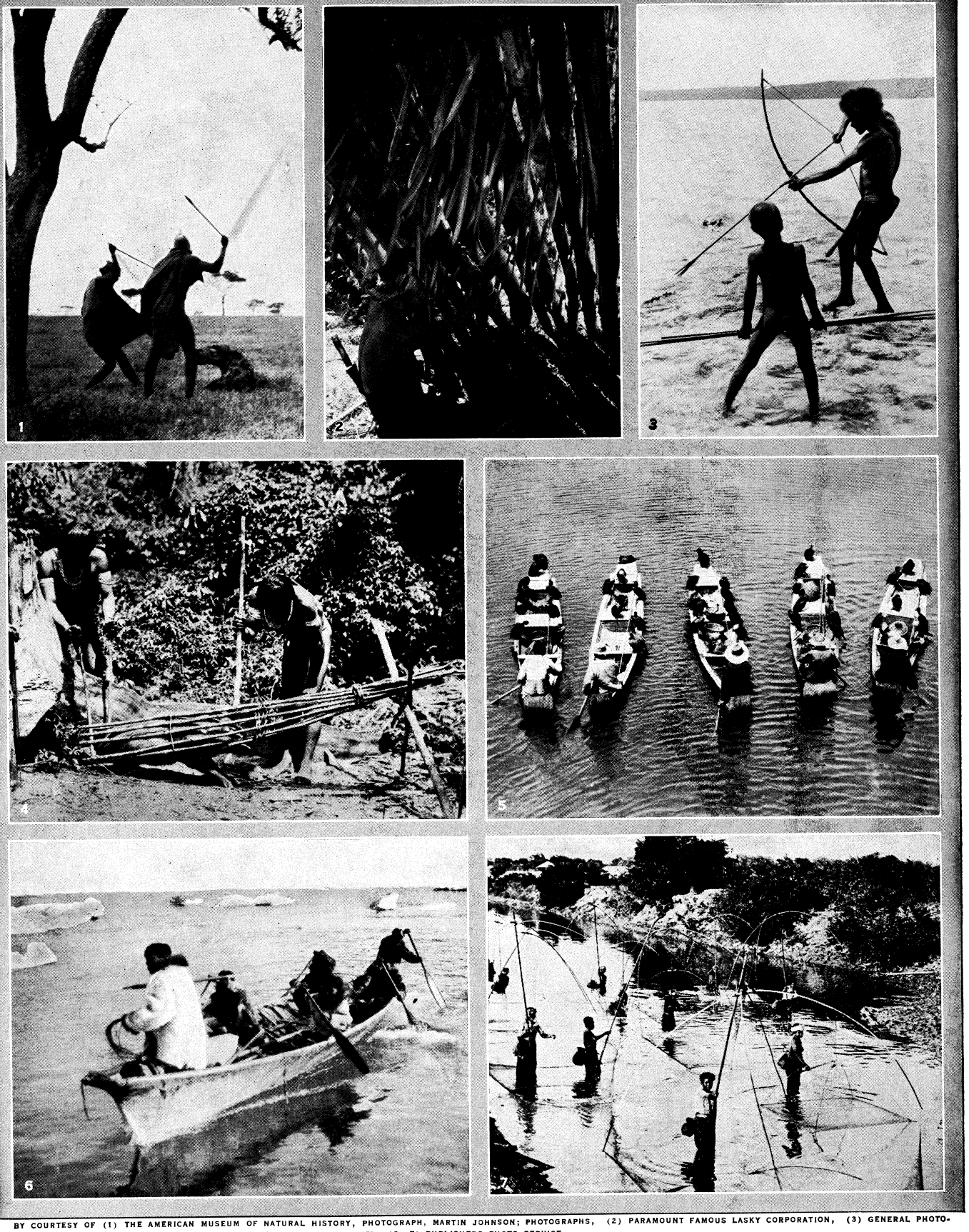
HUNTING IN ENGLAND AND THE UNITED STATES

1. The Cottesmore hunt. This famous shire pack is seen here on the hillside between Pickwell and Cold Overton
2. The Piedmont foxhounds, Upperville, Va. The huntsman is shown with the pack of American hounds
3. Mr. Stewart's Cheshire foxhounds, Unionville, Pa. A part of the hunt after the fox had gone to ground — also a glimpse of the "home bred" English hounds, the country and type of fencing

HUNTING AND FISHING



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HUNTING AND FISHING FOR BIG GAME

1. African natives spearing a hyena
2. Setting up a trap for big game in the Malay Peninsula
3. Papuans of New Guinea hunting fish in the native manner
4. Wiama Indians of northern Brazil trapping the peccary (wild hog)
5. Chinese fishermen of Hang-chow-fu fishing with cormorants; a cord around the bird's neck prevents its swallowing the fish
6. Eskimos harpooning walruses from an "umiak" or skin-boat
7. Siamese fishermen fishing with nets on poles, in a "kiong" or canal

When the sport spread from one locality to another. only the most casual notice was taken of how anyone else went about it. Wad this not been the case, it would undoubtedly have taken many more generations for fox hunting to make real headway in North America.

While fox hunting in England started as an exclusively upper-class pastime, it worked down democratically, eventually becoming a national sport. In America, on the other hand, there came a period when attempts were made by certain groups to make of it a privileged sport, limited to a few select club members. Finally, in order to make of hunting all that it should be, attitudes were recast on a broader and more democratic basis.

In 1742 Thomas Walker of Virginia imported a pack of foxhounds from England and established himself as the master of the Castle Hill hounds. the only pre-Revolutionary pack to span the vears into the 20th century without losing its specific identity. Fox hunting became the favourite pastime of several presidents of the United States. cabinet members, justices of the supreme court. senators, congressmen and high-ranking army and navy officers. George Washington devoted practically all his spare time to the chase. having learned the sport from his friend Lord Thomas Fairfax. who came to Virginia in 1746. Martha Washington also hunted occasionally. Thomas Jefferson was a "keen hunter, as eager after a fox as Washington himself."

In 1766 the Gloccester Foxhunting club was organized in Philadelphia by 27 prominent sportsmen and is important as the first recorded fox-hunting club established in America. Although it was disbanded in 1518. hunting continued in the neighbourhood of Philadelphia with increasing spirit. being conducted by many offshoot groups of the Gloucester. In New York city. fox hunting was extremely popular before and after the Revolution. Many early newspapers carried accounts of hunting on Manhattan Island as well as Long Island, North Riding and Westchester county. Col. Jaines de Lancey and Gen. Statts Long Morris maintained well-known packs of foxhounds.

In 1783 the St. George Hunt club was organized in New York city with John Evers its first master. Evers had brought a pack from England in 1768. Members of the club included George Washington, Alexander Hamilton, Charles Lee and John Jay. When Evers died in 1807 Cadwallader D. Colden (mayor of New York city. 1818) became master. About this same period in New York there existed a Colonial hunt. Little is known of its make-up. During the period of the War of 1812. the Belvidere hunt was established on Manhattan Island by Edward and Rufus Prime. n-ho lived at 1 Broadway. The Belvidere scheduled most of its fixtures at Cato's Inn. 67th street and Third avenue. Fox hunting continued on Manhattan Island until about 1821. The population of the city at that time was 123.706.

Other prominent organizations established in the 1800s included the Baltimore and Washington hunts. Among the Washingtonians who followed hounds in those days were Andrew Jackson. John Marshall and Roger B. Taney. In 1856 the Brooklyn Foxhunt club was organized by T. C. Carpendale. Henry W. Herbert. who gained fame as a writer under the pseudonym "Frank Forester." was a member of this hunt. as mas William T. Porter. who established the Spirit *of* tile *Times* (1831), early American sporting newspaper. The Brooklyn Foxhunt club was disbanded in 1861.

In Canada the Montreal hunt, founded in 1826, continued through the years to become the oldest organized hunt on the North American continent. The Toronto hunt was established in 1843. By the second half of the 20th century Canada had more than 100 recognized hunts associated with the Master of Foxhounds association of Sorth America.

Growth of For *Hunting* in *the United* States.—Before the American Revolution, fox hunting. as indicated above. was a hit-or-miss affair. most packs being trencher-fed (hounds being owned individually and brought together only when hunting). Though the Revolution interrupted the sport, some informal activity in it continued. George Washington, for example. mentioned above as an enthusiast. often managed to enjoy a few hours of hunting between battles, according to his diary. Between the Revolutionary and Civil wars fox hunting was followed seriously by Americans, particularly the landed gentry of Virginia, Maryland and Pennsylvania. Hounds and hunt servants were imported from England, and much more attention was paid to formality than had been previously. The Civil War halted this. however, only four hunts surviving, two in Canada and two in the United States. But immediately following that war enthusiasm returned, and the importation of hounds and hunt staffs increased steadily.

The formation of the Masters of Foxhounds association in 1907 did much to stabilize hunting and improve it through organization. Territories were allotted to recognized hunts, hunt colours were registered. and type of country and preferred type of horse were listed. The period directly after World War I saw the establishment of many new packs. and the depression of the 1930s did not affect the sport seriously. Interest continued through World War II. But what wars and depressions could not destroy, prosperity seemed to threaten. The postwar increase in building meant the conversion of many large farms and estates to building developments. Thus land through which the hunt had been accustomed to gallop. especially around the big cities. was lost to the sport and hunting was curtailed. On the other hand. there developed a newly born interest in parts of the west. midwest and southwest. in territories formerly given over to ranching. By the 1960s there were 90 recognized fox hunts in the United States.

Differences Between *Hunting* in the *U.S.* and in *England.*—U.S. fox hunting. though it follows the etiquette and general rules of English fox hunting. has had to adjust itself to somewhat dissimilar conditions. In England the fox is protected. and the earths. drains, etc.. are stopped (see abovej during the night before a meet while the fox is out foraging. Furthermore England has fewer large. dense woodlands and swamps through which a horse and rider cannot penetrate. In the U.S. earths are not stopped. so the fox goes to ground more frequently than not. and most U.S. masters do not consider it sporting to dig out a fox except at the beginning of a run. Much of the territory is not negotiable by a horse. Consequently the method of hunting is different; in many parts of the country a more rugged type of horse is preferred and hounds must be trained to be more independent and to hunt much more on their own than are the English hounds, which are far better disciplined and leis independent.

Country.—To a fox hunter the term "country" means topography of terrain and type of obstacle. There is the stone-wall country of New England and upper New York state. for example, where the fields are small and the walls rough and often unjumpable except where they have been panelled with telephone poles called riders. Long gallops are few and checks frequent. A rugged, half-bred horse is preferred, one whose tendons mill not suffer in heavy. muddy going. As a contrast, along the eastern seaboard and in Pennsylvania is the post-and-rail country. with great rolling fields enclosed in the familiar split chestnut rail fencing. These run from 4 to 4½ ft. in height. so many are panelled with "chicken coops." a solid board construction, wider at the bottom than at the top and shaped like a peaked roof. In this country the thoroughbred horse is usually preferred. as the going is much faster and not so rough as it is farther north. American fox hunters like timber jumps and find the hedges. ditches and banks of the British Isles terrifying. whereas the average British or Irish rider prefers a ten-foot bank to a three-foot barway. The modern wire fence bedevils the sport of both British and American enthusiasts, whereas the Australians train their horses to jump wire with complete aplomb.

But though hounds and countries may differ, in the 20th century as in the 18th. fox hunting is still a question of pitting animal intelligence against animal intelligence. Modern weapons have not been introduced. As in the days when the sport was the prerogative of kings and nobles, it is the hounds that do the hunting, the field following along as best it may.

"One-Gallus" Fox *Hunters.*—Another form of fox hunting which is strictly indigenous to the Sorth American continent is that enjoyed by a very large number of individual, informal hunters. Often called night fox hunting, this sport. game or pastime might be described as a passive. "hill-topping" type of fox hunting—a fox race in which the only active participants are the fox and

hounds with people sitting around a fire on top a hill in the moonlight and listening to hound music. Those who enjoy this pastime do so without ritual, equipment or style; all that is required is a foxhound. The respective owners of the individual hounds. who group them so as to make up a pack, possess a devotion to this form of recreation which cannot be claimed by many hard-riding foxhunters; viz., a knowledge and love of hounds. They know about hound breeding, hound development, what they do, how they run and how they speak to the line. Field trials include a U.S. open.

During the fox race, an owner by listening carefully can single out. his own hound and its position in the race by the manner in which the hound throws its tongue. The Sox-race type of American hound has been bred for nearly 300 years, and many individualized hound strains have become famous. The most popular are the Walkers, Triggs, Julys and Goodmans.

(J. B. VAN U.; M. C. SF.)

See also references under "Hunting" in the Index volume.

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HUNTING AND FISHING, PRIMITIVE. Both archaeological evidence from the past and observations on the simpler societies of the present day show an appreciation of animal food and considerable ingenuity in methods of capturing it. The earliest fossil teeth suggest that man was omnivorous, eating flesh as well as vegetable products; primitive hearths contain animal bones intentionally smashed with stones for the extraction of marrow; and stone weapons have been found embedded in vertebra and skull of Paleolithic reindeer (Dordogne) and Neolithic ox (Cambridge). The cave paintings of western Europe are thought to represent the efforts of hunters to obtain success in their hunting by magic.

Before the invention of agriculture primitive man everywhere depended on hunting and fishing for his supply of animal food. Later, hunting became accessory to agriculture. providing variety in the vegetable diet and surviving as sport or recreation; or was required to protect flocks and herds, against predatory beasts. Primitive agriculture often is the work of women, while men are hunters. But where nature is sufficiently lavish in vegetable food. or where land mammals are comparatively few and small, hunting is of secondary importance to fishing, and fishing to agriculture; which then usually becomes men's work or the work of the entire family.

In modern times few tribes survive who support themselves entirely by hunting. Civilization and political control have encroached upon outlying less desirable lands into which hunting tribes had retreated. The development of aviation brought most regions of wilderness under routine observation, and the depletion of game makes it impossible for all but a few hunting bands to maintain themselves by hunting alone. In a few subarctic areas, as in Canada and Serbia, the seasonal trapping of fur-hearing animals can be followed on a scale sufficient to enable a small number of individuals to support their families on a bare subsistence level, depending upon the trader to supply trapping equipment, firearms. clothing and staple foods in exchange for furs. Nevertheless, these hunters are intermittently dependent upon government aid. The result is that surviving primitive hunters in most parts of the world have adjusted their living economy to that of the nations in control of their original territory, though they still preserve the traditions of recent times when they were self-supporting. By collecting and integrating these traditions and surviving folkways the anthropological field researcher often is able to reconstruct the mode of life of a given tribe when the people did live as independent hunters.

This article is limited to the consideration of people who were gatherers of wild food as distinguished from those who produced at least a sizable fraction of their food by the domestication of plants and animals. For ages all human beings lived entirely by what nature provided but eventually some groups here and there began to supplement the available supply of wild food by the cultivation of plants and the taming of birds and animals. In historical perspective by gradual extension of these practices agriculture and animal husbandry became the primary form of economy. Peoples may be characterized as pure hunters and food gatherers, primary hunters, secondary agriculturists, primary agriculturists, secondary herders. primary herders. and finally populations whose entire support is by farming and stock raising. Thus in 1492 the Indian tribes of North America east of meridian 100° west and south of parallel 45° north were for the most part secondary agriculturists. In a relatively small area comprising what are now New Mexico and Arizona; with a fringe in border states, the Indians were primarily agricultural. resorting to hunting for skins and a supplementary food supply only. But much of what is now the United States and Canada was occupied by pure hunters and gatherers. The aboriginal inhabitants of Mexico. middle America and the Andean highlands north of latitude 35° were primarily agricultural. For the most part the lowlands of the corresponding parts of South America were secondarily agricultural. Below parallel 35° south. the aboriginal tribes were almost entirely hunters and gatherers of wild foods. In the old world of corresponding date (1492) pure

hunters and gatherers dominated Australia, a few isolated areas in Siberia, Africa and southeastern Asia. Most of the Pacific islands approached a primary agricultural economy, supplemented by the gathering of wild foods.

The term civilization implies (among other features) dense populations dependent on a well-organized integration of agriculture and animal husbandry. a form of living which had appeared in the valleys of the Tigris and Euphrates, the Sile and the Indus rivers by about 4000 B.C.

Density of human population depends upon the group's mode of life. Under a pure hunting and food-gathering economy population must of necessity be sparse. It has been estimated that for people depending entirely upon food gathering and hunting there must be available from 7 to joo sq.mi. per capita according to climatic conditions. Since a hunting and food-gathering form of existence seems to have prevailed until about 10000 or 8000 B.C. and, if the minimum space required for such a mode of life be taken as 7 sq.mi. per capita and the earth's surface as 50,000,000 sq.mi., it can be hypothesized that the total world population at that time could not have exceeded 7,000,000 persons. At any rate, great populations pertain to modern times. Hunters and even fishing peoples could not have maintained cities in the modern sense without engaging in extensive farming and stock raising. In fact permanent towns were rarely possible, the family group being forced to move whenever the supply of food began to decline. The existence of large populations is fundamentally dependent upon farming and animal husbandry.

The recognition of definite rights over hunting grounds or fishing waters is usually clearly established and poaching vigorously resented by the rightful owners! who are sometimes, however, placated by a share of the spoil. The Eskimo may form an exception to this rule! for it appears that they have no strict division of hunting territory. The rights of the individual or the hunting group over the game killed were sometimes definitely fixed in primitive societies. Usually the man whose arrow first struck the animal, or first struck it in a vital part, had first claim. In the Xndaman Islands a pig belonged to the man whose arrow first struck it. but a bachelor had to be content to see it distributed by one of the older men, all the best parts going to his seniors, while he and his contemporaries received the inferior parts.

Magic plays a very important part in primitive hunting and fishing. and a man relies for his success on supernatural as well as natural means. while ill-success is ascribed less to lack of skill and inadequate weapons, than to failure in some preliminary ritual, or to the stronger magic of some rival force.

See AGRICULTURE, PRIMITIVE.

PRIMITIVE INVENTIVENESS IN FOOD GETTING

HUNTING

Methods of hunting vary with the nature of the country and of the animal hunted, the ingenuity and inventiveness of the hunters and the materials at their disposal. The Australians had few and plain weapons before European contact: their traps and snares were for the most part, simple and obvious. They depended on their stone or bone-tipped spears. wooden clubs and missile club or boomerang. They stalked both emus and kangaroos. used pituri plant decoctions to stupefy emus at nater holes, and exploited the curiosity of the bird by luring it on to a pitfall in nhich it was speared. The Bushmen of the Kalahari desert, south Africa, run an unnounded springbok to a standstill in the hottest part of the day, keeping the animal constantly on the move. preventing it from lying down, until. by reason of the hot sand getting between its hoofs. it sinks exhausted to the ground. The Eskimos pursue sea birds in kayaks, folloning them by the bubbles when they rise, and by tiring them out. catch them by hand. They also run down fanns in the spring, driving them into deep snow, a method formerly used by the Plains Indians for killing the floundering bison in winter.

Disguise, Traps, Snares, etc.—Patience and cunning of a higher order are seen in the devices by which the hunter conceals his approach and in the various nooses. snares, nets, traps, game pits and decoys found almost universally among primitive hunters. The Australian covers his head with waterweeds as he swims after waterfowl, or approaches the emu carrying a leafy branch to prevent the bird from noticing him. The African Bushman scatters a handful of dust over his head to make himself the same colour as the dry grass, or plaits a kind of saddle of grass, sticks some ostrich feathers in it and places it on his shoulders, holding up a long stick with the head curved to look like an ostrich. He imitates the actions of the bird, feeding, running, preening its feathers, and, always moving up wind, contrives to get as near as possible to the flock before discharging his poisoned arrow. Sometimes the imitation is too realistic, and the cock bird, resenting the advances of a rival, attacks the hunter. The North American Indians stalked deer disguised in deerskin, and put on a bison skin when stalking bison. Nooses, snares, traps and pitfalls are quite varied, and the peculiarities of the animal to be lured are carefully studied, human ingenuity being pitted against animal cunning. Firing the bush or prairie was a method of startling game, which could easily be trapped or knocked over in terrified flight. Fire forinerly was used by African natives for elephant hunting. When a herd was discovered a large circle surrounding it was fired and the entrapped animals, crowded together, bewildered by the flames and blinded by the smoke, would be unable to escape. In North America the Plains Indians used fire in killing bison.

Weapons.—Any stick or stone can be picked up at random to knock over birds and small game, but specially shaped clubs or throwing sticks are common, such as the African knobkerry and the Australian waddy, which developed into the more specialized trombash of the Upper Nile or the Australian boomerang (*q.v.*). The Australian spear is often only a stick, with its end hardened in the fire, though barbs may be added, or stone heads fixed in with "gum." The knife is a sharpened stone or is made of the leg bone of the emu. In Australia! as in arctic America, the spear is propelled by the spear thrower to give greater range. Except in Australia bows and arrows are universal among primitive hunters, varying according to the skill of the maker, the materials at his disposal and the prospective victims. The blowpipe or blowgun is more silent than bow and arrow and, with its poisoned darts. is one of the deadliest weapons in the hands of the primitive hunter.

See BOW AND ARROW; WEAPONS, PRIMITIVE.

Poisons.—Poisons are both animal and vegetable, and consist of many ingredients which are mixed with secrecy and magic. The central Australians catch emu by pounding up pituri (*Duboisia hopwoodi*) leaves with water as a bait; the bird becomes stupefied and is easily speared. In parts of the Amazon region the poison is assaca sap. The Macusi of British Guiana make their famous *curare* (*q.v.*) poison from the climbing *Strychnos toxifera,* mixed with other plants, adding black and red ants, and the poison fangs of snakes. The Punan poison in Borneo is the dried juice of the upas tree. The Bushmen of south Africa have a wide range of vegetable poisons, including *Strychnos, Euphorbia, Digitalis, Strophanthus* and the "Bushman poison bush," *Acokanthera venenata.* They add snake poison glands, poisonous spiders and scorpions, and in particular the little and specially deadly caterpillar called *"ngwa."*

Dogs.—Dogs have long been used to track and kill game, and their remains are found in deposits of Neolithic and earlier ages. The hunting dogs of the Lilloet of British Columbia were carefully trained and treated: one good dog was worth a large dressed elk skin. Among the Eskimo seal hunting would be scarcely possible without the help of dogs to smell out the breathing holes under the snow. Dogs help the Labrador Eskimo in hunting the polar bear.

Among the Gilyaks of the Amur river region, Siberia, the dog is held in high esteem, for at death the soul of the hunter is believed to pass into his favourite dog, which is fed with choice food and finally sacrificed on his master's grave.

The Nagas of northeastern India hunt in large numbers while the dogs drive out the game. Custom provides for the dogs (or their owners) a share of the quarry, known as the "dog's share."

The "dog's share" also is a recognized part of the spoil in Africa and in Melanesia.

Fishing

Fishing is commonly accessory to hunting and as widely distributed but more restricted in its range, since purely fishing peoples are found only on the banks of large rivers or lakes or on sea coasts. There: however, if the fish are abundant, fishers are able to maintain a more settled life than hunters on land, supporting themselves entirely on their catch, for food and trade. They are also less isolated than hunting peoples. Fish are not easily exterminated, and large groups can live in fishing villages, while the water provides a means of intercommunication.

There are tribes among whom fish forms the staple food the year round. The Indians on the banks of the great rivers of northwest America. where sturgeon grow to an extraordinary size, could catch and dry enough fish to last from one season to the next, and if not. there was scarcely a month in which some species of salmon could not be caught. The Eskimo are great fishermen and in the winter live mainly on sea or river produce. In the summer the women fish while the men hunt, and dried or frozen fish and seal meat form the winter provisions. At the extremity of the South American continent the coast-dwelling Fuegians fish from their frail boats made of bark and train their dogs to assist them by plunging into the water and driving the fish. Fishing is important on all the great rivers of Siberia. The Gilyaks and Golds of the Amur river live entirely on fish and on the bears which crowd down to join in the fishing; when the salmon run. Transparent fish skin supplies the windows for their semi-subterranean houses, and, in former days, the clothing was of salmon skin! ornamented with carp skin, a fashion later abandoned, although fish skin shoes are worn in the summer.

In Africa many people living on the banks of the great rivers or on the shores of the great lakes are mainly if not entirely dependent on fishing. Throughout the islands of the Pacific, fish, dugong and turtle are especially welcome as a change in the ordinary vegetable diet. In some islands anything connected with fishing is considered sacred; the type of fish-eaten by pregnant women, priests and other special groups may be circumscribed. In southeastern Asia! in the Malay archipelago and on the Chinese coast. are families and groups of families who seldom land on shore and never settle there for any length of time. Their homes are their boats, and fishing is their livelihood, supplemented by trade, or, in former times, by piracy.

Simplest Methods. — The most primitive fishing methods consist merely in the collecting; the fish are caught by hand. speared or shot with bow and arrow. The .Australians catch catfish with their feet, or, stirring up the water, hit or spear the fish coming to the surface. The African Bushmen spread grass on the surface of a pool, then, wading in, push the grass and fish into the shallows where they are easily caught. Farther north, near Stanley pool (Belgian Congo). as the river shrinks in the dry season, fish are scooped out of pockets in the rocks with gourds. a pint or more at a dip. And when the *sukai*, the "fish of fishes" (Onchorynchus), swam up the Fraser river (British Columbia) to spawn or the oolichan (*Thaleichthys pacificus*) choked the river in a plentiful run. the Salish Indians speared them in hundreds or scooped them up in buckets.

Weapons and Nets. — Spears, bows and arrows are the principal weapons for fishing as for hunting, to which may be added harpoons for larger fish and sea mammals. Nets are fairly general from the small hand nets, mainly used by women and children in shallow water and at low tide, to enormous seine or drag nets stretching right across reaches of the rivers or shallows of the sea; but the use of hook and line, though found among many primitive fishers, is not universal. The Andamanese. most skillful fishermen: used no hook or line; the central Australians had no hooks before the coming of the white man, and neither nets nor hook and line were known to the Tasmanians. The Bushmen have barbed harpoons for fishing, but rely on baskets instead of nets. In Torres straits the Murray islanders wade into the sea with conical baskets to scoop up the sardinelike shoals of *tup*. In central Australia nets made of rushes, without floats or sinkers, are stretched from tree to tree or stakes. and left there. If a man wants some fish: he swims out and helps himself.

Fire and Poison. — In fishing fire is man's ally, as in hunting, and fish are everywhere lured to destruction by the light of a torch. Poison is also commonly used. In Africa circles of *Euphorbia* stakes are planted in a river, and the fish become entangled and stupefied; or bruised stems of poisonous plants are thrown in. and the helpless fish float to the surface. The Polynesians mix *Tephrosia piscatoris* or *Barringtonia speciosa* with taro as a poison bait and catch the fish by hand.

Dogs and Suckerfish. — The dog is occasionally used to drive fish (*e.g.*, by the Fuegians, by the Ainu of Japan and in some places in England and Ireland) as otters are trained on the Yangtze; while in Chinese lakes and canals cormorants dive for fish: with a cord round their necks to prevent the catch from being swallowed. In Australia and Torres straits, as in Central America: suckerfish (*Echeneis naucrates* or *remora)* are used for catching small turtle. The fish is thrown out of a canoe with a line attached to the tail and attaches itself to the turtle. The line may then be drawn in, together with the turtle, or may serve as a guide to a man who swims down and gives the turtle a finishing blow.

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HUNTINGDON, EARLS OF. GEORGE HASTINGS, first earl of Huntingdon[1] (*c.* 1488–1545). was the son and successor of Edward. second Baron Hastings (d. 1500), and the grandson of William. Baron Hastings. who was put to death by Richard III in 1483 He mas created earl of Huntingdon in 1529, and he was one of the royalist leaders during the suppression of the rising known as the Pilgrimage of Grace in 1536.

His eldest son FRANCIS, the second earl (c. 1514–1561), was a close friend and political ally of John Dudley, duke of Northumberland. sharing the duke's fall and imprisonment after the death of Edward VI in 1553; but he was quickly released, and was employed on public business by Mary.

His brother Edward (*c.* 1520–1j72) was one of Mary's most valuable servants; a stout Roman Catholic. he was master of the horse and then lord chamberlain to the queen, and was created Baron Hastings of Loughborough in 1558, this title becoming extinct when he died.

The second earl's eldest son HENRY, the third earl (*c.* 1535–1595), married Korthumberland's daughter Catherine. His mother was Catherine Pole (d. 1576), a descendant of George, Duke of Clarence; and, asserting that he was thus entitled to succeed Elizabeth on the English throne, Huntingdon won a certain amount of support, especially from the Protestants and the enemies of Rlary, queen of Scots. In 1572 he was appointed president of the council of the north and during the period between the flight of Mary to England in 1568 and the defeat of the Spanish armada, twenty years later, he was frequently employed in the north of England. He was for a short time in 1569 one of the custodians of Mary. Lady Elizabeth Hastings (1682–1739), daughter of Theophilus, the seventh earl, was famous for her charities and her piety. Her beauty drew encomiums from Congreve and from Steele in the pages of the *Tatler,* and her other qualities were praised by William Law. She was a benefactor to Queen's college, Oxford. THEOPHILUS (1696–1746), the ninth earl, was the husband of the famous Selina, countess of Huntingdon (*q.v.*). The earldom became dormant in 1789, and was not revived until 1818.

See H. N. Bell, The *Huntingdon Peerage* (1820).

HUNTINGDON, SELINA HASTINGS, COUNTESS OF (1707–1791), English religious leader and founder of a sect of Calvinistic Methodists, known as the Countess of Huntingdon's

[1]The title of earl of Huntingdon had previously been held in other families (see HUNTINGDONSHIRE). The famous Robin Hood (*q.v.*) is said to have had a claim to the earldom.

Connection, was the daughter of Washington Shirley, 2nd Earl Ferrers. She was born at Stanton Harold, near Ashby-de-la-Zouch, Leicestershire, on Aug. 24, 1707, and in 1727 married Theophilus Hastings, 9th earl of Huntingdon. In 1739 she joined the first Methodist society in Fetter Lane, London. On the death of her husband in 1746 she threw in her lot with Wesley and Whitefield in the work of the great revival. Isaac Watts, Philip Doddridge and A. M Toplady were among her friends. In 1748 she gave Whitefield a scarf as her chaplain, and he frequently preached in her London house in Park Street to audiences that included Chesterfield, Walpole and Bolingbroke. In her chapel at Bath there was a curtained recess dubbed "Nicodemus's corner," where some of the bishops sat incognito to hear him Lady Huntingdon spent her ample means in building chapels in different parts of England, *e.g.*, at Brighton (1761), London and Bath (1765), Tunbridge Wells (1769), and appointed ministers to officiate in them. under the impression that as a peeress she had a right to employ as many chaplains as she pleased In 1j68 she converted the old mansion of Trevecca, near Talgarth, in South Wales, into a theological seminary for young ministers for the connection.

Up to 1779 Lady Huntingdon and her chaplains continued members of the Church of England, but in that year the prohibition of her chaplains by the consistorial court from preaching in the Pantheon, a large building in London rented for the purpose by the countess, compelled her, in order to evade the injunction, to take shelter under the Toleration Act. This step placed her legally among dissenters. Till her death in London on June 17, 1791, Lady Huntingdon continued to exercise an active, and even autocratic, superintendence over her chapels and chaplains. She successfully petitioned George III. in regard to the gaiety of Archbishop Corn\\-allis's establishment, and made a vigorous protest against the anti-Calvinistic minutes of the Wesleyan Conference of 1770, and against relaxing the terms of subscription in 1772. Her 64 chapels and the college were bequeathed to four trustees. In 1792 the college was removed to Cheshunt, Hertfordshire. where it remained till 1905, when it was transferred to Cambridge.

See The Life of the Countess of Huntingdon (2 vols., *1844)*; A. H. New, *The Coronet and the Cross, or Memorials of Selina, Counters of Huntingdon* (1857); **Sarah** Tyler, *The Countess of Huntingdon and her Circle* (1907).

HUNTINGDON, a municipal borough and county town in the Huntingdon parliamentary division of Huntingdonshire. Eng.. on the Ouse. 60 mi. N. of London by road. Pop. (1951) 5,282. Area **3.3** sq.mi. Huntingdon (*Huntandun* in 921) was recovered from the Danes about 921 by Edward the Elder. who raised a fortress there. probably on the site of the Danish defenses. but in 1010 the Danes again destroyed it. A castle was built by order of William the Conqueror to guard the river crossing but it was among those destroyed by order of Henry II in 1174. At the time of Domesday Book Huntingdon n-as a royal borough. Three monasteries and three hospitals were founded and 16 parish churches built in mediaeval times. but by 1j50 only 3 churches and one hospital remained. The borough was incorporated by Richard III in 1484. and in 1630 Charles I granted a new charter. which remained in operation until 1835 The burgesses were represented in parliament by two members from 1295 to 1867 and by one until 188j when representation ceased. Huntingdon owed its prosperity to its situation on the Roman Ermine street which made it a coaching centre. It is now the centre of an agricultural area with other industries making beer. soft drinks, hosiery. foodstuffs and electrical equipment.. Ornamental plants are grown. During the Civil War it was several times occupied by the royalists though they sacked it in 1645. It forms a twin ton-n with Godmanchester (*q.v.*) with which it is linked by an old bridge (*c.* 1300).

The ton-n is mainly Georgian and consists basically of one street. in the centre of nhich is the market place where are All Saints' church, the mother church of the borough. which was rebuilt between 1475 and 1520, the town hall (1745) and the 17th-century Walden's house. now the County Council offices. The parish church of St. Mary is on the site of the Augustinian priory in which David Bruce. Scottish earl of Huntingdon. was buried. Some Norman remains of the 1ath-century hospice of St. John the Baptist were incorporated in the buildings of Huntingdon grammar school. once attended by Oliver Cromwell. who was born in the town. and by Samuel Pepys. Hinchingbrooke house. chiefly of the 16th century and the seat of the Cromwell family. occupies the site and preserves the plan of a Benedictine nunnery.

HUNTINGDONSHIRE (abbr. Hunts). an east midland county of England, bounded north and west by Northamptonshire, southwest by Bedfordshire and east by Cambridgeshire.

Physical Features.——All the stratified rocks are of Jurassic age, except a small area of Lower Greensand north of Potton. The Greensands form low, rounded hills. A narrow strip of Inferior Oolite reaches from Thrapston by Oundle to Wansford near Peterborough. It is represented about Wansford by the Northampton Sands and by a slight development of the Lincolnshire Limestone. The Great Oolite Series has at the base the Upper Estuarine Clays; in the middle. the Great Oolite Limestone. which forms the escarpment of Alwalton Lynch; and at the top, the Great Oolite Clay. The Cornbrash is exposed along part of the Billing brook and near Yaxley. Over the remainder of the county the lower rocks are covered by Oxford Clay, about 600-ft. thick. All the strata have a general dip southeast. Much glacial drift clay with stones covers the older rocks; it is a bluish clay, often containing masses of chalk. The fens on the eastern side of the county are underlain by Oxford Clay. which here and there projects through the prevailing newer deposit of silt and loam. There are usually two beds of peat or peaty soil separated by a bed of marine deposits. Black loamy alluvium and valley gravels, the most recent deposits, occur in the valleys of the Ouse and Nene. Calcareous tufa is formed by the springs near Alwalton. Oxford Clay is dug for brickmaking at Fletton and Warboys.

The Bedford Levels occupy about 50,000 ac. in the northeast. The Ouse skirts the borders of the county near St. Neots. and after flowing north to Huntingdon runs eastward past St. Ives into Cambridgeshire on its way to the Wash. The Kym. from Northamptonshire. joins the Ouse at St. Neots. while the Alconbury brook falls into it at Huntingdon. The Nene forms for 1j mi. the northwestern border of the county and quitting it near Peterborough. enters the Wash below Wisbech. in Cambridgeshire. The course of the old Sene river flows eastward midway between Huntingdon and Peterborough, and about 1½ mi. N.E. of Ramsey it is intersected by the Forty Foot. or Yermuyden's drain, a navigable cut connecting it with the old Bedford river in Cambridgeshire.

History and Antiquities.— Flint implements of the Lower Palaeolithic Age, together with contemporary mammalian bones, are found in most of the gravel workings of the Nene and Ouse valleys. By the latter 1950s, however, no remains of the Upper Palaeolithic or Mesolithic ages had been identified. It is along these same areas of gravel and alluvial soil that there is most evidence of prehistoric settlement. Surface finds of chipped flint tools and flakes are common and can be attributed to the Neolithic and succeeding Bronze ages. During the Bronze Age the fen areas became drier and there, too. tools and weapons ha e frequently been found.

Population was scarce in the immediate pre-Roman Iron Age but after the Roman Conquest most of the clay uplands were occupied in addition to the valleys and there is evidence of trade along the waterways. Small towns were built along the Roman Ermine street at Godmanchester and Chesterton and at the latter pottery making became an important industry.

There is no evidence of early Saxon settlement except in the extreme north and south, the area between the Ouse and Nene being almost devoid of pagan cemeteries. The county was probably divided tribally betn-een the Sweodora (west) and the South Gyrwas (east).

After their conquest of East Anglia in the latter half of the 9th century. Huntingdon became an important seat of the Danes. About 921 Edward the Elder wrested the fen country from the Danes and a few years later the district was included in the earldom of East Xnglia. Religious foundations were established at Ramsey and St. Neots by the Benedictines in the 10th century and a cell at St. Ives before the Conquest. In 1011 Huntingdonshire

was again overrun by the Danes and in 1016 was attacked by Canute. A few years later the shire was included in the earldom of Thored (of the Middle Angles), but in 1051 it was detached from Mercia and formed part of Harold's East Anglian earldom. Shortly before the Conquest. however. it was bestowed on Siward, and became an outlying portion of the earldom of Northumberland passing to David of Scotland. After the separation of the earldom from the crown of Scotland in the Bruce and Balliol disputes. it was conferred on various persons and finally in 1529, on George, Baron Hastings, whose descendants now hold it.

The Norman Conquest was followed by a general confiscation of estates. only four or five thanes retaining lands. In the Domesday survey it is recorded that the abbot of Ramsey held 26 manors while most of the other holdings were divided between the crown and the sheriff, Count Eustace of Boulogne. This shrievalty was united with that of Cambridgeshire by 11jj and remained united except from 1636 to 1643. when they were independent of each other. The boundaries of the county have scarcely changed since the time of the Domesday survey: except that parts of the Bedfordshire parishes of Everton. Pertenhall and Keysoe and the Northamptonshire parish of Hargrave were then assessed under this county. At Huntingdon the castle remains as an earthwork, and the castle at Kimbolton is a mansion. restored by Sir John Vanbrugh and later acquired by Kimbolton grammar school. Both Hinchingbrooke,house (16th century), once occupied by the Cromwells and later by the earls of Sandwich, and Elton hall (1664) are mansions with art collections.

At the end of the 11th century Huntingdonshire was constituted an archdeaconry, comprising the deaneries of Huntingdon, St. Ives, Yaxley, St. Neots and Leightonstone. and the divisions remained unchanged until the creation of the deanery of Kimbolton in 1879. The county was transferred from the diocese of Lincoln to that of Ely in 1837. During the reign of William the Conqueror the Benedictines established a nunnery at Winchingbrooke. while in 1147 the Cistercian abbev was founded at Sawtry. In the same century the Austin canons established a priory at Huntingdon, while another at Stonely is first mentioned in 12 74. Toward the end of the 13th century the Austin friars had a house at Huntingdon.

Fine bridges span the Ouse at Huntingdon (*c.* 1300), St. Ives (c. 1400) and St. Neots (c. 1600). Great Paxton church dates from the 11th century. Outstanding 12th-century churches are at Alwalton, Bury. Eynesbury. Fletton. Haddon. Ramsey and Southoe and 13th-century churches at Alconbury Kimbolton and Yaxley. St Neots is a beautiful example of the late 1jth century

In 1174 Henry II captured and destroyed Huntingdon castle and during the Wars of the Roses the tonn was sacked by the Lancastrians Huntingdon although the birthplace of Oliver Cromwell. had royalist sympathies in the Civil War. St. Neots market square was the scene of a battle in 1648 when a royalist force was routed and the earl of Holland. captured. In the reign of Charles I Nicholas Ferrar founded the famous religious community at Little Gidding.

Industries. — Although Huntingdonshire has always been mainly an agricultural county. there was, even during mediaeval times, a considerable volume of trade and industry based on navigation between the Wash and the riverside towns of St. Neots, Huntingdon. Godmanchester and St. Ives. At the latter was held in the 13th century an annual cloth fair of international importance. This trade was intensified when locks on the Ouse were completed as far upstream as St. Neots in the early 17th century.

These towns still support a variety of light industries and in the north at Fletton is one of the principal brickmaking centres of the country. . Other chief industries, in order of persons employed in the late 1950s, were electrical engineering. plastics. canning, woodworking. building, motor engineering, agricultural engineering, hosiery manufacture. milling, paper manufacture and printing.

Agriculture. — In 1954 the total acreage under crops and grass was 198,214. Of this figure arable and temporary grass accounted for 154.414 ac.. the remainder being permanent grass. The agricultural depression of the 1930s was the cause of a large increase in the acreage of rough grass and derelict land in the county. During World War II. large drainage and reclamation schemes were carried out; thereafter a high standard of husbandry was maintained. The farm land of most of the county is a heavy clay soil. and the chief crops gronn are wheat. barley. potatoes, sugar beets and clover. In the northeast there is an area of rich fenland, the town of Rarnsey being the centre of this district. The main crops grown there are potatoes, sugar beets and some vegetable crops such as carrots. Although three-quarters of the county was arable in the late 19jos, livestock returns showed increases in everything, except sheep. over 1939 figures. Milk and beef were produced in about equal proportions.

Gravels of the Ouse valley form the chief source of water, but supplies also come from Northamptonshire and Cambridgeshire.

Woodwalton fen (514 ac.), first endowed as a nature reserve in 1919, has a rich fen flora and is the place where the large copper butterfly was reintroduced into England from the Netherlands about 1929. Holme fen and Monk's wood are also nature reserves.

Communications. — The middle of the county is traversed from south to north by the main line of the eastern region of British railways, which enters it at St. Neots and passing by Huntingdon leaves it at Peterborough. From St. Ives lines run northeast to Ely (Cambridgeshire) and north to Wisbech (Cambridgeshire!. The northwestern border is served by lines between Peterborough and Wansford. There were about 648 mi. of highways in the late 1950s.

Population and Administration. — The area of the administrative county is 365.7 sq.mi. with a population (1961) of 79.579. The county contains four hundreds. The municipal boroughs are Godmanchester (pop. 1951. 2.502), Huntingdon (5,282), the county town! and St. Ives (3,078); the urban districts are Old Fletton, Ramsey and St. Neots; there are four rural districts. The county is in the southeastern circuit and assizes are held at Huntingdon. It has one court of quarter sessions and is divided into six petty sessional divisions. The county returns one member to parliament.

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HUNTINGTON, a U.S. family whose fortune was established in the development of western railroads.

COLLIS POTTER HUNTINGTON (1821-d goo), U.S railroad builder. was born at Harminton. Conn.. Oct. 22, 1821. He went to work uhen he was 14 and at the age of 28 he set out for the California gold fields. An early advocate of an overland railway. Huntington, mith Mark Hopkins, Leland Stanford and the Crocker brothers. incorporated the Central Pacific Railroad of California in 1861. Huntington secured government land grants and financial aid to construct a line from the Pacific coast to a meeting with the Union Pacific. Later he turned his attention to the building of the Southern Pacific and completed the 9.600-mi. line. He also made the Chesapeake and Ohio a profitable line by extending its eastern terminus and operating it in connection with the Southern Pacific. Huntington died Xug. 13, 1900, near Raquette Lake, N.Y.

His nephew, HENRY EDWARDS HUNTINGTON (1850–1927), was born at Oneonta, N.Y, Feb. 27, 1850. After working in hardware firms, in 1871 he supervised one of his father's sawmills, and ultimately held important executive positions with several railroads and promoted electric railway and utility development in California, particularly in Los Angeles. After 1910 he devoted considerable time to assembling a choice art collection and library. especially rich in rare editions of early English literature and in Americana. The library and mansion housing it were deeded to the U.S. public in perpetuity, and a trust fund of $8,000,000 was established for further additions, research and publications. He died in Philadelphia. hlay 23. 1927.

ARCHER MILTON HUNTINGTON (1870–1955), the adopted son of C. P. Huntington, American Hispanic scholar, was born in New York city. March 10, 1870. While studying in Spain. he specialized in Spanish archaeology. In 1904 he founded the Hispanic Society of America, to which he gave a home, endowment and collections

He died Dec. 11, 1955, in Bethel, Conn. (W. H. D.)

HUNTINGTON, DANIEL (1816–1906), U.S. painter of the romantic school. was born in New York on Oct. 14, 1816. In 1835 he studied with S. F. B. Morse, and produced "A Bar-Room Politician" and "A Toper Asleep." Subsequently he painted some landscapes on the Hudson river and in 1839 went to Rome. On his return to America he painted portraits and began the illustration of *Pilgrim's Progress*, but his eyesight failed and in 1844 he went back to Rome. Returning to New York in 1846 he devoted his time chiefly to portrait painting, although he had painted many genre, religious and historical subjects. He was president of the National academy, 1862–70, and again 1877–90. He died on April 19, 1906, in New York city.

HUNTINGTON, ELLSWORTH (1876–1947), U.S. geographer well known for his doctrines with regard to the influence of climate on civilization. was born at Galesburg, Ill., on Sept. 16, 1876, and educated at Beloit college, Wis. (A.B., 1897), Harvard (A.M., 1902) and Yale (Ph D.. 1909). From 1897 to 1901 he was an instructor in Euphrates college, Harput (Turkey) and in 1901 he carried out an exploration of the canyons of the Euphrates river for which he was awarded the Gill memorial of the Royal Geographical society. In 1903–06 he traveled widely with expeditions in central Asia, recorded in his books *Explorations in Turkistan* (1905) and *The Pulse of Asia* (1907), the latter one of his best. He then taught for some years at Yale. as instructor and later as assistant professor of geography; in 1917 was appointed research associate. In 1909 he headed the Yale expedition to Palestine and Asia and in 1911 published *Palestine and Its Transformation.* From 1910 to 1913 he was research associate of the Carnegie Institution of Washington and made climatic investigations in the United States. Mexico and Central America. His work was notably concerned with climate and its relation to land forms. geological and historical changes, and to human activities and the distribution of civilizations. His researches bore fruit in *The Climatic Factor* (1914), *Civilization and Climate* (1915; rev. ed., 1924) and *World Power and Evolution* (1 919). These interests led him to investigate the causes of climatic variation, in *Climatic Changes*, with S. S. Yisher (1922), and *Earth and Sun* (1923). In addition to a number of textbooks, several in collaboration, other important works are *The Character of Races* (1924); *The Pulse of Progress* (1926); *The Human Habztat* (1927). In later years he wrote extensively on heredity and eugenics. A vigorous and prolific writer nho as a geographer gained a world-wide reputation, his last book, *Mainsprings of Civilization* (194j) provides an epitome of much of his wide-ranging earlier work. He died on Oct. 17, 1947, at New Haven, Conn.

See *Geographical* ***Review,*** pp. 153–55 (1948). (*G.* My)

HUNTINGTON, SAMUEL (1731–1796), U.S. jurist and public official, was born at Windham. Conn.. on July 3, 1731. He received only a common school education, but read widely and in 1753 began to study law. In 1760 he settled at Norwich, Conn., nhere he achieved rapid and extensive success in his practice. He was elected to the assembly of the Colony from Norwich in 1764 and served until he was appointed associate justice of the supreme court in 1774. The following year he was made a member of the governor's council. Despite these royal appointments he sided with the Colonies in the impending struggle with the mother country, and in 1775 became a member of the Connecticut council of safety. Later in that year he nas elected a delegate to the Continental Congress, and as such in 1776 voted for and signed the Declaration of Independence. He nas a member of the congress until 1783. and served from Sept. 1779, to July 1781, as its president, succeeding John Jay in that office He returned to Connecticut in 1783 to be made chief justice of the supreme court in 1784, lieutenant-governor in 178j and governor in 1786. The latter office he retained by successive annual re-elections until his death at Norwich on Jan. 5, 1796.

HUNTINGTON, a city of West Yirginia, U.S., and seat of Cabell county, lies on the Ohio river just below the mouth of the Guyandot river near the point where Ohio, Kentucky and West Virginia meet. It is an important railway, trading and manufacturing centre about 50 mi. W. of Charleston.

Huntington was founded and incorporated in 1871 as the western terminus of the Chesapeake and Ohio railroad, on the site of Molderby's Landing, a stretch of farm land that extended along the Ohio river from the west bank of the Guyandot It was named for Collis P. Huntington, president of the railroad, who delegated his brother-in-law Col. Delos A. Emmons to purchase 21 farms embracing 5.000 ac. of level land along the river bank. He then employed Rufus Cook, a Boston engineer, to lay out a city of broad streets and boulevards. In a spirited election in 1887, the seat of Cabell county was moved from Barboursville to Huntington.

The yards, division point, general locomotive and car shops of the Chesapeake and Ohio railway were established there and the city grew rapidly.

Apart from the railway shops and offices there are foundries. nickel and nickel alloy plants, and factories producing electrical equipment, glass, cement, furniture and food products. There are a number of wholesale houses, and oil and gas interests. The Ohio river furnishes facilities for shipment of coal and for gasoline from Louisiana and Texas.

Huntington is the seat of a state mental hospital and six private hospitals. The oldest house of the city is preserved in Ritter park, where there is also an art gallery.

Marshall college (state supported) with an enrollment of about 3,500 was founded as Marshall academy in 1837 and named for Chief Justice John Marshall.

Huntington suffered from floods in 1884, 1913, 1936 and 1937; the 1937 flood was particularly disastrous. An 11-mi. wall was constructed with locks and dams giving maximum flood protection. and making Huntington one of the few walled cities of North America.

Pop. (1960) 83,627. (For comparative population figures *see* table in WEST VIRGINIA: *Population.*) The Huntington-Ashland standard metropolitan statistical area had a population of 254.780 in 1960. (K. K. McC.)

HUNTINGTON PARK, a commercial, industrial and residential city in south-central Los Angeles county, Calif., U.S. It is sometimes called the "shopkeeper of southern Los Angeles," and is located 7 mi. S. of the Los Angeles civic centre.

Throughout much of the 19th century, Huntington Park was a portion of the Rancho San Antonio. It remained a possession of the Lugo family from 1810 until 1865. After passing through a succession of hands without development, it was acquired by real estate subdividers after 1900. These men advertised the area as La Park, but in 1904 the name was changed to Huntington Park, after Henry E. Huntington's Pacific Electric railroad was completed through the proposed city. In 1906 Huntington Park was incorporated as a California General Laws city. It adopted a city-manager form of local government in 1957.

It became a major centre for retail sales, supplying a populous area of about 350,000, and its manufactures include oil-well equipment, automobiles and parts, rubber goods. paints, steel, iron and heavy hardware. For comparative population figures *see* table in CALIFORNIA: *Population.* (J. M. Wo.)

HUNTINGTOWER, a village in the parish of Tibbermore, Perthshire. Scot.. on the Almond. 3 mi. N.W. of Perth. Huntingtower (originally Ruthven) castle was the scene of the Raid of Ruthven, when the Protestants under William, earl of Gowrie, kidnapped the boy king James VI, in 1582. The earl's sons were killed in the Gowrie conspiracy (1600), after which the Scots parliamenr ordered the barony to be known in future as Huntingtower. The castle has been restored. (G. S. P.)

HUNTLY, EARLS AND MARQUESSES OF. This Scottish title. in the Gordon family, dates as to the earldom from 1449, and as to the marquessate (the premier marquessate in Scotland) irom 1599. The first earl (d. 1470) was Alexander de Seton, lord of Gordon—a title known before 1408; and his son George (d. 1502), by his marriage with Princess Annabella (afterward divorced), daughter of James I of Scotland, had several children, including. besides his successor the 3rd earl (Alexander), a second son Adam (who became earl of Sutherland), a third son William (irom whom the mother of the poet Byron was descended) and a daughter Katherine. who first married Perkin

Warbeck and afterward Sir Matthew Cradock (from whom the earls of Pembroke descended). Alexander, the 3rd earl (d 1524), consolidated the position of his house as supreme in the north; he led the Scottish vanguard at Flodden. and was a supporter of Albany against Angus. His grandson George. 4th earl (1514–62), who in 1548 was granted the earldom of Moray, played a leading part in the troubles of his time in Scotland, and in 1562 revolted against Queen Mary and was killed in fight at Corrichie, near Xberdeen. His son George (d. 1576) was restored to the forfeited earldom in 1565; he became Bothwell's close associate —he helped Bothwell. who had married his sister, to obtain a divorce from her; and he was a powerful supporter of Mary till he seceded from her cause in 1572.

GEORGE GORDON, 1st marquess of Huntly (1562–1636), son of the 5th earl of Huntly. and of Anne. daughter of James Hamilton. earl of Arran and duke of Chatelherault. was born in 1562, and educated in France as a Roman Catholic. He took part in the plot which led to the execution of blorton in 1581 and in the conspiracy which delivered King James VI from the Kuthven raiders in 1583. In 1588 he signed the Presbyterian confession of faith. but continued to engage in plots for the Spanish invasion of Scotland. On Nov. 28 he was appointed captain of the guard, and while carrying out his duties at Holyrood his treasonable correspondence was discovered. James. however, pardoned him. In April 1589 he raised a rebellion in the north. but was obliged to submit. and after a short imprisonment in Borthwick castle was again set at liberty. He next involved himself in a private war with the Grants and the Mackintoshes, who were assisted by the earls of Atholl and Murray; and on Feb. 8. 1592, he set fire to Murray's castle of Donibristle in Fife. and stabbed the earl to death with his own hand. This outrage. which originated the ballad "The Bonnie Earl of Moray," brought down upon Huntly his enemies. who ravaged his lands. In December the "Spanish Blanks" were intercepted (see ERROLL, FRANCIS HAY. 9TH EARL OF). two of which bore Huntly's signature, and a charge of treason was again preferred against him. On Nov. 26. he and the other rebel lords were freed from the charge of treason. heing ordered at the same time. however, to renounce Komanism or leave the kingdom. On their refusal they were attainted. Subsequently Huntly joined Erroll and Bothwell in a conspiracy to imprison the king. Huntly and Erroll gained a victory over the king's troops at Glenlivat. but his castle of Strathbogie was blown up by James, and he left Scotland about March 1595. He returned secretly. submitted to the Kirk and was restored to his estates. In 1599 he was created a marquess and. with Lennox. appointed lieutenant of the north. He was treated with great favour by the king. and was reconciled with Murray and Argyll. Doubts. however. as to the genuineness of his abjuration again troubled the Kirk. On March 19. 1607, he was summoned before the privy council. Huntly thereupon went to England and appealed to James himself. He was excommunicated in 1608, and imprisoned in Stirling Castle until Dec. 10, 1610, when he signed again the confession of faith. He was again imprisoned in 1616. At the accession of Charles I Huntly lost much of his influence at court. For the private war waged against the Crichtons from 1630 onward, he was again summoned before the privy council in 1635, and was imprisoned in Edinburgh castle. He died at Dundee on June 13, 1636, after declaring himself a Roman Catholic.

GEORGE GORDON, 2nd marquess of Huntly (d. 1649), his eldest son by Lady Henrietta, daughter of the duke of Lennox, was brought up in England as a Protestant, and created earl of Enzie by James I. His influence in Scotland was employed by the king to balance that of Argyll in the dealings with the Covenanters. In the Civil War he took the king's side, and in 1647 was excepted from the general pardon; in March 1649, he was beheaded by order of the Scots parliament at Edinburgh. The attainder was reversed by parliament in 1661.

HUNTLY, a small burgh of Aberdeenshire, Scot., at the confluence of the Deveron and Bogie, salmon and trout rivers, 39 mi. N.W. of Aberdeen by road. Pop. (1961) 3,952. It is a market, angling and holiday town and the centre of a large agricultural area with industries that include the weaving of woolen cloth and the making of agricultural machinery. Huntly is built on a rectangular plan, and in the market square are the "Stan'in stanes" of Strathbogie, probably prehistoric, and the Brander library, above which is the MacDonald museum. George MacDonald (*q.v.*) mas born in Huntly. The Gordon schools were founded in 1839. Huntly (Strathhogie until 1506) castle, ½ mi. N. and now in ruins, was owned in the 14th century by the Gordons, who rebuilt it. It was blown up in 1594, restored in 1602 and in 1752 Huntly lodge (later a hotel) was built from its stones.

HUNTSVILLE, a city of northeastern Alabama, U.S., and the seat of Madison county, is about 85 mi. N. of Birmingham. It was founded in 1805 by John Hunt of Virginia, a Revolutionary War veteran, and was originally called Twickenham by Leroy Pope, a kinsman of Alexander Pope who had settled in the area, in memory of the English poet's home. In 1811 the settlement was incorporated as Huntsville by the territorial government, the first in Alabama to receive a city charter. It was the meeting place of the convention that framed the first state constitution (1819). During the Civil War, the town was occupied by Federal troops (1862). After the war, its former position as a commercial centre for hay, cotton, corn and tobacco was restored.

By mid-20th century the development of the U.S. Redstone arsenal as a centre for rocket and guided missile research had resulted in considerable growth of the city in area and population. The city's manufactures include textiles, sheet metal products, cottonseed oil, stoves, wire staples and farm implements. It is also known for its watercress nurseries. Monte Sano state park is nearby.

Huntsville has two Negro colleges, the Alabama Agricultural and Mechanical college (1875) and Oakwood college (1896).

The population of Huntsville in 1960 was 72,365. The standard metropolitan statistical area of Huntsville (Madison county) had 117,348 inhabitants in 1960. For comparative population figures see table in ALABAMA: Population. (B. CR.)

HUNYADI, JOHN (JANOS) (c. 1387–1456), Hungarian statesman and warrior, was the son of Vojk, a Magyarized Vlach who married Elizabeth Morzsinay. He derived his family name from the small family estate of Hunyad, in Transylvania. The epithet Corvinus, adopted by his son Matthias, was derived from another property, Piatra da Corvo. While a youth, he entered the service of King Sigismunc!, accompanied him to Frankfort in 1410; took part in the Hussite War in 1420, and in 1437 drove the Turks from Semendria. For these services he received numerous estates and a seat in the royal council. In 1438 King Albert II. made him ban of Szoreny, a most dangerous dignity entailing constant warfare with the Turks. On the death of Albert in 1439, Hunyadi supported the candidature of the young Polish king Wladislaus III. (1440), against the partisans of the Austrian candidate Ladislaus V., took a prominent part in the ensuing civil war and was rewarded by Wladislaus III. with the captaincy of the fortress of Belgrade and the voivodeship of Transylvania, which latter dignity he shared with his rival Mihaly Ujlaki.

The burden of the Turkish War now rested entirely on his shoulders. He won brilliant victories at Semendria (1441), near Hermannstadt (1442) and near the Iron Gates (1442). In 1443 he advanced across the Balkans, captured Niš, defeated three Turkish pashas, and, after taking Sofia, united with king Wladislaus' army and defeated Murad II. at Snaim. When he returned home (Feb. 1444), he had broken the sultan's power in Bosnia, Herzegovina, Serbia, Bulgaria and Albania. The Pope, the despot of Serbia (George Branković) and the prince of Albania (George Castriota) urged him on his return to resume the war and drive the Turks from Europe. All preparations were made, when Turkish envoys arrived in Hungary to conclude a ten years' truce. The pact was concluded, but broken when news arrived that a Venetian fleet had started to prevent the Sultan (who had retired to Asia Minor) from recrossing into Europe. In July the Hungarian army recrossed the frontier and advanced towards the Euxine coast to join the galleys. Branković, however, privately informed Murad of the advance, and prevented Castriota from joining it. On reaching Varna, the Hungarians found that the Venetian galleys had failed to prevent the transit of the sultan, who now confronted them with fourfold odds, and in Nov. 1444

they were utterly routed, Wladislaus falling on the field and Hunyadi narrowly escaping.

At the diet which met in 1445 a provisional government of five Magyar captain-generals, was formed, Hunyadi receiving Transylvania and the ultra-Theissian counties as his district; but the resulting anarchy became unendurable, and in June 1446 Hunyadi was unanimously elected governor of Hungary in the name of Ladislaus V., with regal powers. His first act as governor was to proceed against the German king Frederick III., who refused to deliver up the young king. After ravaging Styria, Carinthia and Carniola and threatening Vienna, Hunyadi's difficulties elsewhere compelled him to make a truce with Frederick for two years. In 1448 he received a golden chain and the title of prince from Pope Nicholas V., and immediately afterwards resumed the war with the Turks. He lost the two days' battle of Kosovo owing to the treachery of Dan, hospodar of Wallachia, and of his old enemy Branković, who imprisoned him at Semendria; but he was ransomed by the Magyars, and, after composing his differences with his enemies in Hungary, led a punitive expedition against the Serbian prince. In 1450 Hunyadi went to Pressburg to negotiate with Frederick the terms of the surrender of Ladislaus V. To refute the accusation made by his enemies that he was aiming at the throne, he resigned all his dignities into the hands of the young king, on his return to Hungary in 1453, whereupon Ladislaus created him count of Bestercze and captain-general of the kingdom.

Meanwhile the Turkish danger had again become pressing. In 1455 Hunyadi provisioned and armed the fortress of Belgrade at his own expense, and leaving in it a garrison under his brother-in-law Mihály Szilágyi and his eldest son László, he proceeded to form a relief army and a fleet of zoo corvettes. To the eternal shame of the Magyar nobles, he was left entirely to his own resources. His one ally was the Franciscan friar, Giovanni da Capistrano (see JOHN, SAINT), thanks to whose preachings Hunyadi's small mercenary army was reinforced by a host of peasant volunteers. On July 14, 1456, Hunyadi with his flotilla destroyed the Turkish fleet; on the 21st and 22nd he routed the forces investing Belgrade. forcing Mohammed to raise the siege. return to Constantinople, and thus securing the independence of Hungary for another 70 years. On Aug. 11, however, Hunyadi died of plague in his camp.

Hunyadi was one of Christendom's most glorious champions, and also a great statesman. He recognized the insufficiency and the unreliability of the feudal levies, and was one of the first to employ a regular army on a large scale. A man of average education, he owed his influence partly to his natural genius and partly to the transparent integrity and nobility of his character.

See J. Teleki. *The Age oj the Hunyadis in Hungary* (Hung.) (1852–57; supplementary volumes by D. Csánki 1895); G. Fejer, *Genus, incunabula et virtus Joannis Corvini de Hunyad* (1844); *J.* de Chassin, *Jean de Hunyad* (1859); *P.* Frankl, *Der Friede von Szegedin und die Geschichte seines Bruches* (1904); *R.* N. Bain, "The Siege of Belgrade, 1456," *Eng. Hist. Rev.* (1892); A. Bonfini, *Rerum ungaricarum libri xlv., editio septima* (1771).

HUNZA (also known as KANJUT) and **NAGAR,** two states of Pakistan, on the northwest frontier of Kashmir (*q.v.*) under the administration of the Gilgit agency. The two states, which are divided by a river which runs in a bed 600 ft, wide between cliffs 300 ft. high, are inhabited generally by people of the same stock, speaking the same language and professing the same form of the Moslem religion. Hunza has an area of 3,900 sq.mi. Formerly Hunza was the more prominent of the two, because it held possession of the passes leading to the Pamirs, and could plunder the caravans on their way between Turkistan and India. But they are both shut up in a recess of the mountains, and were of no importance until about 1889, when the advance of Russia up to the frontiers of Afghanistan: and the great development of her military sources in Asia, increased the necessity for strengthening the British line of defense. This led to the establishment of the Gilgit agency, the occupation of Chitral, and the Hunza expedition of 1891, n-hich asserted British authority over Hunza and Nagar. The country is inhabited by a Dard race of the Yeshkun caste speaking Burishki. Pop. of Hunza (1951) 15,691; of Nagar (1951) 18,333. Sagar has an area of 1,600 sq.mi. (See GILGIT.) The Hunza-Nagar expedition of 1891, under Colonel A. Durand. was due to the defiant attitude of the Hunza and Nagar chiefs toward the British agent at Gilgit. The fort at Silt was stormed. and after a fortnight's delay the cliffs (1,000 ft. high) beyond it were also carried by assault. The chief of Nagar was reinstated and the half brother of the raja of Hunza was installed as chief. Pakistan acquired control of the states after 1948.

HUON OF BORDEAUX, hero of romance. The French *chanson de geste* of Huon de Bordeaux dates from the first half of the 13th century. Huon. son of Seguin of Bordeaux, kills Charlot, the emperor's son: who had laid an ambush for him, without recognizing his assailant. He is condemned by Charlemagne to be hanged, but reprieved on condition that he visits the court of Gaudisse, the amir of Babylon, and brings back a handful of hair from the amir's beard and four of his back teeth: after having slain the greatest of his knights and three times kissed his daughter Esclarmonde. By the help of the fairy dwarf Oberon, Huon succeeds in this errand. in the course of which he meets with further adventures. The Charlot of the story has been identified by A. Longnon (*Romania* viii. 1–11) with Charles l'Enfant, one of the sons of Charles the Bald and Irmintrude. The poem exists in a later version in alexandrines. and, with its continuations; was put into prose in 1454 and printed by Michel le Noir in 1516, since when it has appeared in many forms, notably in a beautifully printed and illustrated adaptation (1898) in modern French by Gaston Paris. The romance had a great vogue in England through the translation (*c.* 1540) of John Bourchier. Lord Berners, as *Huon of Burdeuxe.* The tale was dramatized and produced in Paris by the Confrérie de la Passion in 1557, and in Philip Henslowe's diary there is a note of a perlormance of a play, *Hewen of Burdoche,* on Dec. 28, 1593. For the literary fortune of the fairy part of the romance see OBERON.

The *Chanson de geste* of Huon de Bordeaux was edited by F. Guessard and C. Grandmaison for the *Anciens poètes de la France* in **1860;** Lord Berners's translation was edited for the E.E.T.S. by S. L. Lee in 1883–85. *See* also *Hist. litt. de la France* (vol. xxvi., 1873); L. Gautier, *Les Épopées françaises* (2nd ed. vol. iii. pp. 719–773); A. Grai, I *complementi della Chanson de Huon de Bordeaux* (1878); M. Schweigel, "Esclarmonde," etc. in *Ausg. u. Abhandl. . . . der roman. phil.* (1889); *C.* Voretzsch, *Epische Studien,* vol. i. (1900).

HUON PINE, botanical name *Dacrydium franklinii,* the most valuable timber tree of Tasmania, Austr., member of the order Coniferae. It is a fine tree of pyramidal outline, 80 to 100 ft high and 10 to 20 ft. in girth at the base with slender. pendulous much-divided branchlets. densely covered with the minute scalelike sharply keeled bright green leaves. It occurs in Tasmania's swampy localities from the upper Huon river to Port Davey and Macquarie harbour, but is less abundant than formerly because of the demand for its timber, especially for ship- and boatbuilding. The wood is close grained and easily worked. See CONIFERS; GYMNOSPERMS.

HUPA, the most advanced and best-known Indian tribe of the Pacific coast division of the Athabascan linguistic stock. At mid-20th century about 600 lived near the lower Trinity river in Hoopa valley. northwestern California. Their traditional culture, shared by the Turok (*q.v.*) and Karok, was characterized by an economy of deer and elk hunting. salmon fishing and food gathering; canoes, frame houses of planks bearing individual names: clanless villages, a wealth aristocracy owning debt slaves, fishing places and oak groves, shell and woodpecker scalp currency, treasures of albino deerskins! fine basketry, huge obsidian blades? furs, etc.; little political authority but an intricate law of property; wealth displaying. dancing to the recitation of narrative magical formulas. Theirs was the southernmost efflorescence of the native culture characteristic of the north Pacific coast, though lacking the potlatch festivals, secret societies and masks, totem poles and carving art of the northern tribes.

See J. Goddard, "Life and Culture of the Hupa," *Univ. Calif. Publ. Amer. Archaeol. Etlzn.,* vol. i (1904); A. L. Kroeber, Bureau of American Ethnology *Bull. 78* (1925).

HUPEH (HU-PEI SHENG), a province in the central Yangtze

(*q.v.*) river valley in the heart of agricultural China. Area 72,394 sq.mi. Pop. (1957 est.) 30,790,000. The eastern part of the province (about two-thirds) is lowland. The Yangtze and its chief tributary. the Han, meander in great loops past a maze of shallow lakes the chief of which. the Tung-t'ing Hu (*q.v.*), lies just south of the border of Hunan. The western part (about one-third) is upland and rises to 5,000–6.000 ft. in the mountains of the Wu Shan and Ta-pa Shan. In the north the low T'ung-pai Shan divides the Han valley from the north China plain. On the east and southeast the ranges of the Ta-pieh Shan and Mu-fou Shan constrict the plain through which the Yangtze leaves the province.

Summers are hot and humid, winters relatively mild. The 300-day growing season and 47-in. average annual rainfall favour agriculture. The region is transitional between the rice and winter wheat realms. with rice dominant. This also is one of the three most important cotton regions of China. Maize, kaoliang, tea and sweet potatoes are other food crops, while soybeans, silk, hemp and tobacco are other industrial crops. Tung-nut–oil production from the western hills ranks high. In the late 1950s it was claimed that the production of food grains for the province had reached 21,940,000,000 catties (one catty averages $1\frac{1}{3}$ lb.); ginned cotton, 4,300,000 piculs (one picul averages $133\frac{1}{3}$ lb.); and vegetable oils, 6.020.000 piculs.

Iron ore at Ta-yeh and coking coal nearby form the basis for one of the most significant iron and steel complexes in China. with a steel plant built in the late 1950s at Huang-shih on the Tangtze near the southeast border. Gypsum is important, especially at Ying-ch'eng in the northwest.

The population is mostly concentrated in the eastern lowlands where the Han river joins the Yangtze at the great tricity metropolis of Wu-han (*q.v.*). This major industrial 'and commercial centre had a population of 2.146.000 in 1957. with the heavier concentration in Hankow, the most important city in central China. The first bridge over the Yangtze, constructed there in 1956, permits through traffic from Peking to Canton. Commercially, Wu-han (Hankow, Wu-ch'ang and Han-yang) municipality commands the gateway to the Szechwan basin in the west and to Hunan and Kweichow in the south and southwest. Ocean-going steamships reach Wu-han and transport products to Shanghai and abroad. Across the Han river bridge from Hankow is the heavy-industry centre of Han-yang. From the latter runs the great bridge across the Tangtze joining Hankow and the provincial seat of Wu-ch'ang. I-ch'ang (*q.v.*) and Sha-shih farther up the Tangtze in south central Hupeh are important provincial and commercial centres. South of Sha-shih is the Ch'ing-chiang (Kingkiang) flood detention basin or reservoir covering about 350 sq.mi. In the middle reaches of the Han river is the twin city of Hsiang-fan (Siangfan), consisting of Fan-ch'eng on the north bank and Hsiang-yang (Siangyang) on the south bank, handling the products of the Han basin.

Under the Manchus, Hupeh n-as originally part of the ancient province of Hu-kuang. After Nanking fell to the Japanese in Dec. 1937 during the Chinese-Japanese War, Hupeh was host province to the National government of China: Hankow being the temporary capital until the government moved to Chungking in Szechn-an. (H. J. Ws.)

HURD, RICHARD (1720–1808), English bishop and writer, was born at Congreve. Penkridge. Staffordshire, on Jan. 13, 1720, and educated at Emmanuel college. Cambridge, of which he became a fellow. He was ordained in 1734, and in 1748 he published some *Remarks* on an *Enquiry into the Rejection of Christian Miracles by the Heathens* (1746), by William Weston, a fellow of St. John's college, Cambridge. He prepared editions, which won the praise of Gibbon. of the *Ars poetica* and *Epistola ad Pisones* (1749), and the *Epistola ad Augustum* (1751) of Horace. A compliment in the preface to the edition of 1749 led to a lasting friendship with William Warburton, through whose influence he was appointed one of the preachers at Whitehall in 17jo.

In 1765 Hurd became preacher at Lincoln's Inn. and in 1767 archdeacon of Gloucester. In 1768 he delivered at Lincoln's Inn the first Warburton lectures. which were published in 1772 as *An Introduction to the Study of the Prophecies concerning the Christian Church*. He became bishop of Lichfield and Coventry in 1774 and tno years later tutor to the prince of Wales and the duke of York. In 1781 he was translated to the see of Worcester. He built at Hartlebury Castle a fine library, to which he transferred Pope's and Warburton's books. purchased on the latter's death. In 1783 he declined the primacy.

Hurd's *Lettevs on Chivalry and Romance* (1762), written in continuation of a dialogue on the age of Queen Elizabeth which was included in his *Moral and Political Dialogues* (1759), had some influence in stimulating the romantic movement; two later dialogues On *the Uses of Foreign Travel* were printed in 1763.

Hurd edited the *Works* of William Warburton, the Select *Works* (1772) of Abraham Cowley, and left materials for an edition of Addison (6 vols., 1811). His own works were published in 8 vols. in 1811. *See* Francis Kilvert, *Memoirs* of . . . *Richard Huvd* (1860).

HURDES, LAS, or JURDES, a region of northwest Spain, south of Salamanca and the Sierra de Peña de Francia and east of the Sierra de Bejar. The Hurdanos are a peculiar people, probably originally a settlement of religious and political refugees; they number about 6,000 and inhabit primitive slate hamlets in the isolated mountainous region of the Sierra de Gata. The principal wealth consists in goats and bees. Much damage is done by boars and wolves. In the high-lying districts the Hurdanos suffer from goitre; along the rivers they are subject to malaria. After World War I rapid progress was made in the improvement of this region, until the outbreak of the civil war of 1936–39.

A good road was built from La Alberca to the lovely valley of Las Batuecas. which was previously almost inaccessible.

See M. Legendre. *Las Jurdes. Étude de géographie humaine* (192;).

HURDLING, running races over a series of obstacles. called hurdles. which are set a fixed distance apart. Indoors the race distances vary from 45 yd. to 70 yd.. over 42-in. or 30-in. hurdles, 1j yd. from the start to the first hurdle and usually with 10 yd. between hurdles. Outdoors the competitive distances are longer, and an additional competition over 36-in. hurdles is added. The standard hurdle heights and distances are often shortened for secondary-school competition, but collegiate and international outdoor competition is conducted at 120 yd., over ten 42-in. hurdles set 10 yd. apart with a 1j-yd. start and finish; at 220 yd. over ten 30-in. hurdles set 20 yd. apart with 20-yd. start and finish; at 440 yd. over ten 36-in. hurdles set $38\frac{1}{4}$ yd. apart with a $49\frac{1}{4}$-yd. start and a $46\frac{1}{2}$-yd. finish. Oxford, Cambridge and National Collegiate Athletic association distances are 120-yd. high hurdles and 220-yd. low hurdles. Amateur Athletic union championship races are conducted in all three hurdle races in either metres or yards. For indoor competition the standard A.A.C. distances are 50 yd. (4 hurdles), 60 yd. (5 hurdles) and 70 yd. (6 hurdles).

History. — Hurdling began in 19th-century England, and the first races were held at Eton college about 1837. In those days hurdlers merely ran and jumped over each hurdle in turn, landing on both feet and usually checking their forward momentum. In an effort to gain more efficient hurdle clearance and to prevent stopping after each hurdle was cleared, a new form came into use in England shortly after 1840. Hurdlers began to "sail" over the hurdle with the body upright, front leg curled under the body and the rear leg trailing. This provided more efficient clearance and allowed for a landing on one foot, thus helping to maintain forward momentum.

Experimentation with standard numbers of steps between hurdles soon followed: and the step pattern for hurdlers was the result. Hurdlers take 3 steps between each high hurdle. 7 steps between each low hurdle and usually 1j between each intermediate hurdle. Further refinements in hurdling were made by A. C. M. Croome of Oxford university about 1885. He showed more economical hurdle clearance by using a straight front leg with a forward lunge of the trunk. This "step-over" action is the basis of modern hurdling style.

Alvin Kraenzlein of the Cniversity of Pennsylvania illustrated in 1898 the advantage of sprinting action between the hurdles when he turned from sprinting to hurdling to set world records;

and Earl Thomson, later a U.S. navy coach. showed how more forward lean was advantageous with the introduction of his double-arm forward thrust as he cleared the barrier. Thomson's form made it possible for hurdlers to bring the trailing leg through nearly "flat." putting them in the best sprinting position for the next stride forward after the hurdle has been cleared. The pause or checking of forward momentum after the hurdle was cleared was virtually eliminated as a result.

Method of Hurdling. — In clearing a hurdle, the athlete takes off about 7 ft. from the hurdle by leaning forward, raising the "lead" leg and extending the opposite arm (or both arms) directly fonvard as he drives from the ground. The rear or trailing leg, bent at the knee, is brought forward over the hurdle at right angles to the body as the arm thrust pulls the trunk forward over the thigh of the lead leg. As the hurdle is cleared, the leading leg is cut down about 5 ft. beyond the hurdle; the body maintains its forward lean so the trailing leg can be pulled through almost parallel to the ground with the toe up. As the hurdler comes off the hurdle, he must continue to pull the trailing leg completely through and forward into the next step, while maintaining his forward lean so he is in sprinting position for the steps between hurdles. Hurdlers must vary body angle slightly when running the different hurdle races. The forward lean is extreme in the high hurdles, moderate in the intermediate hurdles and almost erect in the low hurdles as the hurdler steps over the 2 ft. 6 in. barriers.

Champions. — United States athletes have dominated international competition in the 20th century with some outstanding stars of modern times being Dick Attlesey, Fred Wolcott, Harrison Dillard, Jack Davis and Lee Calhoun in the high and low hurdles and Glenn Hardin, Charles Moore and Glenn Davis in the intermediate hurdles.

For records *see* OLYMPIC GAMES.

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(D. B. CM.; S. J.R.; E. J.G.)

HURDY-GURDY, now loosely used as a synonym for any grinding organ. but strictly a medieval drone instrument with strings set in vibration by the friction of a wheel, being a development of the *organistrum* reduced in size so that it could be conveniently played by one person instead of two.

The hurdy-gurdy originated in France: and during the 13th and 14th centuries was known by the name of *Symphonia* or *Chyfonie,* and in Germany, *Lira* or *Leyer.* Its popularity remained undiminished in France until late in the 18th century, but in Germany it never obtained recognition among serious musicians. The idea embodied in the mechanism stimulated ingenuity, however, the result being such musical curiosities as the *Geigenwerk* or *Geigen-Clavicymbel* of Hans Hayden, of Nürnberg *(c.* 1600), a harpsichord in which the strings, instead of being plucked by quills: were set in vibration by small wheels.

HURGRONJE, CHRISTIAAN SNOUCK (1857–1936), Dutch orientalist noted for his studies of Arabic and of Islam, was born at Oosterhaut on Feb. 8, 1857. After completing his studies in theology and oriental languages he went to Arabia, where he stayed for several years, and to other parts of the near east. The result of these travels was his work *Mekka,* 2 vol. (1888–89). He refused a nomination as professor of Arabic at Cambridge university in succession to Robertson Smith and also nominations in Germany and at Leiden, preferring to continue his studies on Islam in the Netherlands Indies (1889–1906), where for several years he was counselor to the government in Islamic affairs. In 1893–94 he published *De Atjehers,* which was translated into English in 1900. He returned to the Netherlands in 1906, where he accepted the chair of Arabic at the University of Leiden; in 1907 he was nominated counselor for Indian and Arabian affairs to the Dutch and the Netherlands Indies government. Among his other works are *Nederland en* de *Islam* (1911) and *Verspreide Geschnifften* (1923 *et seq.).* He died on June 26, 1936.

HURLEY, PATRICK JAY (1883–), U.S. politician, soldier and diplomatist, was born on Jan. 8, 1883, in Indian territory. now Oklahoma. In 1908 he began the practice of law in Oklahoma. After serving as colonel in the American expeditionary force during World War I, Hurley was prominent in Republican party politics during the 1920s, serving as secretary of war in the Hoover administration (1929–33). On U.S. entrance into World War II, Hurley, promoted to brigadier general, went to the far east as Gen. George C. Marshall's personal representative to examine the possibility of relieving U.S. troops on Bataan. During the remainder of the war, Hurley served in various diplomatic capacities as President Roosevelt's personal representative. As U.S. ambassador to China in 1944–45, Hurley, in the interest of intensifying the Chinese war effort, attempted vainly to reconcile the Kuomintang government and the Communist faction; his mission was a failure and he resigned his post in Nov. 1945 after some controversy with the administration. (1%'.R. E.)

HURLING. An outdoor stick and ball game somewhat akin to hockey (*q.v.*) and long recognized as the national pastime of Ireland. There is considerable reference to hurling (*iomáin* in Gaelicj in the oldest Irish manuscripts; the heroes of the ancient tales were all expert hurlers. The stick used is called a hurley, *camán* in Gaelic, and *camáns* in relief decorate some monuments to 15th-century chieftains.

Hurling was for long a communal game played between rival parishes with unlimited numbers of players on either side. Boughs of stripped wood bent to the form of a bow were used as goal posts. Games were often played for heavy money stakes.

An association to revive and standardize hurling, the Gaelic Athletic association, was founded in Thurles, County Tipperary, in 1884, and by mid-20th century there were more than 2,000 clubs in Ireland. County, provincial and all-Ireland championships are played.

Method of Play. — The stick, resembling a hockey stick, is made of young pliable ash, 3 ft. long and $3\frac{1}{2}$ in. wide in the striking part. The width of the striking part enables the ball to be hit overhead from man to man as well as along the ground. Each team consists of 15 players. The average pitch is 150 yd. long and 90 yd. wide. The goals at each end have posts 16 ft. high and 21 ft. apart with a crossbar 8 ft. above the ground. One point is scored by hitting the ball over the opposing crossbar, at any height between the posts. A goal, scored by driving the ball under the crossbar, is equal to three points. The ball, or *slitter,* is of cork. wound with wool and leather covered. It may be caught in the hand before hitting but not thrown or lifted; it may also be hit from left or right. (P. D. M.)

HURON. This French epithet, meaning "bristle head" or "ruffian," was applied to a group of Indian tribes calling themselves Wendat, whence Wyandot. At the time of their discovery by Jacques Cartier in 1534 they were settled in agricultural villages near the St. Lawrence river. The family, the matrilineal clan, the larger clan groupings called phratries and the tribal confederacy were the main social and political units. Political leaders were selected by the matrons. The Hurons belonged to the Iroquoian linguistic family but were bitter enemies of the Iroquois, with whom they competed in the fur trade. Before the arrival of Samuel de Champlain in 1603 the Iroquois had driven part of the Hurons from the St. Lawrence river westward into Ontario, where kindred tribes seem to have been already resident.

About 1590 four of these groups, the Bear, Cord, Rock and Deer people, established a confederacy which included also a number of smaller or dependent tribes. The confederacy numbered perhaps 20,000 persons. The Hurons received the French as friends and the Jesuit missionaries made many converts; but in 1648–50 Iroquois invasions destroyed the confederacy, thousands of Hurons being killed, others taken captive or forced to settle among their conquerors and the remnants driven west. These fragments drifted back and forth between Michigan, Wisconsin, Ontario, Ohio and Quebec, in alliance or conflict with many tribes, some of them also victims of the Iroquois.

At mid-20th century there remained about joo Huron at Lorette in Quebec and 900 Wyandot in northeastern Oklahoma.

See also CANADA: *Native Peoples;* IROQUOIS; and MANA: *Ambivalence* (on Huron religion).

HURON, LAKE, named by the French from the Huron Indians, the second largest of the Great Lakes of North America, is bordered on the west by the state of Michigan, U.S., and on the north and east by the province of Ontario, Can. The lake roughly has the form of a wide crescent convex to the northeast, with Georgian bay lying outside the crescent in that direction. The lake is 247 mi. long from northwest to southeast, and its maximum width is 101 mi. The surface area of the lake, including Georgian bay, is 23,010 sq.mi., and the area of its drainage basin, excluding lake surface, is 49.610 sq.mi. The mean annual precipitation in the area is 31 in. The mean height of the lake above sea level is 581 ft., the same-as that of Lake Michigan, with which it is joined at its northwestern extremity by the Straits of Mackinac. The deepest point in the lake, 750 ft., is 169 ft. below sea level. Currents in the lake generally are slight and variable, the most consistent movement of water being a slow drift from the northwest toward the outlet at the south end. (For comparisons with the other Great Lakes, a discussion of their origins, connections, utilizations, etc., *see* GREAT LAKES, THE.)

History. — Huron was the first of the Great Lakes to be discovered by Europeans. Samuel de Champlain and Étienne Brulé, traveling up the Ottawa and Mattawa rivers, reached Georgian bay in 161j. Brule traversed the North channel to the St. Marys river in 1618. A Jesuit mission, named Ste. Marie, was established among the Huron Indians at the Wye river (southeastern corner of Georgian bay) in 1638. Iroquois Indians destroyed the mission and wiped out most of the Huron nation in 1649. After that the centre of French activities was shifted northwestward to the settlement at Sault Ste. Marie on the river connecting Lakes Superior and Huron. Father Jacques Marquette established a mission at St. Ignace on the Straits of Mackinac in 1671.

Meanwhile Louis Jolliet, returning eastward from the Sault in 1669, had traveled by canoe down Lake Huron: through St. Clair river and lake and the Detroit river, and discovered Lake Erie. Robert Cavelier de la Salle's ship the "Griffin," sailing westward from Niagara, traversed Lake Huron in 1679. A fort was built on the St. Clair river in 1686 by Daniel Greysolon, Sieur Dulhut. British penetration of the lower lakes developed strongly in the mid-I700s. Major Robert Rogers with zoo rangers captured Detroit for the British in 1760 and took Michilimackinac on the Straits of Mackinac in 1761. At the close of the Revolutionary War the boundary between the United States and Canada was drawn through Lake Huron from its south end to the St. Marys river. The fort on Mackinac Island, overlooking the Straits of Mackinac. was captured by the British in the War of 1812 and reoccupied by U.S. troops at the close of the war.

Physiography. — Inflow into Lake Huron is received from Lake Superior via the St. Marys river (73,700 cu.ft. per second), from Lake Michigan and from numerous streams draining the adjacent lands. The discharge of the lake, through the St. Clair river at its south end, averages 177,500 cu.ft. per second. When strong winds blow from the east or northeast, over the expanse of Georgian bay and eastern Lake Huron, they develop high seas which run athwart the main course of traffic through the lake.

Resistant Niagaran Dolomite rock forms the north shore of the lake for 40 mi. eastward from the Straits of Mackinac. and also forms the southern and western shores of the chain of islands and of Saugeen peninsula, nhich separate the main body of the lake from Georgian bay. Dundee and other limestones underlie the south shore of Lake Huron from the straits southeastnard to Thunder bay, and an unusually pure phase of the limestone. quarried at Calcite and Rogers City, Mich., is the principal source of flux material for the steel industry of the loner lakes.

There is evidence that the surface of Lake Huron was approximately 400 ft. below its present level when the margin of the last continental glacier retreated and permitted the lake to drain from the northeastern corner of Georgian bay to the Mattawa and Ottawa river valleys of Ontario. Uplift of the land has since raised that outlet area and caused the lake to rise and discharge down the St. Clair river.

The principal mineral resources of the region are the widely distributed sand and gravel; petroleum, limestone and salt in the lower peninsula of Michigan; nickel ores. mined near Sudbury, Ont., and uranium, found mainly near Blind River, Ont.

Harbours **and** Commerce. — The average season of navigation on Lake Huron is from mid-April to mid-December in the north and from early April to late December in the south. The most important traffic on the lake is the through commerce betneen Lake Erie and Lakes Superior and Michigan, but large tonnages of limestone are loaded at Rockport and Rogers City, Mich., along the west coast of Lake Huron. Other harbours, important in local trade, include: in Michigan, Cheboygan, near the Straits of Mackinac; Alpena, on the southwestern shore of Thunder bay; Bay City, at the head of Saginaw bay; and Harbor Beach. 60 mi. N. of the head of the St. Clair river; and. in Ontario on Georgian bay, Collingwood, Midland, Tiffin, Port McNicoll and Depot Harbor. *See* GEORGIAN BAY; MACKINAC, STRAITS OF.

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HURONIAN: *see* PRE-CAMBRIAN TIME.

HURRIANS, a people who played an important role in the history and culture of the near east during the 2nd millennium B.C. Little was known of them to modern scholars until. in the course of the first half of the 20th century! archaeological research and a gradually increased understanding of the Hurrian language helped to trace the zone of their expansion. Even so, many aspects of their early history and provenance remained uncertain, constituting some of the most arduous problems of the historiography of the area.

The earliest recorded presence of demonstrably Hurrian onomastic elements (personal and place names) goes back to Mesopotamian records of the late 3rd millennium, notably those of the 3rd dynasty of Ur; these point uniformly to the area east of the Tigris and the mountain region of Zagros as the Hurrian habitat and to gradual penetration of hlesopotamia proper. From then on, and especially during the early 2nd millennium, there is scattered evidence of a westward spread of Hurrians. An inscribed Hurrian tablet of northern Mesopotamian provenance, apparently dating from the Old Akkadian period, was published in 1948; some religious poems in Hurrian from Mari (Tell el Hariri) on the middle Euphrates belong to Hammurabi's time; and Xlalakh (Tell Atchanaj in northern Syria was considerably hurrianized in the 18th century B.C. An even greater westward migration must have taken place after 1700 B.C., probably issuing from the area between Lake Van and the Zagros. When the records become abundant, c. 1 joo B.C., there is evidence of Hurrian dominance or presence over a wide area. This Hurrian wave was probably set in motion by the intrusion of Indo-Iranians from the north into the region of the later Iran and is connected with the approximately contemporary incursions of Kassites into Babylonia and perhaps of Hyksos into Egypt. There is every indication that Hurrians overthrew the Assyrian dynasty of Shamshi-Adad I and Ishme-Dagan I and subsequently dominated Xssyria. East of the Tigris the flourishing commercial centre of Nuzi was a basically Hurrian community, as is shown by the proper names of its inhabitants and various other Hurrian linguistic elements in its records. Hurrian influence prevailed in many communities of Syria. Hurrian names predominate at Alalakh; and Ugarit has yielded. besides its Canaanite records, Hurrian religious texts in alphabetic cuneiform, a conventional syllabic Sumero-Hurrian vocabulary and a short Hurrian-Akkadian bilingual document. Hurrians likewise occupied large sections of eastern Asia Minor, thereby becoming eastern neighbours and later partly dependents of the Hittites.

Yet the Hurrian heartland during this period of maximum expansion was northern blesopotamia, the country then known as Hurri, where the political units were dominated by dynasts of Indo-Iranian origin. In the 15th century B.C. these principalities and their dependencies ranging from the Iranian mountains to Syria were united into a state called Mitanni or (in Mesopotamian records) Hanigalbat, under the leadership of an Indo-Iranian warrior caste natned *maryannu,* which, like the royal names (*e.g.,* Artatama, Shaushshatar), has a clearly Indo-European etymology. Mitanni, with its capital Washshukanni, warred especially with

Thutmose III of Egypt for the possession of Syria. During the reign of Xmenhotep III of Egypt friendly relations prevailed, an extensive letter from the Hurrian king Tushratta to this Pharaoh is the longest extant Hurrian text. In the middle years of the 14th century B C, after the political decline of Egypt under the Pharaoh Ikhnaton the resurgent Hittite empire under Suppiluliumas I defeated Mitanni and reduced Tushratta's son Mattiwaza to vassaldom, while Assyria under Ashur-uballit I seized the opportunity to reassert its independence. In spite of political subjection, the continued Hurrian ethnic and cultural presence in Syria and in the Cilician region (Kizzuwatna) exerted a strong influence on the Hittite empire.

The carvings at Yazilikaya suggest that the official pantheon of the empire was thoroughly hurrianized through the inclusion and syncretization of Hurrian deities, especially Teshub and Hebat; Hurrian cultic texts nere found at the capital site of Hattusas (Bogazkoy); Hittite queens had Hurrian names: and Hurrian mythology appears in Hittite epic poems. Moreover. the Indo-Iranian overlords of Mitanni had introduced horse breeding and chariot warfare into the near east, and Mitannian specialists in this line were employed by the Hittites at Hattusas.

The principality of Hayasha in the Armenian mountains was another Hittite dependency; Suppiluliumas, in a famous treaty with its ruler Huqqanas, warns him against certain incestuous family relations which seem to have been originally current among the Hurrians under a fratriarchal system, also attested in traces at Nuzi. This hinterland region provided the last stronghold for Hurrian ethnic identity. The people of the Haldian (Khaldian) kingdom of Urartu during the 9th–7th centuries B.C. spoke a language definitely akin to Hurrian. Everywhere else Hurrians appear to have spent themselves in the latter part of the 2nd millennium B.C.; before modern discoveries only such meagre traces as the brief mentions of "Horites" in the Pentateuch remained as uninstructive witnesses of their forgotten greatness. Yet the typically Hurrian "Armenoid" physical type had left its lingering imprint on the racial features of the near east.

Language. — The Hurrian language, once called improperly Mitannian or Subarian (after Subartu, an old cuneiform name for regions north of Sumer and Akkad), is attested chiefly in four varieties of cuneiform: Old Akkadian; Babylonian; specifically Hurrian; and consonantal Ugaritic. Continuous texts, mostly from Mari, from the Amarna archives in Egypt (Tushratta's letter), from Bogazköy and from Ugarit, are supplemented by onomastic materials, glosses and loan words from many sites, notably Nuzi and Alalakh Combinatory analysis, especially of the long continuous text of the Tushratta letter, has permitted considerable penetration into the language, which is neither Indo-European nor Semitic. The grammatical structure is dominated by a profusion of suffixes, and the verbal system is particularly complicated. There is a basic distinction of transitive and intransitive forms and constructions; the full transitive expression is conceived in a passive sense. nith the object of the action in a "subject case," while the doer takes on the form of the "agent case," so that "and my brother requested a wife" is expressed as *šeniwwuš-an ašti šaruša* "by my brother and" (Sena "brother," *-iwwu-* "my," *-š* agent suffix, an "and") "a wife" (*ašti* subject case without suffix) "was requested" (*šaruša*). These characteristics suggest that Hurrian may have an affinity not only with Urartaean but with modern Georgian and related languages of the Caucasus.

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HURRICANE, a tropical storm, originally in the West Indies only, but a term now applied to this type of storm in other parts of the world. The name is derived from the word huracan of the Arawak-speaking Indians of the West Indies. It is also used to designate a wind of force 12 on the Beaufort scale (*q.v.*), that is, a wind of more than 75 m.p.h.

The hurricane season lasts roughly from June to October. In midseason, Aug. and Sept.. hurricanes develop mainly near or to the east of the Lesser Antilles. Early and late in the season, in June and from the latter part of September onward, the area with most frequent formation is the western Caribbean. The Gulf of Mexico also is a breeding ground for hurricanes, as is the Pacific just off the Central American coast. In the Atlantic-Gulf region the mean hurricane frequency is seven per year; it is reasonable to assume that about the same number form in the eastern Pacific, but the information is quite uncertain in that area. In individual years the frequency has ranged irregularly from 2 to 21 in the Atlantic. However, when considering frequency in terms of decades, a definite cycle is apparent. Hurricane frequency was high from 1890 (roughly the start of the record) to 1910, low from 1910 to 1930 and high from 1930 to the late 1950s.

After formation. most hurricanes move northwest, gradually turning more directly north as they move out of the tropics. The United States intercepts all hurricanes moving northward in the Gulf, and since the land mass extends farther east with increasing latitude. it also intercepts many hurricanes moving northward on the ocean side of Florida. Some of the most extensive damage suffered from hurricanes has been sustained in New England. This damage has resulted partly from the nind, especially the effect of wind upon the sea near coasts, but also from floods following heavy rains in the mountainous sections of New England.

See TROPICAL STORM. (H. RL.)

HURRY (URRY), **SIR JOHN** (d. 1650), Scottish soldier of fortune, was born in Aberdeenshire and saw much service as a young man in Germany. In 1641 he was involved in the plot known as the "Incident" (see HAMILTON, JAMES HAMILTON. *1st* Duke of). At the outbreak of the Civil War Hurry joined the army of the earl of Essex, but early in 1643 he deserted to the royalists, bringing with him information on which Rupert acted at once. Thus was brought about the action of Chalgrove field, where Hurry again showed conspicuous valour; he was knighted on the same evening. In 1644 he was with Rupert at Marston Moor. where with Lucas he led the victorious left wing of horse. But a little later, thinking the king's cause lost, he again deserted, and eventually was sent with Baillie against Montrose in the Highlands. His detached operations were conducted with great skill, but his attempt to surprise Montrose' camp at Auldearn ended in complete disaster. He once more joined Charles's party, and he was taken prisoner in the campaign of Preston (1648). Sir John Hurry was Montrose' major general in the last desperate attempt of the Scottish royalists. Taken at Carbisdale, he was beheaded at Edinburgh. May 29, 1650.

HURST, JOHN FLETCHER (1834–1903), U.S. Methodist Episcopal bishop and educator, was born in Salem. Md., on Aug. 17, 1834. He graduated at Dickinson college, Carlisle. Pa.. in 1854, taught for tno years and then went to Germany to study at Halle. On his return to the U.S. he was engaged in pastoral work. and from 1867 to 1871 taught Methodist mission institutes in Germany. In 1871 he became professor of historical theology at Drew Theological seminary, Madison, N.J., of which he was president from 1873 till 1880, when he was made a bishop. He died at Bethesda, Md., on May 4, 1903.

Bishop Hurst. by his devotion, recovered the endowment of Drew Theological seminary, lost by the failure in 1876 of Daniel Drew, its founder. The American university (Methodist Episcopal) at Washington, D.C.. for postgraduate work, of which he was chancellor from 1891 till 1902, was the outcome of his labours to improve the quality of Methodist scholarship. Besides translating and revising many important works he published *A* History of *Rationalism* (1865; rev. ed., 1901); Life and *Literature in* the *Fatherland* (18jj), brilliant sketches of Germany: *Indika:* the *Country* and People *of* India and Ceylon (1891); *History* of the Christian Church (1897–1900); and edited the History of *Methodism* (1902–04), a co-operative work.

HURSTMONCEUX or HERSTMONCEUX, a village in the Hailsham rural district of East Sussex. Eng., on the Brighton-Hastings road 12 mi. N. of Eastbourne. Pop. (1951) 1,856. It takes its name from Waleran de Hcrst Monceux, lord of the manor in 1216.

The castle. built in 1440 by Sir Roper de Fienes as a fortified manor surrounded by a moat. is one of the earliest brick buildings in England. Towers flank the corners and there is a beautiful turreted entrance gate, but the interior was destroyed in 1777 when Canon Robert Hare-Naylor (father of Augustus and Tulius Hare) used the material to build Hurstinonceux place. In 1948 the castle became the home of the Royal observatory which had been at Greenwich since 1675. All Saints church dates from the 11th century.

HUSAIN IBN ALI (*c.* 1854–1931), amir of Mecca from 1908 to 1916 and king of Hejaz from 1916 to 1924, was the second son of Mohammed ibn Xun oi the Abadila clan of Ashraf. He was brought up in Bedouin surroundings but spent a great part of his liie at Constantinople. Reputed to harbour Anglophil tendencies, he was deeply versed in the byways of Ottoman politics. His best trait was a profound knowledge of the desert, for n'hich he always maintained a genuine affection. At the beginning of his amirate he won golden opinions by his sagacity and modesty and set himself vigorously to forward Turkish interests in Arabia. In 1910 he subdued a rebellion in Asir and subsequently invaded Qasim without result, but in 1913 he began to show his true colours by opposing the extension of the Hejaz railway to Mecca.

When World War I broke out he entered into negotiations with the British, which culminated in the Arab revolt in June 1916. In October he proclaimed himself "king of the Arab countries" though he was formally recognized only as king of Hejaz. At the Versailles peace conference (1919) he was represented by his third son, Faisal, but refused to ratify the treaty as a protest against the mandatory regimes imposed on Syria, Palestine and Iraq. Subsequently his domestic policy was marked by ever-increasing avarice and reaction, while he sowed the seeds of iuture trouble by deliberately courting the enmity of Ibn Sa'ud. In March 1924, while on a visit to Trans-Jordan. he proclaimed himseli caliph; but war with Ibn Sa'ud was imminent, and the Wahhabi attack on Ta'if in September found him unprepared. On Oct. 5 he abdicated and proceeded to Aqaba. In July 1925 the British conveyed him to Cyprus, where he lived till 1930. He died at Amman in 1931.

By his first marriage Husain had three sons: Ali, Abdullah. amir of Trans-Jordan, and Faisal. The first of these, Ali ibn Husain, who was born about 1880, took no conspicuous part in affairs during his father's amirate. Aiter World War I he became amir of Medina and in that capacity did much useful work in connection with the reconstruction of the Hejaz railway. In 1924 he was pressed to accept the amirate of Trans-Jordan but declined in favour of returning to Medina. He succeeded his iather as second king of Hejaz on Oct. 3, 1924, but abdicated on Dec. 10 of the following year (*see* HEJAZ) and returned to Baghdad to live as the guest of his brother Faisal.

See George Antonius, *The Arab Awakening* (London. 1938); King Abdullah ibn Husain of Jordan, *Memoirs* (London, 1950).

HUSBAND AND WIFE. For the methods by which the relation of husband and wife may be constituted and dissolved see MARRIAGE and DIVORCE: *see* also ROMAN LAW. The present article deals only with the effect of marriage on the legal position of the spouses.

The person chiefly affected by the contract is the wife, who under most early systems oi law became subject In consequence of the marriage to some kind of disability. though the husband by virtue of his marriage accepted a number of liabilities. The most iavourable system scarcely left the wife as iree as an unmarried woman and the most uniavourable subjected her absolutely to the authority of her husband. In modern times in English law the trend has been to lessen or remove the disabilities of the wife and to reduce the obligations of the husband; and the effect of marriage on property is perhaps the most important of the consequences arising irom the relationship, and on this point the laws of different countries show wide diversity of principles.

English Law.— The contract of marriage, which is by law regarded as a civil contract only, is in its essence a consent on the part of a man and woman to cohabit with each other and with each other only. This contract differs irom all other civil contracts in that it is indissoluble at the will of the parties. The English common law relating to marriage is indigenous to the country, the rules relating alike to the ceremony itself and to the legal results oi the ceremony being entirely insular in their origin and deducible irom no foreign source. There is, however, considerable analogy between the later development of the civil law oi Rome and the modern law of England—in that both, starting from an extreme theory of the possessory right oi the husband over the person and property of the wife, have subsequently tended toward practical equality between the sexes. The original concept in English law mas an absolute merger of the personality of husband and wife by virtue of the marriage ceremony. Hence a man could not grant or give anything to his wife. because she was himself, and if there n-ere any compacts between them beiore marriage they were dissolved by the union of persons. A husband, moreover, during his lifetime, had an absolute power of disposing of the personal property and chattels real (leasehold interests) of the wife, no act of hers being of any iorce to affect or transier that which by the intermarriane she had assigned to him. In the wiie's freeholds the husband's ownership was not absolute, he having no power to dispose of them without her consent, although as master and governor of the family he was entitled to receive the profits during the life of his wife

Courts oi equity, however, in process ot time considerably modified the stringency of the common law by the introduction of the doctrine of separate estate, *i.e.*, property settled to the wife for her separate use. In such case a married woman was entitled to deal with her property as it she were unmarried. Connected with the doctrine of separate use mas the equitable contrivance of restraint on anticipation whereby property might be so settled to the separate use of a married woman that she could not, during coverture, alienate it or anticipate the income; this, originally a device ior the protection of married women, in the society of the 20th century became a restriction upon women's enjoyment of their property, and the Married Women (Restraint Upon Anticipation) act. 1949, provides that no restraint upon anticipation or alienation attached to enjoyment of property by a woman which could not have been attached to enjoyment of property by a man was to have any effect after the passing of the act. This measure was made retrospective so that it was to have effect irrespective of the date of the act or instrument containing the provision which attached the restriction. In yet another way the court of chancery interiered to protect the interests of married women. When a husband applied to the court to get possession of his wife's choses in action (*i.e.*, a legal right not in possession), he was required to make provision for her and her chiidren out of the fund sought to be recovered. This provision was called the wife's equity to a settlement.

The corresponding interests of the wife in the property oi the husband were much less satisfactory. Besides a general right to maintenance at her husband's expense she had at common law a right to don-er in her husband's lands and, ii he died intestate. to a third of his personal estate. Both of these rights were abolished by the Administration of Estates act, 1925, which substituted thereior the provisions following. If an intestate leaves surviving a husband or wife (with or without issue) the survivor takes the personal chattels of the deceased absolutely with a sum of £1,000 irom the residuary estate. and in addition (should the intestate leave no issue) a life interest in the residuary estate. If the intestate leaves issue, then a life estate of one-hali of the residuary estate goes to the surviving spouse, and the other half on statutory trusts for the issue of the intestate. The act further provided for the ultimate distribution of the residuary estate. Under the older law the regulation of the respective rights of husband, wife and children by marriage settlements tended largely to obviate the hardships and injustices imposed upon women by the common lam.

In close relation to the above provisions oi the Administration of Estates act are those of the Inheritance (Family Provisions) act, 1938, which empower the court to award payments to a widow or widower or, in certain circumstances. a child oi a deceased person where, in its opinion, reasonable provision has not already been made.

A necessary sequence to the theory of the unity of person in the marriage relation was that neither husband nor wife could give evidence against the other in any legal proceeding whether civil or criminal. Survivals of this old law still exist in the fact that the combination oi husband and wife, without a third party. for an unlawful purpose does not constitute an indictable misdemeanour so as to support a charge oi conspiracy; and (apart irom treason and murder) it is still a good defense for a wife to prove that the crime with which she is charged was committed in the presence of and under the coercion of her husband (15 and 16 G.5. c. 86 s. 47). A third survival of the old law was to be found in the fact that a husband continued liable for the pure torts of his wife, *i.e.*, ior any tort not directly connected with a contract (*Edwards* v. *Porter*, 1925, X.C. 1) but this rule was abolished by the Law Reiorm (Married Women and Tortieasors) act, 1935, which provides, among other thinrs, that a husband is no longer liable ior a tort committed by his wife whether before or after marriage merely because of his marriage.

The iundamental changes introduced by the Married Women's Property acts, 1882, 1893, 1907, have enormously improved the position of a woman unprotected by settlements, practically placing her in the position of a feme sole.

The chief provisions of the act of 1882 are, shortly, that a married woman is capable of acquiring, holding and disposing of, by will or otherwise, any real and personal property: in the same manner as if she were a single woman, without the intervention of any trustee. The property of a woman married after the commencement oi the act, whether belonging to her at the time of marriage or acquired aiter marriage, is held by her as a feme sole. After marriage a woman remains liable for antenuptial debts and liabilities, and as between her and her husband, in the absence of contract to the contrary, her separate property is deemed primarily liable, the husband being liable only to the extent of property acquired irom or through his wife.

The Married Women's Property act of 1893 provided specifically that every contract thereinafter entered into by a married woman, otherwise than as an agent, should be deemed to be a contract entered into by her with respect to and be binding upon her separate property, whether she was or was not in fact possessed of or entitled to any separate property at the time when she entered into such contract, that

it should bind all separate property which she might at that time or thereaiter be possessed of or entitled to, and that it should be enforceable by process oi law against all property which she might thereaiter, while discovert, be possessed of or entitled to. The act of 1907 provided that a settlement or agreement ior a settlement whether before or aiter marriage, respecting the property of the woman, should not be valid unless executed by her if she was of iull age or confirmed by her aiter she attained full age. The act of 1908 provided that married women possessing separate property should be liable for the maintenance of their parents. The Guardianship of Infants act, 1925, gave the mother of an infant equal right with the father to apply to a court of guardianship of a child. The act of 1926 provided ior the legitimation of children *(see* LEGITIMACY AND LEGITIMATION) by the subsequent marriage of their parents. The Law of Property act, 1925, enabled a married woman, without her husband, to dispose of or join in disposing of real or personai propcrty held by her solely or jointly as trustee or personal representative in like manner as if she mere a ieme sole. It further enabled her to disclaim any estate or interest in land without the concurrence of her husband and to acquire as well irom her husband as irom any other person any interest in real or personal property, and to hold the same either solely or jointly with third parties as a trustee or personal reprrsentative as if she mere a ieme sole.

The broad effect of modern legislation, starting with the Married Women's Property act, 1882, and culminating in the Law Reform (Married Women and Tortieasors) act, 1935, has been to provide that a married woman can acquire, hold and dispose of property as if she 1%-erea single woman. "She has iull capacity to enter into contracts, is subject to the bankruptcy law, and her husband is no longer liable on her ante-nuptial contracts." At the same time the husband remains liable ior the maintenance of his wife, who continues to have the right to pledge his credit ior necessaries according to his standards oi life; and in certain respects, notably by the Law Reform (Miscellaneous Provisions) act, 1949, and the Married Women's (Maintenance) act, 1949, the machinery for enforcing payment where the husband has failed adequately to maintain has been improved. The parties to a marriage are still one in law, so that they cannot sue one another in tort. The change is neatly illustrated in *Rees* v. Hughes (1946. K.B.D. 517) where it was decided that, when a woman leaves sufficient estate to pay funeral expenses, her husband is no longer liable for them, a married woman now being in the same position as a man in her capacity to own and dispose of property. *Drinkwater* v. *Kimber* (1952.2 Q.B.D. 281) and *Baylis* v. *Blackwell* (1952.1 K.B.D. 154) exemplify the continued unity in lam created by the marriage relation. In the former, where the plaintiffs were man and wife, and the male plaintiff mas held partly responsihie for the collision, the defendant was unable to recover irom the husband any contribution in respect of the damage to the wife, since the latter herself could not have recovered damages from her husband; in the latter, a husband was held not to be entitled to sue his wife for an antenuptial tort.

Law of Scotland. — For the law oi Scotland, which differs less from English lam than the use of a very different terminology mould lead us to suppose, see SCOTS LAW. (W. W.-P.; W. T. Ws.)

Continental Law. — On the continent of Europe and especially among the Latin nations (after age-long vicissitudes of varying custom and procedure possibly derived from an infiltration of Teutonic law and principle into the civil code) the main ideas of Roman jurisprudence became established as the bases of the law governing the marriage relation. The leading ieature in modern continental marriage law is the community of goods between husband and wife. Of this system it is said "the community is not regarded in French law as a legal entity except for the purposes of taking an account. It is somewhat like a private partnership." It generally extends to all property of the husband and wife and to the income or other proceeds derived therefrom. It extends also to all immovable property of the husband and n-iie acquired during the marriage. By a law dated Sept. 22, 1942, it 7%-asestehded to salary or business profits earned by the wife as well as those of the husband. The property thus acquired is liable to the debts of the spouses existing at the time of the marriage, to the debts contracted by the husband or the wife during the community, mith the husband's consent, and to debts contracted ior the maintenance of the iamily.

By two laws dated Feb. 18, 1938, and Sept. 22, 1942, the property oi the community was made liable to debts contracted during the community by the wife as representing her husband. This requires the civil court's permission, when the husband is not in a condition to give his consent, but not when the wife contracts as a manageress of affairs for the community. That property is also liable to the debts contracted during the community by the wife in her own name, in the interest of the family with civil court's sanction, and by the mife in the interest of her individual business, without civil court's sanction. When the community is dissolved an account is taken to ascertain what each partner owes to the partnership and what the partnership owes them: and the partnership property is divided equally between husband and wife. Certain modifications of this general principle have, however, been introduced in French legislation by a series of enactments dating from 1881 which sonleu-hat assimilates the Gallic law to that of England in matters relating to personal savings or profits derived by a married woman irom her individual exertions. A law dated July 13, 1907, confirmed by the law of 1942, accorded to a married woman an absolute right to deal as she pleases with salary or business profits earned by her or with any property she may have purchased therewith; an enactment of 1924 gave protection (subject to certain saieguards against fraud) to the goods and property of a married woman from seizure by her husband's creditors, whether such property was owned by her before marriage. has since been inherited by her or has been acquired by her personal exertions. Should she, however, squander her separate estate her husband may apply to the court to restrict her freedom of disposal.

In Denmarl;, Finland, Iceland, Norway and Sweden the legal effects resulting irom the contract of marriage are practically identical, the result of the adoption by these countries of the Marriage act of 1925 and the Inheritance act of 1926 being to confer on husband and wife legal equality during lifetime and equal rights of inheritance upon the death of either oi the parties. In these countries the principle of community of property between husband and wife is preserved concurrently with right to the possession of separate estate. The communal property can only be encumbered or disposed of with the joint consent oi the spouses, but the separate estate may be disposed of by either without reference to the other. Separate estate may consist of antenuptial property, not brought into the community upon the marriage, or such earnings of either spouse as are not required for the iamily maintenance. In case of desertion, bankruptcy or mismanagement of the joint estate by husband or wife the lam permits of an equitable resettlement by the court. In Germany the civil code came into operation in 1900 (art. 1367) provided that the wife's wages or earnings shall form part of her *Vorbehaltsgut* or separate estate, which a previous article (1365) placed outside her husband's control. In Italy a law of July 17, 1919, abolished the last contractual incapacity of married women. Henceiorth the husband has no legal right either to veto or control the acts of his wife or to interfere with her separate estate. In 1906 Switzerland enacted a statute conferring on married women contractual emancipation. (W. W.-P.; J. M.-M. L.)

United States Law.—As in England, the most remarkable changes in the law of husband and wife in the United States occurred with respect to the wife's control over property, although other innovations are of considerable importance. In the United States, Married Women's Property acts had become common by the end of the 19th century. This legislation, conferring on the wife the right to deal mith her property as a single woman, was closely followed by acts permitting her to control her own earnings, to sue and be sued and to enter into contracts. The practical eifect oi the legislation placed the mife on an equal plane with her husband in property control.

Notwithstanding this general achievement, specific provisions of state law differ greatly. The Married Women's Property acts have had pronounced but varied effects on the types of permissible common holdings by the husband and mife. Dower, a widow's life interest in certain lands of her husband. and curtesy, a somewhat similar interest oi the husband's where there have been legitimate children born of the marriage, are still recognized in many states. Where they have been abolished they have generally been replaced by giving the surviving spouse rights in a designated portion of intestate propcrty, both real and personal. In addition to these protections to the spouse, most jurisdictions also have provided for the existence of certain property free from creditors' claims by passage of homestead and exempt property and allowance legislation.

In some instances efforts to remove the wife's common-lam disabilities have progressed, it is thought, to a point where her position is more advantageous than her husband's. The so-called disabilities under which she sufiers, such as the disability of contracting as a surety, are, however, not only to be regarded as favouring the wife but as affording protection to the family as well.

Neither husband nor wife is ordinarily liable for the other's obligations However, where the wife incurs debts ior household purchases or for the education of children, she is rebuttably presumed to be acting as her husband's agent. In those states with family expense statutes, she is regarded as a codebtor for such expenditures. Such statutes have, in fact, gone far toward effectuating a joint responsibility for support. There is also an incipient trend to impose on the mifc a positive duty to support her husband.

In the community-property states, in addition to the separate funds oi husband and wife, a third fund comprising property acquired during the marriage by efforts of the spouses is recognized. Persons in these states at one time possessed a significant income-tax advantage over the residenrs of noncommunity-property jurisdictions. This was virtually eliminated by provision of the Internal Revenue act of 1948 for income-tax returns filed jointly by husband and wife and allowing them to split the income for taxation in the bracket applicable to 50% of the total.

Certain rules, which were derived irom the uniqueness of the marriage relationship, remained in effect. In nearly all jurisdictions the privilege of one spouse not to testify against the other was still in force. Rights to contract *inter* se are restricted in an ever-smaller number of jurisdictions, while in a majority husband and wife continued to be barred from suing one another in tort for personal injuries. Even the presumption that a wife's crime committed in the husband's presence was committed under his coercion was retained, or proof of coercion was available to the wife as a defense, in 40 states.

The direction of modern law is, nonetheless, clear. It seeks to

equalize the rights and, increasingly, the obligations of husband and wife and to recognize them, in their actions and responsibilities, as individuals (M. K. R.)

HÜSEYIN RAHMI GURPINAR (1864–1944), Turkish novelist, was a prolific writer who skilfully depicted Istanbul middle and loner-middle class society. Born in Istanbul in 1864. the son of a general, he was educated privately and at the School of Political Science. He retired from the civil service in 1908 and thereafter, apart from a short spell as a member of parliament. lived a solitary life on Heybeli Island in the Sea of Marmara. He was a disciple of Ahmed Midhat rather than of the French-inspired school of writers but soon developed an independent style. He wrote over 30 novels, a number of short stories and a few unsuccessful plays, and translated several French novels. He is at his best in reproducing dialogue and his work is valuable to the student of Istanbul life and language at the turn of the century.

See O. Spies, *Die turkische Prosaliteratur der Gegenwart* (1943). (F. I.)

HU SHIH (1891–1962), Chinese historian, philosopher and diplomat, called the father of China's literary renaissance, was born in Shanghai in 1891, the son of a magistrate in Formosa who died in 1895. His ancestral home was in Hui-chou, Anhui province. Precocious as a child, Hu Shih began early to study the classics, mainly through the sacrifice and encouragement of his widowed mother. In 1904–10 he attended school in Shanghai, where he displayed independence of judgment by publishing. at the age of 15, articles in the living tongue of the people instead of the ancient classical style, in which, however, he was fully competent. In 1910 he passed the examinations held in Peking for study in the United States under the newly established Boxer Indemnity fund. He entered Cornell university and in 1914 received his A.B. degree. At the 25th reunion of his class he was named its most distinguished member. In 1917 he received his doctorate at Columbia university, where he was much influenced by the pragmatism of John Dewey. While yet a student in the university he published suggestions for language reform that were echoed by like-minded scholars in China. In 1916, for example, he resolved never to write poetry except in the spoken language. The year 1917, when he returned to China to teach philosophy in the Peking National university, marks the beginning of the literary renaissance that flourished until the Japanese invasion in 1937 *(see* CHINESE LITERATURE). The movement was hailed by younger writers, teachers and students in all parts of the country, and hundreds of periodicals arose to establish the spoken language as a suitable literary medium. Though the work of Hu Shih has been compared to that of Wycliffe and Dante in creating for England and Italy their respective national languages, he himself has described it as the culmination of a long evolutionary process in which Chinese novels and dramas had earlier set the pattern. The movement did not stop, however, with language reform; it went on to the revaluation and reorganization of China's entire cultural and social heritage. Hu Shih led the way by championing, in the new medium, neglected figures in Chinese history. and by applying the most rigorous historical methods to the study of ancient texts and to the authorship and development of China's great novels. His numerous articles in Chinese, written mith kindliness and great clarity, have been brought together in several collections. Two English works may be mentioned: *The Development* of *the Logical Method in Ancient China* (1928) and *The Chinese Renaissance* (1934). Among his books in Chinese are: "A History of Chinese Philosophy" (ancient period), "The Philosophy of Tai Tung-yuan" and "My Liie to the Age of Forty." Except for an interval (1928–30) when he taught in Shanghai, he continued at the Peking National university, where he later became dean of the college of arts. For nearly four pears he was China's ambassador to the United States, returning to his university in 1946 to be chancellor. After the establishment of the Communist regime he lived in New York city, continuing his researches in history and philosophy. In 1957 he was appointed one of China's representatives in the United Nations.

In 1958 he returned to Taiwan (Formosa) to engage in writing and to direct China's leading scholarly organization, the Academia Sinica. He died there on Feb. 24, 1962. (A. W. H.)

HUSKISSON, WILLIAM (1770–1830), English statesman and financier, was descended from an old Staffordshire family of moderate iortune, and was born at Birch Moreton, Worcestershire, on March 11, 1770. He went to Paris at 14 to the care of his uncle, Doctor Gem, physician to the British embassy in Paris, and witnessed the French Revolution. In Jan. 1793 he was employed by Dundas in the carrying out of the Aliens act; and in 1795 he was appointed undersecretary for war. Huskisson sat in parliament for Morpeth (1796–1802), Liskeard (1804–07), Harwich (1807–12), Chichester (1812–23) and Liverpool (1823–30). He was secretary to the treasury under Pitt (1804–05) and Portland (1807–09). He took a prominent part in the Corn law debates of 1814 and 1815; and in 1819 he presented a memorandum to Lord Liverpool advocating a large reduction in the unfunded debt and explaining a method for the resumption of cash payments which was embodied in the act passed the same year. In 1821 he was a member of the committee appointed to inquire into the causes of the agricultural distress then prevailing, and the proposed relaxation of the Corn laws embodied in the report was understood to have been chiefly due to his strenuous advocacy. In 1823 he was appointed president of the board of trade and-treasurer of the navy, and shortly afterward he received a seat in the cabinet. In the same year he was returned for Liverpool as successor to Canning, and as the only man who could reconcile the Tory merchants to a free trade policy. Among the more important legislative changes with which he was principally connected were a reform of the navigation acts, admitting other nations to a full equality and reciprocity of shipping duties; the repeal of the labour laws; the introduction of a new sinking fund; the reduction of the duties on manufactures and on the importation of foreign goods; and the repeal of the quarantine duties. In accordance mith his suggestion Canning in 1827 introduced a measure on the Corn laws proposing the adoption of a sliding scale to regulate the amount of duty. A misapprehension between Huskisson and the duke oi Wellington led to the duke proposing an amendment, the success of which caused the abandonment of the measure by the government. After the death of Canning in the same year Huskisson accepted the secretaryship oi the colonies under Lord Goderich, an office which he continued to hold in the new cabinet formed by the duke of Wellington in the following year. After succeeding with great difficulty in inducing the cabinet to agree to a compromise on the Corn laws, Huskisson resigned office in May 1828 on account of a difference with his colleagues in regard to the disfranchisement of East Retford. On Sept. 15, 1830, he was accidentally killed by a locomotive engine while present at the opening of the Liverpool and Manchester railway.

HUSS or Hus, **JOHN** (1369–1415), Bohemian reformer, was born of peasant parents at Husinec (Husinetz), near the Bavarian frontier. He was educated at the University of Prague where he began to lecture in 1398. He was made dean of the philosophical faculty in Oct. 1401, and was rector (Oct. 1402–April 1403) of the university. His appointment in 1302 as rector of the Bethlehem chapel. which had been erected in 1391 by zealous citizens of Prague to provide good popular preaching in the Bohemian tongue, influenced his religious life, and led him to an appreciation of the philosophical and theological writings of Wycliffe, whose *Trialogus* he had translated into Czech in 1403.

In 1405, while still unconscious of any opposition to Catholicism, Huss published his *De omni sanguine Christi glorificato*, in which he declaimed against forged miracles and ecclesiastical greed, and urged Christians to desist irom looking for sensible signs of Christ's presence, but rather to seek Him in His enduring word. More than once, also. Huss was appointed to be synod preacher, and in this capacity he delivered at the provincial councils of Bohemia many admonitions. In 1408, however, the clergy laid before the archbishop a formal complaint against the strong expressions used by Huss with regard to clerical abuses. He was deprived of his appointment as synodal preacher, and forbidden the exercise of priestly functions. Simultaneously with these proceedings, negotiations had been going on for the removal of the long-continued papal schism. King Wenceslaus of Bohemia had requested that the clergy and the university observe a strict neutrality toward both popes. Hut the clergy remained supporters of Gregory XII, and of the university only the Bohemian "nation" under Huss avowed neutrality. There followed an expression of nationalist feeling, with the result that a royal edict (Jan. 18, 1409) was issued, by which the Bohemian "nation" received three votes, while only one was allotted to the Bavarians, Saxons and Poles combined; whereupon all the foreigners, to the number oi several thousands, immediately withdrew from Prague.

His Teaching. — It was a dangerous triumph ior Huss; for his popularity at court and in the general community had been secured only at the price of clerical antipathy. Among the first results of the changed ortler of things were on the one hand the election of Huss (Oct. 1409) to be again rector of the university, but on the other hand the appoint-

ment by the archbishop of an inquisitor to inquire into charges of heretical teaching and inflammatory preaching brought against him. He had spoken disrespectfully of the church, it was said, had even hinted that Antichrist might be found to be in Rome, had fomented in his preaching the quarrel between Bohemians and Germans, and had, notwithstanding all that had passed, continued to speak of Wycliffe as both a pious man and an orthodox teacher. The direct result of this investigation is not known, but it is probably connected with the promulgation by Pope Alexander V, in 1409, of a bull which ordered the abjuration of all Wycliffite heresies and the surrender of all his books, while at the same time—a measure specially leveled at the pulpit of Bethlehem chapel—all preaching was prohibited except in localities by long usage set apart for that use. The archbishop publicly burned about 200 volumes of the writings of Wycliffe, and excommunicated Huss and certain of his friends, who had in the meantime protested and appealed to the new pope (John XXIII). Again the populace rose on behalf of their hero, who continued to preach in the Bethlehem chapel, and in the university began publicly to defend the so-called heretical treatises of Wycliffe, while from king and queen, nobles and burghers, a petition was sent to Rome praying that the condemnation and prohibition in the bull of Alexander V might be quashed. In March 1411 the ban was anew pronounced upon Huss, and ultimatelv the whole city was laid under interdict; yet he went on

The struggle entered on a new phase with the proclamation of the papal bulls by which a religious war was decreed againdt the excommunicated King Ladislaus of Naples, and indulgence was promised to all who should take part in it. By his bold opposition to this procedure against Ladislaus. and still more by his doctrine that indulgence could never be sold without simony, and could not be lawfully granted except by genuine contrition and repentance. Huss at last isolated himself, not only irom the archiepiscopal party but also from the theological faculty of the university. The excommunication against Huss was renewed, and the interdict again laid on all places which should give him shelter. In December Huss had to yield to the king's wish by temporarily withdrawing from Prague to Kozihradek, and to Krakowitz. There he carried on a copious correspondence, and composed the *De ecclesia,* which subsequently furnished most of the material for the charges against him. This work mas largely based on the doctrines of Wycliffe.

Trial and Death.—In 1413 his presence was requested at the council of Constance, and, arriving there on Nov. 3, 1414, he received the famous imperial "safe conduct," the promise of which had been one of his inducements to quit the comparative security he had enjoyed in Bohemia. This safe conduct stated that, whatever judgment might be passed on him, Huss should be allowed to return freely to Bohemia. This by no means provided for his immunity from punishment. If faith to him had not been broken he would have been sent back to Bohemia to be punished by his sovereign, the king of Bohemia. The treachery of King Sigismund is undeniable and was indeed admitted by the king himself. The saie conduct was probably indeed given by him to entice Huss to Constance. On Dec. 4 the pope appointed a commission of three bishops to investigate the case against the heretic, and to procure witnesses; but the flight of Pope John XXIII in the following March furnished a pretext for the removal of Huss from the Dominican convent to a more secure place oi confinement under the charge of the bishop of Constance at Gottlieben on the Rhine. On May 4 the temper of the council was revealed in its unanimous condemnation of Wycliffe, especially of the so-called "forty-five articles," as erroneous, heretical. revolutionary. On June 5, when the case of Huss came up for hearing, he was unable to make his defense by reason of the violent outcries. The sitting of June 7, at which King Sigismund was present, was better disciplined. Propositions extracted from the *De ecclesia* were brought up, and the relations between Wycliffe and Huss were discussed. The accused repudiated the charge of having abandoned the doctrine of transubstantiation. while expressing admiration ior Wycliffe. On June 8 he declared that among the propositions he could abjure was that relating to transubstantiation; among those he felt constrained to maintain mas that which denied that Peter mas the head of the church. The council finally demanded that Huss should declare that he had erred in all the articles cited against him; second, that he should promise on oath neither to hold nor teach them in the future; third, that he should publicly recant them. He declined, and sentence of death was pronounced on July 6, in the presence of Sigismund and a full sitting of the council. Once again he attempted to remonstrate, but in vain, and finally he betook himself to silent prayer. He was handed over to the secular arm: and on the same day the fire was kindled, and his voice as it audibly prayed in the words of the "Kyrie Eleison" was soon stifled in the smoke, When the flames had done their office, the ashes that were left and even the soil on which they lay were carefully removed and thrown into the Rhine.

Not many words are needed to convey a tolerably adequate estimate of the character and work of the "pale thin man in mean attire," who in sickness and poverty thus ended at the stake the 46th year of a busy life. The value of Huss as a scholar was iormerly underrated. The publication of his *Super IV sententiarum* has proved that he was a man of real learning. Yet his principal glory will always be iounded on his spiritual teaching. It is not easy to formulate precisely the beliefs for which he died, and certainly some of them, *e.g.,* that regarding the church, were such as many Protestants would regard as unguarded and difficult to harmonize with the maintenance of external church order. By propagating the reiormatory doctrines of Wycliffe, Huss may be said to have handed on to Luther the torch which kindled the Reformation. His popularity in his own country was due both to his oratorical powers and to his pastoral activity.

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HUSSAR, originally the name of a soldier belonging to a corps of light horse raised by Matthias Corvinus, king of Hungary, in 1458, to fight against the Turks. The hussar was the typical Hungarian cavalry soldier, and, in the absence of good light cavalry in the regular armies of central and western Europe, the name and character of the hussars gradually spread into Prussia, France, etc. Frederick the Great sent Maj. H. J. von Zieten to study the work of this type of cavalry in the Austrian service. and Zicten so far improved on the Austrian model that he defeated his old teacher, General Baranyai. in an encounter between the Prussian and Austrian hussars at Rothschloss in 1741. The typical uniform oi the Hungarian hussar was followed, with modifications, in other European armies. It consisted of a busbq or a high cylindrical cloth cap. jacket with heavy braiding and a dolman or pelisse, a loose coat worn hanging from the left shoulder. Several hussar regiments of the British army were converted irom light dragoons in the 19th century. The name survived into the Korean war when the 29th British Commonwealth brigade group, embarking irom England in Oct. 1950, included the 8th Royal Irish hussars as the tank unit. (Ls. Ms.)

HUSSERL, EDMUND (1859–1938). philosopher. the father of phenomenology, was born of Jewish parents at Prossnitz (Prostejov) in Moravia on April 8. 1859. To complete the mathematical studies that he had begun in German universities, he went to Vienna in 1834. where. under the influence of Franz Brentano. he discovered that his real bent was for philosophy. In 188; he joined the Lutheran Church. He taught philosophy as *Privatdozent* (unpaid but ofticial lecturer) at Halle from 1887, then as proiessor at Göttingen from 1901 and at Freiburg im Breisgau from 1916 to his retirement in 1928. He died at Freiburg on April 27, 1938.

The phenomenological method, discovered by Husserl about 1896 as a new philosophical approach to describe and define the genuine essence (*eidos*) of conscious data, was presented ior the first time in his *Logische Untersuchungen,* 2 vol. (Halle, 1900–01). In that work he applies this method primarily to the more formal meanings oi logic and mathematics. Intentionality of the consciousness (*i.e.,* the necessary relation of every conscious act to a meaningiul object) is emphasized as being the universal law of awareness; as the source and root of the content and value of all knowledge, he maintains the absolute priority of the intuition.

In *Ideen zu einer reinen Phanomenologie,* hook i (Halle, 1913), phenomenological description is presented as the necessary propaedeutic method to begin authentic philosophical inquiry about every intentional meaning whatsoever. To grasp the meaning of the "intentionally given" in its purity, phenomenological "reduction" is necessary; reduced to meaning as such. the world to be explained in philosophy is not the existing world supposed by the natural attitude, but an infinite multitude of meaningful data, unified by the universal structures by which these data belong to the world. Phenomenology has to describe the basic meanings and structures by "intentional analysis" oi them; *i.e.,* an analysis of their meaning as such. Such an analysis has to respect the necessary relation act-object of all consciousness; consequently the "noetical" (act) and "noematical" (object) aspects of every intentional datum must be analyzed correlatively. Transcendental phenomenology. the theory of the universal constitution of all meaning by the transcendental ego, is nothing else than the metaphysical background required by the intentional analysis. Phenomenology at this stage claims to be a universal and transcendental philosophy, as in the *Cartesianische Meditationen* (Fr. trans., *Méditations cartésiennes,* Paris, 1931) and in "Die Krisis der europäischen Wissenschaften und die transcendentale Phanomenologie," *Philosophia,* i (Belgrade, 1936).

Husserl's descriptive method and his theories about intentionality and intuition exercised wide influence on philosophy, especially in Germany (Max Scheler, Martin Heidegger) and in France (Jean-Paul Sartre, Maurice Merleau-Ponty), and also on psychology (Ludwig Binswanger, F. Buytendijk). In 1939 his manuscripts (about 40,000 pages) were brought together to form the *Archives-Husserl* at Louvain. Much of this material has been published in thr collection *Husserliana,* directed by *H.* L. van Breda (The Hague, 1950 ff.).

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HUSSITES, the name given to the followers of John Huss (1369–1415), the Bohemian reformer. They were at first often called Wycliffites, as the theological theories of Huss were largely founded on the teachings of Wycliffe. Huss indeed laid more stress on Church reform than on theological controversy. On such matters he always writes as a disciple of Wycliffe. The Hussite movement may be said to have sprung from three main sources. Bohemia was long but very loosely connected with the Church of Rome. The connection became closer at the time when the papacy was discredited by the great schism. The rapacity of its representatives in Bohemia, and the immorality of the clergy caused general indignation. The Hussite movement was also a democratic one, an uprising of the peasantry against the landowners at a period when a third of the soil belonged to the clergy. F'inaliy, national enthusiasm for the Slavic race contributed largely to its importance. The towns were mainly German; and by the regulations of the University of Prague Germans also held almost all the more important ecclesiastical offices —a condition of things greatly resented by the natives of Bohemia, which at this period had reached a high degree of intellectual development. (*See* BOHEMIA.)

Utraquism.—The Hussite movement assumed a revolutionary character as soon as the news of the death of Huss reached Prague. The knights and nobles of Bohemia and Moravia, who were in favour of Church reform, sent to the council at Constance (Sept. 2, 141j) a protest which condemned the execution of Huss in the strongest language. The uncompromising attitude of Sigismund, king of the Romans, caused trouble in various parts of Bohemia. and many Romanist priests were driven from their parishes. Almost from the first the Hussites were divided into two principal sections. Shortly befcre his death Huss had accepted a doctrine preached during his absence by his adherents at Prague, namely, that of "utraquism," *i.e.,* the obligation of the faithful to receive communion in both kinds. This doctrine became the watchword of the moderate Hussites, known as the Utraquists, while the more advanced Hussites known as the Taborites from the name of their stronghold, recognized only two sacraments, Baptism and Communion, and rejected most of the ceremonial of the Roman Church.

Anti-Hussite Movements.— Under the influence of his brother Sigismund, Ring Wenzel endeavoured to stem the Hussite movement. A certain number of Hussites left Prague. They held meetings in various parts of Bohemia, particularly at Usti, near the spot where the town of Tabor was founded soon after ards. At these meetings Sigismund was violently denounced, and the people everywhere prepared for war. The troubles at Prague continued, and on July 30, 1419, when a Hussite procession marched through the streets, stones were thrown at the Hussites from the windows of the town hall of the "new town." The people, headed by John Žižka (1376–1424), threw the burgomaster and several town councillors from the windows and they were immediately killed by the crowd. On hearing this news King Wenzel was seized with an apoplectic fit and died a few days afterwards. The death of the king resulted in renewed troubles in Prague and in almost all parts of Bohemia. Many Romanists. most of them Germans, were expelled from the Bohemian cities. In Prague, in Nov. 1419, severe fighting took place between the Hussites and the mercenaries whom Queen Sophia (widow of Wenzel) had hurriedly collected. After a considerable part of the city had been destroyed a truce was concluded on Nov. 13. The nobles, who, though favourable to the Hussite cause, yet supported Sophia, promised to act as mediators with Sigismund; while the citizens of Prague consented to restore to the royal forces the castle of Vyšehrad, which had fallen into their hands. Žižka, who disapproved of this compromise, left Prague and retired to Plzeň (Pilsen), then into southern Bohemia, and after defeating the Romanists at Sudomeř—the first pitched battle of the Hussite wars—he arrived at Usti, one of the earliest meeting-places of the Hussites. Not considering its situation sufficiently strong, he moved to the neighbouring new settlement of the Hussites, to which the biblical name of Tabor was given. The ecclesiastical organization of Tabor had a somewhat puritanic character, and the Government was established on a thoroughly democratic basis. Four captains of the people were elected, one of whom was Žižka; and a strictly military discipline was instituted.

The Articles **of** Prague.—On March 17, 1420, Martin V proclaimed a crusade "for the destruction of the Wycliffites, Hussites and all other heretics in Bohemia." **A** vast army of crusaders arrived before Prague on June 30 (see ŽIŽKA, JOHN). Negotiations took place for a settlement of the religious differences. The united Hussites formulated their demands in a statement known as the "Articles of Prague." This document, the most important of the Hussite period, runs thus:

"I. The word of God shall be preached and made known in the kingdom of Bohemia freely and in an orderly manner by the priests of the Lord. . . .

"II. The sacrament of the most Holy Eucharist shall be freely administered in the two kinds, that is bread and wine, to all the faithful in Christ who are not precluded by mortal sin—according to the word and disposition of Our Saviour.

"III. The secular power over riches and worldly goods which the clergy possesses in contradiction to Christ's precept, to the prejudice of its office and to the detriment of the secular arm, shall be taken and withdrawn from it, and the clergy itself shall be brought back to the evangelical rule and an apostolic life such as that which Christ and his apostles led. . . .

"IV. All mortal sins, and in particular all public and other disorders, which are contrary to God's law, shall in every rank of life be duly and judiciously prohibited and destroyed by those whose office it is."

These articles, which contain the essence of the Hussite doctrine, were rejected by Sigismund. Hostilities therefore continued, and nearly all Bohemia fell into the hands of the Hussites. Internal troubles prevented them from availing themselves completely of their victory. At Prague a demagogue, the priest John of Želivo, for a time obtained almost unlimited authority over the lower classes of the townsmen; and at Tabor a communistic movement (that of the so-called Adamites) was sternly suppressed by Žižka. Sigismund only arrived in Bohemia at the end of 1421. He took possession of the town of Kutnar Hora (Kuttenberg), but was decisively defeated by Žižka at Německy Brod (Deutschbrod) on Jan. 6, 1422. Bohemia was now again for a time free from foreign intervention, but internal discord again broke out caused partly by theological strife, partly by the ambition of agitators. There were troubles at Tabor itself, where a more advanced party opposed Žižka's authority. Bohemia obtained a temporary respite when, in 1422, Prince Sigismund Korybutovii: of Poland became for a short time ruler of the country. His authority was recognized by the Utraquist nobles, the citizens of Prague, and the more moderate Taborites, including Žižka. Korybutovič, however, remained but a short time in Bohemia; after his departure civil war broke out, the Taborites opposing in arms the more moderate Utraquists, whose principal stronghold was Prague. On April 27, 1423, Žižka now again leading, the Tahorites defeated at Horic the Utraquist army under Čenek of Wartemberg; shortly afterward an armistice was concluded at Konopoišt.

Further Anti-Hussite Attacks.— Papal influence had meanwhile succeeded in calling forth a new crusade against Bohemia, but it resulted in complete failure. In spite of the endeavours of their rulers, the Slavs of Poland and Lithuania did not wish to attack the kindred Bohemians; the Germans were prevented by internal discord from taking joint action against the Hussites; and the king of Denmark, who had landed in Germany with a large force, soon returned to his own country. Free for a time from foreign aggression, the Hussites invaded Moravia, where a large part of the population favoured their creed; but, again paralyzed by dissensions, soon returned to Bohemia. The city of Königgrätz (Králové Hradec), which had been under Utra-

quist rule, espoused the doctrine of Tabor, and called Žižka to its aid. After several military successes gained by Žižka (*q.v.*) in 1423 and 1424, a treaty of peace between the Hussites was concluded on Sept. 13, 1424, at Liben, now part of Prague.

In 1426 the Hussites were again attacked by foreign enemies. In June their forces, led by Prokop the Great—who took the command of the Taborites shortly after Žižka's death in Oct. 1424—and Sigismund Korybutovič, who had returned to Bohemia, signally defeated the Germans at Aussig (Usti nad Labem). After this great victory, and another at Tachau in 1427, the Hussites repeatedly invaded Germany.

The almost uninterrupted victories of the Hussites now rendered vain all hope of subduing them by force of arms. Moreover, the conspicuously democratic character of the Hussite movement caused the German princes, who were afraid that such views might extend to their own countries, to desire peace. Many Hussites, particularly the Utraquist clergy, were also in favour of peace. Negotiations for this purpose were to take place at the council which had been summoned to meet at Basel on March 3, 1431. The Roman see reluctantly consented to the presence of heretics at this council, but indignantly rejected the suggestion of the Hussites that members of the Greek Church and representatives of all Christian creeds should also be present. Before definitely giving its consent to peace negotiations, the Roman Church determined on making a last effort to reduce the Hussites to subjection. On Aug. 1, 1431, a large army of crusaders, under Frederick, margrave of Brandenburg, crossed the Bohemian frontier; but on the arrival of the Hussite army under Prokop the crusaders immediately took to flight, almost without offering resistance.

Settlement: **of** Disputes.--On Oct. 15, the members of the council, who had already assembled at Basel, issued a formal invitation to the Hussites to take part in its deliberations. Prolonged negotiations ensued; but finally a Hussite embassy arrived at Basel on Jan. 4, 1433. It was found impossible to arrive at an agreement. Negotiations were not, however, broken off; and a change in the political situation of Bohemia finally resulted in a settlement. In 1434 war again broke out between the Utraquists and the Taborites. On May 30 the Taborite army, led by Prokop the Great and Prokop the Less, who both fell in the battle, was totally defeated and almost annihilated at Lipan. The moderate party thus obtained the upper hand; and it formulated its demands in a document known as the *Compactata,* which incorporated the principles laid down in the Articles of Prague.

On July 5, 1436, the compacts were formally accepted at Iglau, in Moravia, by King Sigismund, by the Hussite delegates, and by the representatives of the Roman Church. The Utraquist creed, frequently varying in its details, continued to be that of the established Church of Bohemia till all non-Roman religious services were prohibited shortly after the battle of the White Mountain in 1620. The Taborite party never recovered from its defeat at Lipan, and after the town of Tabor had been captured by George of Poděbrad in 1452 Utraquist religious worship was established there. The Bohemian brethren, whose intellectual originator was Peter Chelčicky, to a certain extent continued the Taborite traditions, and in the 15th and 16th centuries included most of the strongest opponents of Rome in Bohemia. After the beginning of the German Reformation many Utraquists adopted to a large extent the doctrines of Luther and Calvin; and in 1567 obtained the repeal of the compacts, which no longer seemed sufficiently far-reaching.

See E. Denis, *Huss et la guerre des Hussites* (1878); Count Lützow, *Bohemia; an Historical Sketch* (1896); *H.* Toman, *Husitské Válečnictvi* (1898). (Lz.)

HUTCHESON, FRANCIS (1694–1747), British philosopher, the exponent of the moral-sense theory in ethics, was born on Aug. 8. 1694, at Drumalig in County Down, the son of a Presbyterian minister. From 1710 to 1716, he studied philosophy, classics and theology at Glasgow university. He then opened a private academy in Dublin, where he made many friends among the clergy of the Established Church. In 1729, he returned to Glasgow as professor of moral philosophy. In spite of being accused in 1738 before the Glasgow presbytery for holding that the standard of moral goodness was the promotion of the happiness of others and that we could have a knowledge of good and evil without and prior to a knowledge of God, Hutcheson enjoyed a well-deserved popularity. He died in Glasgow in 1747.

Ethics.—Hutcheson wrote on all the major branches of philosophy, but is important chiefly for his ethical writings. His theory was propounded in his *Inquiry Into the Original of Our Ideas of Beauty and Virtue,* in two treatises (London, 1725; rev. ed., *Inquiry Concerning Beauty, Order, Harmony and Design* and *Inquiry Concerning Moral Good and Evil,* 1726); and in *An Essay on the Nature and Conduct of the Passions and Affections, With Illustrations Upon the Moral Sense* (London, 1728). Later works were *Philosophiae moralis institutio compendiaria, ethices et jurisprudentiae naturalis elementa continens* (Glasgow, 1742) and the posthumous *System of Moral Philosophy,* 2 vol. (Glasgow, London, 1755). Opposing Hobbes and Bernard de Mandeville, he closely followed the 3rd earl of Shaftesbury, especially as regards the analogy between beauty and virtue, the functions assigned to the moral sense, the position that the benevolent feelings form an original and irreducible part of our nature and the unhesitating adoption of the principle that the test of virtuous action is its tendency to promote the general welfare. According to Hutcheson, man has a variety of senses, internal as well as external, reflex as well as direct, the definition of a sense being "any determination of our minds to receive ideas independently on our will, and to have perceptions of pleasure and pain" *(Essay on the Nature and Conduct of the Passions,* §1). Without exhaustively enumerating these "senses," he specifies, besides the five external senses (1) consciousness, by which each man has a perception of his own mind; (2) the sense of beauty; (3) a public sense, or *sensus communis,* "a determination to be pleased with the happiness of others and to be uneasy at their misery"; (4) the moral sense, or "moral sense of beauty in actions and affections, by which we perceive virtue or vice, in ourselves or others"; (5) a sense of honour or praise and blame; (6) a sense of the ridiculous. Of these "senses" the "moral sense" is the most important. It is implanted in man and pronounces immediately on the character of actions and affections, approving those which are virtuous and disapproving those which are vicious, because the Author of Nature "has made virtue a lovely form to excite our pursuit of it, and has given us strong affections to be the springs of each virtuous action." Hutcheson's use of the term "moral sense" and his failure to couple it invariably with the term "moral judgment" tends to obscure the part played by deliberation.

But though Hutcheson usually describes the moral faculty as acting instinctively and immediately, he does not confound the moral faculty with the moral standard. The criterion of right action is for him, as for Shaftesbury, its tendency to promote the general welfare of mankind. He thus anticipates the utilitarianism of Jeremy Bentham even in the use of the phrase "the greatest happiness for the greatest number" *(Inquiry Concerning Moral Good and Evil,* §3). But since intuition has no possible connection with an empirical calculation of results, Hutcheson in adopting such a criterion practically denies his fundamental assumption. His most distinctive ethical doctrine is the "benevolent theory" of morals by which he opposes Hobbes. He maintains not only that benevolence is the direct source of many of our actions, but also that it is the only source of those actions of which, on reflection, we approve. Actions which flow from self-love only are morally indifferent,, though in so far as a man may justly regard himself as a part of the rational system and may thus "be, in part, an object of his own benevolence," the "personal virtues" may be regarded as fitting objects of moral approbation. Hutcheson inconsistently declares that while self-love merits neither approbation nor condemnation, the satisfaction of the dictates of self-love is one of the very conditions of the preservation of society. In the *Synopsis metaphysicae (see* below), he holds that will is determined by motives in conjunction with our character and habit of mind, and that the only true liberty is the liberty of acting as we will. not the liberty of willing as we will.

The prominence given by Hume and Adam Smith to the analysis of moral action and moral approbation, with the attempt to distinguish between the respective province of the reason and that of the emotions in these processes, is undoubtedly due to the influence of Hutcheson. To a study of Shaftesbury and Hutcheson we might probably attribute Hume's unequivocal adoption of the utilitarian standard. Objections to Hutcheson's system were made by John Balguy in *The Foundation of Moral Goodness* (1727–28); by the dissenter John Taylor (1694–1761) in *An Examination of the Scheme of Morality Advanced by Dr. Hutcheson* (1759); and, most notably, by Richard Price (*q.v.*) in his *Review of the Principal Questions and Difficulties in Morals* (1758). (*See* ETHICS, HISTORY OF.)

Epistemology and Logic. — Hutcheson's most important work apart from the ethical writings was the *Metnphysicae synopsis ontologiam et pneumatologiam complectens* (Glasgow, 1742; and ed., *Synopsis metaphysicae,* etc., 1744). Both his epistemology and his logic are interesting mainly as a link between Locke and the Scottish school. With Locke he rejects the doctrine of innate ideas (*see,* for instance, *Inquiry Concerning Moral Good and Evil,* 1 *ad fin.,* and $4; *cf. Synopsis,* pars i. cap. 2); but he modifies Locke's doctrine and anticipates Thomas Reid when he states that the ideas of extension. figure, motion and rest "are more properly ideas accompanying the sensations of sight and touch than the sensations of either of these senses"; that the idea of self accompanies every thought; and that the ideas of number, duration and existence accompany every other idea whatsoever (see *Essay,* art. 1; *Synopsis,* pars i. cap. 1, pars ii. cap. 1). Like Locke, Hutcheson also depreciates the importance of the so-called laws of thought, distinguishes between the primary and secondary qualities of bodies, asserts that we cannot know the inmost essences of things though they excite various ideas in us and assumes that external things are known only through the medium of ideas (*Synopsis,* pars i. cap. 1). He accounts for our assurance of the reality of externals by referring it to a natural instinct (*Synopsis,* pars i. cap. 1). Of the correspondence between our ideas of the primary qualities of things and the things themselves God alone is the cause, having effected it through a law of nature.

Hutcheson diverges from Locke in his account of the idea of personal identity, which he appears to have regarded as made known to us directly by consciousness. Generally, he speaks as if we had a direct consciousness of mind as distinct from body (*see,* for instance. *Synopsis,* pars ii. cap. 3), though in the posthumous *System of Moral Philosophy* he expressly states that we know mind as we know body "by qualities immediately perceived though the substance of both be unknown" (bk. i, ch. 1). Other points in which he supplemented or departed from Locke are: the distinction between perception proper and sensation proper. which is not explicitly worked out; the imperfection of the ordinary division of the external senses into five; the limitation of consciousness to a special mental faculty; and the disposition to refer on disputed questions of philosophy not so much to formal arguments as to the testimony of consciousness and our natural instincts. The last point suggests the "common-sense philosophy" of Reid.

The short *Logicae compendium* contains a large proportion of psychological matter. The author distinguishes between the mental result and its verbal expression (idea as distinct from term; judgment as distinct from proposition). constantly employs the word "idea" and defines logical truth as *convenientia signorum cum rebus significatis* ("a concord of the signs with the things signified"), thus implicitly repudiating a merely formal view of logic.

Aesthetics. — Hutcheson is one of the earliest modern writers on aesthetics. He maintains that the special sense by which we perceive beauty. harmony and proportion is a *reflex* sense. presupposing sight and hearing. Beauty is also perceived in universal truths, in the operations of general causes and in moral principles and actions. Thus, the analogy between beauty and virtue, a favourite topic with Shaftesbury, is prominent in Hutcheson also. (*See* AESTHETICS.)

BIBLIOGRAPHY — There is a biography by William Leechman printed with Hutcheson's *System of Moral Philosophy. See* also *W.* R. Scott, *Francis Hutcheson* (Cambridge, 1900); T. Fowler, *Shaftesbury and Hutcheson* (London, 1882); C. de W. Thorpe, "Addison and Hutcheson on the Imagination." *Journal of English Literary History,* vol. ii (Baltimore, Md., 1935); D. D. Raphael, *The Moral Sense* (London, Toronto, 1947); C. Reto, *Die Problenzatik des Moral Sense in der Moralphilosophie Hutchesons* (Bregenz, 1950); and general histories dealing with 18th-century ethical thought, such as Leslie Stephen, *History* of *English Thought in the Eighteenth Century,* 3rd ed. (London, New York, 1927).

HUTCHINS, ROBERT MAYNARD (1899–), U.S. educator and critic of overspecialization and lack of balance in the college curriculum and the failure of colleges and universities to maintain and enlarge the intellectual tradition of the western world. He was born in Brooklyn, N.Y., on Jan. 17, 1899. After two years at Oberlin college, Oberlin, O., he served in the ambulance service of the U.S. army, 1917–19, and the Italian army. 1918–19. He received the degrees of A.B. (1921) and LL.B. (1925) from Yale where he later became dean of the law school. In 1929, at the age of 30, he was elected president of The University of Chicago, becoming chancellor in 1945 and remaining there until his appointment as a foundation executive in 1951. He became a centre of controversy by insisting that the problems of higher education in the United States following World War I have been confusion about the purposes of higher education, with consequent overemphasis upon athletics, social life and specific vocational training, and use of hours spent in class as a measure of a student's education. His criticisms and proposals have been vigorously debated and widely accepted. His interests in educational reform are part of his broader concern with the improvement of American society. His vigorous defense of nonconformity and protest as having been essential to the growth of that society and his analysis of education in the United States as drifting toward specialization and pragmatism are presented in his published lectures, including *The Higher Learning in America* (1936), *Education for Freedom* (1943), *The Conflict in Education* (1953), *University of Utopia* (1953) and *Sonze Observations on American Education* (1956). His other publications include books and articles on education and *Freedom, Education, and the Fund: Essays and Addresses, 1946–1956* (1956). He became editor in chief of *Great Books of the Western World* (1952) and chairman of the board of editors of *Encyclopedia Britannica.*

(R. W. TR.)

HUTCHINSON, ANNE (*c.* 1600–1643), American religious enthusiast and one of the founders of Rhode Island, was born in Lincolnshire, Eng., the daughter of a clergyman, Francis Marbury, and according to tradition, a cousin of John Dryden. She married William Hutchinson, and in 1634 emigrated to Boston, Mass. Although her orthodoxy was suspected and for a time she was not admitted to the church, she soon organized meetings among the Boston women, among whom her exceptional ability and her services as a nurse had given her great influence. At these meetings, which were soon attended even by some of the ministers and magistrates, she discussed and commented upon recent sermons and gave expression to her own theological views. She asserted that she; John Cotton (*q.v.*) and her brother-in-law, the Rev. John Wheelwright, were under a "covenant of grace," that they had a special inspiration, a "peculiar indwelling of the Holy Ghost," whereas the other ministers of the colony were under a "covenant of works." Anne Hutchinson, according to Winthrop a woman "of a ready wit and bold spirit," was, in fact, voicing a protest against the legalism of the Massachusetts Puritans, and was also striking at the authority of the clergy in an intensely theocratic community. As a result the entire colony was divided into factions. Mrs. Hutchinson was supported by Gov. Sir Henry Vane. Cotton, Wheelwright and the great majority of the Boston church; opposed to her were Deputy Gov. John Winthrop, the Rev. John Wilson of the Boston church and all of the country magistrates and churches. The strength of the parties was tested at the general court of election of May 1637, when Winthrop defeated Vane for the governorship. Cotton recanted, Vane returned to England in disgust, Wheelwright was tried and banished. Mrs. Hutchinson was tried by the general court chiefly for "traducing the ministers," and was sentenced to banishment; later she was

tried before the Boston church and formally excommunicated. With William Coddington and others she established a settlement on the island of Aquidneck (now Rhode Island) in **1638.** Four years later, after the death of her husband, she settled on Long Island sound near what is now New Rochelle, N.Y., and was killed by the Indians in Aug. **1643,** an event regarded in Massachusetts as a manifestation of divine providence. Anne Hutchinson and her followers were called "Antinomians," rather as a term of reproach than with any reference to her doctrinal theories, and the controversy in which she was involved is known as the "Antinomian controversy."

BIBLIOGRAPHY.—Charles Francis Adams, *Antinomianism in the Colony of Massachusetts Bay, 1636–1638* (1894), *Three Episodes in Massachusetts History,* vol. i (1893); George F. Ellis, *The Puritan Age and Rule in the Colony of Massachusetts, 1629–1685* (1888); Helen Augur, *An American Jezebel: the Life of Anne Hutchinson* (1930); Edith Curtis, *Anne Hutchinson: a Biography* (1930). (RT. P. B.)

HUTCHINSON, JOHN (1615–1664), English Puritan, son of Sir Thomas Hutchinson of Owthorpe, Nottinghamshire, was baptized on Sept. **18, 1615.** On the outbreak of the Civil War he took parliament's side and was made in **1643** governor of Nottingham castle, which he defended till the triumph of the parliamentary cause. He became a member of parliament for Nottinghamshire in March **1646,** took the side of the Independents, opposed the offers of the king at Newport and signed the death warrant. Though a member at first of the council of state, he disapproved of Oliver Cromwell's policy and took no further part in politics during the lifetime of the protector.

He resumed his seat in the recalled Long parliament in May **1659,** and followed George Monk in opposing John Lambert, believing that Monk intended to maintain the Commonwealth. He was returned to the Convention parliament for Nottingham but expelled on June **9, 1660.**

In Oct. **1663** he was arrested upon suspicion of being concerned in the Yorkshire plot, imprisoned in the Tower of London and in Sandown castle, Kent, where he died on Sept. **11, 1664.**

HUTCHINSON, JOHN (1674–1737), English theological writer, was born at Spennithorne, Yorkshire, in 1674. He served as stenard in several families of position, latterly in that of the duke of Somerset, nho ultimately obtained for him the post of riding purveyor to the master of the horse, a sinecure worth about £200.

He taught that the Bible contained the elements not only of true religion but also of all rational philosophy. He held that the Hebrew must be read without points, and his interpretation rested largely on fanciful symbolism. His followers were called Hutchinsonians.

His *Works* were edited by Robert Spearman and Julius Bate 12 vol. (1748). A *Supplement,* with *Life* by Spearman prefixed, appeared in 1765.

HUTCHINSON. SIR JONATHAN (1828–1913), English surgeon and pathologist. whose principal nork was in the study of syphilis, was born on July **23, 1828,** at Selby. Yorkshire, his parents belonging to the Society of Friends. He entered St. Bartholomew's hospital and gained a reputation as a skillful operator and a scientific inquirer. He was Hunterian professor at the Royal College of Surgeons, 1879–83, and in **1889** nas president of the college. His lectures on neuropathogenesis, gout, leprosy, diseases of the tongue. etc., as well as his studies in syphilis, were full of original observations. He was the founder of the London Polyclinic or Post-graduate School of Medicine and the promoter of the New Sydenham society for the publication of translations of important foreign medical treatises. He published several volumes on his own subjects and was editor of the quarterly *Archives* of *Surgery.* Hutchinson received a knighthood in 1908 and died at Haslemere on June 26, 1913.

HUTCHINSON, THOMAS (1711–1780), the last royal governor of the province of Massachusetts, son of a wealthy merchant of Boston, Mass., mas born there on Sept. **9,** 1711. He graduated at Harvard in 1727 and for several years thereafter devoted himself to business. In 1737 he began his public career as a member of the Boston board of selectmen, and a few weeks later he was elected to the general court of Massachusetts Bay, of which he was a member until 1740 and again from 1742 to 1749, serving as speaker in **1747,** 1748 and 1749. He consistently contended for a sound financial system and vigorously opposed the operations of the "land bank" and the issue of pernicious bills of credit. His first trip to England was in 1740 when he represented his colony in a boundary dispute with New Hampshire. He was a member of the Massachusetts council from **1749** to **17j6,** was chief justice of the superior court of the province from **1761** to **1769,** was lieutenant governor from 1758 to 1771, acting as governor in the latter two years. and from 1771 to **1774** was governor. In 1754 he was a delegate from Massachusetts to the Albany convention and, with Franklin, was a member of the committee appointed to draw up a plan of union. Though he recognized the legality of the Stamp act of 1765, he considered the measure inexpedient and impolitic and urged its repeal, but his attitude was misunderstood; he was considered by many to have instigated the passage of the act, and in Aug. 1765 a mob sacked his Boston residence and destroyed many valuable manuscripts and documents. He was acting governor at the time of the "Boston massacre" in 1770, and it was his orders that removed the British troops from the town. Throughout the prerevolutionary disturbances in Massachusetts he was the representative of the British ministry, and though he disapproved of some of the ministerial measures he felt impelled to enforce them and necessarily incurred the hostility of the Whig or patriot element. In 1774, upon the appointment of Gen. Thomas Gage as military governor, he went to England, and acted as an adviser to George III and the British ministry on American affairs, uniformly counseling moderation. He died at Brompton, now part of London, on June **3, 1780.**

He wrote *A Brief Statement of the Claim of the Colonies (1764);* a *Collection of Original Papers Relative to the History of Massachusetts Bay* (1769), reprinted as *The Hutchinson Papers* by the Prince Society in 1865; and a judicious, accurate and very valuable *History of the Province of Massachusetts Bay* (vol i, 1764, vol. ii, 1767, and vol iii, 1828). His *Dzary and Letters, With an Account of Hzs Administtation,* was published at Boston in 1884–86.

See J. K. Hosmer, *Lzfe of Thomas Hutchinson* (1896); and a biographical chapter in John Fiske, *Essays Historical and Literary* (1902) For an estimate of Hutchinson as an historian, *see* M. C. Tyler, *Literary History of the American Revolution* (1897).

HUTCHINSON, a city of south-central Kansas, US., and seat of Reno county, **40** mi. N.W. of Wichita Established on the north bank of the Arkansas river in **1871** by C. C. Hutchinson. who was originally sent to Kansas as an Indian agent for the federal government, Hutchinson began developing with the arrival of the Santa Fe railroad in **1872,** the year of the city's incorporation.

In Sept. **1887** thick beds of salt were discovered there, which led to the development of a major industry. The city sits atop what are reputedly some of the world's richest salt deposits, which are mined, processed and shipped to markets in all parts of the U.S. Hutchinson is also a principal primary hard wheat market, aith a grain storage capacity of approximately 35,000,000 bu. It is centred in one of the middle west's richest oil fields, and its petroleum production, banking, transportation, flour milling, building products, farm machinery manufacturing and wholesale grocery business are important factors in the economy of the area.

Hutchinson is the site of the annual Kansas State fair, several important athletic tournaments and the State Industrial reformatory. Hutchinson junior college. founded in **1928** as a senior high school, is operated as a part of the public-school system. For comparative population figures *see* table in KANSAS: *Population.*

(R. W. RI.)

HUTTEN, PHILIPP VON (*c.* 1511–1546), German knight, a relative of Ulrich von Hutten, joined the band of adventurers which under Georg Hohermuth, or George of Spires, sailed to Venezuela, or Venosala as Hutten calls it, with the object of conquering and exploiting this land in the interests of the Augsburg family of Welser. The party landed at Coro in February 1535 and Hutten accompanied Hohermuth on his toilsome expedition into the interior in search of treasure. After the death of Hohermuth in December 1540 he became captain-general of Venezuela. Soon after this event he vanished into the interior,

returning after five years of wandering to find that a Spaniard, Juan de Caravazil, or Caravajil, had been appointed governor in his absence. With his travelling companion, Bartholomew Welser the younger, he was seized by Caravazil in April 1546 and the two were afterwards put to death.

Hutten left some letters, and also a narrative of the earlier part of his adventures, this *Zeitung aus India Junkher Philipps von Hutten* being published in 1785.

HUTTEN, ULRICH VON (1488–1523), German humanist and soldier, was born on April 21, 1488, at the castle of Steckelberg, near Fulda, in Hesse. His life may be divided into four parts:—his youth and cloister-life (1488–1504); his wanderings in pursuit of knowledge (1504–1515); his strife with Ulrich of Wurttemberg (1515–1519); and his connection with the Reformation (1519–1523). He was the eldest son of a poor but not undistinguished knightly family.

Wanderings. — As he was mean of stature and sickly his father sent him to the Benedictine house at Fulda; the thirst for learning there seized on him, and in 1505 he fled from the monastic life. He went first to Cologne, next to Erfurt, and then to Frankfort-on-Oder on the opening in 1506 of the new university of that town. For a time he was in Leipzig, and in 1508 we find him a shipwrecked beggar on the Pomeranian coast. In 1509 the university of Greifswald welcomed him, but the sensitive ill-regulated youth, who took the liberties of genius, wearied his burgher patrons. He left Greifswald and was robbed of clothes and books, his only baggage, by the servants of his late friends; in the dead of winter, half starved, frozen, penniless, he reached Rostock.

Here under the protection of the Humanists he wrote against his Greifswald patrons, thus beginning the long list of his satires and fierce attacks on personal or public foes. From Rostock he wandered on to Wittenberg and Leipzig, to Vienna and on to Pavia, where he spent the year 1511 and part of 1512. In the siege of Pavia (1512) by papal troops and Swiss, he was plundered by both sides, and escaped, sick and penniless, to Bologna; on his recovery he took service as a private soldier in the emperor's army.

In 1514 he was again in Germany, under the patronage of the elector of Mainz, Archbishop Albert of Brandenburg. But the murder in 1515 of his relative Hans von Hutten by Ulrich, duke of Wiirttemberg, changed the whole course of his life; satire, chief refuge of the weak, became Hutten's weapon; with one hand he took his part in the famous *Epistolae obscurorum virorum*, and with the other launched scathing letters, eloquent Ciceronian orations, or biting satires against the duke. The emperor took Hutten under his protection and gave him a laureate crown in 1517. The poet, who had meanwhile revisited Italy, again attached himself to the electoral court at Mainz. In 1518 his friend Pirckheimer urged him to abandon the court and dedicate himself to letters, but he insisted on his mission as a knight of the empire.

The Knightly Satirist. — In 1519 he issued in one volume his five attacks on Duke Ulrich, and then took part in the private war against him; in this affair he became intimate with Franz von Sickingen, the champion of the knightly order (Ritterstand). Hutten now espoused the Lutheran cause, but he was at the same time mixed up in the attempt of the "Ritterstand" to assert itself as the militia of the empire against the independence of the German princes. Soon after this time he discovered at Fulda a copy of the manifesto of the emperor Henry IV. against Hildebrand, and published it with comments as an attack on the papal claims over Germany. He hoped thereby to interest the new emperor Charles V., and the higher orders in the empire, in behalf of German liberties; but the appeal failed. Luther had succeeded by speaking to cities and common folk in homely phrase, because he touched heart and conscience; Hutten tried to touch the more cultivated sympathies and dormant patriotism of princes and bishops, nobles and knights. And so he at once gained an undying name in the republic of letters and ruined his own career. He showed that the artificial verse-making of the Humanists could be connected with the new outburst of genuine German poetry. The Minnesinger was gone; the new national singer, a Luther or a Hans Sachs, was heralded by the stirring lines of Hutten's pen. These have in them a splendid natural swing and ring, strong and patriotic.

The attack on the papacy, and Luther's vast and sudden popularity, frightened Elector Albert, who dismissed Hutten from his court. Hoping for imperial favour, he betook himself to Charles V., but was rebuffed. He now attached himself more closely to Franz von Sickingen. He fled to Basel, where Erasmus refused to see him, both for fear of his loathsome diseases, and also because the beggared knight was sure to borrow money from him. A paper war consequently broke out between the two Humanists, which embittered Hutten's last days, and stained the memory of Erasmus. From Basel Ulrich went to Miilhausen; and then to Zurich.

There Zwingli helped him with money, and found him a refuge on the little isle of Ufenau on the Zurich lake. There the frail and worn-out poet, writing swift satire to the end, died on Aug. 29, 1523 at the age of thirty-five. He left behind him some debts due to compassionate friends; he did not even own a single book, and all his goods amounted to the clothes on his back, a bundle of letters, and that valiant pen which had fought so many a sharp battle, and had won for the poor knight-errant a sure place in the annals of literature.

Ulrich von Hutten is one of those men of genius at whom propriety is shocked, and whom the mean-spirited avoid. Yet through his short and buffeted life he was befriended, with wonderful charity and patience, by the chief leaders of the Humanist movement. For, in spite of his irritable vanity, his immoral life and habits, his odious diseases, his painful restlessness, Hutten had much in him that strong men could admire, for he passionately loved truth for its own sake. His patriotism is beyond dispute, though the cause with which he associated himself was particularist and doomed to failure. There was no salvation for Germany in the Ritterstand. It is as humanist and poet, and for his frank and noble nature that his claims to honour lie. A swarm of writings issued from his pen; at first the smooth elegance of his Latin prose and verse seemed strangely to miss his real character; he was the Cicero and Ovid of Germany before he became its Lucian.

His chief works were his *Ars versificandi* (1511); the *Nemo* (1518); a worh on the *Morbus Gallicus* (1519); the volume of Steckelberg complaints against Duke Ulrich (including his four *Ciceronian Orations*, his *Letters* and the *Phalarismus)* also in 1519; the *Vadismus* (1520); and the controversy with Erasmus at the end of his life. Besides these were many admirable poems in Latin and German. He was one of the most distinguished contributors to, though not the originator of the *Epistolae obscurorum virorum*, that famous satire on the theoiogians of Cologne with which the friends of Reuchlin defended him. In 1909 the Latin text of the *Epistolae* with an English translation was published by F. G. Stokes. D. F. Strauss concludes that he had no share in the first part, but that his hand is clearly visible in the second part, which he attributes in the main to him. To him is due the more serious and severe tone of that bitter portion of the satire. *See* W. Brecht, **Die** *Verfasser der Epistolae obscurorum virorum* (1904).

For a complete catalogue of the writings of Hutten, *see* E. Bocking, *Index Bibliographicus Huttenianus* (1858). Bocking also edited the complete works (7 vol., 1859–62). **A** selection of Hutten's German writings, edited by G. Balke, appeared in 1891.

BIBLIOGRAPHY.—The best biography (though it is also somewhat of a political pamphlet) is that of D. F. Strauss *(Ulrich von Hutten,* 1857; new ed. by O. Clemen, 1914; Eng. trans. by G Sturge, 1874), with which may be compared P. Kalkoff, *Ulrich oon Hutten und die Reformation* (1920), and Huttens, *Vaganten zeit und Untergang* (1925), in which a less favourable view of Hutten's political and religious activity is taken.

HUTTER, LEBNHARD (1563–1616), German Lutheran theologian, born at Nellingen, near Ulm, began to lecture at Jena in 1594, and in 1596 became professor of theology at Wittenberg. where he died on Oct. 23, 1616. Hutter was a champion of Lutheran orthodoxy, as set down in the confessions and embodied in his own *Compendium locorum theologicorum* (1610; reprinted 1863). He was called "Luther redonatus."

In reply to Rudolf Hospinian's *Concordia discors* (1607), he wrote *Concordia concors* (1614), defending the formula of Con-

cord, which he regarded as inspired. His *Irenicum vere christianum* is directed against David Pareus (1548–1622), of Heidelberg, aho had pleaded for a reconciliation of Lutheranism and Calvinism; his *Calvinista aulopoliticus* (1610) nas written against the "damnable Calvinism" which was becoming prevalent in Holstein and Brandenburg. Another work, based on the formula of Concord, was entitled *Loci communes theologici*. Karl von Hase used his name as the symbol of orthodoxy in his *Hutterus redivivus* (1827).

HUTTON, ARTHUR WOLLASTQN (1848–1912), English clergyman and author, was born at Spridlington, Lincolnshire, on Sept. 5, 1848. A scholar of Exeter college, Oxford, he took orders in the Church of England in 1872, but under Newman's influence became a Roman Catholic and from 1876 to 1883 was a member of the Edgbaston Oratorian community. Later he renounced Roman Catholicism and became known as an agnostic and freethinker. For several years he was librarian at the National Liberal club in London. In 1898 he mas readmitted to the Church of England, and from 1903 until his death was rector of Bow church, London.

Hutton died at Blackheath on March 25, 1912. He wrote a *Life of Manning* (1892).

HUTTON, JAMES (1726–1797), Scottish geologist who formulated the basic theory that geologic phenomena can be explained in terms of observable geologic processes, was born in Edinburgh on June 3, 1726. He qualified as a doctor of medicine, studying in Edinburgh and Paris, but turned to practical agriculture, in which he made many improvements. In 1768 he retired, and from then until his death (in Edinburgh on March 26, 1797) he devoted himself to scientific pursuits.

Hutton conceived larger ideas than were entertained by the mineralogists of his day. He desired to trace the origin of the various minerals and rocks and thus to arrive at some clear understanding of the history of the earth. In 1785 he communicated his views to the recently established Royal Society of Edinburgh in a paper entitled "Theory of the Earth, or an Investigation of the Laws Observable in the Composition, Dissolution, and Restoration of Land Upon the Globe," published in the society's *Transactions*. Hutton's work was little recognized until the publication of John Playfair's *Illustrations of the Huttonian Theory* (1802; facsimile reprint with introduction by G. W. White, 1956), a lucid exposition of the postulate that the processes that have been at work on the earth in the past are the same as those now in operation.

The same volume of the *Transactions* in which his "Theory of the Earth" appeared contained also a "Theory of Rain," which was read to the Royal society in 1784 His other works include: *Dissertations on DifferentSubjects in Natural Philosophy* (1792), in which he discussed the nature of matter, fluidity, cohesion, light, heat and electricity, and *Arc Investigation of the Principles of Knowledge, and of the Progress of Reason From Sense to Science and Philosophy*. His closing years were devoted to the extension and republication of his *Theory of the Earth*, of which two volumes appeared in 1795. A portion of the manuscript of a third volume was edited by A. Geikie in 1899.

For an evaluation of Hutton's contributions to geologic theory *see* GEOLOGY: *Development of the Science: 18th-Century Advances*. (A. GEI.; *X.*)

HUTTON, RICHARD HOLT (1826–1897), English writer and theologian, son of Joseph Hutton, Unitarian minister at Leeds, was born at Leeds on June 2, 1826. From 1855 to 1895 Hutton and Walter Bagehot were joint editors of the *National Review*, a new monthly, and conducted it for ten years. In 1861 Hutton became joint editor and part proprietor of the *Spectator*, then a \yell-known Liberal weekly. Hutton's own articles became and remained up to the last one of the best-known features of serious and thoughtful English journalism. He was an original member of the Metaphysical society (1869), an antivivisectionist and a member of the royal commission (1875) on that subject. Hutton died on Sept. 9, 1897. Selections from his *Spectator* articles were published in 1899 under the title of *Aspects of Religious and Scientific Thought*.

HUXLEY, SIR JULIAN SORELL (1887–), English biologist, philosopher, educator and author who had a great influence in the modern development of embryology, systematics, behaviour and evolution. The son of Leonard Huxley and the grandson of Thomas Henry Huxley, he was born June 32, 1887, at London. He was educated at Eton and at Balliol college: Oxford. Some of his most important positions were those of assistant professor at Rice institute, Houston, Tex. (1913–16); fellow, New college, Oxford (1919–25); professor, King's college, University of London (1925–27); secretary of the Zoological Society of London (1935–42): and director general of the United Nations Educational, Scientific and Cultural organization (1946–48). He was an officer of many scientific societies, several of which he organized. He mas elected a fellow of the Royal society in 1938. Huxley was author, co-author or editor of many important books, including *The Individual in the Animal Kingdom* (1912); *Religion Without Revelation* (1927); *The Science of Life* (1931); *Problenzs of Relative Growth* (1932); *The Captive Shrew and Other Poems of a Biologist* (1932); *The Elements of Experimental Embryology* (1934); *The New Systematics* (1940); *The Uniqueness of Man* (1941); *Evolution, the Modern Synthesis* (1942); *Touchstone for Ethics, 1893–1943* (1947); *Soviet Genetics and World Science* (1949); *Evolution as a Process* (1954); and *Toward a New Humanism* (1957).

Huxley was a leader in relating science to human social life and to religion. His versatility of interests, combined with scientific scholarship, philosophical penetration and communication with the public, constitute his noteworthy contributions to modern culture. (A. E. E.)

HUXLEY, THOMAS HENRY (1825–1895), English biologist whose speculations on philosophy and religion led him to a powerful advocacy of the principle of agnosticism: was born on May 4, 1825, at Ealing, the seventh child of George Huxley, a schoolmaster. "Physically. . . I am the son of my mother so completely . . . that I can hardly find any trace of my father in myself, except an inborn faculty for drawing, . . . a hot temper, and that amount of tenacity of purpose which unfriendly observers sometimes call obstinacy." (*Life*, i, 3.) When his father moved to Coventry about 1835, young Henry was left to his own devices. His great desire to be a mechanical engineer ended in his devotion to "the mechanical engineering of living machines." At the age of 17, with his elder brother James, he commenced regular medical studies at Charing Cross hospital, and on graduating in 1845 published his first paper on the hitherto unrecognized layer in the inner sheath of hairs, subsequently known as Huxley's layer.

Having obtained the qualification of the Royal College of Surgeons, Huxley sought and received an appointment in the Royal Navy; according to books kept on board Nelson's old ship "Victory," he was posted for duty to Haslar hospital. Huxley's chief at Haslar, Sir John Richardson, a well-known arctic explorer and naturalist, recognized his ability and procured for him the post of surgeon in H.M.S. "Rattlesnake," which was about to set out for surveying work in Torres strait, between north Australia and Papua. By the time the ship was paid off at Chatham in Nov. 1850, Huxley had made a profound study of the surface life of the tropical seas. His important paper "On the Anatomy and the Affinities of the Family of Medusae" was printed by the Royal society in its *Philosophical Transactions* (1849). Huxley united the hydroid polyps with the Medusae to form a class, the Hydrozoa, in which the body consisted of two layers comparable with the ectoderm and endoderm formed during the development of higher animals.

Huxlcy was elected a fellow of the Royal ,society in 1851, and in the following year received the society's royal medal and was elected to the council.

In anatomical studies, his views differed sharply from the accepted notions of Richard Owen, the leading comparative anatomist in Great Britain. Owen was a disciple of Georges Cuvier, and adopted largely from him the deductive explanation from idealistic conceptions of anatomical facts, to which he added the transcendental "archetypal" theory of Lorenz Oken. Huxley would have none of either view, for his methods were purely inductive. He would not hazard any statement beyond what the facts revealed?

and Herbert Spencer, whose acquaintance he made in *1852*, was unable to convert him to belief in evolution in its widest sense *(Life*, i, *168)*. At about the same time, in his first interview with Charles Darwin, Huxley expressed his belief "in the sharpness of the line of demarcation between natural groups" and was received with a humorous smile *(Life*, i, *169)*.

In July *1854*, after leaving naval service earlier that year, Huxley became lecturer in natural history at the School of Mines, and in *1855* naturalist to the geological survey. His most important published work at this period was the Croonian lecture of 1858 on "The Theory of the Vertebrate Skull," in which, by his inductive method, he completely demolished the idealistic views of the origin of the skull held by Richard Owen. This finally disposed of the "archetype," and may be said to have liberated the English anatomical school from the deductive method.

In *1859* Darwin's *The Origin of Species* was published. This was a momentous event in the history of science, and not least for Huxley, who found in Darwin's theory an intelligible hypothesis on which to base a study of evolution. At the Oxford meeting of the British Association for the Advancement of Science in *1860*, Huxley's defense of evolution against the attacks of Bishop Samuel Wilberforce *(q.v.)* resulted in a victory for science over obscurantism. *(See* also DARWIN, CHARLES ROBERT; DARWINISM.) Owen, who could not break with orthodoxy, asserted that man was clearly marked off from other animals by the anatomical structure of his brain. This statement was inconsistent with known facts, and was effectually refuted by Huxley in various papers and lectures, summed up in *1863* in *Man's Place in Nature*. In 1881 he asserted that if the hypothesis of evolution "had not existed, the palaeontologist would have had to invent it" *(Essays*, iv, *44)*. In *1892* he wrote: "The doctrine of evolution is no speculation, but a generalization of certain facts . . . classed by biologists under the heads of Embryology and of Palaeontology" *(Essays*, v, 42).

Meanwhile, Huxley had been drawn into paleontological research. His numerous memoirs on fossil fishes established many far-reaching morphological facts. The study of fossil reptiles led to his demonstration of the fundamental affinity of reptiles with birds as one group, under the title of Sauropsida. His *Lessons in Elementary Physiology (1866)* and *Anatomy of Vertebrated Animals (1871)* were masterpieces of exposition in these subjects. He also proposed a rearrangement of the zoological regions into the primary divisions — Arctogaea, to include the land areas of the northern hemisphere, and Notogaea for the remainder.

From *1870* onward Huxley was more and more drawn away from scientific research by the claims of public duty. Between *1862* and *1884* he served on no less than ten royal commissions. From *1871* to 1880 he was a secretary of the Royal society, and from 1883 to *1885* its president; while from 1870 to *1872* he served as a member of the newly constituted London school board. During his brief period of activity in this last position, he probably made a deeper impress on the foundations of national elementary education than any other man. He made war on the scholastic methods which wearied the mind in merely taxing the memory; the children were to be prepared to take their place worthily in the community. Physical training was to be the basis of the curriculum; domestic economy, at any rate for girls, was insisted upon, and for all some development of the aesthetic sense by means of drawing and singing. Reading, writing and arithmetic were the indispensable tools for acquiring knowledge, and intellectual discipline was to be gained through studying the rudiments of physical science. He insisted on the teaching of the Bible, partly for its standing as a great literary heritage, partly because he was "seriously perplexed to know by what practical measure the religious feeling, which is the essential basis of conduct, was to be kept up, in the present utterly chaotic state of opinion in these matters, without its use" *(Essays*, iii, 397), and also because it was "the most democratic book in the world."

In *1872* the School of Mines was moved to South Kensington, and Huxley had, for the first time, appliances for teaching beyond the lecture room. Up to this time he had been able to bring his influence to bear upon his pupils by oral teaching only; but now he was able to design a laboratory course enabling the student to examine for himself the things described in lectures. His system of instruction, for classes of elementary teachers, in the general principles of biology indirectly affected the teaching of the subject throughout the country. In *1892* he was made a privy councilor.

The later years of Huxley's life were mainly occupied with contributions to periodical literature on subjects connected with philosophy and theology. The only approach to certainty which he admitted lay in the order of nature. "If there is anything in the world which I do firmly believe in, it is the universal validity of the law of causation, but that universality cannot be proved by any amount of experience." *(Essays*, ix, 121.) The assertion that "There is only one method by which intellectual truth can be reached, whether the subject-matter of investigation belongs to the world of physics or to the world of consciousness" *(Essays*, ix, 126) laid him open to the charge of materialism, which he vigorously repelled.

From 1880 onward Huxley was occupied in a campaign against orthodox beliefs. In 1885 he formulated "the perfect ideal of religion" in a passage which has become famous: "In the 8th century B.C. in the heart of a world of idolatrous polytheists, the Hebrew prophets put forth a conception of religion which appears to be as wonderful an inspiration of genius as the art of Pheidias or the science of Aristotle. 'And what doth the Lord require of thee, but to do justly, and to love mercy, and to walk humbly with God' " *(Essays*, iv, 161). Two years later he was writing: "That there is no evidence of the existence of such a being as the God of the theologians is true enough" *(Life*, ii, *162)*. He never really advanced beyond the recognition of "the passionless impersonality of the unknown and unknowable which science shows everywhere underlying the thin veil of phenomena" *(Life*, i, 239), though he insisted that "atheism is on purely philosophical grounds untenable" *(Life*, ii, *162)*. In its place he put forward the principle of agnosticism *(q.v.)* which involved the subordination of belief to evidence and reason *(Life*, ii, *221)*.

Huxley's personal creed was a kind of scientific Calvinism. He finally defines that which, "since the second century, has assumed to itself the title of orthodox Christianity" as a "varying compound of some of the best and some of the worst elements of Paganism and Judaism, moulded in practice by the innate character of certain people of the Western world" *(Essays*, v, 142). He did not omit, however, to do justice to "the bright side of Christianity," and was deeply impressed with the life of St. Catherine of Siena. He contrasted the moral with the aesthetic sense, which he declared to be intuitive, and, in the Romanes lecture for *1893* (Oxfordj, defined "law and morals" to be "restraints upon the struggle for existence between men in society." Apparently he thought that the moral sense in its origin was institutional and in its development utilitarian. "The cosmic process has no sort of relation to moral ends" *(Essays*, ix, *83)*; "of moral purpose I see no trace in nature. That is an article of exclusive human manufacture" *(Life*, ii, *268)*. The cosmic process gives rise to what is evil in man's moral life, and in the long run will get the best of the contest, and "resume its sway" when evolution enters on its downward course *(Essays*, ix, *45)*. Huxley's health broke down completely in 1885. In 1890 he moved from London to Eastbourne, where, after a painful illness, he died on June 29, 1895.

In 1855 Huxley had married Henrietta Anne Heathorn, whom he had met during one of the visits of the "Rattlesnake" to Sydney, Austr. Their eldest son, Leonard (1860–1933), was a classical scholar and writer on scientific, educational and literary subjects. Leonard Huxley's eldest son, Julian *(1887–*), achieved fame as a biologist and writer on science and philosophy and was knighted in 1958; another son, Aldous *(1894–*), also became a well-known writer.

BIBLIOGRAPHY.—Huxley's own works include: *Scientific Memoirs*, 5 vol. (1898–1903); *Collected Essays*, 9 vol. **(1898)**; *Diary of the Voyage of H.M.S. "Rattlesnake," ed.* by Julian Huxley (1935). *See* also L. Huxley, *Life and Letters* of *Thomas Henry Huxley*, 2 vol., 1st ed. (1900), 3 vol., 2nd ed. (1903); T. **H.** and Julian Huxley, *Evolution and bthics* (1947); P. Chalmcrs Mitchell, *Thomas Henry Huxley, a Sketch of His Life and Work* (1900); E. Clodd, *Thomas Henry Huxley* (1902); J. **R.** Ainsworth Davis, *Thonzas Henry Huxley* (1907); W. Irvine, *Apes, Angels, and Victorians* (1955). *(G.* DE B.)

HUY, a town of Belgium (Lat. *Hoium,* and Flem. *Hoei),* on the two banks of the Meuse, at the point where it is joined by the Hoyoux. Pop. (1955 est.) 13,112. It is 19 mi. E. of Namur and a trifle less west of Liège. Huy certainly dates from the 9th century. Its citadel crowns a grey rock between which and the Meuse is the fine collegiate church of Notre Dame (14th century with 13th century gateway). The citadel is partly a military depot and partly a prison. The ruins are still shown of the abbey of Neufmoustier founded by Peter the Hermit on his return from the first crusade. He was buried there in 111j. Neufmoustier was one of ten abbeys in this town alone dependent on the bishopric-of Liege. Huy is surrounded by vineyards, and the bridge which crosses the Meuse at this point connects the fertile Hesbaye north of the river with the rocky Condroz south of it.

HUYGENS (latinized HUGENIUS), **CHRISTIAAN** (1629–1695), Dutch mathematician, astronomer and physicist. was the founder of the wave theory of light. He was born at The Hague on April 14, 1629. In 1655, Huygens, working with his brother Constantijn on the improvement of the telescope, hit upon a new method of grinding and polishing lenses. The immediate results of the clearer definition obtained were the detection of a satellite of Saturn and the resolution of Saturn's rings into their true form. Huygens was also in 1656 the first effective observer of the Orion nebula; he delineated the bright region still known by his name and detected the multiple character of its nuclear star. His application of the pendulum to regulate the movement of clocks sprang from his experience of the need for an exact measure of time in observing the heavens. The invention dates from 1656. On June 16, 1657, Huygens presented his first "pendulum-clock" to the states-general; and the *Horologium,* containing a description of the requisite mechanism, was published in 1658.

In 1663 he was elected a fellow of the Royal Society, and delivered before that body in Jan. 1669 a clear and concise statement of the laws governing the collision of elastic bodies.

Huygens had before this time taken up residence in France. In 1665 Jean Colbert. on behalf of Louis XIV. made him an offer too tempting to be refused, and from 1666 to 1681 his stay at the Bibliothbque du Roi was only interrupted by two short visits to his native country. His *magnum opus* dates from this period. The *Horologium oscillatorium* (1673) contained many original discoveries, as well as the first successful attempt to deal with the dynamics of a system. This remarkable treatise also included the determination of the true relation between the length of a pendulum and the time of its oscillation; the invention of the theory of evolutes; the discovery that the cycloid is its own evolute; the ingenious although practically inoperative idea of correcting the "circular error" of the pendulum by applying cycloidal cheeks to clocks. The theorems on centrifugal force in circular motion with which it concluded helped Sir Isaac Newton to formulate his law of gravitation.

In 1681 he returned to Holland. He then spent six years on the production of lenses of enormous focal distance, which, mounted on high poles and connected with the eyepiece by means of a cord, formed what were called aerial telescopes. Three of his object glasses, of respectively 122, 170 and 210 ft. focal length, are in the possession of the Royal Society. He also succeeded in constructing an almost perfectly achromatic eyepiece, still known by his name. But his researches in physical optics constitute his chief title deed to immortality. He developed the nave theory of light which had already been adopted by Robert Hooke in 1665; he assumed that all the points of a wave front originate secondary waves, the aggregate effect of which is to reconstitute the primary disturbance at the subsequent stages of its advance, thus accomplishing its propagation;'so that each primary wave front is the envelope of an indefinite number of secondary undulations. This resolution of the original wave is the well-known principle of Huygens, and by its means he was able to prove the fundamental laws of optics and to assign the correct construction for the direction of the extraordinary ray in uniaxial crystals. These investigations, together with his experiments on polarization, are recorded in his *Traité de la lumière,* composed in 1678 and published at Leyden in 1690.

Huygens died at The Hague on June 8, 1695, bequeathing his manuscripts to the University of Leyden.

HUYGENS, SIR CONSTANTIJN (1596–1687), Dutch poet and diplomatist, was born at The Hague on Sept. 4, 1596. His father, Christiaan Huygens, was secretary to the state council. Constantijn received a liberal education, became a master of Latin verse, a great gymnast, a good musician and an accomplished artist. After a year's further study at Leyden, he went, in 1618, to London with the English ambassador Dudley Carleton. He remained in London for several months, and then went to Oxford, where he studied for some time in the Bodleian library, and to Woodstock, Windsor and Cambridge. He was introduced at the English court, and played the lute before James I. An intimacy sprang up between the young Dutch poet and John Donne, for whose genius Huygens preserved through life an unbounded admiration. He returned to Holland in company with the English contingent of the synod of Dort, and in 1619 he received a diplomatic mission at Venice; on his return he nearly lost his life in scaling the topmost spire of Strasbourg cathedral. In 1621 he published his *Batava Tempe,* and in the same year he went again to London, as secretary to the ambassador, Wijngaerdan, but returned in three months. During his third diplomatic visit (1621–23) his volume of satires, *'t Costelick Mal,* dedicated to Jacob Cats, appeared at The Hague. In the autumn of 1622 he was knighted by James I. In 1625 he was appointed private secretary to the stadholder, and in 1630 a member of the privy council. In 1634 he is supposed to have completed his long-talked-of version of the poems of Donne, fragments of which exist. In 1637 his wife, Susanna van Baerle, died. Their married life is celebrated in the didactic poem, *Dagwerck. Hofwijck* (1653) describes the splendid house and garden which Huygens built for himself at The Hague In 1647 he wrote his poem *Oogentroost,* to gratify his blind friend Lucretia van Trello. Huygens wrote only one play, *Trijntje Cornelis,* which deals with the adventures of the wife of a ship's captain at Zaandam. In 1658 he rearranged his poems. and issued them with many additions, under the title of *Corn Flowers.* He proposed to the government that the present highway from The Hague to the sea at Scheveningen should be constructed. and during his absence on a diplomatic mission to the French court in 1666 the road was made as a compliment to the venerable statesman. who expressed his gratitude in a descriptive poem entitled *Zeestraet.* Huygens edited his poems for the last time in 1672, and died in his 91st year, on March 28, 1687. He was buried, with the pomp of a national funeral, in the church of St. Jacob, on April 4. His second son, Christiaan, the eminent astronomer. is noticed separately.

Constantijn Huygens is the most brilliant figure in Dutch literary history. Other statesmen surpassed him in political influence, and at least two other poets surpassed him in the value and originality of their writings. But his figure was more dignified and splendid, his talents were more varied and his general accomplishments more remarkable than those of any other person of his age, the greatest age in the history of the Netherlands. Huygens is the *grand seigneur* of the republic. the type of aristocratic oligarchy, the jewel and ornament of Dutch liberty. As a poet Huygens shows a finer sense of form than any other early Dutch writer; the language, in his hands, becomes as flexible as Italian. His epistles and lighter pieces, in particular. display his metrical ease and facility to perfection.

See the complete edition by T. A. Worp of his works, 8 vol. (1892–99) and of his correspondence, 6 vol. (1913–17); also G. Kalff, *Constantin Huygens* (1900). (E. G.; X.)

HUYSMANS, the name of three Flemish painters, who matriculated in the Antwerp gild in the 17th century.

JACOB HUYSMANS (1633?–1696), was born at Antwerp. He went to England toward the close of the reign of Charles II. and competed with Peter Lely as a fashionable portrait painter. Among the portraits executed by him are those of Queen Catherine of Braganza and Izaak Walton. He died in London in 1696

JAN BAPTIST HUYSMANS (1654–1716), was born and died in Antwerp. There are several of his paintings in the museums of Antwerp, Brussels and Munich, representing southern landscapes

with hgures and cattle.

His elder brother, CORNELIUS HUYSMANS (1648–1727), was born at Antwerp and educated by Gaspar de Wit and Jacob van Artois. Cornelius is the only master of the name of Huysmans whose talent was largely acknowledged. He received lessons from two artists, one of whom was familiar with the Roman art of Nicolas Poussin. while the other inherited the scenic style of the school of Rubens. He combined the two in a rich. highly coloured style, seldom attempting anything but woodside views with fancy backgrounds, half Italian: half Flemish. He first practised at Malines, where he married in 1682. From 1706 to 1717 he lived at Antwerp, and then returned to Malines, where he died on June 1, 1727. According to Walpole, he also visited England. Though most of his pictures were composed for cabinets rather than for churches, he sometimes emulated van Artois in the production of large sacred pieces, and for many years his "Christ on the Road to Emmaus" adorned the choir of Notre Dame of Malines.

HUYSMANS, CAMILLE (1871–), Belgian statesman. was born at Bilsen in Belgian Limbourg on May 26, 1871. After graduating in Germanic philology at Liège, he became a professor. first at the College Libéral at Ypres, and then at the Université Nouvelle, Brussels. He wrote in the *Peuple* and other Socialist papers, and, after World War I, started the Flemish *Volksgazet* in Antwerp. He entered the chamber in 1910, first as deputy for Brussels and then for Antwerp, where he became an alderman of public instruction. From 1905 until 1922 he was secretary of the Socialist international bureau. After the war he became the chief organizer of the Socialist party in Antwerp. In June 1925 he became minister of science and arts, in 1936 president of the chamber of deputies and from Aug, 1946 to March 1947 he was prime minister. His works include: *Limburghsch Jaarboek* (1891–95); *Toponymische Studie* (in conjunction with J. Cuvelier. 1897); *Stockholm* (1919); *De Coster's Stephanie* (1926); *Don Juan,* a Flemish dramatic work of the 18th century (1928); *The Works* of *De Swaen,* 4 vol. (1928); *Letters to* a *Young Socialist* (1945).

HUYSMANS, JORIS KARL (1848–1907), French novelist, was born in Paris on Feb. 5, 1848. He belonged to a family of artists of Dutch extraction; he entered the ministry of the interior and was pensioned after 30 years' service. He thus led a thoroughly bourgeois existence in striking enough contrast to the character of his novels. His earliest venture in literature, *Le Drageoir à épices* (1874), contained stories and short prose poems showing the influence of Baudelaire. *Marthe* (1876), the life of a courtesan, was published in Brussels, and Huysmans contributed a story, "Sac au dos," to *Les Soirkes de Médan,* the collection of stories of the Franco-German war published by Zola. He then wrote a series of novels of everyday life, including *Les Sœurs Vatard* (1879), *En Ménage* (1881), and *A vau-l'eau* (1882), in which he outdid Zola in minute and uncompromising realism. Of these the most important is *En Ménage,* which describes the complete disillusion of two friends, Adrien and Cyprien. the one by means of marriage, the other by a vulgar liaison: "The book," says Lalou, "oozes with misanthropy, with hatred of a society incurably common, ugly and stupid." But there is more in Huysmans' work than the presentment in realistic detail of the more disagreeable side of life. He was, in fact, influenced more directly by Flaubert and the brothers de Goncourt than by Zola.

In *L' Art moderne* (1883) Huysmans gave a careful study of impressionism and in *Certains* (1889) a series of studies of contemporary artists. He went on to glorify art at the expense of nature, and the real importance of his work is to be found in his later works, in which the excesses of the aesthetic revolt find a serious and quite humourless exponent. *À Rebours* (1884), the history of the morbid tastes of a decadent aristocrat, des Esseintes, provides a caricature of literary and artistic symbolism which nevertheless contained much of the real beliefs of the aesthetes. In *Là-Bas* Huysmans' most characteristic hero, Durtal, makes his appearance. Durtal is occupied in writing the life of Gilles de Rais; the insight he gains into Satanism is supplemented by modern Parisian students of the black art; but already there are signs of a leaning to religion in the sympathetic figures of the religious bell ringer of Saint Sulpice and his wife. *En Route* (1895) relates the conversion of Durtal to mysticism and catholicism in his retreat to La Trappe.

In *La Cathkdrale* (1898). Huysmans gives a symbolist interpretation of the architecture of the cathedral of Chartres which is a magnificent evocation of the spirit of the place. The life of *Sainte Lydwine de Schiedam* (1901), an exposition of the value of suffering, gives further proof of his conversion; and *L'Oblat* (1903) describes Durtal's retreat to the Val des Saints, where he is attached as an oblate to a Benedictine monastery. Huysmans was nominated by Edmond de Goncourt as a member of the Académie des Goncourt. He died as a devout Catholic, after a long illness of cancer in the palate on May 13, 1907. Before his death he destroyed his unpublished manuscripts. His last book was *Les Foules de Lourdes* (1906).

See Arthur Symons, *Studies in Two Literatures* (1897), *The Symbolist Movement in Literature* (1899); Jean Lionnet in *L'Évolution des idées* (1903); Eugène Gilbert in *France et Belgique* (1905); J. Sargeret in *Les Grands convertis* (1906).

HUYSUM, JAN VAN (1682–1749), Dutch painter of still life and landscapes. was born at Amsterdam on April 15, 1682, and died in his native city on Feb. 8, 1749. He was the son and pupil of Justus van Huysum, who is said to have been expeditious in decorating doorways, screens and vases. His pictures of flowers and fruit, in oil and water colours, were finished in every detail and highly prized during his lifetime. He also painted landscapes with Arcadian scenery. His work may be seen in many European galleries.

HUYTON-WITH-ROBY, an urban district (1895) in the Huyton parliamentary division of Lancashire. Eng.. 6 mi. E. of Liverpool. Pop. (1951) 55,796. Area 4.8 sq.mi. Though Hitune and Rabil were mentioned in Domesday, the town was not of much importance until its rapid growth as a dormitory area for Liverpool. Pre-eminently residential, it has industries making cables, hosiery-knitting machines, foodstuffs. vacuum flasks and metal goods. George Stephenson's Liverpool-Manchester railway, which was laid down in 1830 and is probably the second oldest in England, runs through the town.

HVAR, a Dalmatian island in the Adriatic sea (Ital. Lesina), in Croatia, Yugos. Pop. (1953) 12,721. It is 43 mi. long and from 2 mi. to 5 mi. broad. Area 112 sq.mi. The warm and equable climate lends itself to the successful growth of grapes, olives, figs. dates and the locust bean. Other industries of the islanders are the making of rosemary essence and liqueurs, beekeeping, boatbuilding, fishing and marble quarrying. There are many villages but Hvar (Lesina), the capital, and Stari Grad (Cittavecchia) are the chief towns and seaports. The former possesses, among other beautiful Venetian buildings. the finest loggia in Dalmatia, and has also an arsenal and an observatory. It is a Roman Catholic bishopric and nearby there is a Franciscan monastery, which was burned by the Turks in 1471 but rebuilt in 1571. Stari Grad is one of the busiest ports in the Dalmatian islands, and still possesses "Cyclopean" walls, possibly raised by the primitive Illyrians whose stone cists and bronze instruments have been found near the capital. The island is memorable as the home of two Slav poets. Lucic, a writer of exquisite lyrics, and the more famous Hektorovic (1487–1572), a democratic noble, several centuries ahead of his time, who devoted his genius to the writing of national songs.

About 390 B.C. a Greek colony from Paros built a city on the site of the present Hvar and called it Paros or Pharos. In 229 B.C. Demetrius, the lieutenant of the Illyrian queen Teuta, betrayed the island to the Romans. but as he proved false to them also, they razed his capital in 219 B.C. Neos Pharos, now Stari Grad, took its place and flourished till the 7th century, when the Slavs, fleeing from the Avars, settled upon the island. Throughout the middle ages, and on to modern times, it remained purely Slavonic. The island became a bishopric in 1145 and received a charter from Venice in 1331; was sacked by the Genoese in 1354 and 1358; ceded to Hungary in the same year; held by Dubrovnik (Ragusa) from 1413 to 1416 and incorporated in the Venetian dominions in 1420. During the 16th century Hvar had a considerable maritime trade

and though sacked and partly burned by the Turks in 1571, it remained the chief arsrnal of Venice in those waters until 1776. In 1797 it passed to Austria, was held by the French from 1805 until 1813, when it was surrendered to Austria, remaining in the possession of that country until the close of World War I. In 1918 it was forcibly occupied by the Italians, until it was formally annexed to Yugoslavia; but in 1941 the Italians reoccupied it.

HVIEZDOSLAV (pseudonym of PAVOL ORSZÁGH) (1849–1921), the most powerful and versatile of Slovak poets, was born at Vyšný Kubin, Slovakia, Feb. 2, 1849. In the 1860s, when he began to write in Slovak, the new literary language was still in its uncertain initial stage; by the time of his death the Slovaks already possessed an extensive poetic literature of a high order. Hviezdoslav's contribution to this development was of decisive importance. In his main epics—*Hájnikova* Qena("The Gamekeeper's Wife"; 1886) and *Ežo Vlkolinský* (1890)—he treated local themes in a style which combined realistic descriptive power with lyric echoes from folksong. In his voluminous lyric output he experimented with a variety of metrical forms and forged a characteristic style, interwoven with neologisms and dialect elements. Most memorable are his *Krvavé sonety* ("Blood-red sonnets"; 1919) which express a moving and unconventional attitude to World War I. He died in the village of his birth, June 8, 1921.

(R. AY.)

HWAI SENG, Chinese monk, traveled with Sung Yun to India in 518–521 to collect books.

HWANG-HO, the most northerly of China's great rivers, approximately 2,900 mi. in length. The name, literally the "Yellow river." is due to the loess (*hwang tu* or "yellow earth") which it carries in suspension and which it derives from the deposits stretching across the middle part of its basin. The Hwang-ho flows through a region having a much lower rainfall than the Yangtze basin and its discharge is in consequence very much smaller. It pursues a very composite course. It rises in a marshy trough just west of the Tsaring-nor within the parallel ranges of the Kuen-Lun whose central and northern ranges it eventually cuts across before entering on the Ordos, an extension of the Gobi desert. The northern limit of the Ordos is defined by the mountain arc of the Ala-shan Khara-narin-ula and Ta-tsing-shan, and the Hwang-ho, keeping on the inner side of this arc, occupies a much more open valley than in its upper course. Then the river which was heading eastward for the "grill of Peking" deserts this mature valley to turn abruptly southward and in a very rapid and obviously immature course rushes through a long trench cut into the very border of the loess-filled basin of North Shensi. At the south end of this north–south course, it receives first the Fen-ho on its left bank and then the Wei-ho on its right bank, which together gather up the drainage of a string of fertile loess basins in south Shansi and central Shensi. Their combined waters then flow due east. as though the Wei-ho were the master stream, through the Tungkwan gorge, where the river is restricted by the approach of the ridges of south Shansi toward the Tsin-ling. and enter on the funnel-shaped valley which leads across Honan to the north China plain. The Tungkwan gorge forms the historic gateway into the north China plain from the Wei-ho valley and beyond from Kansu and the Tarim basin. About Kaifeng the valley gives way to the plain and there the character of the river changes also. With the neighbourhood of Kaifeng as a pivot. the Hwang-ho, after breaking its dykes during flood, has several times shifted bodily the whole of its lower course through the plain. For over five centuries before 1852 the Yellow river entered the Yellow sea well to the south of the Shantung uplands, but since 1852 its mouth has lain to the north of them, involving a change of more than 250 mi. (*See* CHINA.)

The most irregular feature in this long course of the Hwang-ho is the entrenched torrent along the Shansi-Shensi border in the very middle of its course and between two mature valley stretches, that across the Ordos and that through Honan. This disposition suggests that the torrent stretch has comparatively recently joined two formerly independent drainage systems. In its course across the Ordos the Hwang-ho is heading for the ridge and trough country of the "grill of Peking." The troughs are broad enough to take the river and an enormous deltaic fan to the northwest of Peking, too big to be produced by any existing stream of the neighbourhood. may represent its outfall. In its valley course through Honan the Hwang-ho simply continues the line of the broad Wei-ho valley and these together, though broken by the Tungkwan gorge, may represent a second formerly independent river. The headstreams of the Wei-ho valley lie near to the point where the upper Huang-ho emerges from the Kuen-Lun ranges. The upper Hwang-ho may be related therefore to either the Ordos or the Wei-ho system. If the grill of Peking were tilted, up in the north and down in the south, which the decreasing elevation of its ridges to the south would indicate has actually taken place, then the Ordos river would be compelled to turn southward until it could escape to the east. This it could not do until it came across the great Ta-hwa fault along which the grill system is broken against the Tsin-ling. By this means it would encounter the southernmost of the once independent rivers that flow along the northern foot of the Tsin-ling ranges.

In its torrential stretches the current is too swift and in its course through the plain the channel is too wide and shallow for the Hwang-ho to be of much use for navigation. The Ordos loop is navigable from Chungwei to Hokow except during low water in winter and flood in summer. but the region through which it flows is unproductive. Further down, there is some local traffic along the trench between Hokow and Tungkwan, but it is nearly all downstream because of the swift current. In its lower course only the last 25 mi. are really suitable for navigation.

The economic significance of the Hwang-ho is not as an artery of commerce but as the source of many of the floods which from time to time devastate the north China plain and which have earned it the names of "China's Sorrow," "The Ungovernable," "The Scourge of the Sons of Han." The plain has only a very gentle slope toward the sea and is to some degree the deltaic accumulation of the Hwang-ho, the Hwai-ho and the Chihli rivers. In its course over it the channel of the Hwang-ho becomes exceedingly broad and shallow. With the agricultural reclamation of the plain this broad channel has become confined by dyke construction and the river silt formerly spread over a wide area has become concentrated on the river bed itself so that the river is now flowing on the top of the plain as much as within it. The river surface of the Hwang-ho is at low water 15 ft. above the general level of the plain, at high water as much as 30 ft. It is estimated that it is raising its bed, mainly when the current is slackening after the summer floods, at the rate of 1 ft. in every 100 years, but this represents only about 1% of the total amount of silt brought down within such a period. In this lower course the dykes are sufficiently far apart for the river to have considerable swing, which not only lengthens the river course but also facilitates the breaching of the dykes by an aggressive meander. The International Famine Relief commission in the 1920s proposed to control the river by straightening its channel which would increase the current and thereby the scour of the river bed and would prevent the breaching of dykes by meandering. By this means it was hoped not only to prevent flood but also to add to the land reclaimed for agriculture. Little, however, if anything was done about these proposals.

In 1955 the Chinese Communist regime published a long-range plan designed to transform "China's Sorrow" into an economically useful river. The plan called for the building of a series of hydroelectric stations and storage reservoirs along the Hwang-ho to contain the seasonal floods. Vast areas of the loess region were to be afforested to stem the heavy erosion. Large tracts were to be irrigated along the arid upper course and along the lower reaches of the north China plain. The first major project initiated under this long-term development plan was the construction of a 1,000,000-kw. hydroelectric station and dam on the Hwang-ho at San-men-hsia (Three-Gate gorge), on the Honan-Shansi border, 130 mi. W. of Cheng-hsien (Chengchow). Plans were announced for a second dam and 1,000,000-kw. hydroelectric station, to be constructed at the Liu-chia-hsia, on the Kansu-Tsinghai border, 50 mi. W.N.W. of Lan-chou (Lanchow).

HWICCE, one of the kingdoms of Anglo-Saxon Britain, coin-

ciding generally with the medieval diocese of Worcester, the early bishops of which bore the title "Episcopus Hwicciorum" It would therefore include Worcestershire, Gloucestershire except the forest of Dean, the southern half of Warwickshire and the neighbourhood of Bath. The name Hwicce survives in Wychwood forest in Oxfordshire. This district, or at all events the southern portion, was according to the *Anglo-Saxon Chronicle*, *s.a.* 577, originally conquered by the West Saxons under Ceawlin. In later times, however, the kingdom of the Hwicce appears to have been always subject to Mercian supremacy and possibly it was separated from Wessex in the time of Edwin. The first kings were two brothers, Eanhere and Eanfrith, probably contemporaries of Wulfhere. They were followed by Osric, a contemporary of Aethelred, and by Oshere. Oshere's three sons Aethelheard, Aethelweard and Aethelric succeeded him, the two last reigning in 706 At the beginning of Offa's reign the kingdom was ruled by three brothers named Eanbert, Uhtred and Aldred; the latter two lived until *c.* 780 After them the title of king seems to have been given up. Their successor Aethelmund, who was killed in a campaign against Wessex in 802, is described only as an earl. The district remained in possession of the rulers of Mercia until the fall of that kingdom. Together with the rest of English Mercia it submitted to Ring Alfred *c.* 877–883 under Earl Aethelred, who possibly himself belonged to the Hwicce. No list of kings has been preserved, and it is not known whether the dynasty was connected with that of Wessex or Mercia.

See Bede, *Historia Eccles.*, ed by Plummer, iv, 23 (1896); Birch, *Cartularium Saxonicum* (1885–89). (F. G. M. B.)

HYACINTH, also called JACINTH, one of the most popular of spring garden flowers (Liliaceae or lily family) It was in cultivation prior to 1597, at which date it is mentioned by John Gerard. 'By the middle of the 18th century about 50 single-flowered varieties and nearly 100 double-flowered ones were described as a selection of the best from the catalogues of two celebrated Dutch growers. One of the Dutch sorts, called La Reine de Femmes, a single white, is said to have produced from 34 to 38 flowers in a spike, and on its first appearance to have sold for 50 guilders a bulb; while one called Overwinnaar, or Conqueror, a double blue, sold at first for 100 guilders, Gloria Mundi for 500 guilders and Koning Saloman for 600 guilders. Several sorts are at that period mentioned as blooming well in water glasses.

ROCHE

COMMON HYACINTH (HYACINTHUS ORIENTALIS)

The original of the cultivated hyacinth, *Hyacinthus orientalis*, a native of Greece and Asia Minor, is by comparison with these an insignificant plant, bearing on a spike only a few small, narrow-lobed, washy blue flowers, resembling in form those of the common English bluebell. So great has been the improvement effected by the florists, and chiefly by the Dutch, that the modern hyacinth would scarcely be recognized as the descendant of the type above referred to. The spikes are long and dense, composed of a large number of flowers; spikes produced by strong bulbs not infrequently measure six to nine inches in length and from seven to nine inches in circumference, with the flowers closely set from bottom to top. Size of the individual flowers and the breadth of their recurving lobes have been much increased, and the colours have gained in brilliancy and depth.

The peculiarities of the soil and climate of the Netherlands are so favourable to hyacinth production that Dutch florists have made a specialty of the growth of those and other bulbous-rooted flowers. Hundreds of acres are devoted to the growth of hyacinths in the vicinity of Haarlem.

In the spring flower garden few plants make a more effective display than the hyacinth. Dotted in clumps in the flower borders and arranged in masses of well-contrasted colours in beds, there are no flowers which impart during their season—late spring—a gayer tone to the garden.

The cultivation of hyacinths is easy, for the purchased bulbs already contain a well-developed flower bud and sufficient nourishment to ensure flowering the following spring, even when grown in pebbles and water. The bulbs, which need a winter chilling, should be planted in late autumn for bloom the following spring. Any ordinary garden soil will do, but if it is enriched with well-rotted manure the results are improved. The manure should be put at the bottom of the hole and covered with an inch of soil for no manure should directly touch the bulb. Bulbs should be planted five or six inches deep and spaced eight to ten inches apart. In severe climates the beds should be covered with a winter mulch of straw or stray manure, which should be removed in early April in the U.S. (earlier in England).

Most of the older varieties of hyacinth were single flowered and among the most fragrant of all garden flowers. The fad for double-flowered sorts, of which many were developed, led to a coincident loss of fragrance. Most modern varieties are again single flowered and their fragrance is generally superb. The single-flowered sorts produce more regular and symmetrical spikes of blossom, the flowers being closely set and more or less horizontal, whereas in most of the double sorts the bells are distant and dependent, so that the spike is loose and by comparison an ineffective display.

Originally blue, the hyacinth can now be had in white, pink, mauve and various shades of blue from pale to porcelain. The Roman hyacinth *(H. orientalis albulus)* is less hardy than the common sort and has two or three flower stalks to each plant.

(N. TR.)

HYACINTH or JACINTH, in mineralogy, a variety of zircon (zirconium silicate) of yellonish-red colour, used as a gem stone. Hyacinth is not a common mineral. It occurs, with other zircons, in the gem gravels of Ceylon, and very fine stones have been found as pebbles at Mudgee, N.S.W. Most of the gems known in trade as hyacinth are only garnets, generally the deep orange-brown hessonite or cinnamon stone. The stones known as Compostella hyacinths are simply ferruginous quartz from Santiago de Compostella, Sp. For composition and characters *see* ZIRCON.

(L. J. S.; X.)

HYACINTHUS, in Greek legend, a young man (parentage variously given) of Amyclae in Laconia. According to the general story, which is probably late and composite, his great beauty attracted the love of Apollo, who killed him accidentally when teaching him to throw the discus (quoit); others say that Zephyrus (or Boreas) out of jealousy deflected the quoit so that it hit Hyacinthus on the head and killed him. According to the representation on the throne of Apollo at Amyclae he was translated into Heaven with his virgin sister Polyboea. Out of his blood there grew the flower called *hyacinthos* (perhaps a fritillary; not our hyacinth), the petals of which were marked with the mournful exclamation *AI, AI* ("alas"). It was also said to have sprung from the blood of Ajax, son of Telamon.

The death of Hyacinthus was celebrated at Amyclae by the second most important of Spartan festivals, the Hyacinthia, which took place in the Spartan month Hyacinthius. What month this was is not certain. Arguing from Xenophon *(Hellenica)* we get May; assuming that the Spartan Hyacinthius is the Attic Hecatombaion, we get July; or again it may be the Attic Scirophorion, June. At all events the Hyacinthia was an early summer festival. It lasted three days, and the rites gradually passed from mourning for Hyacinthus to rejoicings in the majesty of Apollo. This festival is clearly connected with vegetation, and marks the passage from the youthful verdure of spring to the dry heat of summer and the ripening of the grain.

There can be little doubt that Hyacinthus is a pre-Hellenic god. His name is not Greek. The precise relation that he bears to Apollo is obscure. The supposed "tomb of Hyacinthus," which forms the base of the monument of Apollo at Amyclae, described by Pausanias, may be taken as evidence of his subordination to the greater god. Into the "tomb" at Amyclae were put offerings for

the hero, before gifts were made to the god. This and the taboo on cereals during the first part of the Amyclean festival suggest an underworld vegetation deity whose death is mourned like that of Adonis. Sir James Frazer suggests that he may have been regarded as spending the winter months in the underworld and returning to earth in the spring when the "hyacinth" blooms. With the growth of the hyacinth from his blood should be compared the oriental stories of flowers springing from the blood of Attis (*q.v.*) and from that of Adonis (*q.v.*).

HYADES, "the rainy ones," a group of five stars in the head of the constellation Taurus. In mythology they were maidens (their number and parentage vary in different accounts) who nursed the infant Dionysus, and as a reward were translated to heaven and placed among the stars (Hyginus, *Poet. astron.).* According to another version they were sisters, whose brother Hyas was killed while hunting (Ovid, *Fasti;* Hyginus, *Fab.).* They lamented him so bitterly that Zeus, out of compassion, changed them into stars—five into the Hyades, the remainder into the Pleiades. Their name is derived from the fact that the rainy season commenced when they rose at the same time as the sun (May 7–21).

The Romans derived the name from *Hys* (pig), and translated it by *Suculae* (Cicero, *De nut. deor.).*

HYATT, ALPHEUS (1838–1902), U.S. zoologist and paleontologist achieved eminence in the study of invertebrate fossil records. He was born at Washington, D.C., on April 5, 1838. He studied at Harvard (1858–62) under Louis Agassiz and in 1863 served as a volunteer in the Civil War, attaining the rank of captain. In 1867 he was appointed curator of the Essex institute at Salem, Mass., and in 1870 became professor of zoology and paleontology at the Massachusetts Institute of Technology (resigned 1888) and custodian of the Boston Society of Natural History (curator in 1881). In 1886 he was appointed assistant for paleontology in the Cambridge museum of comparative anatomy, and in 1889 was attached to the United States geological survey as paleontologist. Hyatt rose to foremost rank among U.S. investigators in the field of invertebrate paleontology. He was the chief founder of the American Society of Naturalists, acting as first president in 1883. He also took a leading part in establishing the marine biological laboratories at Annisquam and Woods Hole, Mass.

Hyatt died at Cambridge on Jan. 15, 1902.

His works include *Observations on Polyzoa* (1866); *Fossil Cephalopods of the Museum of Comparative Zoology* (1867); *Revision of North American Porifera* (1875–77); *Genera of Fossil Cephalopoda* (1883); *Larval Theory of the Origin of Cellular Tissue* (1884); *Genesis of the Arietidae* (1889); and *Phylogeny of an Acquired Characteristic* (1894). He wrote the section on Cephalopoda in Karl von Zittel's *Palaontologie* (1900); and his valuable study on the fossil pond snails of Steinheim, "The Genesis of the Tertiary Species of Planorbis at Steinheim." appeared in the *Memoirs* of the Boston Natural History society in 1880.

Hyatt was a founder and editor (1867–71) of the *American Naturalist.*

HYBLA, the name of several cities in Sicily. The best known historically is Hybla Major. near modern Melilli, where numerous Sicel tombs have been found, about 4 mi. S.W of Megara Hyblaea (*q.v.*). It was this Hybla that was famous for its honey. Orsi *(Romische Mitteilungen,* 1909) identifies Hybla Major with Paternb; the view here given is that of Ziegler (Pauly-Wissowa, *Realencyklopädie, s.v.*). Another Hybla, known as Hybla Minor or Geleatis, is represented by the modern Paternb, with its conspicuous medieval castle. Various remains have been found, especially tombs of the Sicel period; and there are also numerous Roman remains, two arches of a bridge, remains of baths, cisterns, etc.

HYBRIDISM. A hybrid or mongrel is the offspring of a cross between dissimilar parents; *e.g.,* belonging to different species or to very distinct races, varieties or breeds. Such crosses used to be regarded as something base and evil, hence the word "hybrid" is derived from a Greek word meaning "insult" or "outrage." In genetics, any individual heterozygous for one or more genes or chromosome structures is, however, called a hybrid *(see* HEREDITY). In this wider sense, almost all individuals of sexually reproducing organisms, including man, are hybrids, because their parents usually differ in several genes. Hybridism is a corollary to sexual reproduction. Only where self-fertilization is the rule (as in wheat) can many individuals be homozygous or "pure" (*i.e.*, carrying like genes for any certain character) and, hence, nonhybrid.

Hybridism is biologically very important because it permits accumulation in natural populations of sexually reproducing organisms of hereditary variability. This variability may be compared to a store of raw materials from which evolutionary changes are built. Yet, hybridization of forms which possess genetic systems adapted to different environments or living conditions results in emergence of disharmonious and ill-adapted types. Hybridism is in general favourable on lower levels of evolution but unfavourable on higher levels.

Hybrid Vigour or **Heterosis.**—Customs and laws which forbade inbreeding (marriage of close relatives) have existed in many countries since antiquity. Their biological justification lies in the fact that the offspring of matings of close relatives are frequently inferior in vigour to crossbred individuals. The extent of the deterioration of the viability produced by inbreeding varies in different organisms. In maize, no inbred lines equal crossbred strains in vigour or yield. In man, inbreeding is generally deleterious, yet marriages of brothers and sisters practised in some royal families of Egypt and Peru allegedly led to no undesirable results. Many plant species reproduce mostly or exclusively by self-fertilization, which is the closest possible form of inbreeding. Crossing of inbred lines is followed in the immediate offspring by hybrid vigour or heterosis; *i.e.,* by restoration of the vigour lost during inbreeding. The extent of heterosis is, as expected, proportional to the degree of harmfulness of inbreeding in the same species or race *(see* INBREEDING).

To account for the observed effects of inbreeding and crossing, G. F. Shull (1908) and D. F. Jones (1917) postulated that normally crossbred strains carry unfavourable recessive genes in heterozygous condition, covered up by their more favourable dominant alleles. In different lines different unfavourable recessives become homozygous because of inbreeding. Intercrossing of the inbred lines results, therefore, in the deleterious recessives becoming again concealed by heterozygosis. hence the restored vigour in the hybrid. A proof of this hypothesis was obtained two to three decades after its formulation, chiefly through genetic analysis of natural populations of *Drosophila* flies (q *v.).* Almost every individual in such populations carries deleterious recessive genes, often recessive lethals, concealed in heterozygous condition. In the homozygous condition recessive lethals often cause the death of an organism in an early stage of development. There is no doubt that human populations are comparable in this respect to those of *Drosophila* flies; at any rate, numerous hereditary defects appear much more frequently in the offspring of consanguineous marriages than in marriages between persons not known to be related.

The surprising fact that deleterious recessive genes accumulate in natural populations of organisms is explained very simply. Mutations occur in all organisms, and most mutations are known to be unfavourable to their carriers. Unfavourable dominant and semidominant mutants are rapidly eliminated by natural selection. The fate of the unfavourable recessives depends upon the reproductive biology of the organism in question. Where self-fertilization or mating of close relatives is the rule (as in wheat and many other plants), the recessive defects become homozygous and are eliminated soon after their appearance by natural selection. In such organisms inbreeding is not deleterious and outbreeding is not accompanied by heterosis. Where consanguineous matings are rare, unfavourable recessive mutants are protected, or "sheltered," from natural selection by their dominant alleles, and, therefore, are allowed to accumulate in the populations. Here inbreeding is deleterious and heterosis clearly pronounced.

Heterosis is taken advantage of in plant and animal breeding. The development of hybrid corn in the United States is a striking application of the modern science of heredity to agriculture. Hybrid corn is the first generation hybrid between two inbred

lines of maize. The average increase in yield in hybrid corn, compared to the open-pollinated varieties (from which the inbred lines giving rise to the hybrid were obtained), is between 15% and 20%, and some increases up to 35% have been recorded. For example, in 1943 approximately 50,000,000 ac. of hybrid corn mere planted in the corn belt of the Cnited States, and it is estimated that the yields were increased thereby by over 600,000,000 bu.

G. Dahlberg (1938) surmised that the increase of the average stature of the human populations observed in many countries for more than a century may be due, in part, to heterosis. Inhabitants of sparsely populated country districts may be somewhat inbred. The development of communications and increasing population densities led to wide intercrossing of human strains, to increased hybridity and to heterosis.

Isolating Mechanisms.—Hybridization of species of sexually reproducing organisms is restricted or prevented by a variety of isolating mechanisms. The simplest of these is geographic isolation—related forms inhabit different territories and their meeting and mating are hindered or excluded by their separation. Geographic isolation prevents the interbreeding not only of distinct species but of races and colonies of the same species as well. Human races were geographically isolated before the advent of civilization and even now the fusion of races is hindered somewhat by separation.

Reproductive isolation is the common name for isolating mechanisms other than geographic isolation. Complete reproductive isolation indicates distinction of species, but its rudiments may occur even between races. The principal kinds of reproductive isolation are as follows.

Ecological Isolation.—Representatives of different species may lack the opportunity to hybridize because, though they share the same geographic area, they occupy different habitats and seldom or never come in contact. Thus, some pairs of related plant species in England differ in that one member occurs only on soils with high and the other with low lime content.

Seasonal *Isolation.*—Related species may have different and nonoverlapping breeding or flowering seasons.

Sexual or Psychologzcal Isolation.—When sexually mature representatives of related species occur in the same milieu, matings between individuals which belong to the same species occur more readily than those between different species. Absolute aversion from copulation with individuals of foreign species is very common; on the other hand, instances are known where distinct species which do not normally occur together intercross readily if artificially placed next to each other. Causes which make interspecific matings repugnant are diverse. Differences in specific scents are undoubtedly important in many insects. Differences in songs may play an important role among birds. The courtship techniques are more or less fixed within a species but different between species. In many spiders, insects, mollusks, fish and birds courtship develops into highly complex rituals which make species recognition secure. In some instances the psychological barriers to crossing can be overcome by conditioning and training.

Mechanical Isolation.—Differences in the structures of the genitalia or of other body parts which play a role in the sexual act may prevent normal coitus and sperm delivery. This is particularly true among insects and other arthropods with chitinous genitalia. Differences in the flower structures and scents among species of plants are analogues of the mechanical and sexual isolations on the animal level.

Incompatibility of *the* Sex Cells.—Failure of hybridization may be caused by spermatozoa of one species not being normally viable in the sexual ducts of another, or not being attracted to the foreign egg cells. Failure of the pollen of one species to develop pollen tubes on the stigma or in the style of another is a very important isolating mechanism in higher plants.

Hybrid Inviability.—The development of the organism produced by the union of sex cells of different species may be abnormal, and terminate in death at any stage of the life cycle. Yet, some species hybrids (*e.g.*, the mule) are not inferior in bodily vigour to the parental species, and may even exhibit the phenomenon of heterosis. The death of the hybrids is sometimes caused by relatively minor disturbances, the proper treatment of which may allow the hybrids to survive. Thus, some plant hybrids can be brought to maturity by excising the embryos from the seeds and cultivating them for a time on artificial media.

Hybrid Sterility.—Species hybrids often fail to produce mature sex cells (*e.g.*, the mule), or these sex cells give rise to poorly viable offspring in the next generation. Sterility of a hybrid is not necessarily an accompaniment of constitutional weakness—some weak hybrids are fertile and some vigorous ones sterile. Causes underlying hybrid sterility fall into at least two categories: chromosomal sterility (attributable to differences in the gene arrangements in the chromosomes of the parental species) and genic sterility (produced by the gene composition of the hybrid).

It should be understood that species are kept apart in nature by different isolating mechanisms or combinations of isolating mechanisms. Thus, sexual isolation is important in species of *Drosophila* flies but not among species of toads. Hybrid sterility is not necessarily a mark of species distinction; hybrids between some unquestionably good species are fertile (*e.g.*, between mallard and pintail ducks). Any reproductive isolating mechanism has, however, the same biological end effect: prevention of hybridization, and consequently of gene exchange, between species. *See* also ANIMAL BREEDING; PLANT BREEDING.

BIBLIOGRAPHY.—T. Dobzhansky, *Genetics and the Origin of Species*, 3rd ed. (1951); H. K. Hayes, F. R. Immer and D. C. Smith, *Methods of Plant Breeding*, 2nd *ed.* (1955); E. *Mayr, Systematics and the Origin of Species* (1942). (T. DY.)

HYDANTOIN crystallizes from water in colourless needles, and melts at 208°–220° C. It is constitutionally glycolyl urea, or the ureide of glycollic acid, CO$\langle$NH.CH$_2$ / NH.CO$\rangle$, and is obtained by heating allantoin or alloxan with hydriodic acid, by heating bromoacetylurea with alcoholic ammonia or by the action of urea on dihydroxytartaric acid. When hydrolysed with baryta water, hydantoin yields hydantoic (glycoluric) acid,

$$H_2N.CO.NH.CH_2.CO_2H$$

colourless prisms, m.p. 153°–156°, which are readily soluble in hot water.

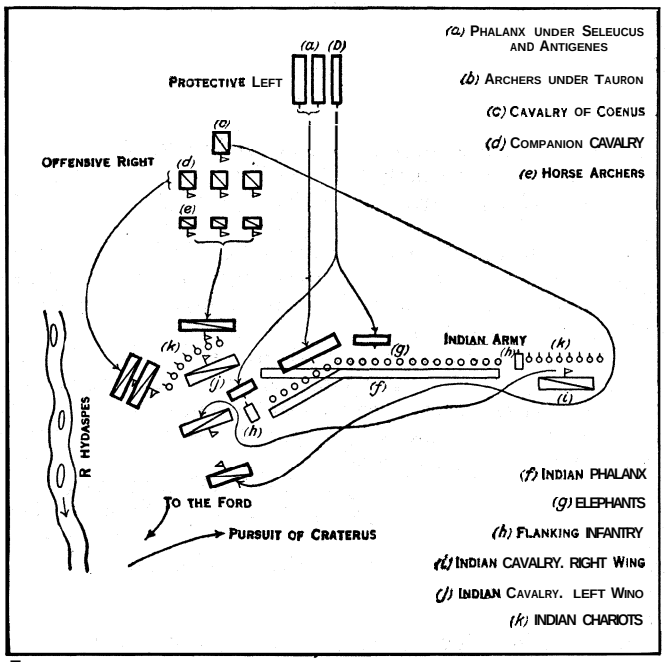
HYDASPES, BATTLE OF THE (326 B.C.). The battle of the Hydaspes (Jhelum) is the most interesting of the four great battles fought by Alexander. since he was not only faced by a well-organized enemy protected by a river in flood but by a force of war elephants against which his decisive arm—heavy cavalry—was useless. Porus, his adversary, occupied the left bank of the river; he was a man of courage and sense, the most efficient general Alexander ever met. According to Diodorus, his army consisted of 50,000 infantry, 3,000 cavalry, about 1.000 chariots and 130 elephants.

Alexander was encamped near modern Jalapur, the left bank of the river being picketed by the Indians. As he was not able to force a crossing, he divided his army into many parts and laid in a great store of corn in order to make Porus believe that he did not intend to cross until the winter had set in. In any case he could not cross in face of Porus, since the elephants drawn up on the far bank "by their aspect and trumpeting" would have caused his horse to take panic; he therefore resolved to steal a crossing under the cover of the following stratagem. He sent parties of cavalry up and down the river to make every kind of noise, Porus marching along the opposite bank where the clamour was heard.

After a time, nothing taking place, Porus "perceiving that his fear had been groundless" kept his position in his camp. Having thus stupefied his adversary, Alexander determined to make a night march and cross the river at a bend about 18 mi. N. of modern Jhelum. He left Craterus in camp with the bulk of the army, instructing him not to attempt to force a passage unless Porus moved away; then, at the head of 5,000 horse and about 9,000 foot, he set out northward to the point of crossing where skin rafts and pontoons had been secreted.

The river was successfully crossed and, once the army was marshalled. Alexander advanced at the head of the cavalry, ordering the infantry to follow at a slow pace in regular formation. His object was to fix his enemy before he could deploy or retire.

Preliminary Engagement. — Porus, still seeing a large force in Alexander's camp. on hearing that a crossing of the river had been



THE BATTLE OF THE HYDASPES. 326 B.C., BETWEEN PORUS AND ALEXANDER

Alexander executed his favourite manoeuvre of attacking with the right wing (d), first employing horse archers and then charging with the cavalry

effected by the enemy. sent forward his son at the head of 2.000 cavalry and 120 chariots to delay them. On seeing this force approach. Alexander at first thought that it was Porus himself, and sent out his horse archers to reconnoitre. Learning, however, that it was but a detachment, he charged home killing Porus' son and 400 of his men. Apprised of this defeat. Porus was in doubt what to do. Craterus was now attempting to cross the river, and Alexander was advancing on him at top speed. Leaving some elephants and a small force to watch the ford. he moved off the clayey ground, and deployed his elephants into line at intervals of about 100 ft. Behind these he drew up his infantry in phalangial order. On the flanks he posted forces of cavalry, infantry and his chariots.

Seeing the Indians drawn up in order of battle, Alexander halted his cavalry so that his infantry might come up, and then, after resting them, he determined to advance against the enemy's left wing, and so avoid the elephants. His plan was as follows: The horse archers were to move against the enemy's left to throw his cavalry into confusion. Under cover of this fire the Companion cavalry were to move against this same wing, and attack the Indian cavalry "while still in a state of disorder." By moving the bulk of his cavalry against the enemy's left wing he foresaw that Porus would probably withdraw his right wing cavalry to support his left wing, and so uncover his right wing. To take advantage of this probability he ordered Coenus and a force of horse, directly he saw Porus move his right wing cavalry, to gallop round the enemy's right wing and charge it in rear. The phalanx and the archers were ordered not to engage "until they observed the enemy's cavalry and phalanx of infantry thrown into disorder by the cavalry under his command."

The Battle. — To understand the battle as described by Arrian it must be presumed that Porus wheeled back the left of his army to meet the approaching attack. and that he drew his elephants more and more from his right toward his left. With his right wing cavalry he did exactly what Alexander had foreseen, whereupon Coenus galloped round the rear of the Indian infantry, and. as Arrian says. "threw the ranks as well as the decisions of the Indians into confusion." To counter this charge Porus wheeled round his cavalry to meet it, whereupon Alexander, seeing his opportunity, charged home at the head of his Companions and drove the enemy back onto their elephants "as to a friendly uall for refuge." The elephants, thrown into confusion, were nevertheless urged forward by their mahouts, whereupon the phalanx, covered by the archers, charged down on them, but itself became disorganized. The Indian cavalry, seeing this, wheeled round to charge, but Alexander had once again reorganized his cavalry, and, charging the Indian cavalry. cut them down in great numbers. One by one the mahouts were killed, and "when the beasts were tired out . . . they began to retire sloaly, facing the foe like ships backing water, merely uttering a shrill piping sound." Alexander now surrounded the whole of the enemy's line with his cavalry, and, giving the signal to the infantry to link shields, he charged his disorganized foe, and won the battle after eight hours fierce contest. The pursuit was at once taken up by Craterus. According to Diodorus the Indian losses were 12.000 and Alexander's 980.

Tactics. — The first paint which strikes the student is the preparatory moral attack made by Alexander on Porus by a series of feints which blind him by tiring out his vigilance. Directly this has been accomplished. he sets out at the head of a small force; he did not require a large one, because the whole idea of his attack was based on surprise. For surprise to prove successful, it was essential that Porus should not notice any serious reduction in the numbers opposed to him; consequently, when he learned of Alexander's advance. he did not realize what was happening. In brief, it was because Craterus was so strong that the surprise of the smaller force was so complete. Alexander's main problem was. seeing that he could not attack the Indian front, which of its two flanks should he select. His army was so small that he must maintain touch with Craterus, and if he could turn Porus' left flank he would facilitate the crossing of the river by Craterus. He decided to concentrate against the enemy's left flank, and to assist this concentration he detached Coenus, for by this economical distribution of force he added vastly to his main blow which was delivered under cover of demoralization due to surprise. Secured on his right flank by the river and his main army which threatened the Indian rear, he protected the left of his cavalry by the phalanx, and prepared his assault by the fire of his horse archers. Then in oblique order he converged on the enemy's left. As the enemy cavalry was scattered the phalanx approached and with it he delivered a left-hand punch under cover of which he withdrew his cavalry — his right-hand punch. No sooner was this done than he withdrew his phalanx, and charged home with his cavalry. Then with his phalanx, (his left) he knocked his antagonist out.

See *Bibliography* under GRANICUS, **BATTLE** OF THE. (J. F. C. F.)

HYDATID, the bladder-worm stage (fluid-filled sac containing heads) of the tapeworm Echinococcus.

HYDE, the name of an English family distinguished in the 17th century. Robert Hyde of Norbury, Cheshire, had several sons, of whom the third was Lawrence Hyde of Gussage St. Michael, Dorsetshire. Lawrence's son Henry was father of Edward Hyde, 1st earl of Clarendon (*q.v.*), whose second son by his second wife was Lawrence, earl of Rochester (*q.v.*) and whose daughter Anne married James; duke of York. Another son of Lawrence was Sir Lawrence Hyde, attorney general to Anne of Denmark, James I's consort; and a third son was Sir Nicholas Hyde (d. 1631), chief justice of England. Sir Nicholas entered parliament in 1601 and soon became prominent as an opponent of the court, though he does not appear to have distinguished himself in the law.

Before long, however, he deserted the popular party, and in 1626 he was employed by the duke of Buckingham in his defense against impeachment by the commons; and in the following year he was appointed chief justice of the king's bench. In 1629 Hyde was one of the judges who condemned Sir John Eliot. Denzil Holles and Valentine for conspiracy in parliament to resist the king's orders; refusing to admit their plea that they could not be called upon to answer out of parliament for acts done in parliament. He died in Aug. 1631.

Robert (1595–1665), son of Lawrence, attorney general to Anne of Denmark, became recorder of Salisbury and represented that

borough in the Long Parliament. in which he professed royalist principles, voting against the attainder of the earl of Strafford. He gave refuge to Charles II on his flight from Worcester in **1651,** and on the Restoration was knighted, made a judge of the common pleas and in **1663** chief justice of the king's bench.

See Lord Clarendon, *The Life of Edward, Earl of Clarendon,* 3 vol. (1827); Edward Foss, *The Judges of England,* 9 vol. (1848–64).

HYDE, CHARLES CHENEY (1873–1952), U.S. authority on international law, was born in Chicago, Ill., on May 22, **1873.** He was educated at Yale (A.B., **1895;** A.M., **1898)** and Harvard law school (LL.B, **1898).** After engaging in private practice, and teaching at Northwestern university law school, Chicago, Hyde was appointed to the Hamilton Fish professorship of international law and diplomacy at Columbia university, New York city, which he occupied from **1925** to 1945.

He was a member of the panel known as the Permanent Court of Arbitration at The Hague, an editor of the *American Journal of International Law,* president of the American Society of International Law and a member of the Institut de Droit International.

As solicitor for the U.S. department of state, he was responsible for drafting, in 1923, what became a model treaty of commerce and navigation. His private practice included the representation of several governments.

Hyde's major treatise, *International Law Chiefly as Interpreted and Applied by the United States* (1922; rev. ed., 1945), was often cited by courts and international tribunals. Richly documented, it became the standard work mirroring the United States approach. For the future he concluded that the price of peace might prove to be the gradual and ultimate vesting of all military power in some international security organization. He died in New York city, Feb. **13, 1952.** (J. N. HE.)

HYDE, DOUGLAS (DUBHGLAS DE H-IDE, known in Ireland as "An Craoibhin Aoibhinn") (1860–1949), president of Eire 1938–45, Irish scholar and writer, was born at Frenchpark, County Roscommon, **1860,** and educated at Trinity college, Dublin. In 1891 he acted as interim professor of modern languages at the University of New Brunswick, Can. He formed in **1893** the Gaelic league, for the preservation and extension of the Irish language, and was president of that body until **1915.** In **1899** his production, before a vice-regal committee on education, of letters from leading Celtic scholars throughout Europe saved the Irish language on the intermediate board which regulated the curriculums for Irish schools.

During 1905 he toured America and raised £11,000 for the Gaelic league. On his return he was appointed a member of a royal commission on Irish university education. Hyde was professor of modern Irish at University college, Dublin, 1909–32. He became a senator in the Irish Free State in **1925,** and editor of *Lia Fáil.* The movement created by him resulted in the compulsory teaching of the language in Irish schools. In **1938** Hyde was elected president of Eire.

He died July 12, 1949.

Among Hyde's more important works are *A Literary History of Ireland* **(1899);** collections and translations of the *Love Songs of Connacht* **(1893);** *Raftery's Irish Songs* (1904, 1933); *The Religious Songs of Connacht* **(1906).** He also wrote several short plays in Irish.

HYDE, THOMAS (1636–1703), English philologist whose chief work was in the study of ancient Persian, was born at Billingsley, near Bridgnorth, in Shropshire on June **29, 1636.** At King's college, Cambridge, he studied languages under Abraham Wheelocke, and after only one year of residence was invited to London to assist Brian Walton in his edition of the Polyglot Bible.

Besides correcting the Arabic, Persian and Syriac texts for that work, Hyde transcribed into Persian characters the Persian translation of the Pentateuch, which had been printed in Hebrew letters at Constantinople in **1546.** To this work Hyde appended the Latin version which accompanies it in the Polyglot.

After holding various preferments, he was at length appointed, in **1691,** Laudian professor of Arabic; and in **1697,** on the deprivation of Roger Altham, regius professor of Hebrew and a canon of Christ .Church. Under Charles II, James II and William III, Hyde discharged the duties of eastern interpreter to the court. He died at Oxford on Feb. **18,** 1703. In his *Historia religionis veterum Persarum* (1700) he made the first attempt to correct from eastern sources the errors of the Greek and Roman historians who had described the religion of the ancient Persians.

With the exception of the *Historia religionis,* which was republished by Hunt and Costard in **1760,** the writings of Hyde, including some unpublished manuscripts, were collected and printed by Gregory Sharpe in **1767** under the title *Syntagma dzssertationum quas olim. . . Thomas Hyde separatim edidit,* with a life of the author. Hyde also published a catalogue of the Bodleian library in **1674.**

HYDE, a market town and municipal borough **(1881)** in the Stalybridge and Hyde parliamentary division of Cheshire, Eng., 7½ mi. E. of Manchester. Population **(1951)** 31,494. Area **6.5** sq.mi.

Standing on the Peak Forest canal and on the Tame, which divides it from Lancashire, it has grown up with the establishment of the cotton industry, though the Hyde family held the manor as early as the reign of John.

Besides the staple cotton trade there are heavy and light engineering and factories for making rubber, leather, leather cloth, hats, paper, ice cream, etc., and there are coal mines in the vicinity. Werneth Low, on the edge of the Pennines 1½ mi. S., was bought by the borough as a war memorial.

HYDE DE NEUVILLE, JEAN GUILLAUME, BARON (1776–1857), French politician, was born at La Charité-sur-Loire (Nièvre), on Jan. 24. 1776, of an English family which had emigrated with the Stuarts after the rebellion of 1745. From 1793 he was an active agent of the exiled Bourbon princes; he took part in the royalist rising in Berry in 1796, and after the coup d'état of **18** Brumaire (Nov. **9,** 1799) tried to persuade Bonaparte to recall the Bourbons. After an accusation of complicity in the infernal machine conspiracy (1800–01), subsequently retracted, Hyde de h'euville went to the United States, returning after the Restoration.

His mission from Louis XVIII to induce the British government to transfer Napoleon to a safer place of exile than Elba was cut short by the emperor's return to France in March 1815. Under the Restoration he was ambassador at Washington, D.C., and at Lisbon, where his action at the time of the coup d'état of Dom Miguel (April **30. 1824)** was disapproved in Paris. Hyde de Neuville was recalled. He then opposed the policy of Villele's cabinet in the chamber and in **1828** became minister of marine in Martignac's moderate administration. During the Polignac ministry (1829–30) he was again in opposition, being a firm upholder of the charter; but after the revolution of July 1830 he entered an all but solitary protest against the exclusion of the legitimate line of the Bourbons from the throne, and resigned his seat. He died in Paris on May **28, 18.5';.**

His *Mémoires et souvenirs,* 3 vol. (1888), compiled from his notes by his nieces, the vicomtesse de Bardonnet and the baronne Laurenceau, are of great interest for the Revolution and the Restoration An English edition translated and abridged by F. Jackson was published, 2 vol (1913).

HYDE PARK, a township and unincorporated village of Dutchess county, N.Y., U.S., is located on the east side of the Hudson river about 80 mi. N. of New York city and includes the land that formerly comprised the estate where Pres. Franklin Delano Roosevelt was born and is buried. Part of the estate, including the Roosevelt family home and the president's grave, is a National Historic site. Adjacent to this is the Franklin D. Roosevelt library, containing more than **30,000** books, a museum, the president's papers and the papers of many of his contemporaries and associates. It also houses collections of material on U.S. history and politics from 1910 to 1945, U.S. naval history and New York colonial history.

The township, established in **1821,** may have taken its name from an estate called after Edward Hyde, Viscount Cornbury, governor of New York (1702–08). The Frederick W. Vanderbilt mansion, constructed on this property in **1898,** and the Vanderbilt estate are now a National Historic site and arboretum. The village was originally named Stoutenburg's Landing after the first

white settler, who arrived in 1741. It is chiefly a residential village with a population of less than 7,000. (E. M. A.)

HYDERABAD, OSMAN ALI, NIZAM OF (1886–), was born in Hyderabad. April 6, 1886. and after a private education succeeded his father, Mahbub Ali. on Aug. 29, 1911. He achieved considerable learning; patronized the foundation of Osmania university, Hyderabad. in 1918; and despite enormous riches lived frugally. But, unlike some neighbouring princes. he maintained the feudal character of his state: showed little interest in the increasing voice of the Hindu majority among his people; and sponsored the formation of Majlis Ittehad al-hluslimin. or Movement for Moslem Unity, with its private army. the Razakars. After the partition of the subcontinent into Pakistan and India the nizam persisted for a year in his refusal to accede to the latter. He disputed India's claim to Great Britain's lapsed paramountcy; appealed to his special alliance with the British (in 1918 the king-emperor. George V, had conferred upon him the titles of "exalted highness" and ',faithful ally"); and placed his case before the United Nations. He rejected an Indian ultimatum and on Sept. 13, 1948, Indian troops entered his state. Four days later the nizam yielded. On Jan. 26. 1950, he was appointed constitutional head. or *rajpramukh,* of the state.

HYDERABAD, a former constituent state of India: was divided between the states of Andhra Pradesh, Mysore and Bombay on Nov. 1. 1956. Area 82,168 sq.mi.; pop. (1951) 18,655,108. The state occupied a large part of the plateau of the Deccan. It was bounded north and northeast by the Berar area of Madhya Pradesh, south and southeast by Mysore and Andhra and west by Bombay. Two tracts may be distinguished from one another geologically and ethnically, and are locally knoun from the languages spoken as Telingana (Telugu-speaking area) and Marathwara (Marathi-speaking). In some parts it is mountainous, wooded and picturesque. in others flat and undulating. The territory is well watered, with many rivers. tanks and artificial sheets of n-ater, especially in Telingana. The principal rivers are the Godavari. with its tributaries. the Dudna. Manjra and Pranhita; the Wardha, with its tributary the Penganga; and the Kistna. with its tributary the Tungabhadra. The climate is in general good; and as there are no arid bare deserts, hot winds are little felt.

The revenue of the state is largely derived from the land. and the development of irrigation and railways caused considerable expansion. More than half the population is dependent on agriculture. The soil is generally fertile, though in some parts it consists of *chilka,* a red and gritty mould little fitted for agriculture. The principal crops are millets, rice. wheat, oilseeds, cotton. tobacco and fruits and garden produce. Lac, gums and oils are found, and hides. raw and tanned, are of commercial importance. The principal exports are cotton, oilseeds. grain. timber, indigenous clothing and hides; the imports are salt. timber. European piece goods, sugar. cattle. metals, oil and yarn. Mineral resources include coal. copper. iron, diamonds and gold, but development was not very successful. The only coal mine worked in the later 1950s was a large one at Singareni.

The Bombay-Madras line (Central railway) runs through the southwest of the former state, and another line (the former nizam's railway) runs from Wadi junction on this line through Hyderabad to Bezwada. The Hyderabad-Godavari line traverses rich cotton country, and cotton presses have been erected along the line. There are also cotton-weaving and flour mills. The state formerly had its own currency. the osmani sikka (O.S. 116 = Indian Rs. 100), but this was replaced by the Indian rupee on April 1, 1955.

The nizam of Hyderabad was the principal Moslem ruler in India. The family was founded by Asaf Jah, a distinguished Turkoman soldier of the emperor Aurangzeb, who in 1713 mas appointed subahdar of the Deccan. but eventually threw off the control of the Delhi court. His death in 1748 was followed by internecine struggle among his descendants, in which the British and French took part. At one time the French nominee. Salabat Jang, established himself with the help of the marquis de Bussy. But when the British had secured their predominance throughout southern India. Nizam Xli took his place. He confirmed the grant of the Northern Circars in 1766, and joined in the two wars against Tipu Sultan in 1792 and 1799. The additions of territory which he acquired by these wars were afterward (1800) ceded to the British, as payment for the subsidiary force which he had undertaken to maintain. By a later treaty in 1853, the districts known as Berar were "assigned" to defray the cost of the Hyderabad contingent. In 1857 when the mutiny broke out, the nizam remained loyal to the British. In 1902 by a treaty made by Lord Curzon, Berar was leased in perpetuity to the British government, and the Hyderabad contingent was merged in the Indian army. The last nizam and first *rajpramukh,* Osman Ali, received the title of "faithful ally" of the British government. He received Rs. 25 lakhs (£167,000) a year for the rent of Berar, thus substituting a fixed for a fluctuating source of income. A British financial adviser was appointed and a resident, representing the government of India. had his headquarters at Hyderabad.

At the 1947 partition of the Indian subcontinent, difficulties at once arose over Hyderabad. Although more than 86% of its population is Hindu, government was in Moslem aristocratic hands. When India and Pakistan became independent, the nizam declined for the time being to accede to either, and signed with India, the country within which his was isolated, a "standstill" agreement to last one year from Nov. 29. 1947. Meanwhile, Indian troops were withdrawn. However. Hyderabad subsequently raised difficulties about contributions to defense; banned Indian currency; tried to obtain a loan from Pakistan; and failed to introduce representative government and Hindu participation in the administration. Most serious of all were Indian allegations of raids into dominion territory by the Razakars, a Hyderabad irregular army under Kazim Razvi, pledged to fight to the last man for Moslem supremacy in the Deccan. Further Indo-Hyderabad negotiations were abortive. India felt that Hyderabad was using the standstill arrangement to play for time, and now insisted upon accession as a prerequisite of all further progress; the nizam, adamantly jealous of his independence, appealed, as "faithful ally," to King George VI. Deadlock was now complete and on Sept. 13, 1948. Indian troops marched in. The Razakars were dispersed and the nizam capitulated. After a period of military and provisional civil government, a popular ministry and legislature were set up in March 1952. The nizam was installed as constitutional head of state (*rajpramukh*). Following partition Berar was definitely merged with the Central Provinces (Madhya Pradesh).

HYDERABAD, capital of the state of Andhra Prndesh and the former state of Hyderabad, India. with surrounding administrative district, on the right bank of the Musi. a tributary of the Kistna. with Golconda 5 mi. to the northwest and the city and cantonment of Secunderabad (British till 1945) 6½ mi. to the northeast. It is the fourth largest city in India; pop. (1961) 1,252,337, including suburbs and cantonment. It was,founded in 1589 by Mohammed Kuli. fifth of the Kutb Shahi kings. The Char Minar or Four hiinarets (1591) stand in the centre of the city. with four roads radiating from their base. The Xshur Khana (1594), a ceremonial building, the hospital. the Gosha Mahal palace and the Mecca mosque, a sombre building designed after a mosque at Mecca, were the other principal buildings of the Kutb Shahi period, though the mosque was only completed in the time of Aurangzeb. The city proper is surrounded by a stone wall with 13 gates, completed in the time of the first nizam, who made Hyderabad his capital. There are several fine palaces built by various nizams, and the former British residency is an imposing building in a large park on the left bank of the Musi, northeast of the city. The bazaars around it are picturesque. Four bridges crossed the Musi, the most notable of which was the Purana Pul, of 23 arches, built in 1593. In 1908, however, the river, swollen by torrential rain. swept them away. Enormous damage was done, and thousands of lives were lost. Osmania university (1918) is unique among Indian universities in that Urdu was the medium of instruction from its inception. English being taught as a compulsory second language. The university has a number of component colleges in or near the city. Hyderabad is an important centre of general trade. and there is a cotton mill in its vicinity.

HYDERABAD DISTRICT (1,957 sq.mi.) had a population in 1951 of

1,596,750. It was formed after the accession of Hyderabad to India, from parts of the nizam's *sars-i-khas illaka* or privy estate and other privilege areas.

HYDERABAD, a city and cantonment, district and division of West Pakistan; the city was the capital of the former Sind province. It stands on a hill about 3 mi. from the left bank of the Indus and 90 mi. E.N.E. of Karachi. Pop. (1951) 241.801. including 12.389 in the cantonment. On the site of the present fort is supposed to have stood the ancient town of Nirun, which in the 8th century A.D. submitted to the Arab general Mohammed bin Kasim. In 1768 the present city was founded by Ghulam Shah Kalhora; and it remained the capital of Sind until 1843. After the battle of Meeanee (Miani) it was surrendered to the British and the capital transferred to Karachi. After the separation of Karachi from Sind in 1948 it became the capital of the province. When separate provinces in West Pakistan were abolished in 1955 it became the headquarters of a division. The city is built on the most northerly hills of the Ganjo range, a site of great natural strength. In the fort, which covers an area of 36 ac., are the arsenal and the palaces of the former mirs of Sind. In addition to the manufacture of silk: gold and silver embroidery, lacquerware and pottery, a number of modern factories have been established including those for glass, cotton textiles, tanning, oilseed crushing and vegetable ghee refining, fruit cordials, jams and fruit canning. One of the four Sind industrial trading estates was established at Hyderabad in the mid-1950s. It is the seat of the University of Sind (1947).

HYDERABAD DISTRICT has an area of 5,084 sq.mi.; pop. (1951) 892,539. It consists of a vast alluvial plain on the left bank of the Indus, 210 mi. long and 48 mi. broad. A limestone range, the Ganjo hills, runs due south nearly parallel to the river for about 14 mi. Forests fringe the river and avenues of trees line the canals in an otherwise monotonous landscape. The principal crops are millets, rice: oilseeds, cotton and wheat, which are dependent on irrigation, mostly from government canals.

Three railways traverse the district: (1) one of the main lines of the North-Western railway, following the Indus valley and crossing the river near Hyderabad on its way to Karachi; (2) a broad-gauge branch running south to Badin; and (3) a metre-gauge line from Hyderabad to Khokarpar on the Indian border. Hala (9,481), 30 m i N. of Hyderabad, is famous for glazed pottery and tiles (made from Indus clay and powdered flint), lacquerware and susis, striped cotton cloth.

HYDERABAD DIVISION comprises Hyderabad, Tatta, Dadu, Mirpur Khas and Sanghar districts.

HYDER ALI or HAIDAR ALI (c. 1722–1782), Indian ruler and commander. This Mohammedan soldier-adventurer was the great-grandson of a fakir or wandering ascetic of Islam who came from the Punjab to Gulburga in the Deccan, and the second son of a naik or chief constable at Budikota, near Kolar in Mysore. His elder brother rose to command a brigade in the Mysore army, while Hyder acquired a useful familiarity with the tactics of the French under Joseph Dupleix. He is said to have induced his brother to employ a Parsee to purchase artillery and small arms from the Bombay government and to enrol about 30 sailors of different European nations as gunners and is thus credited with having been "the first Indian who formed a corps of sepoys armed with fire-locks and bayonets, and who had a train of artillery served by Europeans."

After the siege of Devanhalli (1749) Hyder received an independent command in Mysore; within the next 12 years his energy and ability had made him master of minister and rajah alike. In everything but in name he was ruler of the kingdom. In 1763 the conquest of Kanara gave him the treasures of Bednor, which he resolved to make the most splendid capital in India: under his own name, thenceforth changed from Hyder Naik into Hyder Ali Khan Bahadur; and in 1765 he retrieved previous defeat by the Marathas by destroying the Nairs or military caste of the Malabar coast and by conquering Calicut.

Hyder Ali now occupied the serious attention of the Madras government. which in 1766 agreed to furnish the nizam of the Deccan with troops to be used against the common foe. But a secret arrangement was agreed upon between the two Indian powers, the result of which was that Col. Joseph Smith's small force was met with a united army of 80,000 men and 100 guns. British dash and sepoy fidelity, however, prevailed, first in the battle of Chengam (Sept. 2. 1767) and again still more remarkably in that of Tiruvannamalai (Trinomalai).

On the loss of his recently made fleet and forts on the western coast, Hyder Ali offered peace overtures; on their rejection, bringing all his resources and strategy into play. he forced Colonel Smith to raise the siege of Bangalore and brought his army within five miles of Madras. The result was the treaty of April 1769, providing for the mutual restitution of all conquests and for mutual aid and alliance in defensive war; it was followed by a commercial treaty in 1770 with the authorities of Bombay. Under these arrangements Hyder Ali, when defeated by the Marathas in 1772, claimed British assistance, but in vain; this breach of faith aroused a desire for vengeance.

His time came when in 1778 the British, on the declaration of war with France, resolved to drive the French out of India. The capture of Mahé on the Malabar coast in 1779, followed by the annexation of lands belonging to a dependent of his own, gave him a pretext. Again master of all that the Marathas had taken from him, and with empire extended to the Kistna, he descended through the passes of the Ghats amid burning villages, reaching Conjeeveram, only 45 mi. from Madras, unopposed. Not till the smoke was seen from St. Thomas' Mount, where Sir Hector Munro commanded 5,200 troops, was any movement made; then, however, the British general sought to join a smaller body under Col. William Baillie recalled from Guntur. The incapacity of the officers resulted in the destruction of Baillie's force of 2,800 (Sept. 10, 1780). Warren Hastings sent from Bengal Sir Eyre Coote, who, though repulsed at Chidambaram, defeated Hyder thrice successively in the battles of Porto Novo, Pollilur and Sholingarh, while his son Tipu (see TIPU SAHIB) was forced to raise the siege of Wandiwash, and Vellore was provisioned. On the arrival of Lord hfacartney as governor of Madras, the British fleet captured Negapatam and forced Hyder Ali to confess that he could never ruin a power which had command of the sea. He had sent Tipu to the west coast, to seek the assistance of the French fleet, when his death took place at Chittur in Dec. 1782.

See L. B. Bowring, *Haidar Ali and* ***Tipu*** *Sultan* (Oxford, *1893).* For the personal character and administration of Hyder Ali *see* the *History of Hydur Naik,* written by Mir Hussein Ali Khan Kirmani, trans. from the Persian by Col. W. Miles and published by the Oriental Translation Fund (London, 1842), and the curious work written by Le Maître de la Tour, commandant of his artillery *(Histoire d'Hayder-Ali Khan,* Paris, 1783) For the whole life and times *see* Mark Wilks, *Historical Sketches of the South of India, 3* vol. (London, 1810–17); H. N. Pearson, *Menzoirs oj Schwartz* (London, 1834); *N.* K. Sinha, *Haidar Ali* (Calcutta, 1949).

HYDNOCARPUS, an Indo-Malayan genus of trees of the family Flacourtiaceae. The seeds of some species are a source of hydnocarpus or chaulmoogra oil, which has some therapeutic effectiveness in some forms of leprosy (*q.v.*) but is of questionable or no value in others. Chaulmoogra oil and its purified derivatives as chemotherapeutic agents have been largely replaced by antibiotics. (N. TR.)

HYDRA, an island of Greece (anc. HYDREA), lying about 4 mi. off the southeast coast of Argolis and forming with the neighbouring island of Dokos (Dhoko) the Bay of Hydra. The greatest length from southwest to northeast is about 11 mi., and the area is 20 sq.mi.; a rocky and treeless ridge with hardly a patch or two of arable soil. Hence the epigram of Antonios Kriezes to the queen of Greece: "The island produces prickly pears in abundance, splendid sea captains and excellent prime ministers." The highest point, Mt. Ere, so called (according to Miaoules) from the Albanian word for wind, is 1,936 ft. high. The next is known as the Prophet Elias, from the large convent on its summit. There the patriot Theodorus Kolokotrones was imprisoned, and a pine tree is still called after him. In former times the island was richly wooded as its Turkish name Tchamliza, "the place of pines," shows. It was once well watered (hence the designation Hydrea), but is now wholly dependent on the rain supply, and sometimes water

must be brought from the mainland. This change may be due in part to earthquakes, which are frequent; that of 1769 continued for six days.

Hydra, the chief town, population 2,563, near the middle of the northern coast, on a very irregular site. has uhite and handsome houses, and its streets, though narrow, are clean. There are three other ports on the north coast—Mandraki, Molo, Panagia, but none sufficiently sheltered. Almost all the population of the island is collected in the town, which has a bishop, a local court, numerous churches and a high school. Cotton and silk weaving, tanning and shipbuilding are carried on, and there is a fairly active trade.

Hydra was of no importance in ancient times. In 1580 it was the refuge of Albanians from Kokkinyas in Troezenia; and other emigrants followed in 1590, 1628. 1635, 1640 and subsequent pears. At the close of the 17th century the Hydriotes took part in the reviving commerce of the Peloponnesus. About 1716 they began to build *sakturia* (of from 10 to 15 tons' burden), and to visit the islands of the Aegean; not long after they introduced the *latinadzka* (40–50 tons). and sailed as far as Alexandria, Constantinople, Trieste and Venice; eventually to France and even America.

From the grain trade of south Russia they derived great uealth. In 1813 there were about 22.000 people on the island, and of these 10,000 were seafarers. At the time of the outbreak of the war of Greek independence the total population was 28.190, of whom 16.460 were natives and the rest foreigners. One of their chief families, the Konduriotti, was worth £2,000,000. Into the national struggle the Hydriotes flung themselves with rare enthusiasm and devotion and the final deliverance of Greece was mainly due to their fleets.

See Pouqueville, Voy. de la *Grèce,* vol. vi; Antonios Miaoules, Ὑπόμνημα περὶ τῆς νήσου Ὕδρας (Munich, 1834), Id., Συνοπτικὴ ἱστορία τῶν ναυμαχιῶν 61b τῶν πλοίων τῶν τρίων νήσων, Ὕδρας, Πέτσων καὶ Ψαρῶν (Nauplia, 1833); Id. Ἱστορία τῆς νήσου Ὕδρας (Athens, 1874); G. D. Kriezes, Ἱστορία τῆς νήσου Ὕδρας (Patras, 1860).

HYDRA, in Greek legend, the offspring of Typhon and Echidna, a gigantic monster with nine heads (the number is variously given), the centre one being immortal. Its haunt mas the marshes of Lerna by Argos. The destruction of this hydra was one of the 12 "labours" of Hercules. which he accomplished with the assistance of Iolaus. Finding that as soon as one head was cut off two grew in its place, they burned out the roots with firebrands, and at last severed the immortal head from the body, and buried it under a rock. The arrows dipped by Hercules in the poisonous blood or gall inflicted fatal wounds.

HYDRACRYLIC ACID is a sirupy liquid, which on distillation is resolved into water and acrylic acid, $CH_2:CH.CO_2H$. It is β-hydroxypropionic acid, $CH_2OH.CH_2.CO_2H$, and is prepared by acting with silver oxide and water on β-iodopropionic acid, or from ethylene by the addition of hypochlorous acid, the addition product being then treated with potassium cyanide and hydrolyzed by an acid. Hydracrylic aldehyde, $CH_2OH\,CH_2.CHO$, is obtained as a colourless oil by heating acrolein with water.

HYDRANGEA is a genus of shrubs of the saxifrage family embracing about 80 species. distributed in North and South America and Asia. The simple leaves are opposite, petioled and marginally toothed. Flowers, in corymbiform cymes or cymose panicles, are four-five-parted, perfect, marginally sterile, or all sterile. Sepals are enlarged. often dentate; petals are small; stamens. numbering eight-ten; two-celled capsule opening between the diverging styles. Its persistent flower clusters, erect or climbing, are effective ornamentals in borders and arbours.

Hydrangea flowers are white or coloured. The colours, pink or blue, depend upon the presence of aluminum in the floral buds before opening. In those plants growing in basic soil the flowers are pink; in acid soil they are clear blue. The blue colour may be maintained by adding a soluble aluminum sulfate to the soil. Conversely, the pink colour may be maintained by adding lime to the soil.

Hydrangea is propagated by suckers, parts of older plants or cuttings. Cuttings are obtained in summer from young stems of plants grown under glass. Rooted cuttings may be cultivated in pots or in beds of rich, well-drained, loamy soil, with frequent watering. Partial shade is desired for foliage; sunlight stimulates flowering. In the fall or in early spring, the stems are pruned back to a few pairs of buds. For winter protection the plants may be lifted from beds for storage in cool cellars; otherwise, the stems may be tied together within straw or burlap and the plants covered with boughs; or the beds may be boarded along sides and filled with light earth. Seeds. seldom if ever used, should be planted in the fall in boxes under a scant soil cover.

H. petiolaris, native to Japan, is a luxuriant vine, with pure white, fragrant flowers, climbing by roots. H. *arborescence,* var. *grandiflora* (hills of snow), an American species, is renowned for its mostly sterile white flower clusters up to 7 in. across. Its rhizomes and roots contain a diuretic principle. Frequently cultivated in northern gardens is H. *paniculata,* var. *grandiflora* (Peegee hydrangea), with panicles of flowers up to 12 in. long, changing to pink and russet in the autumn. *H. macrophylla* (largeleaf hydrangea) of greenhouses or gardens bears blue or pink flowers.

(O. LA.)

HYDRASTIS, a genus comprising two species of plants of the Ranunculaceae family, one species occurring in Japan and the other in eastern North America, known as golden seal or orangeroot.

The native species is a low perennial herb that sends up, in early spring, from a thick yellow rootstock a single radical leaf and a simple hairy stem that is two-leaved near the apex and terminated by a single greenish-white flower bearing many stamens and 12 or more pistils in a head, the two-ovuled pistils becoming crimson, fleshy, berrylike in fruit. The rootstocks are gathered in the wild and under cultivation for the alkaloid hydrastine used in medicine. (J. M. BL.)

HYDRATE, in chemistry, a liquid or solid compound containing combined water. In some cases the crystalline character of a solid hydrate depends on this water which is present. Common examples of hydrates are the well-known sodium compounds: Glauber's salt (*q.v.*), which is decahydrated sodium sulfate, $Na_2SO_4.10H_2O$; washing soda, which is decahydrated sodium carbonate. $Na_2CO_3.10H_2O$; and borax, uhich is sodium pyroborate, $Na_2B_4O_7$, with five or ten molecules of water. Blue vitriol, $CuSO_4.5H_2O$, the pentahydrated copper sulfate, is another common example.

The alums owe their characteristic crystalline form partly to the presence of combined water; for example, potash alum, $KAl(SO_4)_2.12H_2O$, crystallizes in will-defined octahedra, which crumble into powder on removing the water. Acids and bases also form hydrates. $Ba(OH)_2.8H_2O$, hydrated barium hydroxide, is a well-crystallized substance. Sulfuric acid and hydrochloric acid combine with water to form hydrates, and since certain of these are stable only at comparatively low temperatures they are termed cryohydrates.

A remarkably stable solid hydrate is chloral hydrate, $CCl_3.CH(OH)_2$, produced by adding water to liquid chloral (*q.v.*). In this substance the added water has probably become hydroxide of constitution. so that this hydrate may be regarded as a connecting link between the loosely knit hydrates and the true hydroxides (*q v.*). (G. T. M.; X.)

HYDRAULIC LIME: *see* CEMENT.

HYDRAULIC POWER TRANSMISSION: see POWER TRANSMISSION.

HYDRAULICS: *see* MECHANICS, FLUID.

HYDRAULICS, APPLIED. Applied hydraulics is that science of engineering utilizing the basic principles of fluid mechanics and hydraulics to applied problems of economically developing and utilizing an available supply of water. Although the applied problems associated with utilization of other liquids such as oils in hydraulically operating mechanisms are sometimes included in applied hydraulics, this article will deal with the subject in the narrower sense.

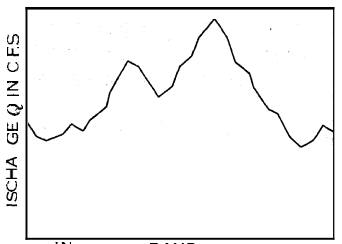
Some system of storage usually must be provided for a water supply, involving dams, diversion works, spillways and energy dissipaters (stilling basins). Water must be conveyed to its point of utilization and some system must be provided for drainage of used or excess water away from the point of utilization. Proper control of the water involves hydraulic machinery and measuring

devices throughout. Special hydraulics problems have to do with river engineering and coastal engineering. Frequently model studies can be used to advantage in the design and construction of hydraulic structures. Each of these subjects is treated briefly in the following article. Not considered in this article, however, is the fact that the usefulness of applied hydraulics is frequently conditioned or limited by social, economic and political considerations (see WATER RIGHTS).

WATER

Use.--When man diverts water from its natural location or course of movement, it is the job of the hydraulic engineer to design the system for diverting and using the water and also to care for the problems associated with such diversion. The various uses of water can be divided broadly into consumptive and temporary. Water which is temporarily used is diverted and then later returned to the natural drainage system (or to storage). This water can then be used repeatedly as it progresses down the natural drainage to the ocean. Consumptive use of water involves evaporation, transpiration and chemical combination of the water so that it cannot return to the natural drainage system. Among the more common uses of water are domestic, industrial, agricultural (including irrigation), power (both hydro power and condensing water for steam plants), sanitation, navigation, flood control, recreation and maintenance of marine life. One or more of these purposes may be the primary reason for using water at a specific location. Consideration, however, must also be given to each of these uses to ensure that one or more of them is not denied to some other hydraulic project.

Multipurpose projects are those that involve one or more of the foregoing purposes. Basically, multipurpose projects are designed and operated so that the combined use of the water provides maximum benefits for all concerned. Usually this requires a compromise for at least some of the interests, since the water must be handled in different ways for different purposes. In the operation of a reservoir, for example, a maximum available storage space is required for flood control, whereas for hydro power and irrigation projects the reservoir should be full.



BY COURTESY OF MAURICE L. ALBERTSON

FIG. 1.— TYPICALHYDROGRAPH

Examples of multipurpose projects include the St. Lawrence seaway the Tennessee Valley authority, the Damodar valley in India, the Columbia basin project in Washington, the Colorado-Big Thompson project in Colorado and the Missouri river project in the north central United States. In many projects, flood control is the primary purpose (see FLOOD). The U.S. army corps of engineers is charged with the primary responsibility of designing and building flood-control works along individual rivers and in metropolitan areas of the United States. The bureau of reclamation does similar work in the utilization of water on the arid lands of the western United States.

Supply.— The principal factors involved in the utilization of a water supply are its quantity, quality and location. The existing situation with respect to these factors must be related to the needs of the project. The quantity of the water is expressed in terms of discharge—the volume rate of flow—and in terms of total volume over a period of time. Knowledge of the minimum, maximum and average values are needed if the project is to operate successfully under varying conditions. The quality of water involves its chemical composition, for example, its hardness or mineral content; its bacterial content: materials such as sediment in suspension; temperature; and reliability. The location of the water involves both its placement on the surface of the earth and its elevation or depth.

Sometimes the needs of a particular project permit a wide variation in these characteristics. In other projects the characteristics must be controlled within narrow limits.

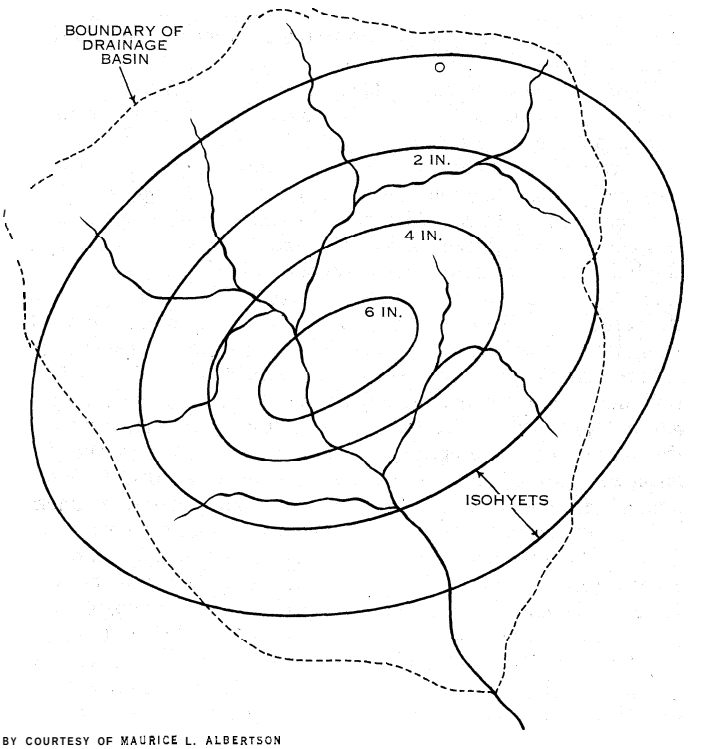


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FIG. 2.—ISOHYETAL MAP

A study of the hydrologic cycle (*see* HYDROLOGY; WATER SUPPLY) reveals the source and disposition of water diverted and utilized in applied hydraulics. The principal source of a water supply is precipitation. Water is also obtained from deep underground sources and from the ocean. Rainfall may be available directly as surface runoff or indirectly as ground water (*q.v.*). Snowfall is not immediately available but is later released as melt from snowbanks or glaciers, and in turn may become either surface flow or ground water. The deep underground water is that which is not replaced by seepage from the surface of the earth but rather has been trapped during geologic processes.

Precipitation frequently must be analyzed in the hydraulic design of a project. Factors considered are the rate and total amount of rainfall over a period of time ranging from a few hours to several years. Both the maximum and minimum are significant. An isohyetal map (fig. 2) is used to show the amount of rainfall over a given area during a period of two days. (For maximum rates of rainfall, see RAINFALL.)

The hydrograph (fig. 1) is a chart that shows the variation, with respect to time, of the depth of flow or the discharge in a river or stream. It is used by the hydraulic engineer to indicate the variations in runoff with which he must contend. These may be

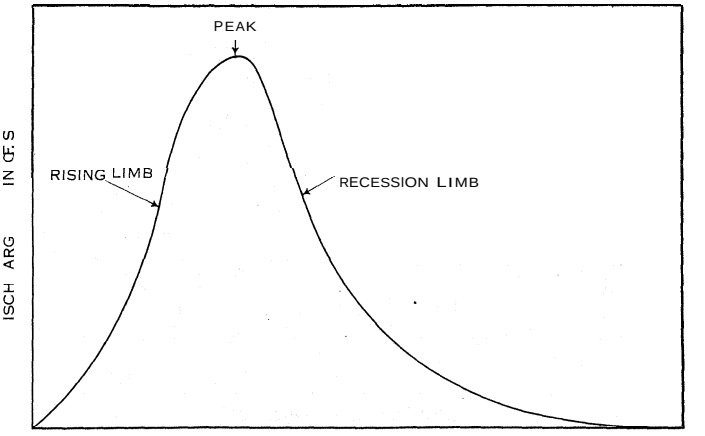

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FIG. 3.— TYPICALHYDROGRAPH FOR SINGLE STORM

caused by daily fluctuations due to variations in barometric pressure, evapo-transpiration and temperature, which affects both snow melt and ground-water flow. The surface runoff from a single storm creates a hydrograph similar to the one in fig. 3. Other variations are seasonal and are related to evapo-transpiration, availability of ground water and precipitation, average daily temperature and seasonal movement of air masses. Long-range cycles of precipitation and runoff have been found to exist over a period of approximately 21 years. These long-range cycles are claimed by some scientists to be correlated with similar cycles in the activity of the sun. (For magnitudes of flow in rivers see RIVER AND RIVER ENGINEERING.)

In studying and obtaining a water supply, it is necessary to take measurements of the precipitation, the runoff, the ground-water level, the water level in lakes and reservoirs and the amount of water delivered for use. Such measurements require a wide array of instruments, some read and recorded by an observer and others which record automatically.

Storage. — Because of the irregular supply or the irregular demand for water, storage facilities are needed to provide water for future use or disposition. Storage may also be needed to allow sediment carried by the water in a stream to settle out. The storage may be for a short period of time to compensate for the variations in hourly consumption by a metropolitan area, or for as long as a period of several years to provide water during a possible drought. The storage in Lake Mead (32,000,000 ac.ft.), created by Hoover dam on the Colorado river, for example, is intended, if necessary, to last over a period of many years of less than average flow.

Water can be stored above or below ground. Above ground it may be stored in reservoirs. channels, valleys such as that of the Mississippi river, or in snow and glaciers. Underground storage may result from natural seepage of rain water or runoff as well as from artificial water spreading. Water spreading not only increases the quantity of ground water but in some cases is used to dissipate floods from small watersheds. Important factors to consider in the storage of water are losses due to seepage and evaporation as well as possible significant changes in quality. These include changes in chemical, bacteriological and sediment composition, as well as in temperature.

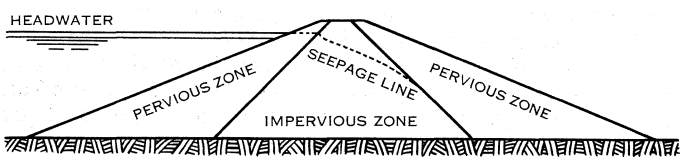

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FIG. 4. — TYPICAL EARTH DAM

Surface reservoirs must be carefully planned as to location and operation. The storage capatity with respect to water-surface elevation in the reservoir must be determined together with a mass curve, the variation of accumulated runoff over a period of time. In the design and operation of a reservoir, plans also must be made for the disposition of sediment that is carried in with the water. This sediment can completely fill a reservoir in a few years if it is introduced in sufficient quantities. Coarse sediment settles out at the entrance to the reservoir where the water is slowed and its sediment-carrying capacity reduced. The finer materials, which may take many days to settle, are usually carried as a dense submerged current under the reservoir along the old channel, and deposited at the bottom of the reservoir. An example of the effect of sediment deposits is Elephant Butte reservoir in New Mexico the capacity of which was decreased by 16% during the period 1915–40 by sediment deposited from the upstream watershed at the rate of 1,600 tons per square mile per year.

Reservoirs may be operated singly or in combination. Furthermore, in multipurpose projects their use must be considered in connection with the various needs of possibly conflicting operations. Obtaining maximum efficiency of operation is a complicated procedure, so complicated in fact that electronic computers are used to integrate all the variables to be considered.

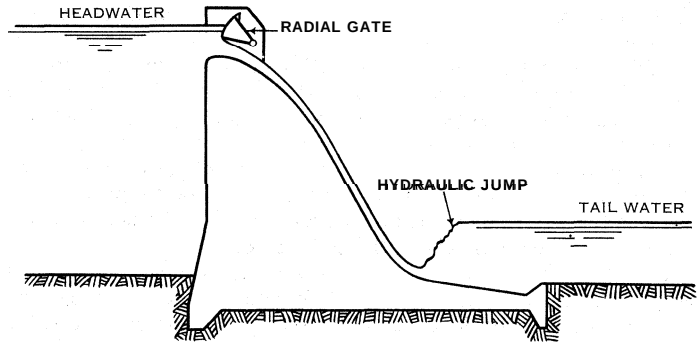

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FIG. 5. — TYPICAL OVERFALL GRAVITY DAM

HYDRAULIC WORKS

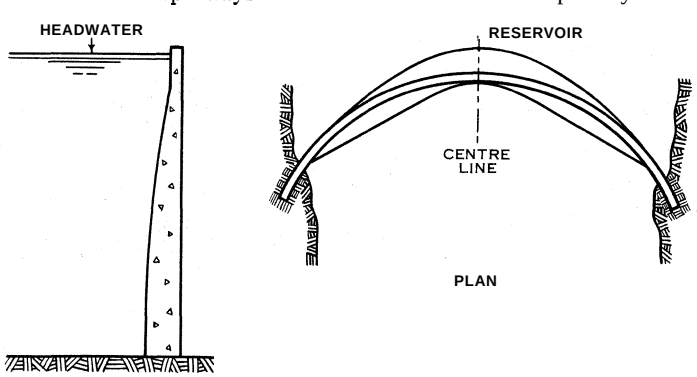
Dams. — The creation of a reservoir usually requires construction of a dam to impound and store water, either temporarily or for longer periods of time, for use while stored or for later release and use. Low dams are used to divert water from one conveyance system, such as a river, into another. The basic problems involved in the design and construction of a dam are the stability of the dam; the seepage of water around, through, or under the dam; the disposition of floodwaters; protection against waves and sudden drawdown; and foundation support for the dam. Stability of the dam involves its vertical weight, the pressure of the water upstream, the pressure of the silt upstream, the pressure of the ice upstream. uplift pressure under the dam, the foundation materials and seismic forces from vibrations such as explosions and earthquakes. Seepage takes place through all dams to a greater or lesser extent. It is only when the seepage is of such quantity as to waste the water or to endanger the safety of the dam that it becomes of major concern. The failure of most dams is due to flood flows for which there has not been provided adequate spillway capacity for passing the flood flow over, around or through the dam. (For a fuller discussion of the construction and operation of dams, see DAM.)

Spillways and Outlet Works. — Nearly all types of dams and control works that require release of water involve a spillway or outlet works of some kind. **A** spillway is a structure which permits the water to pass around, over, through or under a dam or other structure safely, in desired quantities and at the desired time. This water may be floodwater that cannot be stored in the reservoir or it may be water stored under normal conditions that is released for use downstream.

The crest of the overfall type of spillway is shaped like the underside of the jet of water that flows over a weir (*q.v.*). The water, after leaving the spillway, flows into a stilling basin downstream from the dam where its kinetic energy is dissipated.

The morning-glory or shaft spillway is usually located in the reservoir upstream from the dam. The water flows radially inward over a rounded crest down a shaft to a pipeline that passes through, under or around the dam.

Side-channel spillways accumulate the water over a spillway crest



BY COURTESY OF MAURICE L. ALBERTSON

FIG. 6. — TYPICAL ARCH DAM

upstream from the dam and carry it into a tunnel or chute around the end of the dam.

Spillways that siphon water over the top of a dam are advantageous for drops in elevation of 50 ft. or less. Because of the siphoning action it is possible to obtain a much greater discharge for a given size opening or passsgeway.

The flow (Q) over a spillway crest is represented by the equation $Q = KLH^{3/2}$ in which K is the coefficient of flow (approximately 4), L is the length of the spillway crest and H is the height of the water in the reservoir above the spillway crest.

Outlet works arc used to discharge water through a dam at a level lower than the crest of a spillway and are thus under greater pressure than an ordinary spillway, the head sometimes reaching hundreds of feet. The water, after passing through the outlet, is discharged into a stilling basin. Various types of gates and regulating valves control the rate of flow.

Energy-Dissipation Systems.—In order to protect the banks and beds of a stream or river against erosion and to reduce waves, surges and water spray, kinetic energy of the initial high-velocity flow in the spillway or outlet works must be dissipated. Kinetic energy can be dissipated by shear resistance and pressure resistance (fig. 7). A boundary along which water is flowing will create a resistance to the flow that results in a reduction in kinetic energy (fig. 7[A]), which is converted to turbulence and heat. Furthermore, energy can be dissipated in either the vertical or horizontal direction or in a combination of both. The hydraulic jump (fig. 7[B]) is based upon the momentum principle. Dissipation of energy in the direction vertically downward is shown in fig. 7(C), while the manifold stilling basin (fig. 7[D]) dissipates energy vertically upward.

Dissipating energy vertically results in radial spreading of the flow and very efficient dissipation with little energy remaining in the form of high-velocity jets or eddies or in the form of waves to erode the bed and banks of the downstream channel.

Conveyance and Diversion Systems.—Conveyance systems, in the form of natural or man-made waterways or conduits, are used to transport water from point of origin, diversion or storage to point of further storage, utilization or waste, while diversion works are for the purpose of diverting water from storage or from one conveyance system into another. Such diversion works can consist of a simple head gate that releases stored water into the conveyance system or of a complex combination of a diversion dam with control gates, sluice gates and head gates. The control gates on the diversion dam are intended to pass floodwaters and to control the elevation of the water upstream in order to divert the desired quantity into the conveyance system. Sluice gates are mounted at a much lower level in order to wash any sand or other sediment away from the head gates. This prevents sediment from entering the head gates of the conveyance system.

Immediately downstream from the head gates is usually a device for ejecting or removing any undesirable sediment that may have entered the conveyance system. This ejector usually flushes such sediment back into the main channel (fig. 8). Usually near the head gate is also located a device, such as a Parshall flume, for measuring the water diverted into the conveyance system.

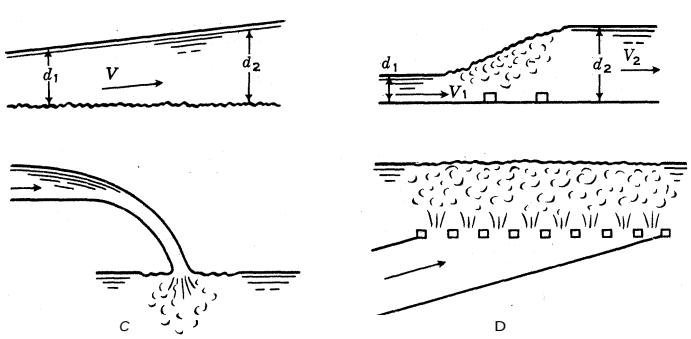


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FIG. 7.— METHODS OF DISSIPATION OF KINETIC ENERGY, d BEING DEPTH AND V, VELOCITY, SHOWING (A) CHANNEL RESISTANCE, (B) HYDRAULIC JUMP. (C) DOWNWARD INTO POOL, (D) UPWARD THROUGH MANIFOLD STILLING BASIN

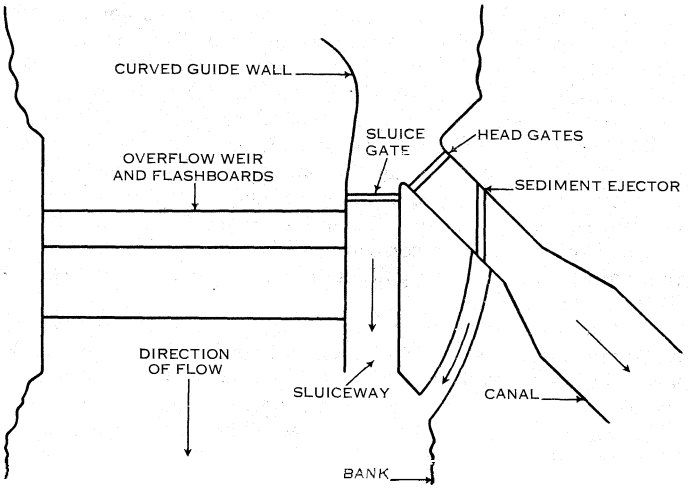

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FIG. 8.— TYPICAL LAYOUT OF DIVERSION DAM AND CANAL HEADWORKS

Closed conduits such as pipes and tunnels are often used for conveying water from one point to another. The pipes may consist of cast iron, steel, concrete, clay or wood stave. Penstocks are a special type of pipes that convey water into hydroelectric turbines. The design of an economic closed conduit depends in part upon the resistance to flow (see MECHANICS, FLUID). In some flow systems the boundary resistance is of major importance, whereas in others the energy losses due to fittings, bends, gates, valves, etc., called minor losses, are of primary importance.

Measurement of flow in closed conduits is usually accomplished by means of measuring flow pressures with a Pitot tube, Venturi meter, orifice meter, flow nozzle or other device and computing the rate and volume of flow from the pressure values thus obtained. (See MECHANICS, FLUID: Applications: *Fluid* Meters).

Water hammer, a pressure wave that travels through the water with the speed of sound, must be considered in any closed conduit where automatic and sudden stoppages of flow are apt to occur. If the pressure generated is of sufficient magnitude, it can burst the conduit. Although water hammer is frequently thought to be the noise associated with the sudden closure of a water faucet on a water line such as that in a home, the noise created in such cases is caused by the conduit or pipe, actuated by a water hammer, striking some other object such as a wall.

Some closed conduits operate partially full so that there is air above the liquid: This air may be at atmospheric pressure or at some modified pressure. Under these conditions the problems of analysis and design are the same as for flow in an open channel.

Examples of closed conduits include domestic water-supply systems, cross-country lines for natural gas and other petroleum products, industrial and agricultural water supplies and pipelines for chemical and industrial processes.

Open channels include flow of water in natural channels such as rivers and in artificial channels such as canals, flumes and aqueducts. The type of boundary may be rigid or it may be alluvial so that sand or gravel is moved along the bed. (For the method of analyzing flow in open channels, see MECHANICS, FLUID: *Applications: Flow* of *Liquids* in Open Channels.)

Associated with diversion and conveyance systems are regulating and control structures such as gates and valves to control the flow, measuring devices to measure the amount of water being diverted and delivered to the consumer, turnouts to deliver water, wasteways to dispose of excess water, checks to maintain the water in the canal at a higher level for delivery at small discharges, dividers to divide the flow into certain proportions regardless of the amount of the total flow and locks to permit vessels to go from one level to another.

Protective structures are also necessary on conveyance systems. These include automatic spillways to dispose of unexpected flows automatically without damage to the structures; overchutes to carry excessive drainage water such as storm runoff over canals;

culverts to carry excess water under canals; bridges and aqueducts to carry vehicular and pedestrian traffic as well as water over canals or natural drainage systems; drain inlets which permit a small amount of surface drainage to enter the canal; and sand traps and settling basins which collect excess sediment.

Drainage Systems. — Often a drainage system is employed in connection with hydraulic projects to transport waste or excess water safely and economically to a river or other point of disposition. This drainage water may be flowing over the surface of the ground or underground. Surface water usually consists of storm water or excess and waste water from irrigation, industrial and domestic sources. Surface water must be taken around, over, under or through the main conveyance system. This is usually done through overchutes and culverts or under bridges and aqueducts.

Subsurface drainage involves ground water and water that has leaked into the earth through porous media. Such drainage is usually accomplished by means of systems of tile piping laid underground or by open trenches, ditches and cuts that intercept the subsurface water and dispose of it. (See LAND RECLAMATION.)

Control structures for water-drainage systems are similar to those for water-conveyance systems.

HYDRAULIC MACHINERY

To serve its purposes a hydraulic project must have machinery. Machinery to control and regulate flow usually consists of gates or valves. Pumps are used to add energy to the flow while turbines subtract energy from the system by converting it into other forms such as mechanical or electric energy.

Gates. — Gates may be designed to operate under low heads of only a few feet or high heads of several hundred feet. They may be operated manually or automatically. Low-head gates are usually associated with spillways and canals while high-head gates are usually to be found with outlet works and penstocks for dams and hydroelectric plants.

A radial or Taintor gate is a segment of a cylinder at the centre of which is the pivot for the gate (fig. 5). One of the least expensive as well as one of the simplest to operate, it is used for control gates on dams, head gates, control gates and checks in canals. and for sluice gates.

The leaf gate consists of a sliding plane located in a conduit perpendicular to the direction of flow. Leaf gates that are hinged along one edge are for low head only, while the sliding or vertical-lift gates are designed for both low and high heads. For low heads the sliding or vertical-lift gate simply slides along a seat since the friction is not too great to be overcome by a hoisting mechanism. For high heads, however, it is necessary to have wheels on the gate or wheels fixed in the seat so that the sliding friction is reduced. Otherwise the friction would be so great that the gates could not be raised or lowered.

For the crests of dams and other types of diversion works flashboards and needles are sometimes used. Flashboards are horizontal boards and needles are vertical boards. Both are placed across the flow in order to increase the elevation of the water surface, usually for diversion purposes. Stop logs are usually planks or logs that slide into vertical grooves on the side of a canal or flume in order to close a flow passage either temporarily or permanently.

Valves. — Valves are associated with closed conduits and usually are designed for high-head conditions. Outlet works associated with discharge at a low level behind a dam or the discharge of water into a hydroelectric plant are usually controlled by valves. The most common type of valve is the needle valve (fig. 9). The interior part of the valve is composed of two streamlined sections, one of which is rigid and remains fixed, the other being movable so that it can move into the opening. A modification of this valve is the tube valve, which has the movable portion at the downstream end cut off in order to simplify its operation. A further simplification of the needle valve is the hollow-jet valve, which has the movable portion upstream and the casing, as well as the interior, cut off downstream. This valve discharges directly into the atmosphere rather than into a conduit downstream. Perhaps the simplest of valves for high-head installation is the Howell-Bunger

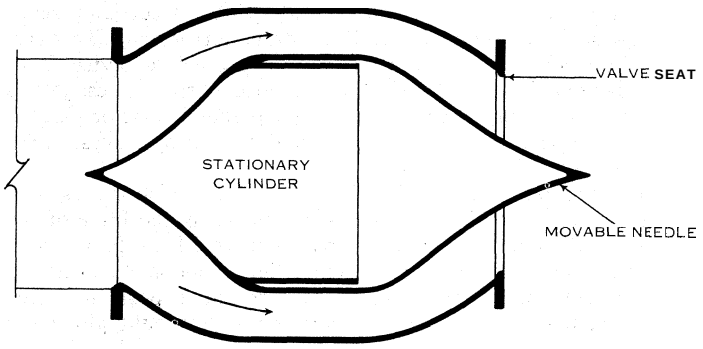

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FIG. 9. — NEEDLE VALVE

valve, consisting of a cone facing upstream that moves into the cylindrical valve chamber to close off the flow. This type of valve discharges radially outward into the atmosphere and greatly aids energy dissipation but increases spray.

The cylinder gate is similar in some respects to the tube valve except that it operates in a vertical direction and is customarily used to release water from a reservoir.

Butterfly valves (fig. 10) are most commonly used to control the flow from a penstock into a hydroelectric turbine because of the very small energy loss through the valve. When the valve is open the butterfly leaf is simply a streamlined disk parallel to the flow. To close the valve, the butterfly leaf is turned 90° so that it is perpendicular to the flow, shutting it off.

The discharge from gates and valves frequently has sufficient kinetic energy that stilling basins must be provided downstream.

Pumps **and** Turbines. — Pumps and turbines (see PUMP; TURBINE: WATER) are similar in design and operation except that the water flows in one direction for the pump and in the opposite direction for the turbine. The purpose of the pump is to increase the kinetic energy or the potential energy of the water in the system. Some of the largest pumps ever built were for Grand Coulee dam, Washington. These operate with 65,000 h.p. at 200 r.p.m. to deliver 1,350 cu.ft. per second (c.f.s.) of water against a head of 310 it. Centrifugal pumps can be combined in multiple stages in order to pump against extremely high heads. One of the highest-head pumps ever built was for 875 gal. per minute (g.p.m.) against a head of 8,600 ft.

The Francis-type turbine corresponds to the centrifugal pump and the Kaplan-type turbine to the propeller pump (see TURBINE: WATER). Some of the largest Francis-type turbines are the 115,000-h.p. turbines for Hoover dam, Arizona-Nevada, which operate at 180 r.p.m. with a head of 510 ft. At Grand Coulee dam there are 150,000-h.p. turbines operating at 120 r.p.m. with a head of 330 ft. At the Marne plant in Italy is a Kaplan turbine for 7,320 h.p. under 105 ft. of head. Francis turbines have been used for heads greater than 1,000 ft.

COASTAL ENGINEERING

Hydraulics problems associated with coastal engineering involve the design, operation and maintenance of docks, harbours, beaches, estuaries and navigation channels. Natural phenomena that com-

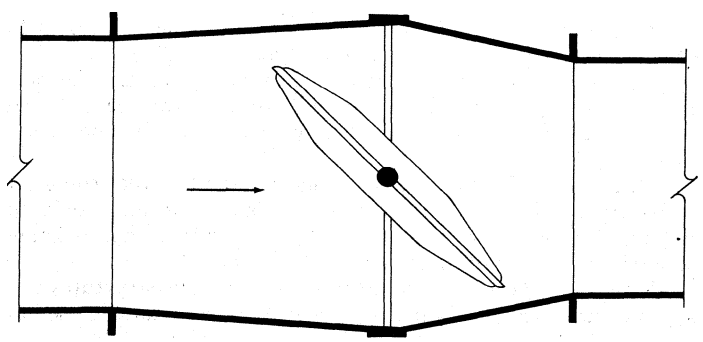

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FIG. 10. — BUTTERFLY VALVE

plicate this work are waves, surges, tides, littoral currents. scour and deposition of sediment, and salt-water intrusions. To overcome these complications various types of protective devices have been developed, including breakwaters, groins, spur dikes, jetties and sea walls. Long dikes or walls built perpendicular or parallel to the shore protect it against waves and erosion by waves. (See BREAKWATER; JETTY.)

The reduction of the height of waves is accomplished most frequently by means of breakwaters which break up the force of the waves, allowing an inner harbour area to be used for safe mooring, operating, handling, loading and unloading of shipping. Littoral currents along the shore erode, transport and deposit sediment that frequently undermines or covers structures built along the shore. Consequently, special consideration and study of sediment control as well as wave control is required when designing and constructing coastal works.

Salt-nater intrusions into fresh-water bays and river estuaries frequently cause difficulty if this water is being used for industrial. agricultural or domestic consumption. Special procedures have been devised for control of the inflow of salt water.

Tides result in a fluctuation of water-surface elevation along a coast varying from a few inches to many feet, the highest tides reaching approximately 60 ft. in the Bay of Fundy in Canada and in the estuary of the Severn river in Great Britain. Although much discussion has taken place regarding the harnessing of the energy in tides, only a few small plants have been built and only in northern France has large-scale hydroelectric power been developed from this source.

MODELS

In hydraulic engineering great use is made of model systems by the operation of which the characteristics of similar but larger hydraulic systems can be predicted. There are three types of similarity — geometric, kinematic and dynamic. If two objects are geometrically similar their shape is similar, although they may not be the same size. Kinematic similarity requires that the pattern of flows about or through the object be the same in the model and in the prototype. Dynamic similarity requires that the ratio of forces acting at any point in the model be the same as the ratio of forces acting at the corresponding point in the prototype. For most hydraulic model studies these forces are associated with the Froude number, relating to gravitational forces, the Reynolds number, viscous forces; and the Weber number, surface energy forces. (See DIMENSIONAL ANALYSIS.) Each of these forces in the dimensionless number is related to the force of inertia. (For a discussion of similarity, see MECHANICS, FLUID.)

Models are built: (1) to study the general appearance and the relative proportions of the various features as they will be in the prototype structure; (2) to study the flow pattern (magnitude and direction of velocity and acceleration) over, through or around the object; (3) to study the pressure distribution and resulting forces on the object or its parts; (4) to determine flow capacities and calibrate the various flow passages; (5) to determine hydraulic efficiencies of hydraulic machinery; (6) to determine mechanical-energy loss due to shear drag and pressure drag; (7) to determine whether the prototype will operate as intended; (8) to determine ways of improving the design of the prototype so that it will operate more effectively; (9) to find ways of changing the design to reduce the eventual cost of the prototype.

The chief advantages of a model are that, by its use, the purposes and objectives of a hydraulic project can be attained more economically, quickly, simply, conveniently and completely.

The principal disadvantage of a model is the fact that complete similarity in the model is sometimes difficult or impossible to obtain. Consequently, in some cases only partial or approximate answers can be obtained by means of a model.

Models have been used for most of the hydraulic structures and systems discussed in this article. They are also commonly used to study naval vessels, aircraft and various types of hydroelectric machinery, as well as pipes, rivers, harbours and hydraulic structures such as dams, spillways and stilling basins.

See also AQUEDUCT; BREAKWATER; CLIMATE AND CLIMATOLOGY; DAM; DIMENSIONAL ANALYSIS; DOCKS; ELECTRIC POWER; FLOOD; GROUND WATER; HARBOURS; HYDROLOGY; HYDROMECHANICS; IRRIGATION; JETTY; LAND RECLAMATION; MECHANICS, FLUID; PUMP; RAINFALL; RIVER AND RIVER ENGINEERING; SEWAGE DISPOSAL: SEWER DESIGN AND CONSTRUCTION; TIDES; TURBINE: WATER; WATER SUPPLY AND PURIFICATION; WATERWAYS, INLAND; WAVES AND SHORE CURRENTS.

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HYDRAULIC TURBINE: see TURBINE: WATER.

HYDRAZINE is a colourless liquid which solidifies at 1.8° to 2.0° C. and boils at 114.5° C. Having the chemical formula of N_2H_4, it belongs to a group of hydrogen-nitrogen compounds known as the hydronitrogens and was first prepared by T. Curtius (1887).

Hydrazine is a powerful reducing agent and is used in the silvering of mirrors and the formation of metal films on glass and plastics. It is used as a corrosion inhibitor to remove dissolved oxygen from boiler waters. A mixture of hydrazine, water and methyl alcohol was used by the Germans in World War II as a rocket- and jet-propulsion fuel.

Anhydrous hydrazine is miscible in all proportions with water, methyl and ethyl alcohols. It forms a high boiling azeotrope with water containing 68.5% N_2H_4 and boiling at 120.5° C. (771 mm. pressure). Care must be taken in the storage of anhydrous hydrazine and its aqueous solutions, since these absorb moisture and carbon dioxide and react chemically with oxygen of the atmosphere. Hydrazine solutions and vapour are toxic. Hydrazine vapour mixed with air is inflammable. Aqueous solutions of hydrazine are more weakly basic than ammonia.

Preparation. — It may be obtained by the reduction of nitrosoamines, nitramines and the nitrosohydroxylamine sulfonates and by the thermal, photochemical or electrical decomposition of ammonia. It is produced technically from aqueous ammonia (or urea) by oxidation with hypochlorite in the presence of gelatin or glue (Raschig process). This process is operated at temperatures between 160° and 180" C. under pressure to yield continuously a dilute reaction liquor containing about 2% N_2H_4.

Concentration is effected by fractional distillation to give a product marketed as 85% or 100% hydrazine hydrate. $N_2H_4.H_2O$. Further concentration to anhydrous hydrazine must be accomplished by dehydration with barium oxide or caustic soda. The anhydrous material is also obtained by treating hydrazine sulfate with liquid ammonia (A. W. Browne).

Salts.—Hydrazine forms two series of salts, $N_2H_4.HX$ and $N_2H_4.2HX$, where HX represents a monobasic acid. Best-known salts are the sparingly soluble sulfate, $N_2H_4.H_2SO_4$, the mono- and dihydrochlorides, $N_2H_4.HCl$ and $N_2H_4.2HCl$ and the mononitrate, $N_2H_4.HNO_3$. The mononitrate has found application as a high explosive and as an ingredient of high-explosive compositions. The bromide $N_2H_4.HBr$ is used as a soldering flux. Double salts such as the chlorides, $N_2H_4.HCl.MCl_2$, and the sulfates, $(N_2H_4)_2.H_2SO_4.MSO_4$ are also known. The copper compound, $(N_2H_4)_2.H_2SO_4.CuSO_4$ has interesting algaecidal and fungicidal properties and has found application as an agricultural fungistatic material. Compounds containing co-ordinated hydrazine. *i.e.*, hydrazinates, have been prepared, for example, $ZnCl_2.2N_2H_4$ and $Co(N_2H_4)_3SO_4$.

Organic **Hydrazines.**—Derivatives of hydrazine have been prepared in which one, two, three and even four of the hydrogen atoms are replaced by alkyl, cycloaliphatic and/or aryl radicals. The simple alkyl hydrazines such as methylhydrazine, $CH_3N_2H_3$ and dimethylhydrazine $(CH_3)_2N_2H_2$ are prepared from the amines and chloramine by a modification of the Raschig process. Phenylhydrazine. $C_6H_5N_2H_3$, was discovered by E. Fischer in 1877 and was employed by him in his classical researches on sugar; it is used along with other organic derivatives of hydrazine to

detect organic substances containing carbonyl groups (see ALDEHYDES AND KETONES; CARBOHYDRATES) since it condenses with these to form hydrazones and azines with the elimination of water.

Acid hydrazides, $RCON_2H_3$, are obtainable by the action of hydrazine on acid chlorides or esters. Best known are the hydrazine derivatives of carbonic acid such as semicarbazide. $CO(NH_2)(N_2H_3)$, carbohydrazide, $CO(N_2H_3)_2$, bi-urea, $(-NHCONH_2)_2$, and aminoguanidine, $C(NH)(NH_2)(N_2H_3)$. The latter substance is obtained in the form of its salts by condensation of cyanamide with hydrazine.

Organic derivatives of hydrazine find application in analytical chemistry (dithizone), as biologically active substances (isonicotinic acid hydrazide in the treatment of tuberculosis) and as chemical intermediates, for example, in the production of specialty fuels, plastics and resinous substances, photographic chemicals and as blowing agents for the manufacture of foam rubber.

For additional information on the hydronitrogens see NITROGEN and AMMONIA.

BIBLIOGRAPHY.—H. Wieland, *Die Hydrazine* (1913); *L.* **F.** Audrieth and B. *A.* Ogg, *The Chemistry of Hydrazine* **(1951)**; *C.* **C.** Clark, *Hydrazine* (1953). (L. *F.* A.)

HYDRAZOIC ACID, sometimes called azoimide, is a compound of hydrogen and nitrogen. It is a colourless liquid, boiling at 37° C., and is sensitive to shock, exploding violently but with a limited radius of action. The acid has a characteristic odour, said to resemble that of a damp cellar, and the vapour causes headache and attacks the mucous membrane. Its salts, which are called azides, and its organic derivatives are also explosive but to a lesser extent. The acid (HN_3) and its derivatives present many points of theoretical interest, but the only derivative of commercial importance is lead azide. This is used as an initiating explosive in detonators and percussion caps and is in some ways superior to mercuric fulminate, especially in being less sensitive to moisture.

Organic derivatives of hydrazoic acid were the first to be known and resulted from the discovery of the aromatic diazo compounds by P. Griess. He found in 1866 that the perhalides of these are converted into azides by ammonia.

$$C_6H_5.N_2.Br_3 + NH_3 \rightarrow C_6H_5N_3 + 3HBr$$

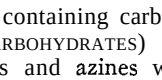
The acid itself was first prepared by T. Curtius in 1890 by the alkaline hydrolysis of benzyl azide; he found that after acidification the acid could be separated by distilling in steam. The first preparation from inorganic materials was by J. Wislicenus in 1892; he used a reaction which remained at mid-20th century still the most important for obtaining the free acid and its salts, the action of nitrous oxide on sodamide at about zoo° C.

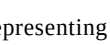
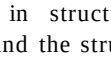
$$NaNH_2 + N_2O \rightarrow NaN_3 + 3H_2O$$

A number of other methods are known, mostly using hydrazine as starting material. This reacts with nitrous acid to give hydrazoic acid, but there are many side reactions so that a useful yield is obtained only under carefully regulated conditions. The anhydrous acid can be prepared from its aqueous solution, which is less explosive than the pure acid, by repeated fractional distillation, but the best method is to warm the pure sodium salt with stearic acid, condense the acid at −40° C., and distill it under reduced pressure between −50° and −80° C.

The chemical behaviour can be roughly summarized by saying that the radical N_3 behaves like a halogen, so that the salts resemble the chlorides and the free acid hydrogen chloride. In aqueous solution, however, it is only a weak acid and of approximately the same strength as acetic acid.

Structure.— The constitution of the azide group N_3 which is covalently linked to hydrogen in the acid and to carbon in the organic derivatives, and which exists as an anion in the salts, nas a matter of controversy for many years. The first formula proposed (I) was that of Emil Fischer in 1878 and this was accepted until J. Thiele and A. Angeli pointed out in 1911 that the straight chain formula (II) could be held to give a better explanation of certain reactions.

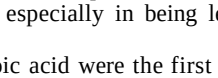
(I)  (II) $-N=N\equiv N$

A decision was impossible at that time. The demonstration that the cyclic formula (I) is incorrect could only be reached when methods became available whereby the actual positions of the atoms in a molecule could be determined. This was first done for the azide ion in sodium and potassium azides by S. B. Hendricks and L. Pauling in 1925, and the result was confirmed later by the Raman spectrum of the ion in solution. The three nitrogen atoms lie in a straight line and the ion is symmetrical about the central atom. The ion must be written $N\leftarrow\overline{N}\rightarrow N$, or with dots representing valency electrons as  . It resembles in structure the cyanate ion, $\overline{N}=C=O$ or  and the structure of the potassium cyanate crystal is almost identical with that of potassium azide.

For the covalently linked azide group a straight chain structure is established beyond doubt by the electron diffraction of methyl azide studied by L. O. Brockway and Pauling in 1933 and by the X-ray analysis of crystalline cyanuric azide carried out independently by Miss I. E. Knaggs and E. W. Hughes in 1935. The group is not. however, symmetrical about the central atom as in the ion; the molecule can be represented as below, the figures showing the distances in angstrom units:

$$H_3C\ 1.47\ N\ 1.24\ N\ 1.10\ N$$

Such a structure cannot be represented by a single formula based on the older views of valency. The original Thiele-Angeli formula (II above) must be rejected because it involves pentacovalent nitrogen, a state not known in any other compound of the element. The alternatives are $R-N=N\leftarrow N$ and $R-N\leftarrow N\equiv N$, which can be written

 and 

these must be excluded as they stand because they imply much higher molecular electric moments than those observed and because the bond lengths do not fit the experimental results. The structure must be taken to be a resonance hybrid (see RESONANCE. THEORY OF) of these two straight chain formulas, a view which is supported by the known heats of formation of phenyl azide and of ethyl azido-acetate. Such a conclusion can be reached only when the existence of resonance is realized and it is thus easy to see why in the earlier part of the century the controversy could not be settled. The azide group is one of the few where, using conventional formulas, no one formula can be written even as an approximation.

Derivatives.— The organic derivatives of hydrazoic acid can be divided into two classes, the alkyl and aryl azides in which the group is attached to a hydrocarbon radical. and the acyl azides which contain the group $-CO.N_3$. Apart from reactions which involve its breakdown, the behaviour of the azide group in all these recalls that of a halogen atom, a further justification for its description as a pseudohalogen. Thus methyl azide, a liquid boiling at 20° C. and somewhat less explosive than the acid, is hydrolyzed by alkalies to methyl alcohol and the alkali azide. while phenyl azide resists such hydrolysis. The aryl azides, which are considerably more stable, show a variety of addition reactions with compounds containing a reactive methylene group and with ethylenic and acetylenic unsaturated compounds. These have been much studied and lead to derivatives of 1,2,3-triazoline.

The acyl azides are derivatives of carboxylic acids and are best obtained by the action of the acid chloride on sodium azide. They resemble acid chlorides in many ways and, though the majority are reasonably stable, certain of them are among the most explosive compounds known; for example the diazide of carbonic acid detonates if gently rubbed with a glass rod. The important reaction of the acyl azides is the Curtius rearrangement which occurs when they decompose in solution. Nitrogen is lost and the resulting radical rearranges to an isocyanate by an intramolecular process (see MOLECULAR REARRANGEMENTS).

$$R.CO.N_3 \rightarrow N_2 + R.CO.N. \longrightarrow R.NCO$$

Since the isocyanate can be hydrolyzed to a primary amine, the reaction is useful for effecting the change $R.COOH \longrightarrow R.NH_2$.

(T. W. J. T.)

HYDRIDES. Chemical compounds in which one or more hydrogen atoms are attached to a metal or metalloid (metallike) atom are called hydrides. Compounds of this class have interesting applications because of their high hydrogen content; some are useful as rocket fuels and as hydrogen sources for filling balloons and others are of prime importance in nuclear fusion processes. The term hydride is also applicable to metallic phases whose composition may vary within narrow limits; *e.g.*, palladium hydride which has the approximate composition Pd_2H. It is used loosely to include solid solutions of hydrogen in metals and all compounds of hydrogen with single elements, including ammonia, NH_3, and even water, H_2O.

All metals are capable of dissolving small amounts of hydrogen, particularly at high temperatures or on melting. Those metals which form true hydrides are likewise capable of dissolving small amounts of hydrogen prior to hydride formation. These solutions of hydrogen in metal are quite different from hydrides and this term is not properly used to describe them.

It is well known that the hydrogen penetration of many metals causes a weakening or embrittling referred to as hydrogen embrittlement. Hydrogen diffuses with great rapidity through several heated metals such as palladium, iron and nickel; it reacts with palladium and about 40 metals to form compounds most of which are brittle. These compounds dissociate on stronger heating, giving back the metal and hydrogen gas. The volume of hydrogen which is taken up by some metals is quite remarkable. Thus titanium hydride, TiH_2, is a metallic-appearing compound which contains 1,620 times its volume of hydrogen. This hydrogen is released by heating to red heat or by reaction with strong acids. The hydrogen atoms in titanium hydride are more tightly packed together than in solidified pure hydrogen at its freezing point.

Hydrides of many of the metals capable of dissolving hydrogen in small amounts are known to exist even though they cannot be formed by reaction of the metal with hydrogen. Such hydrides must be made by indirect syntheses and decompose on heating.

Four types of hydrides have been recognized under a classification based on the type of chemical bond involved.

1. Saline or saltlike: hydrides in which hydrogen is present as an anion H^- similar in size to the fluoride ion F^-. In these compounds hydrogen displays its family resemblance to the halogens: fluorine, chlorine, etc. Saline hydrides are physically similar to corresponding fluorides except that they react vigorously with water giving off large volumes of hydrogen. This property renders them useful as light, portable sources of hydrogen. Examples of primary saline hydrides are sodium hydride, NaH, and calcium hydride, CaH_2. Examples of complex saline hydrides are lithium aluminum hydride, $LiAlH_4$, and sodium borohydride, $NaBH_4$, both of which are chemicals of commerce used as reducing agents.

2. Metallic (formerly termed interstitial): alloylike hydrides which possess some of the characteristics of metals such as lustre and strong electrical conductivity. They tend, however, to be more brittle and sometimes harder than the metals from which they are made. These compounds are regarded as intermediate in nature between salts and alloys. The hydrogen is probably closely associated with two electrons and therefore resembles the anionic form found in saline hydrides. The metal may be regarded as a cation of maximum charge which has given one of its electrons to hydrogen and shares one or more electrons with other metal ions such that the assemblage is immersed in a "sea" of such electrons. Metallic hydrides have also been regarded as made up of protons (positive hydrogen ions H^+), and metal atoms in an electron sea. The lustre and electrical conductivity are attributed to the relative freedom of electron movement in the hydride. Examples are titanium hydride, TiH_2; lanthanum dihydride, LaH_2; thorium dihydride, ThH_2, and a higher hydride, Th_4H_{15}; and uranium hydride, UH_3. Metallic hydrides are generally not reactive toward water unless the finely divided metals themselves are reactive. Thus palladium hydride does not react appreciably with water whereas uranium hydride does.

3. Dimeric or polymeric: hydrides in which hydrogen is presumed to have formed a connecting bridge between metal or metalloid atoms. Classical examples are furnished by the numerous hydrides of boron; *e.g.*, diborane, $H_2BH_2BH_2$ (whose formula is so written to indicate the two bridging hydrogen atoms); penta-

TABLE I.—*Properties of Primary Hydrides (Selected From Literature)*

Formula	Description	Density g./c.c. (liquid or solid)	Reaction with humid air and water at room temperature: Air	Reaction with humid air and water at room temperature: Water	Heat of formation (kg.cal./mol. H_2)	Approximate dissociation pressure of MH_n in cm. of mercury (T = ° K.): 200° C.	Approximate dissociation pressure of MH_n in cm. of mercury (T = ° K.): 500° C.
LiH	white cubic crystals resembling NaCl.	0.778	mod. slow	rapid	−42	$\log P = -9337/T + 10.131$	
NaH		1.36	rapid	violent	−27	$\log P = -5700/T + 2.5 \log T + 2.956$	
KH	LiH melts with marked expansion at 686° C., others undetermined	1.43	inflames	violent	−28	$\log P = -5870/T + 2.6 \log T + 2.895$	
RbH		2.60	inflames	violent	−24	$\log P = -5680/T + 10.80$	
CsH		3.41	inflames	violent	−20	$\log P = -5900/T + 10.79$	
CaH_2	white crystals, ortho.	1.9	mod. fast	rapid	−46	$\log P = -7782/T + 8.07$	
SrH_2	crystals, ortho.	3.27	mod. fast	rapid	−42	$\log P = 10{,}400/T + 10.1$	
BaH_2	crystals, ortho.	4.15	rapid	rapid	−41	$\log P = 6{,}450/T + 7.20$	
LaH_3	metallic gray powder	—	rapid	rapid	$-30(LaH_{2.76})$	—	—
CeH_3	metallic black powder	5.4	pyrophoric	slow	$-31(CeH_{2.7})$	—	—
TiH_2	metallic powder, cubic	3.75	none	none	−20	$\log P = -10{,}630/T + 3.6$	
ZrH_2	metallic powder, tet.	5.47	none	none	−39	$10(ZrH_{1.93})$	$\sim 100(ZrH_{1.92})$
HfH_2	metallic powder, tet.	11.7	none	none	—	—	—
ThH_2	metallic powder, tet.	9.19	very slow	slow	—	$\log P = -7{,}700/T + 8.54(ThH_2)$	
VH	metallic powder, tet.	5.1	none	slow	—	$76(VH_{.4})$	$76(VH_{.2})$
NbH	metallic powder, ortho.	7.64	slow or none	none	—	$76(NbH_{.8})$	$76(NbH_{.4})$
TaH	black metal, ortho.	15.2	none	none	—	—	$76(TaH_{.2})$
UH_3	black powder, cubic	10.5	pyrophoric	moderate	−21	$\log P = -4500/T + 8.28$	
PuH_3	black powder	—	very slow	none	−4.4	$250(PuH_{2.8})$	very high
PdH	black powder, cubic	10.5	very slow	none	−17.7	$912(PdH_{.6})$	?
CuH	brown powder, hex.	6.4	rapid	slow	+5(?)	irreversible	
BeH_2	white powder	0.57	slow	slow	—	irreversible above 250° C.	
MgH_2	white powder, tet.	1.42	mod. rapid	mod. rapid	—	irreversible in part	
ZnH_2	white powder	—	—	—	—	irreversible above 25° C.	
B_2H_6	colourless gas, foul odour	liq. 0.44 (−112° C.)	explosive	moderate	+8.7	irreversible decomposition above 50° C.	
B_4H_{10}	colourless gas, foul odour	liq. 0.59 (−70° C.)	explosive	slow	—	irreversible decomposition	
B_5H_9	colourless gas, foul odour	liq. 0.61 (0° C.)	burns	rapid	—	irreversible decomposition	
$B_{10}H_{14}$	colourless needles, rhombic	0.94	very slow	very slow	—	irreversible decomposition	
AlH_3	white microcrystal. (etherate $AlH_3.\frac{1}{3}Et_2O$)	1.1 app.	slow	moderate	—	irreversible decomposition above 100° C.	
Ga_2H_6	colourless liquid m.p. −21.4° C.	—	—	—	—	unstable at 100° C.	
InH_3	brown powder	—	—	—	—	unstable at 80° C.	
SiH_4	colourless gas, foul odour	b.p. −112° C.	explosive	rapid	−5.9	irreversible decomposition above 500° C.	
Si_2H_6	colourless gas, foul odour	b.p. −14.5° C.	explosive	rapid	—	irreversible decomposition above 400° C.	
GeH_4	colourless gas, foul odour	liq. 1.53 −142° C.	none	none	—	irreversible decomposition	
Ge_2H_6	colourless liquid	liq. 1.98 (−109° C.)	flashes	slow	~ −6	—	
$(GeH)_x$	brown powder	—	slow	slow		irreversible decomposition at 100° C.	
$(GeH_2)_x$	yellow powder	—	rapid	slow		irreversible decomposition at 120° C.	
SnH_4	gas	—	—	slow			
PbH_4	gas, very unstable	b.p. −13° C.	instant	?			
PH_3	colourless, gas, poisonous	liq. 0.74 (−90° C.)	pyrophoric	very slow	+4		
AsH_3	colourless gas, poisonous	b.p. −55° C.	moderate	very slow	+28.6		
SbH_3	colourless gas, poisonous	liq. 2.26 (−25° C.)	rapid	very slow	+23.2		
BiH_3	gas	b.p. −22° C. (unstable)	slow	very slow	+2.2	unstable at 25° C	

TABLE 11.—*Properties of Selected Secondary Hydrides*

Formula	Description	Decomposition temperature (*in vacuo*)	Reaction with humid air and water: Air	Reaction with humid air and water: Water	Heat of formation kg.cal./mol.	Appreciably soluble in
$LiBH_4$	white crystals, d = 0.666, ortho.	280° C.	rapid	vigorous	−44.1	diethyl ether lower amines ice water [water]
$NaBH_4$ KBH_4	white crystals: d. = 1.078, cubic	350° C.	slow very slaw	slow very slow	−43.8 −58	[water] isopropylamine isopropylamine
$LiAlH_4$	white microcrystals, d = 0.94	120° C.	rapid	violent	−24.1	liquid ammonia diethyl ether tetrahydrofuran
$(CH_3)_4NBH_4$	white crystals, d = 0.813	150° C.	slow	very slow	—	methyl cellosolve water
$Al(BH_4)_3$	colourless liquid, b.p. 45° C. d = 0.54	20° C. (very slow) vapour stable at 60° C.	explosive	explosive	− 72	lower ethers (forms etherates)
$Mg(BH_4)_2$	white powder	above 200° C.	very slow	violent	—	lower ethers
$Be(BH_4)_2$	colourless crystals, v.p. 8 mm. 25° C.	above 200° C.	explosive	explosive	—	lower ethers (forms etherates)
$NaBH(OCH_3)_3$	white powder	above 110° C.	rapid	vigorous	—	lower amines
$(CH_3)_2SiH_2$	colourless gas, b.p. −20° C.	above 150° C.	very slow	slow	—	[ethers]
$(SiH_3)_2O$	colourless gas, b.p. −15.2° C.	—	slow	slow	—	[ethers]
$(CH_3)_2GaBH_4$	liquid m.p. 15° C.	below 25° C.	rapid	violent	—	[ethers]
$Th(BH_4)_4$	white crystals, d = 2.50	over 200° C.	slow	rapid	—	ethyl ether

borane, B_5H_9; decaborane, $B_{10}H_{14}$; etc. Such hydrides burn with evolution of considerably more energy than provided by carbonsceous fuels and are of interest as high-energy fuels for rockets. Alurninum and possibly copper and beryllium hydrides belong in the polymeric category. All of these hydrides are nonconductors and may be solid, liquid or gaseous. All are thermally unstable and some explode on contact with air or moisture.

4. Covalent-volatile: hydrides in which the bonds are evidently normal covalent bonds without strong residual affinities. Examples are: silane, SiH_4; arsine, AsH_3; germane, GeH_4; aluminum borohydride, $Al(BH_4)_3$; and digermane, Ge_2H_6. These hydrides are volatile, thermally unstable and usually possess a strong odour. Some are exceptionally toxic, *e.g.*, AsH_3, and others may ignite on contact with air or moisture, *e.g.*, $Al(BH_4)_3$.

The above classification is not rigid and in some cases the distinctions made are a matter of degree, *e.g.*, $LiBH_4$ and $Al(BH_4)_3$, rather than of intrinsic differences. Many families of compounds, such as chlorides, for example, may be similarly differentiated. The reason for the existence of the four categories may be interpreted on the basis of three properties of the metal atom: ionization potential (a measure of the ease with which the atom may lose an electron), number of bonding electrons and number of unfilled energy levels. Two other factors are also involved: the cohesive energy (a measure of the cohesiveness of a metal) and the radius of the metal atom and ion.

Hydrides may also be classed as primary or binary, *i.e.*, one metal and hydrogen such as BaH_2, or as secondary, double or complex, *i.e.*, containing more than one metal or metalloid and hydrogen, such as $NaBH_4$. The term double hydride is best applied to compounds or solid solutions of hydrides in each other such as $ZrNiH_3$ or $CaH_2.xBaH_2$ where the hydrogen is not necessarily associated with only one of the metal atoms. Various atoms or groups may be substituted in part for hydrogen giving substituted hydrides such as dimethyl aluminum hydride, $(CH_3)_2AlH$; dichloroaluminum hydride, Cl_2AlH; sodium trimethoxyborohydride, $NaB(OCH_3)_3H$; etc.

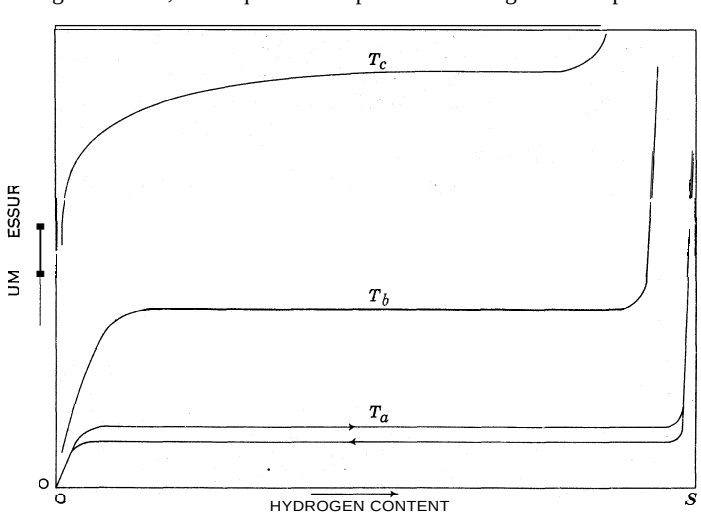
Hydrides.—Lithium borohydride reacts vigorously with water, yielding approximately 4 l. of hydrogen per gram of borohydride. (Half of this hydrogen comes from the water.) Advantage has been taken of this property of several hydrides in the design of portable hydrogen generators for military purposes or use in remote areas. All of the hydrides are reducing agents and several find widespread use for this reason. Thermal dissociation to the metal and hydrogen may be utilized, in the case of volatile hydrides, as a means of depositing metal films or preparing pure metals for use in transistors, etc.

Properties of a number of hydrides are summarized in Table I and Table II which have been compiled from many sources. The heats of formation (col. 6) are rounded off and for the most part are for compositions less than stoichiometric (whole-number ratio of atoms). Where these compositions are known they are indicated in parentheses. Note that in Table I heats of formation are given per molecule of hydrogen contained and in Table II per molecule of compound.

In most cases solid binary hydrides decompose before melting. An exception is lithium hydride which may be melted under hydrogen at 688° C. with a small change in dissociation pressure and electrical conductivity but a large increase in volume. The solid secondary hydrides usually melt at or slightly above the decomposition temperature; *e.g.*, $LiAlH_4$ about 150° C., $LiBH_4$ about 280° C. Some, such as $Be(BH_4)_2$ and $Al(BH_4)_3$, show less ionic and more covalent character and melt well below the temperature of rapid decomposition. The covalent hydrides show normal melting points for the most part. Metallic hydrides are all decomposed before melting, although at the melting point of the metal considerable hydrogen may be reabsorbed.

Saline binary hydrides are insoluble in conventional solvents, including liquid ammonia. They dissolve in fused halides, carbides and, in the case of the alkali hydrides (not LiH), in fused hydroxides. These hydridei are somewhat denser than the parent metals. The metallic hydrides, which are less dense than the parent metals, show typical metallic solubilities, the solvent metal either increasing or decreasing the hydrogen content. Metallic hydrides are wet by mercury and may disperse therein (F. H. Spedding, 1944; A. R. Ubbelohde, 1950). No general rules are formulated concerning solubility of other classes of hydrides.

Dissociation **of Hydrides.**—The thermal dissociation of binary saline and metallic hydrides is generally reversible, whereas polymeric, covalent and secondary hydrides usually decompose irreversibly on heating. Reversible dissociation implies a pressure- and temperature-dependent equilibrium between hydrogen and the solid phases (figure) whereas irreversible dissociation implies only a more or less characteristic decomposition temperature where evolution of hydrogen first becomes noticeable (Tables I and II). In the case of reversible dissociation, the relation of temperature, pressure and hydrogen content has been found somewhat complicated by the fact that at certain magnitudes of these three variables a phenomenon known as hysteresis occurs. This is illustrated by isotherm T_a in the figure where the arrows indicate direction of changing hydrogen content. Thus when hydrogen is being absorbed, the equilibrium pressure at a given temperature



RELATION BETWEEN EQUILIBRIUM PRESSURE AND HYDROGEN CONTENT AT VARIOUS TEMPERATURES

The isotherms are in order of increasing temperature T_a, T_b, T_c. The hydrogen content ranges from zero to S where S is the limiting hydrogen content, usually an integer. Note that horizontal portions (plateaus) become shorter as the temperature increases. They disappear at some higher temperature called the critical temperature (not shown)

may be higher than when the hydrogen is being desorbed during the measurement.

The reversible dissociation of hydrides is found to follow, over short temperature intervals, the relation: $\log P = -A/T + b$ where P is dissociation pressure, T absolute temperature and A and b are constants. A more general relation (C. E. Messer, 1953) is: $\log P = \log P_1 + 2\log\left(\frac{n}{c-n}\right) + W/T\left(\frac{2n}{S} - 1\right)$ where P_1 and W are constants, n is the hydrogen-to-metal ratio and S is a parameter which varies slightly with T. It mill be observed in curves T_a, T_b and T_c of the figure that over certain regions of composition the equilibrium pressure is independent of composition. Values of dissociation pressures in such plateau regions are more meaningful than in those regions near the limiting composition where the pressure changes rapidly with composition. A similar interpretation of the curves shown based on hydrogen-hydrogen-lattice site interaction rather than on phases has been suggested (R. M. Barrer, 1948; J. R. Lacher, 1937; A. Harasima et *al.*, 1947; G. Libowitz, 1957).

The dissociation pressure of saline deuterides is usually greater than that of corresponding hydrides at a given temperature (E. F. Sollers and J. L. Crenshaw, 1937).

Reactions and Uses.—In general the chemical behaviour of the saline primary hydrides is similar to that of the metal element. These hydrides all burn vigorously in air and react rapidly with water and less rapidly with alcohols, according to the equation: $MH + HOH \longrightarrow MOH + H_2$ or $MH_2 + 2H_2O \longrightarrow M(OH)_2 + 2H_2$

The hydrogen so evolved is not in as active a condition as that evolved by the parent metals (*e.g.*, sodium) with water, and primary saline hydrides are correspondingly less active reducing agents than the metals. At elevated temperatures where dissociation occurs, the binary saline hydrides show reducing properties. Potassium hydride reduces carbon dioxide to potassium formate at 225° C. (H. Moissan, 1902). Calcium hydride reduces refractory oxides to metals (titanium, zirconium, uranium, etc.) at about 600° C. (F. M. Perkin, 1907; P. P. Alexander, 1936) where it is slightly dissociated, and reduces sulfates to sulfides (W. E. Caldwell and F. C. Krauskopf, 1930). Sodium hydride is a condensing agent for Claisen and related condensations (V. L. Hansley, 1940). It has been used as a hydrogenation catalyst (A. M. Muckenfuss, 1935).

Sodium, calcium and lithium hydrides have been used for generation of hydrogen by reaction with water. Sodium hydride in molten sodium hydroxide has been used for removing oxide scale from iron and steel.

In general the saline secondary hydrides are powerful reducing agents. Lithium aluminum hydride (discovered by H. I. Schlesinger and A. E. Finholt, 1947) has been widely used for the reduction to alcohols of such compounds as organic acids, esters, anhydrides, amides, nitriles, aldehydes, ketones, etc. (W. G. Brown and R. F. Nystrom, 1947). Examples of such reactions are the following:

$$NaH + CH_2(COOC_2H_5)_2 \rightarrow H_2 + NaCH(COOC_2H_5)_2$$

$$NaBH_4 + 4(CH_3)_2CO \rightarrow [(CH_3)_2CHO]_4NaB \xrightarrow{2H_2O} 4(CH_3)_2CHOH + NaBO_2$$

$$2LiAlH_4 + CH_3CH_2COOCH_3 \rightarrow (CH_3CH_2CH_2O)_4LiAl +$$

$$(CH_3O)_4LiAl \xrightarrow[HCl]{aq.} LiCl + AlCl_3 + 4CH_3CH_2CH_2OH + 4CH_3OH$$

$$LiAlH_4 + 2CH_3CN \rightarrow (CH_3CH_2N)_2LiAl \xrightarrow[HCl]{aq.} 2CH_3CH_2NH_2 + LiCl + AlCl_3$$

$$LiAlH_4 + 4CH_2{=}CH - CH_2I \longrightarrow 4CH_2{=}CH - CH_3 + [LiAlI_4]$$

The solubility of lithium aluminum hydride in ethers or ether-benzene mixtures greatly increases its utility. Compounds such as quinones, Schiff bases, disulfides, acetylenes, aromatic condensed ring systems, nitrocompounds, alkyl halides, alkylhalosilanes, epoxides, sulfonic acids, sulfonylhalides, pyridine derivatives, etc., have been reduced. Carbon to carbon double bonds are unaffected unless conjugated with a carbonyl and phenyl group. Lithium borohydride is a similar but less powerful and versatile reducing agent. It is, however, soluble both in ethers and in primary amines which latter react with lithium aluminum hydride. Sodium borohydride (Schlesinger and H. C. Brown, 1945) has been used in aqueous solution for the reduction of aldehydes and ketones to alcohols (S. W. Chaikin and W. G. Brown, 1949). Sodium trimethoxyborohydride has also been used for the latter reductions (I. Sheft, 1944) and lithium tri-t-butoxyaluminum hydride for reduction of acid chlorides to aldehydes (H. C. Brown, 1956). Sodium borohydride in aqueous solution reduces many metal ions to free metals or borides. The reaction of this hydride with water is catalyzed by nickel or cobalt salts (presumably via the colloidal metals or borides) and by boric acid (H. R. Hoekstra, 1945). The latter combination has been used for hydrogen generation. Lithium borohydride reacts vigorously with water, often inflaming. If the reaction is adiabatic, nearly 14 l. of steam and hydrogen at 100° C. may be produced by 1 g. of the hydride.

Diborane and other dimeric and polymeric hydrides are, for the most part, active reducing agents. Diborane is exceptionally reactive and frequently yields substitution as well as reduction products. Aluminum hydride when freshly prepared acts in the same general fashion as lithium aluminum hydride. Both diborane and aluminum hydride have been decomposed thermally to produce coatings of boron and aluminum on heated objects. Aluminum has been electrodeposited from an ethereal solution of aluminum chloride containing aluminum hydride (D. E. Couch, 1951; A. Brenner, 1956).

The metallic hydrides react, in general, as expected from the independent properties of their components. The hydrogen obtained via aqueous attack is reactive at least in part and will effect reductions comparable to those obtained by dissolving metals in dilute acids. The hydrogen obtained by thermal dissociation is highly active as in the case of the saline hydrides. Several of the metallic hydrides are hydrogenation catalysts; *e.g.*, TiH_2, Pd_2H, ZrH_2. Metallic hydrides find uses in powder metallurgy and for the preparation of metal sponge.

Most of the covalent hydrides are relatively mild reducing agents. The instability of many members of this class makes their study difficult. Bismuth, lead and tin have been deposited in specular form by decomposition of the hydrides at or above room temperature (F. Paneth, 1925). Germanium hydrides have been studied in greater detail (C. A. Kraus, 1949).

Preparation. — The most general method for preparing binary hydrides was first described in 1811 (J. L. Gay-Lussac, L. J. Thénard). It consists of heating a metal in pure hydrogen until absorption occurs, then cooling slowly. All of the binary saline and metallic hydrides may be prepared in this way, although agitation of the reaction mixture is required in the case of sodium and potassium hydrides and hydrogen at high pressure is required for magnesium hydride. Beryllium hydride has not been prepared by this method. Nearly all of the binary hydrides may be made by the action of atomic hydrogen, generated in a glow discharge, upon the metals or metal alkyls, etc. (Paneth, 1922; Schlesinger, 1931; E. Pietsch, 1933). This method is claimed to yield hydrides of tin, lead, bismuth, polonium, gallium. beryllium, thorium, silver, gold, thallium, tantalum, copper and boron.

Reduction of metal oxides or halides at high temperature by calcium, calcium hydride, magnesium or aluminum in the presence of hydrogen has been used to prepare many hydrides; *e.g.*, LiH, CaH_2, ZrH_2, TiH_2 (Alexander, 1936). This method may be employed even for thermolabile volatile hydrides, *e.g.*, B_2H_6, if these are removed rapidly from the reaction zone by a stream of hydrogen (D. T. Hurd, 1949).

Hydrogen evolved at the cathode during electrolysis of aqueous solutions is also active and has been reported to combine with many cathode metals. This method is useful for the preparation of most metallic hydrides but is obviously unsuited to the preparation of water-reactive types. Many metals which do not form true hydrides may be supersaturated with hydrogen when used as cathode metals, mechanical disintegration sometimes occurring as a result. The plating of metals at potentials where hydrogen is also discharged usually leads to absorption of hydrogen. Thus freshly

deposited chromium contains many times its own volume of hydrogen.

Hydrolysis of borides, silicides, germanides by water, aqueous acids or nonaqueous acids, *e.g.,* ammonium bromide (liquid ammonia), has been used for the preparation of boranes, silanes and germanes (F. Jones, 1878; A. Stock, 1917; Hurd, 1947). Copper hydride has been made by reduction of aqueous copper sulfate solutions with hypophosphite (A. Wurtz, 1844).

One of the most elegant and versatile methods of preparing hydrides involves the use of alkali metal hydrides as starting reagents (Schlesinger, Finholt and H. C. Brown, 1946). Lithium aluminum hydride is prepared by reacting finely powdered lithium hydride with aluminum chloride in ethereal solution. Sodium borohydride is prepared without a solvent by reacting sodium hydride with methyl borate at 260° C. An excess of methyl borate yields sodium trimethoxyborohydride. In each case the product is leached away from the insoluble by-product:

$$4LiH + AlCl_3 \rightarrow 3LiCl + LiAlH_4$$
($NaAlH_4$, $LiGaH_4$, B_2H_6 similarly)

$$4NaH + B(OCH_3)_3 \rightarrow 3NaOCH_3 + NaBH_4$$

From these two hydrides many others may be prepared by metathetical reactions; *e.g.:*

$$NaBH_4 + LiCl \xrightarrow{\text{amine}} NaCl + LiBH_4$$

$$3NaBH_4 + AlCl_3 \xrightarrow{\text{heat}} 3NaCl + Al(BH_4)_3$$

$$NaBH_4 + 4BF_3 \xrightarrow{\text{ether}} 3NaBF_4 + 2B_2H_6$$

$$NaBH_4 + SnCl_4 \xrightarrow{\text{aq.}} [NaBCl_4] + SnH_4$$

$$LiBH_4 + (CH_3)_4NF \xrightarrow{\text{water}} LiF + (CH_3)_4NBH_4$$

$$LiAlH_4 + MX_n \xrightarrow{\text{ether}} LiAlX_4 + MH_n$$
(B_2H_6, AlH_3, SiH_4, GeH_4, SnH_4, AsH_3, SbH_3, etc., similarly)

$$LiAlH_4 + MR_n \rightarrow LiAlH_3R + MH_n$$
(BeH_2, MgH_2, ZnH_2, CdH_2, HgH_2 similarly)

The latter two equations are schematic, X represents halogen, R represents an alkyl group (*e.g.,* methyl) and M is a metal or metalloid atom. Borohydrides of titanium, thorium, etc., have been prepared from the halides and aluminum borohydride (Hoekstra and J. J. Katz, 1948). Aluminohydrides and galliohydrides have been prepared by reacting alkali metal hydrides with the respective alkyls, and several borohydrides may be prepared directly from diborane, *e.g.:*

$$NaH + B(C_2H_5)_3 \rightarrow NaBH(C_2H_5)_3$$

$$ZnH_2 + B_2H_6 \rightarrow Zn(BH_4)_2$$

$$2Ga(CH_3)_3 + 3B_2H_6 \xrightarrow{-45°} 2(CH_3)_2GaBH_4 + 2B_2H_5CH_3$$

The preparation and structure of many substituted boron hydrides, especially amino derivatives, have been studied (A. B. Burg, 1950), including such compounds as $Na_2HB(CH_3)_2$, $[(CH_3)_2PBH_2]_3$, $(CH_3)_3PBH_3$, etc. Borazole, $B_3N_3H_6$, is the parent substance of a number of related compounds (Schlesinger, 1950). See also ADSORPTION; BORON; HYDROGEN; SILICON.

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HYDROCARBON, in chemistry, a compound of carbon and hydrogen. Many occur in nature. Petroleum is mainly composed of such compounds; they are present also in the volatile essential oils of plants and in some plant pigments. Familiar examples of the artificial production of hydrocarbons are: (1) the distillation of coal, which yields town gas and coal tar (*q.v.*), both largely composed of hydrocarbons; (2) the hydrogenation of coal under pressure; (3) the formation of petroleum spirit by high temperature and catalytic "cracking" of high-boiling petroleum distillates; and (4) the formation of acetylene by the action of water on calcium carbide. Acetylene is used, not only for welding, but also as an important raw material for the manufacture of solvents, plastics and artificial rubber. For details reference should be made to the articles wherein the above subjects are treated. From the chemical standpoint the hydrocarbons are of fundamental importance because of their variety of types and their great number, and still greater number of derivatives. *See* CHEMISTRY: *Organic;* CARCINOGENIC CHEMICALS. (J. W. CK.)

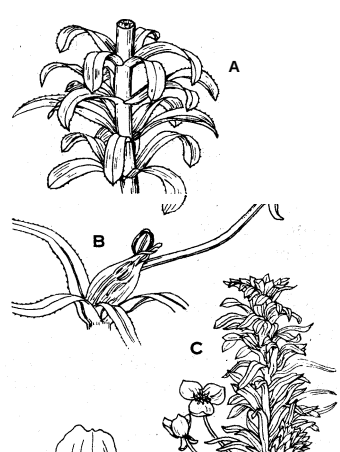
HYDROCELE, the medical term for any collection of fluid other than pus or blood in the neighbourhood of the testis or cord. The fluid is usually serous. Hydrocele may be congenital or arise in the middle-aged without apparent cause. The hydrocele appears as a rounded, fluctuating translucent swelling in the scrotum, and when greatly distended causes a dragging pain. It may be treated and cured by surgical procedures.

HYDROCEPHALUS is a condition, either developmental or acquired, in which there is an abnormal accumulation of the body fluids within the skull. The congenital form is often associated with other developmental anomalies of the spine and spinal cord. The acquired variety usually results from some inflammatory disease such as meningitis, but may occur also as a result of tumours and other obstructions. The immediate cause of hydrocephalus is some interference with the circulation of the fluids in and around the brain. Two varieties are often mentioned, internal and external. In the former the ventricles of the brain become more or less distended with cerebrospinal fluid, which compresses the brain and interferes with its function. In the latter fluid accumulates in the arachnoid spaces on the outer aspect of the brain; this also compresses the brain.

The two varieties are frequently combined. In most instances the condition is progressive, associated with enlargement of the head and separation of the sutures and fontanels of the skull; mental retardation also results. The shape of the face and head, sometimes referred to as Marshall Hall's facies. is characteristic.

When a fetus is afflicted with this disorder, the size of the head may cause serious complications of labour. The condition, however, can be recognized during the prenatal period by X-rays and other diagnostic means, and the situation handled satisfactorily so far as the mother is concerned.

No medical or radiologic treatment is of benefit. except in those cases in which the condition results from a radiosensitive tumour. Various methods of surgical treatment have been tried, with a certain amount of success. (F. L. A.; X.)



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ELODEA DENSA: (A) STEM WITH WHORLS OF LANCEOLATE LEAVES, SHOWING THEIR MINUTELY SERRATE MARGINS, REDUCED TO $\frac{3}{5}$ NATURAL SIZE; (B) SPATHE AND THE FLOWERS, $\times\frac{3}{4}$; (C) HABIT, SHOWING LONG-PEDUNCLED STAMINATE FLOWERS. $\times\frac{1}{4}$; (D) STAMINATE FLOWER, NATURAL SIZE

HYDROCHARITACEAE, a family of chiefly aquatic plants belonging to the order Hydrales

(Butomales) and including such commonly cultivated aquarium plants as the water weed or water thyme (Elodea), eelgrass (*Vallisneria*), frogbit (*Hydrocharis* and *Limnobium*) and water soldier (Stmtioides). The plants are rooted in mud, sometimes becoming free-floating. The leaves are diverse; they are either basal and wholly submersed or with blades emersed, or bladeless and borne in whorls along the stem and wholly submerged.

The flowers are enclosed in a spathelike structure in the leaf axils. regular. usually unisexual with the sexes on different plants, rarely in the same flower. The male flowers number one to several in a spathe, the female ones are usually solitary. The perianth is in two or one series, the outer series three. rarely two. green, not overlapping, the inner three, two or none, overlapping in bud and petallike, often borne on an elongate tubelike extension of the receptacle (hypanthium). The number of stamens may range from three to many. The ovary is inferior (below the perianth and stamens) and is one-celled with several seeds on the ovary wall. The fruit is leathery.

This is a family of plants of diverse habit held together by the inferior ovary, spathelike involucre and elongate tubelike receptacle and parietal placentation.

See John Hutchinson. *Families of Flowering Plants,* vol. ii. pp. 22–32 (1926–34); H. L. Mason, *Flora of* the *Marshes oj California,* pp. 119–123 (1957). (H. L. MN.)

HYDROCHLORIC ACID AND HYDROGEN CHLORIDE. Hydrogen chloride. a compound containing the elements hydrogen and chlorine, is a gas under ordinary conditions. The name hydrochloric acid was formerly applied to both the gas and its solution in water, but later practice favours the restriction of the term hydrochloric acid to the aqueous solution.

Hydrogen chloride and hydrochloric acid, like coal tar, were considered troublesome waste products before they became industrially important. In the 19th century manufacturers of soda ash, under attack because of the noxious fumes discharged from their chimneys. worked out a process for converting it into liquid form; the resultant hydrochloric acid was dumped at sea until a method was found for utilizing it in the manufacture of chlorine, which was much in demand for bleaching.

Hydrochloric acid is present in the digestive juices of the human stomach. Excessive secretion of the acid causes gastric ulcers; a marked deficiency of it impairs the digestive process and is sometimes the primary cause of deficiency anemias. (See GASTRIC AND DUODENAL ULCER; ANEMIA.)

The acid was first mentioned by Johann Rudolf Glauber in 1648, while the gas was first prepared by Joseph Priestley in 1772. The composition of hydrogen chloride was elucidated by Sir Humphry Davy in 1810. Having first shown that chlorine is an elementary substance, Davy demonstrated that hydrogen chloride contains only hydrogen and chlorine, for, on causing the gas to react with sodium and potassium. he obtained only hydrogen and the chloride of the metal. Previously the gas. then known as muriatic acid, was assumed by Claude Louis Berthollet and Antoine Lavoisier to contain oxygen.

Annual production of hydrochloric acid in the United States at mid-20th century was about 350.000 short tons (basis 100% HCI). By-product hydrochloric acid from chlorination of organic materials accounted for 55% of the total; 25% was produced from salt and 20% from chlorine. Principal uses of hydrochloric acid were as follows: activation of oil wells 30%; chemical production 23%; metal production 13%; food industries 12%; metal and general cleaning 10%; miscellaneous 12%.

Preparation — Hydrogenchloride may be formed by the combination of chlorine and hydrogen with no change in volume: $H_2 + Cl_2 = 2HCl$. The reaction is accompanied by the evolution of 22 kilocalories of heat per gram mol of HCl and the compound is stable. being only 0.2% decomposed at 1.j50° C. A mixture of hydrogen and chlorine may be kept at room temperature without apparent reaction. Exposure to sunlight causes an explosive reaction which also occurs when the gases are heated to 250° C. The reaction appears to be hastened by moisture. With well-dried gases it has been found that only 80% reacts in ten minutes at 450° C. A stream of burning hydrogen continues to burn with a steady flame in chlorine and vice versa. The reaction may be brought about also by igniting the two gases after they are brought together in a blow torch.

Hydrogen chloride is prepared both on a laboratory and on an industrial scale by the reaction of a chloride, generally that of sodium, with concentrated sulfuric acid. At moderate temperatures only half of the hydrogen from the sulfuric acid reacts, hydrogen chloride is evolved and a residue of sodium bisulfate remains: $NaCl+H_2SO_4=NaHSO_4+HCl$. At a temperature of 500° C., two molecules of hydrogen chloride per molecule of sulfuric acid may be obtained, the residue being sodium sulfate (salt cake) $2NaCl + H_2SO_4 = Na_2SO_4 + 2HCl$. This reaction, which mas employed in the Le Blanc process for the manufacture of sodium carbonate (see ALKALI MANUFACTURE), provided more hydrogen chloride than could be utilized as hydrochloric acid and much of it was consumed in producing chlorine. With the advent of cheaper chlorine (*q.v.*) the relative positions of chlorine and hydrochloric acid were reversed and considerable hydrochloric acid thereafter was made from chlorine.

Hydrogen chloride is produced by the hydrolysis (see SOLUTIONS) of some chlorides. Phosphorus trichloride hydrolyzes completely at room temperature ($PCl_3 + 3H_2O = H_3PO_3 + 3HCl$) to phosphorous acid and hydrogen chloride. At elevated temperatures magnesium chloride is hydrolyzed by steam ($MgCl_2 + H_2O = MgO + 2HCl$). A convenient way to prepare hydrogen chloride gas in the laboratory is to drop concentrated hydrochloric acid into concentrated sulfuric acid. Hydrogen chloride is also a by-product of the chlorination of many organic substances and this has become an important source.

Hydrochloric acid is prepared by dissolving gaseous hydrogen chloride in water. The solubility of the gas is less at higher temperatures and consequently provision must be made to remove the considerable amount of heat produced when the gas dissolves. Because of the corrosive nature of the acid, ceramic or glass apparatus is commonly used. Tantalum is the most resistant of the metals to corrosion in the presence of hydrochloric acid and, although expensive, is employed to some extent. Pure hydrochloric acid is colourless. The yellow colour of some commercial products is caused by iron and other impurities. Hydrochloric acid is usually marketed as a solution containing 28%–36% hydrogen chloride by weight (18–22 Baumé) commonly known as concentrated hydrochloric acid. The concentration of hydrochloric acid may be approximately calculated by subtracting 1.00 from its specific gravity and multiplying the remainder by 200. For example, hydrochloric acid of specific gravity 1.10 contains $200\times.10=20\%$ by weight of HCl. Anhydrous liquid hydrogen chloride in steel cylinders is available. but because the vapour pressure is about 50 atm. at ordinary temperatures, heavy and expensive containers are required and the use of hydrogen chloride in this form is limited.

Properties. — Hydrogen chloride has a molecular weight of 36.465. It is a colourless gas of strong odour; at 0° C. and 1 atm., weighing 1.639 gr. per litre. The boiling point is −85° C., the freezing point −114° C., the critical temperature is 52° C. and critical pressure 90 atm. Deuterium chloride (DCl) has similar properties but its boiling point is 3° lower and its freezing point 1° lower (*see* DEUTERIUM). The heat, capacity at constant pressure at T° Kelvin is $6.70-0.84\times10^{-3}T$ cal. per g. mol. At 25° C. the free energy is −22.690 cal./mol., the entropy 44.5 cal./mol./degree. The gas is very soluble in water, at 20° C. water will dissolve 477 times its own volume of hydrogen chloride. Because of its great solubility the gas fumes in moist air, forming a mist of hydrochloric acid. The solubility does not follow Henry's law. While at 20° C. hydrogen chloride at 760 mm. pressure is in equilibrium with a solution 42% HCl by weight, the pressure is less than 0.1 mm. over a 15% solution. The solution of one mole (36.465 g.) of gaseous hydrogen chloride in a large amount of water is accompanied by the evolution of 17.63 kilocalories of heat. At 1 atm. a solution 20.24% by weight HCl has the maximum boiling point 110° C., and boils without change in composition. On boiling acids of either greater or less strength than the constant boiling mixture, the composition of the liquid

approaches 20.24%. Since the composition of the constant boiling, or azeotropic, mixture depends upon the atmospheric pressure, it is not considered a chemical compound. However, at low temperatures solid hydrates of hydrogen chloride may be crystallized from the concentrated solution. While liquefied hydrogen chloride and solutions of the gas in nonpolar liquids are extremely poor conductors of electricity, the aqueous solution is a good conductor. At 25° C., the equivalent conductance of tenth normal hydrochloric acid is 389.8, and the limiting equivalent conductance 426.1 reciprocal ohms. Thus. hydrochloric acid is a strong electrolyte. The extensive dissociation in aqueous solution is attributed to the formation of a hydrated hydrogen (hydronium) ion, $HCl + H_2O = H_3O^+ + Cl^-$, this reaction being essentially complete in dilute solution.

Gaseous hydrogen chloride reacts with active metals and their oxides, hydroxides and carbonates to produce chlorides. With ammonia gas it forms fumes of ammonium chloride, $NH_3 + HCl = NH_4Cl$. These reactions occur readily only in the presence of moisture. Completely dry hydrogen chloride is very unreactive. The reactions of hydrochloric acid are those of the hydrogen and chloride ions: both probably hydrated in solution. Some of the reactions of hydrochloric acid which may be attributed to the hydrogen ion are: reactions with metals in which hydrogen gas is displaced; *e.g.,* with zinc ($Zn + 2H^+ + 2Cl^- = H_2 + Zn^{++} + 2Cl^-$); with oxides or hydroxides which are neutralized with the formation of water; *e.g.,* with calcium hydroxide ($Ca[OH]_2 + 2H^+ + 2Cl^- = Ca^{++} + 2Cl^- + 2H_2O$); with salts of weak acids in which the weak acid is displaced: *e.g.,* with iron sulfide ($FeS + 2H^+ + 2Cl^- = Fe^{++} + 2Cl^- + H_2S$). Some of the many uses of hydrochloric acid as a laboratory reagent, *e.g.,* the preparation of metallic chlorides, hydrogen sulfide, sulfur dioxide and carbon dioxide, and the use of a standardized solution of hydrochloric acid in the volumetric determination of alkalis. are suggested by the examples above.

Exposure to as little as 0.1% by volume hydrogen chloride gas in the atmosphere may cause death in a few minutes, but concentrations of 0.001% to 0.005% may be tolerated for several hours without injury. Concentrated hydrochloric acid causes burns and inflammation of the skin, but dilute acid is relatively harmless. Chloride ion is. of course, harmless. being normally present to the extent of 0.25% in human blood and 0.1% to 0.2% as hydrochloric acid in the gastric juices.

The chloride ion is colourless, extremely stable in solution and only oxidized to chlorine by very strong oxidizing agents such as manganese dioxide, dichromate ion and permanganate ion. With manganese dioxide the reaction is: $MnO_2 + 2Cl^- + 4H^+ = Mn^{++} + Cl_2 + 2H_2O$. This and similar reactions also consume hydrogen ions and hence take place more readily in strongly acid solution.

The limiting equivalent conductance of the chloride ion in water at 25° C. is 76.3 reciprocal ohms. In crystals the chloride ion has a radius of 1.81 Å. Chlorides of the alkalis and alkaline earths possess the ionic type of crystal. with high melting points and low volatility. Passing toward the less metallic elements, the chlorides become more volatile and the bonding tends toward the covalent type. Sodium chloride boils at 1,465° C.. magnesium chloride at 1.418" C., aluminum chloride at 180° C.. and silicon chloride at 57° C. Chlorides are, with the exception of silver, mercurous. lead, cuprous and palladous chlorides, soluble in water. The chlorides of nonmetallic elements are, however, generally completely hydrolyzed in water. and many metallic chlorides such as aluminum chloride cannot be recovered in anhydrous condition from solution. On removal of water, hydrogen chloride formed by partial hydrolysis is also lost, hydrolysis becomes complete and only the oxide or hydroxide is obtained. A few chlorides such as bismuth chloride hydrolyze to insoluble basic chlorides; *e.g.,* BiOCl.

The chloride ion enters into many complex ions (see COORDINATION COMPOUNDS); *e.g.,* chloroplatinare ($PtCl_6^=$) and chloraurate ($AuCl_4^-$). Chloroplatinic acid. H_2PtCl_6, finds application in analytical chemistry because its potassium salt is one of the least soluble salts of that metal. The solubility oi cuprous chloride in hydrochloric acid, of gold in aqua regia (*q.v.*), and a number of other reactions are attributed to the formation of stable complex chloride-containing ions. For the same reasons, oxides which dissolve with great difficulty in other acids of equal strength dissolve readily in strong hydrochloric acid. Iron rust (ferric oxide) is readily dissolved by hydrochloric but no: by sulfuric or nitric acid. This reaction accounts for a large industrial use of hydrochloric acid, the cleaning of the surface of iron or steel preparatory to tinning. In industry large amounts of hydrochloric acid are used in preparing both organic and inorganic chlorides. (For chlorides of industrial significance see CHLORINE.)

Analytical.— Hydrochloric acid may be quantitatively determined by titration with a standard base or by the measurement of the amount of chloride present. For dilute solutions the hydrogen-ion (*q.v.*) concentration is also an adequate measure of the total acid (HCI) present. The chloride ion is determined gravimetrically by precipitation as silver chloride which is dried and weighed. It may be determined volumetrically by titration with a standard silver nitrate solution using potassium chromate as indicator (Mohr method); or by the addition of an excess of standard silver nitrate solution and titration of the excess silver ion by standard thiosulfate solution with ferric ion as indicator (Volhard method). Qualitatively, chloride ion is distinguished from bromide and iodide ions by the white colour of silver chloride, silver bromide and silver iodide being yellow-, and silver chloride is soluble in dilute ammonium hydroxide while the other two are not. A chloride also forms volatile brownish-red chromyl dichloride (CrO_2Cl_2) when heated with a dichromate and concentrated sulfuric acid; neither bromides nor iodides react in this nay.

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HYDROCORTISONE: see CORTISONE.

HYDROCYANIC ACID: see PRUSSIC ACID.

HYDRODYNAMICS, the branch of hydromechanics which deals with the motion of fluids (see MECHANICS, FLUID).

HYDROELECTRIC POWER GENERATION: see ELECTRIC POWER GENERATION: Hydroelectric *Generation.*

HYDROGEN is a gaseous element usually assigned to the first group of the periodic system. The hydrogen atom is the lightest of all atoms in weight; it consists of a nucleus with one unit of positive charge and one electron.

Hydrogen is present in almost all animal and vegetable matter, in compounds in which it is joined to carbon and other elements. In the form of hydrocarbons; it is a constituent of petroleum and coal and is contained in all acids. Some authorities believe that hydrogen compounds are more numerous than those of any other element, although until recently the precedence of carbon was generally accepted.

On the weight basis, hydrogen is the ninth most abundant element; the hydrogen content of the earth, including air and terrestrial waters as well as the earth's crust, is 0.9%. Hydrogen is found in the free state in gases irom volcanoes and fumaroles, and occluded in salt deposits, rocks and meteorites. It occurs in many stars, in comets and in the upper atmosphere. Spectroscopic examination indicates that hydrogen constitutes the bulk of the outer atmosphere of the sun; during total eclipse it is observed in the form of protuberances of incandescent gas reaching as far as 300,000 mi. into space.

The chemical atomic weight of hydrogen is 1.0080. Natural hydrogen as it occurs in combined form in water is a mixture of two isotopes (*q.v.*): hydrogen proper, also referred to as light hydrogen or protium (symbol H. ^1H or H^1) and deuterium (*q.v.*) or heavy hydrogen (symbol ^2H, H^2 or D). These two isotopes are present in the ratio of 5000:1 and have the chemical atomic weights of 1.0079 and 2.0142 respectively. Their nuclei are called proton and deuteron respectively. A third isotope of hydrogen. tritium (symbol ^3H, H^3 or T), occurs in nature only in minute amounts, but can be produced artificially. It is radioactive and has a half-life time of 12.5 years.

History. — It appears that Theophrastus Paracelsus in the 16th century had handled hydrogen, since he found that an inflammable gas was evolved when a metal was dissolved in an acid. However. hydrogen was then confused with other inflammable gases such as hydrocarbons and carbon monoxide. In 1766. Henry Cavendish showed that hydrogen, then called "inflammable air," phlogiston or the inflammable principle, was distinct from other combustible gases by measuring its density and the amount of gas evolved from a given amount of acid and metal. J. Warltire noticed in 1776 that water was formed when hydrogen was burned. In 1781 Cavendish confirmed this observation and Antoine L. Lavoisier coined the name hydrogen (Greek for "maker of water"). In 1929, on the basis of earlier theoretical work by P. M. Dennison. Karl F. Bonhoeffer and Paul Harteck showed that ordinary hydrogen is a mixture of two kinds of molecules, orthohydrogen and parahydrogen. In 1931, Harold C. Urey. Ferdinand G. Brickwedde and George M. Murphy discovered the heavy hydrogen isotope. Tritium was first 'prepared by Lord Rutherford, Marcus L. E. Oliphant and Harteck by the bombardment of deuterophosphoric acid with fast deuterons in 1935.

Uses of Hydrogen. — The first industrial use of hydrogen was the inflation of balloons by Jacques A. C. Charles in 1783. The barrage balloons used in England during World War II were filled with hydrogen. Hydrogen is used as fuel gas in the oxyhydrogen flame (see FLAME) in the production of synthetic gems. for melting and working of silica or quartz and of platinum, for lead burning and for autogeneous welding and cutting. However, in the latter application, hydrogen was being replaced by acetylene.

Hydrogen is the reducing agent in the manufacture of metallic tungsten and molybdenum and in the production of spongy iron for use in powder metallurgy. A hydrogen atmosphere is employed in the pouring of special castings, in the manufacture of magnesium, in the annealing of metals and for the cooling of large electric motors. Large quantities of hydrogen are used in the synthesis of ammonia, of methyl alcohol, in the Fischer-Tropsch synthesis (see below) and in the hydrogenation of various organic chemicals (*e.g.*, benzene, phenol, naphthalene) and of vegetable and animal oils and fats (in the production of margarine and vegetable shortening) and of coal (in the conversion to petroleumlike material). During World War II the major portion of Germany's petroleum requirement was produced by the latter process. Hydrogen is used to reduce aldehydes, fatty acids of esters to the corresponding alcohols and to manuiacture hydrogen chloride and bromide (see OXIDATION AND REDUCTION). A number oi petroleum refining processes are carried out in the presence of hydrogen, but usually in these processes, more hydrogen is formed than consumed. Liquid hydrogen is used in the laboratory to produce extremely low temperatures. Regarding the use oi hydrogen in the hydrogen bomb, see ATOMIC ENERGY.

Production of Hydrogen. — Hydrogen is prepared in the laboratory by the interaction of zinc and dilute acid, usually in Kipp's apparatus, according to the equation $Zn + 2H^+ = Zn^{++} + Hz$ or by the electrolysis of a dilute acid or alkali according to the equations: $2H^+ + 2e^- = Hz$, or $2Na^+ + 2e^- = 2Na$ and $2Na + 2H_2O = 2Na^+ + 2OH^- + Hz$. Hydrogen, used ior the first time industrially ior inflating a balloon, mas prepared by the reacting iron with sulfuric acid. With the military use of balloons a great many methods for producing hydrogen were devised that could be operated in the field and required relatively light raw material and equipment. After the advent of aircraft and the availability of helium as a balloon gas, these methods Iost their importance, although some of them (*e.g.,* the reaction between water and calcium hydride, the hydrolith process) were used during World War II to inflate weather balloons.

The steam-methanol process based on the decomposition reaction $CH_3OH + H_2O = 3H_2 + CO_2$ was also used by the armed forces for producing hydrogen in portable equipment. On an industrial scale, large amounts of hydrogen are produced by the reaction of steam and spongy iron at 650° C., $3Fe + 4H_2O = Fe_3O_4 + 4H_2$. The iron is recovered by reducing the iron oxide with water gas (*q.v.*), a mixture of hydrogen and carbon monoxide, $Fe_3O_4 + 2H_2 + 2C0 = 3Fe + 2H_2O + 2CO_2$. The cheapest source of hydrogen is water gas, from which carbon monoxide is removed by the water gas shift reaction $CO + H_2O \rightleftarrows CO_2 + H_2$ in the presence of a catalyst such as iron oxide containing some chromium oxide. In order to reduce the amount of carbon monoxide present at equilibrium, an excess of steam is used and the reaction is carried out at the lowest temperature, 400°–500° C., at which the reaction velocity is sufficiently high. The carbon dioxide thus formed is then washed out by water or another aqueous solution. The residual carbon monoxide is removed by scrubbing with a cuprous chloride solution or by repeating the water gas shift reaction or by reduction to methane.

By the interaction of methane (or other hydrocarbons) and steam ($CH_4 + 2H_2O \rightleftarrows CO_2 + 4H_2$ and $CH_4 + H_2O \rightleftarrows CO + 3H_2$) in the presence of a suitable catalyst (nickel) at 800°–900° C., a mixture of hydrogen, carbon monoxide and carbon dioxide is obtained. It is then treated as water gas. Hydrogen can also be recovered from water gas or coke oven gas by low temperature fractional distillation since its boiling point (−252° C.) is much lower than that of carbon monoxide (−191° C.) or of nitrogen (−195° C.). This method was extensively used in Germany prior to and during World War II. The thermal decomposition of hydrocarbons over heated brick checkerwork is a convenient method for producing hydrogen in cases when hydrocarbon gases are readily available (*e.g.,* refineries) and when the purity of hydrogen is of no great importance. The purest hydrogen (99.9%) is obtained by electrolysis oi alkaline water in cells specially built to permit separation of the hydrogen and oxygen, the yield being approximately 7 cu.ft. of hydrogen per kilowatt hour. Hydrogen is a by-product in the electrolytic manufacture of caustic alkali and chlorine (*q.v.*), in the butyl alcohol-acetone fermentation and in the refining of petroleum naphthas over platinum and similar catalysts to motor gasoline and to aromatic hydrocarbons. Industrial hydrogen must be specially purified for each particular use.

Orthohydrogen and Parahydrogen. — Hydrogen gas under normal conditions consists of molecules, each of which contains two atoms. The nuclear magnets (spins) of both protons are oriented in the same direction in orthohydrogen molecules. In parahydrogen molecules these magnets are oriented in opposite directions. The ortho molecules rotate with odd rotational quantum numbers while the para molecules rotate with even quantum numbers. Normally, conversions do not occur between ortho and para molecules and for this reason orthohydrogen and parahydrogen can be regarded as two distinct modifications of hydrogen. The equilibrium between orthohydrogen and parahydrogen can be readily established in the presence of catalysts (*e.g.,* charcoal at temperatures below −100° C. and platinized asbestos above −100° C.). The equilibrium concentration of parahydrogen depends on the temperature as shown by the following figures:

−253.1° C.....99.82%	−153.1° C.....32.87%
−223.1" C.....76.89%	0° C.. .....25.13%
−193.1° C.....48.39%	

Thus essentially pure parahydrogen can be produced by bringing hydrogen into contact with charcoal at the temperature of liquid hydrogen, while orthohydrogen cannot be prepared directly since the equilibrium concentration of parahydrogen does not fall below 25%, the amount present in normal hydrogen. Parahydrogen differs from normal hydrogen in its physical properties such as vapour pressure, boiling point, melting point, specific heat, heat conductivity and spectrum, but the two kinds of hydrogen are identical as far as chemical properties are concerned. Parahydrogen can be kept at room temperature without appreciable conversion for many months. At elevated temperatures, under the influence of electric discharges or in the presence of metals and paramagnetic substances, parahydrogen is converted to normal hydrogen. The interconversion of ortho- and parahydrogen is being used extensively for scientific investigations.

Atomic Hydrogen. — When hydrogen molecules are exposed to excessive heat, *e.g.,* contact with a white hot tungsten filament (Irving Langmuir, 1914), to an electric discharge (Robert W. Wood, 1921; Bonhoeffer, 1924), or to an electric arc, they dissociate into atoms. The atoms thus formed have a short lifetime that depends on the pressure (*e.g.,* 0.3 sec. at a pressure of 0.5 mm.Hg). Platinum, nickel and other metals destroy the activity of atomic or active hydrogen by catalyzing the recombination of the atoms. Atomic hydrogen reacts even at room temperature with hydrocarbons (except with methane) causing dehydrogenation, cracking and in the case of unsaturated hydrocarbons, hydrogenation.

It combines with sulfur, tellurium, phosphorus, arsenic, lithium, sodium, chlorine, bromine and other elements and reduces metallic oxides. Atomic hydrogen forms hydrogen peroxide with oxygen, a reaction which has found industrial application. The heat of recombination of the hydrogen atoms is utilized in the arc welding process of Langmuir.

Physical Properties. — Hydrogen is an odourless, colourless and tasteless gas. It is the lightest chemical element. For some physical properties of normal hydrogen and of parahydrogen see Table I.

Hydrogen has the highest heat conductivity and the highest coefficient of diffusion of all the gases. Hydrogen diffuses through porous substances such as clay and has the unique property of diffusing through rubber and, at elevated temperatures, through quartz and silica. It also diffuses through the metals of the nickel, palladium and platinum groups; diffusion is accompanied by the dissolution of hydrogen. Thus under certain conditions palladium can take up almost 900 vol. of hydrogen at 20° C. and atmospheric pressure. The diffusion of hydrogen through a palladium thimble is used in the laboratory to purify hydrogen. The standard electrode potential of hydrogen is zero according to a generally accepted convention.

Chemical Properties. — Hydrogen has chemical properties similar to those of the elements of Groups I and VII of the periodic systems. Combined with the electronegative halogens, hydrogen resembles the

TABLE I.—*Some Properties of Normal Hydrogen and Parahydrogen*

Density at 0° C., 760 mm. pressure	0.08987 g/l.
Buoyancy in air	1.203 g/l.
Melting point: normal hydrogen	−259.24° C.
parahydrogen	−259.28° C.
Boiling point: normal hydrogen	−252.78° C.
parahydrogen	−252.87° C.
Critical temperature	−239.91° C.
Critical pressure	12.8 atm.
Critical density	0.03102 g./ml.
Specific heat:	
gas at const. vol. 20°–100° C.	2.35 cal./g.
liquid at const. vol. −257.4° C.	1.77 cal./g.
solid at const. vol. −260.4° C.	0.536 cal./g.
Heat of evaporation	108 cal./g.
Heat of fusion	14.0 cal./g.
Heat conductivity at 0° C.	0.000413 cal./cm. sec. ° C.
Coefficient of expansion	0.00366
Pressure coefficient	0.0036627
Molecular diameter	2.5×10^{-8} cm.
Heat of dissociation	102.72 kg. cal./mol.
Heat of combustion, 20° C., 1 atm.	68.351 kg. cal./mol.
Ionization potential	13.527 v.

alkali metals since it forms positive ions on dissolution in water. In its compounds with the electropositive alkali metals (hydrides) hydrogen behaves as an electronegative element since it attracts an extra electron to form a negative ion. This ion is discharged at the positive anode on electrolyzing the molten hydride. In volatile hydrides hydrogen forms a nonionic covalent bond. The bond in all gaseous hydrogen halides is similar except in hydrogen fluoride. Hydrogen is univalent in all its compounds.

Under proper conditions, hydrogen combines directly with most of the lighter elements and many of the heavier elements. The reaction with fluorine to form hydrogen fluoride is very violent, even at −252° C. Mixtures of hydrogen and chlorine can react with explosive violence on irradiation or under the influence of a spark. Mixtures of hydrogen and oxygen react at a measurable rate only above 300° C. Such mixtures containing 4% to 94% hydrogen can ignite or explode when heated to 550°–600° C. or brought into contact with a catalyst, spark or flame. Especially violent is the explosion in detonating gas containing oxygen and hydrogen in the proportion 1:2. In air or oxygen, hydrogen burns with a nonluminous flame. With bromine, iodine, the alkali metals, alkaline earths, sulfur, etc., hydrogen reacts at elevated temperatures. Nitrogen and hydrogen form ammonia under pressure above 300° C. in the presence of a suitable catalyst. Carbon and hydrogen combine in the electric arc to form acetylene and they also form various other hydrocarbons in the presence of a catalyst at moderate temperatures. The dissolution of hydrogen by palladium and other metals is accompanied by the formation of hydrides. Hydrogen reduces the oxides of most metals, and some metallic salts, to the metals, especially at elevated temperatures and pressures. The reduction of an aqueous solution of a metallic salt (*e.g.*, palladium chloride) by hydrogen corresponds to the reverse reaction as it occurs in the dissolution of metals in acids. Which of these two reactions will occur depends on the standard electrode potential of the metals involved. All metals that have positive potentials measured on the hydrogen scale can displace hydrogen ions from a solution according to the general reaction $M+H^+=M^++\frac{1}{2}H_2$ while metals with negative potentials will be produced by reducing the corresponding metallic ions with gaseous hydrogen. In the presence of nickel or platinum catalysts, hydrogen combines with unsaturated organic compounds (*see* HYDROGENATION) and reduces certain oxygenated organic compounds to compounds containing less or no oxygen (*see* OXIDATION AND REDUCTION). Under high pressure and temperature, coal and similar material can be converted into petroleumlike products by catalytic hydrogenation.

With carbon monoxide, hydrogen forms a great variety of products depending on the pressure, temperature and catalyst used. Thus the product can be methane, methyl alcohol, a mixture of various alcohols or of hydrocarbons. The latter two processes were originated by Franz Fischer and Hans Tropsch in 1925. In a variation of these processes, in the oxo process, a mixture of hydrogen and carbon monoxide is reacted with olefins to form aldehydes.

Compounds.—Hydrogen ions (*q.v.*), H^+ are present in solutions of acids (*q.v.*) and are responsible for their characteristic properties such as sour taste, neutralization of bases, dissolution of base metals accompanied by evolution of hydrogen and colour changes with certain dyes (*e.g.*, blue litmus to red). In aqueous solutions of hydrogen ions, protons are not present as such but are associated with water molecules forming hydronium ions $(H_3O)^+$. Since water is dissociated to a certain extent into hydrogen and hydroxyl ions (*see* HYDROXIDE) according to $H_2O=H^++OH^-$ water is amphoteric; *i.e.*, it can either lose or take up a hydrogen ion and thus can act as an acid or a base. With other elements hydrogen forms three types of compounds (*see* HYDRIDES): saltlike compounds (*e.g.*, hydrides of alkali metals and alkaline earths); volatile compounds (*e.g.*, water H_2O, ammonia NH_3, phosphine PH_3, hydrocarbons, hydrogen halides); and metallike hydrides (*e.g.*, hydrides of palladium, titanium and zirconium). Besides the compounds already mentioned the following compounds of hydrogen are the most common: hydrogen peroxide (*q.v.*) H_2O_2, hydrazine (*q.v.*) N_2H_4, hydrazoic acid HN_3, hydrogen sulfide H_2S (*see* SULFUR), hydrogen fluoride H_2F_2 (*see* FLUORINE), hydrogen cyanide or prussic acid (*q.v.*) HCN and hydrogen chloride HCl (*see* HYDROCHLORIC ACID). With carbon, hydrogen forms a very large number of compounds, the hydrocarbons (*q.v.*). All these hydrogen compounds have important technical applications. Hydrogen is present in a great variety of compounds, formed by three or more elements, such as acids, bases (*see* HYDROXIDE), compounds containing combined water (*see* HYDRATE) and in almost all organic compounds.

Analysis.—The hydrogen content of a gas is often determined by admixing a known amount of oxygen and measuring the contraction that is caused by the formation of liquid water when the gas is brought into contact with a glowing filament or with a spark. In the presence of other combustible gases, the hydrogen is determined by reacting it with hot copper oxide according to $H_2+CuO=Cu+H_2O$. Other methods that are used for determining the purity of hydrogen and the amount of hydrogen present in other gases are based on measuring density, refractive index, the masses of the components (by the mass spectrograph) and the thermal conductivity.

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(A. Fs.)

HYDROGENATION is the addition of molecular hydrogen to a multiple linkage in the presence of a catalyst. Hydrogenolysis is a special case of hydrogenation in which the addition of hydrogen results in cleavage of the bond.

Few reactions, if any, have served chemists in all branches of organic chemistry so extensively as have catalytic hydrogenation and hydrogenolysis. These processes have vastly enlarged the world's supply of edible fats and soap and have upgraded the quality of gasoline as well as opening a new source of supply.

The basic problem in the synthesis of edible fats is summed up (from Carleton Ellis, *Hydrogenation of Organic Substances* [p. 36], copyright 1930, D. Van Nostrand Co., Inc., Princeton, N.J.) as follows:

"For years the dream of the oil chemist was to find a solution to the problem of converting oleic acid into stearic acid, or olein into stearin, simply by the addition of hydrogen, so as to make valuable hard fats from relatively cheap raw material. Superficially the problem looked simple. Oleic acid is the next-door neighbor of stearic acid, apparently differing only in having a little less hydrogen than stearic acid has in its constitution. Only a trifling amount of hydrogen, less than 1 per cent, is required to transform oleic into stearic acid.

"But the problem was far from simple, as oleic acid stubbornly resisted the invasion of hydrogen into its structure to any material extent under the earlier methods of hydrogen addition, and not until later years, with the discovery of effective hydrogen carriers or catalyzers, has it become possible to bring about this conversion economically with large yields so as to warrant commercial exploitation in an extensive way."

Although the first synthetic edible fats were produced in France in the late 1860s, the industrial importance of the hydrogenation process dates from 1897, when Paul Sabatier discovered that the introduction of a trace of nickel as a catalyst facilitated the mixture of hydrogen with the molecules of carbon compounds.

The manufacture of gasoline by the hydrogenolysis of coal was originated in Germany during World War I by Friedrich Bergius.

Methods.—Several methods are used for carrying out hydrogenation reactions. In the presence of very active catalysts, such as platinum and palladium, and easily hydrogenated material, such as olefins, ketones, aldehydes, or nitro compounds, the reactions can be carried out at a pressure of 1 to 4 atmospheres and at a temperature up to 80° C. For other hydrogenations much higher pressures are used and the reactions are carried out in autoclaves which can withstand high pressures and temperatures.

Low-Pressure Hydrogenation.—This method can be effected in an apparatus consisting of a shielded reaction bottle and a shaker mechanism. The reaction bottle is attached to a hydrogen reservoir. The progress of the reaction is followed by noting the pressure drop.

High-Pressure Hydrogenation.—In the laboratory this process is usually carried out in a steel rocking autoclave which can withstand a pressure of 400 atm. at a temperature of 400° C. The autoclave, fitted with a pressure gauge, is mounted in an electrical heating jacket, the temperature of which is controlled by means

of a thermocouple and an electrical control system The compound, alone or in solution. is agitated with the catalyst and hydrogen at elevated pressure.

Catalysts. — The catalysts most commonly used for low-pressure hydrogenation are platinum oxide, supported palladium and Raney nickel. These catalysts are easily prepared and have high activity at low temperatures and pressures. They catalyze the hydrogenation of a variety of functional groups. For high-pressure hydrogenations copper chromite and nickel supported on kieselguhr are the catalysts most extensively used. The choice of a catalyst depends on the functional group to be hydrogenated and, in the case of polyfunctional groups, on the desired selectivity of hydrogenation.

Variables Affecting Hydrogenation.--One of the primary factors that determine the ease with which a catalytic hydrogenation can be effected is the nature of the functional group to be reduced. There are however, in addition, several external factors such as:

Temperature and Pressure. — In general an increase in temperature causes an increased rate of hydrogenation. For the hydrogenation of most functional groups there is an optimum temperature for the reaction. At temperatures much below this point, the reaction is usually too slow to be practical. Neither is it desirable to conduct the hydrogenation above the optimum temperature since then the rates of side reactions are increased.

An increase in pressure produces an increase in the rate of hydrogenation. The pressure selected for conducting a hydrogenation depends largely on the particular compound in question. For example. with phenol and benzene an increase of pressure from 30 to 300 atm. increases the rate of hydrogenation only by about 50% in the presence of nickel, whereas the rate of hydrogenation of aniline increases three- to fourfold.

Agitation.—In order to effect a hydrogenation smoothly, it is necessary to bring the acceptor, catalyst and hydrogen in intimate contact. This is usually accomplished by shaking the reaction mixture, thus keeping the catalyst well dispersed and affording continuous supply of reactants to the surface.' The rate of reaction increases steadily with agitation up to a certain point.

Solvent. — In many cases, it is desirable to conduct a hydrogenation in the presence of a suitable solvent, especially in the case of high-melting solids and compounds that react very vigorously with hydrogen. Solvents also often facilitate the suspension of the catalyst in the reaction mixture and prevent the separation of an immiscible liquid. The solvents that have been found most useful are ethyl alcohol, low-boiling alkanes, ether, dioxane and acetic acid; the latter can be used only with platinum and palladium type catalysts.

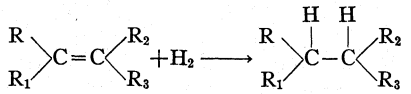
Catalyst Poisoning. — This can be either deliberate or unintentional. In certain types of selective hydrogenation, the catalyst is deliberately poisoned in order to deactivate it to the desired level. The partial poisoning of the nickel catalyst with sulfur makes it an efficient catalyst for the hydrogenation of butadiene to butene without causing the latter to be hydrogenated. The poisoning of palladium with sulfur permits the selective hydrogenation of an acyl chloride to an aldehyde.

Catalyst poisoning is usually unintentional. Deterioration of the catalysts on use can be attributed generally to the presence of sulfur in the reactants, to clogging of the catalyst pores with carbonaceous material and to a host of other causes. In general, Group Vb of the periodic table (phosphorous, arsenic, antimony, bismuth) and Group VIb (sulfur, selenium, tellurium) are poisons for the hydrogenating catalysts such as nickel, platinum and palladium. A poisoned catalyst can often be reactivated by oxidation with certain peracids in the presence of hydrogen peroxide. Oxidation converts the poison into a compound that does not retard catalyst efficiency.

Function of the Catalyst. — The detailed mechanism of hydrogenation, in spite of the significance of the reaction and the extensive studies carried out in various countries, is not too well understood. **A** good catalyst for hydrogenation must maintain its activity under reaction conditions and must (a) adsorb and activate hydrogen, (b) adsorb and activate the hydrogen acceptor, (c) maintain them in the proper space relationship and (d) desorb the hydrogenated compound.

EXAMPLES

Hydrogenation of Functional **Groups.**—*Olefins.*—The reaction can be presented by the general formula:



The saturation of olefinic double bonds occurs readily in the presence of any of the typical hydrogenation catalysts listed above. Platinum and palladium are active at low pressures and temperatures, nickel is active at higher pressures and at temperatures of 40°–60° C.. while copper chromite is active at 100° C. and zoo atm. pressure. The ease of hydrogenation depends on the number and nature of attached groups; an increase in substitution is accompanied by decreasing ease of hydrogenation.

The purpose of hydrogenation of vegetable or animal oils is to obtain a hard fat of greater viscosity than the original liquid oil and to remove certain undesirable impurities, thus rendering the oil edible and useful for industrial consumption. The process consists essentially in hydrogenation of the glycerides of unsaturated acids into glycerides of saturated or partially saturated acids. The reaction is carried out at 100°–200° C. and at pressures less than 15 atm. Nickel is the most commonly used catalyst. The quantity of nickel used is less than 1%. In the latter 1950s in the United States about 1,000,000 tons of glycerides, mainly cottonseed and soybean oil, were hydrogenated to make shortening.

The hydrogenation of diisobutylene to isooctane is of special industrial interest because of the high antiknock performance of the isooctane (2,2,4-trimethylpentane) in internal combustion engines.

Aromatics. — Aromatic rings are more difficult to hydrogenate than isolated olefinic double bonds. Nickel type catalysts are perhaps the most satisfactory catalysts; temperatures ranging from 125° to 175° C. and pressures of about 100 atm. are satisfactory. Platinum oxide is an effective catalyst for the hydrogenation only in the presence of acids, such as acetic acid. The hydrogenation of mononuclear aromatic hydrocarbons proceeds to completion to form cyclohexanes. The hydrogenation of benzene to cyclohexane and of phenol to cyclohexanol are of commercial importance, since these two compounds on oxidation form adipic acid which is the main intermediate in the production of nylon (synthetic fibre).

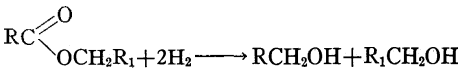
Naphthalene can be hydrogenated to tetrahydronaphthalene (tetraline) and decahydronaphthalene (decaline) depending on the experimental conditions. Both compounds are important industrial solvents.

Hydrogenolysis of Functional Groups. — Nitro Compounds. —The nitro group undergoes catalytic reduction with great ease and any of the common hydrogenation catalysts is effective:

$$RNO_2+3H_2\longrightarrow RNH_2+2H_2O$$

Reduction of the nitro group is highly exothermic and certain precautions must be taken to prevent dangerously high reaction temperatures. The hydrogenation of these compounds can be controlled by use of a low ratio of catalyst to acceptor and low temperatures. In order that the water produced during the hydrogenolysis does not destroy the homogeneity of the reaction medium it is advisable to use an alcohol as a solvent.

Esters. — Copper chromite is the catalyst most widely used for the reduction of esters to primary alcohols:



The reaction is generally conducted at 250° C. and 175 atm. pressure. Substituents containing a functional group have no marked effect on the yield of primary alcohol, provided they are located at sufficiently great distance from the ester function. When the ester is directly bound to an aromatic ring reaction (A)

takes place, if the aromatic ring is separated from the ester by one or more carbon atoms reaction (B) occurs:

(A) $C_6H_5C(=O)OC_2H_5 + 3H_2 \longrightarrow C_6H_5CH_3 + C_2H_5OH + H_2O$

(B) $C_6H_5CH_2C(=O)OC_2H_5 + 2H_2 \longrightarrow C_6H_5CH_2CH_2OH + C_2H_5OH$

Hydrogenolysis of esters is used extensively commercially for making higher molecular weight alcohols from the esters of fatty acids and from waxes. The alcohols thus produced are esterified with sulfuric acid and converted to synthetic detergents

Acid Chlorides.—Often it is necessary to convert an acid to the corresponding aldehyde. The most convenient method of accomplishing this involves the conversion of the acid to the acid chloride and hydrogenation of this derivative in the presence of a supported palladium catalyst, generally palladium on barium sulfate. This selective hydrogenation, known as the Rosenmund reduction, is applicable for the preparation of aliphatic, aromatic and heterocyclic aldehydes.

$$RC(=O)Cl + H_2 \longrightarrow RCHO + HCl$$

Experimental conditions must be chosen so that the aldehyde is not further reduced to the alcohol or hydrocarbon. This is often accomplished by the addition of a regulator, which is simply a selective poison that deactivates the catalyst with respect to reduction of aldehydes but not with respect to acid chlorides. A compound containing sulfur is usually used for this purpose; quinoline treated with sulfur is most commonly used. The reduction is accomplished by bubbling hydrogen through a solution of the acid chloride in which the catalyst and the regulator are suspended.

The Rosenmund reduction is used extensively in the synthesis of fine chemicals and pharmaceuticals.

Hydrogenolysis of Carbon-Carbon Bonds.—*Paraffins.*—Under conditions that are sufficiently drastic paraffinic hydrocarbons undergo extensive hydrogenolysis to yield principally methane. In the presence of nickel at 400° C.. hexane. for example, reacts with hydrogen to yield methane. By employing conditions that are less drastic it is possible to effect a more selective reaction by removing certain specific methyl groups (as methane) from branched-chain hydrocarbons to form hydrocarbons having one less carbon atom. In this reaction, referred as selective demethylation, methyl groups attached to secondary carbon atoms are removed more readily than those attached to tertiary carbon atoms. Methyl groups attached to quaternary carbon atoms are the most difficult of all to remove.

$$CH_3-C(CH_3)(CH_3)-CH(CH_3)-CH_2-CH_2+H_2 \longrightarrow CH_3-C(CH_3)(CH_3)-CH(CH_3)-CH_3+CH_4$$

The reaction is conducted at 200°–320° C. and 1–20 atm. pressure in a flow system with nickel or cobalt as catalyst Careful control of reaction conditions is necessary.

This reaction is of practical importance in that it can be used for the synthesis of branched-chain hydrocarbons that are difficult to obtain by conventional means.

Alkylaromatics.—The large demand for simple, relatively lox- molecular weight aromatic hydrocarbons, such as benzene, toluene and naphthalene. directed attention toward the utilization of kerosene extracts containing high concentrations of alkyl-substituted benzenes and naphthalenes. The hydrogenolysis of the alkylaromatics is usually carried out at high temperatures, 525°–625° C., 25–70 atm. pressures, a hydrogen to hydrocarbon ratio of 3:1 and an hourly liquid space velocity (volume of liquid charged per volume of catalyst per hour) of 1.0. The catalysts preferred are molybdena, chromia or vanadia deposited on alumina.

Primary Alcohols.—The hydrogenolysis of primary alcohols in the presence of catalysts, such as nickel, platinum or palladium, furnishes excellent yields of hydrocarbons having one less carbon atom than the original alcohol:

$$RCH_2OH + 2H_2 \longrightarrow RH + CH_4 + H_2O$$

In the presence of a nickel catalyst the reaction is conducted at 250° C. and 50–100 atm. pressure. The reaction has been applied to a variety of alcohols.

Hydrogenolysis of Coal.—Coal is a mixture of very high molecular weight compounds, containing sulfur, oxygen and nitrogen, in addition to carbon and hydrogen. Coal in a powdered form is first mixed with a small amount of catalyst and with a high-boiling recycle oil containing aromatics, hydroaromatics and phenols. This paste and about 2,000 cu.m. of hydrogen per ton of coal oil is pumped at 500 atm. through a preheater in which the mixture is heated to about 430° C. From the preheater the reactants pass through three pressure vessels in series, where the exothermic heat of reaction results in a temperature increase to 470° C. The contact time is of the order of two hours.

The products are: (1) heavy oil which is recycled to make coal oil paste, (2) middle oil, boiling in the range of 200°–310° C., which is submitted to vapour phase hydrogenolysis to form motor fuel. (3) a relatively small fraction of gasoline, (4) gaseous hydrocarbons, and (5) residue of unreacted coal ash, which is used for fuel.

Most heavy metals and their oxides and sulfides are active as catalysts in primary liquefaction of coal. Tin added as massive metal or as any reactive compound is the most active catalyst known for converting bituminous coal to a heavy oil by hydrogenolysis.

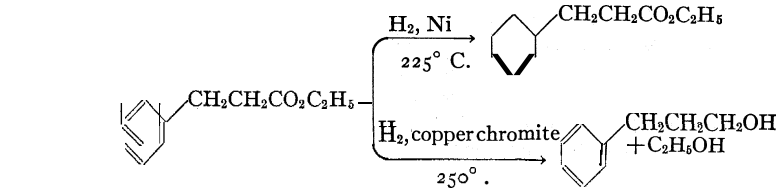
The coal hydrogenation method was used in Germany before and during World War II.

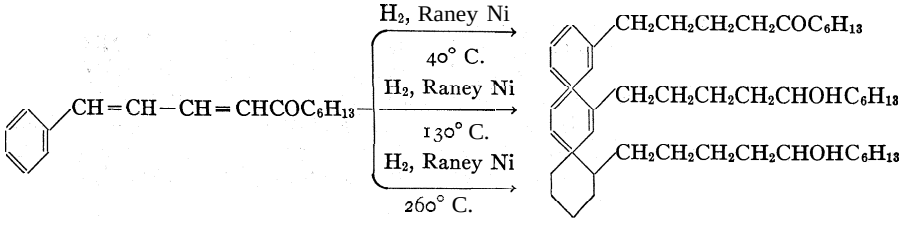
Selective Hydrogenation.— This is a valuable tool used by chemists for reducing one functional group in the presence of another functional group, which is also able to undergo hydrogenation.

This type of hydrogenation is made possible by the existence of a variety of catalysts, wide choice of temperature and pressure conditions, a choice of solvents and a reasonable knowledge of the relative reactivity toward hydrogenation of the various functional groups.

The choice of catalysts can be of great importance. Copper chromite, for example, is more active for the reduction of the carbon-oxygen bond than for that of the benzenoid ring. Nickel is more active toward a benzenoid ring than toward an ester group.

Some of the examples listed below show the effect of catalysts and the effect of temperatures upon the selective hydrogenation of certain compounds:





Hydrogenation of Carbon Monoxide. — A diversity of chemical reactions has involved the catalytic hydrogenation of carbon monoxide. Many of these reactions are of industrial importance.

Methane.—A complete hydrogenation to methane occurs when carbon monoxide and hydrogen are brought into contact in the presence of a nickel catalyst at a temperature above z50° C. This reaction is of industrial importance in the conversion of the carbon monoxide of manufactured gas to methane to increase the heating value and to provide a less toxic fuel gas.

Methanol.—The synthesis of methanol is an outstanding example of the practical importance of catalytic processes. The production of methyl alcohol in the United States in the latter 1950s was about 800.000 tons.

Carbon monoxide may react with hydrogen in many different ways. Methyl alcohol is formed only if certain selective catalysts are used. Only in 1923 was the means found to make methanol the main product of the hydrogenation of carbon monoxide. This was brought about through the use of certain mixed catalysts containing zinc oxide and chromium oxide and a reaction apparatus that did not contain iron or iron alloys.

The prevailing commercial catalysts are composed of the above two oxides, to which copper or copper oxide may or may not be added. The copper is a good conductor of heat, with the result that its addition promotes the distribution of the heat of reaction throughout the catalyst bed; furthermore, it can enhance the activity of the zinc–chromium catalyst. The ratios of the various constituents vary.

The lowest temperature at which the reaction has been found to proceed at an appreciable rate in the presence of a catalyst is 225° C. Most commercial syntheses operate between 300° and 375° C., and between 275 and 350 atm. The usual conversion of carbon monoxide to methanol is 12% to 15%. The ratios of hydrogen to carbon monoxide used vary from 2:1 to 6:1, and the gaseous space velocities (volume of gas per volume of catalyst per hour) from 20,000 to 50,000.

Fischer–Tropsch Synthesis. — Catalysts such as nickel and cobalt, which normally yield chiefly methane from a mixture of hydrogen and carbon monoxide at atmospheric pressure and 250°–400° C., may be modified by the addition of oxides of thorium, magnesium or aluminum and by special preparation procedures so as to produce mainly liquid hydrocarbons. If modified iron is used as a catalyst, alcohols and liquid hydrocarbons are produced. This discovery, made in 1925 by Franz Fischer and Hans Tropsch led to the rapid industrial development of synthetic gasoline in Germany during 1931–38.

Nickel catalysts were soon found to be less useful than cobalt or iron. Cobalt catalysts were used exclusively in all German plants during 1932–46, although later research on iron catalysts showed that with proper preparations and suitable experimental conditions they would equal the performance of the cobalt catalyst.

The standard catalyst in the commercial synthesis of gasoline in Germany during World War II was composed of:

$$Co:ThO_2:MgO:kieselguhr = 100:5:8:200$$

The best results were obtained when pressures of from j to 15 atm. and temperatures of about 250° C. were used and the ratio of $H_2:CO = 2:1$. The product of this synthesis contained about 14% methane, 1% ethane, 25% C_3 and C_4 hydrocarbons, 30% gasoline. 14% diesel oil, 14% paraffin wax and 1% to 2% aliphatic alcohols. The hydrocarbons obtained were mixtures of paraffins and olefins; no naphthenes or diolefins were formed.

Active iron catalysts for the synthesis can be prepared by impregnating precipitated ferric hydroxide with aqueous potassium carbonate so that the dried mixture will contain 0.25% potassium oxide. The activity and durability of the iron catalyst is enhanced by pretreatment with pure carbon monoxide at 325" C.

Synthesis conditions with the iron catalysts are 225°–235° c., zo atm. press.. using 1 vol. of H_2 per 1 vol. of CO and a space velocity of 100 to zoo vol. of the reactant gas per volume of catalyst per hour. The percentage composition of the product is 15% (C_1+C_2), 15% (C_3+Cu), 24% (C_5 to C_{10}), 12% (C_{11} to C_{18}), 22% hydrocarbons boiling above 320° C. and 12% oxygenated organic compounds.

Oxo Reaction. — The oxo reaction involves the addition of carbon monoxide and hydrogen to an olefin in the presence of a cobalt catalyst to produce an aldehyde containing one carbon atom more than the starting compound. The reaction can be presented by the following general equation:

$$RCH=CH_2+CO+H_2 \longrightarrow RCH_2CH_2CHO \text{ and } R\overset{\overset{CHO}{|}}{C}HCH_3$$

The reaction may be regarded as the addition of a hydrogen atom and a formyl group across the double bond. The reaction was first carried out (Roelen. 1938) with ethylene and the products of the reaction were diethyl ketone and propionaldehyde. Because both products contained a carbonyl or oxo group, the reaction was called the oxo reaction. Later it was found that the ketone formation was relatively unimportant; aldehydes being the principal products.

The effective catalyst in the oxo synthesis is cobalt hydrocarbonyl. which probably results from the intermediate formation of dicobalt octacarbonyl:

$$2Co+8CO \longrightarrow [(CoCO)_4]_2 \qquad \Delta H = -55 \text{ kg. cal./mole}$$
$$H_2+[(CoCO)_4]_2 \longrightarrow 2HCo(CO)_4$$

For a maximum yield of aldehydes the reaction should be operated at as low a temperature as possible, compatible with a reasonable rate. The temperature is usually 110°–140° C., and under these conditions the cobalt should be introduced as dicobalt octacarbonyl. As the temperature is raised, there is a tendency for the aldehydes to be reduced to the alcohols. The usual operating pressure of the oxo synthesis is 200 to 300 atm. of synthesis gas ($H_2:CO = 1:1$). It is possible to adjust conditions so that the aldehydes are produced even at 185° C.; this can be done by using sufficient gas to enable the oxo synthesis to proceed, but insufficient to permit the subsequent hydrogenation.

Most oxo reactions are performed with cobalt concentration of about 0.5 to j mole per cent.

Straight-chain terminal olefins yield a mixture of aldehydes consisting of about 40%–60% straight-chain and 60%–40% branched-chain aldehydes. Nonterminal straight-chain olefins yield a mixture of aldehydes practically identical with that given by the isomeric terminal olefins.

The olefin mixture of the greatest commercial interest as a substrate for the oxo reaction is the mixture of heptylenes obtained by the copolymerization of C_3 and C_4 olefins and composed chiefly of 2,2-, 2,3- and 2.4-dimethylpentes. The mixed C_8-alcohols eventually obtained by the oxo process are useful in the manufacture of plasticizers.

Hydrogenation of Elemental Substances.—Hydrogen combines with many elements in the presence of finely divided metals such as platinum or palladium. The elements of fluorine, chlorine, bromine and iodine form the corresponding hydrogen halides. Hydrogen combines also with sulfur, selenium and tellurium. The reaction of nitrogen with hydrogen to form ammonia is of great industrial importance.

See NITROGEN, FIXATION OF.

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HYDROGEN CYANIDE: see PRUSSIC ACID.

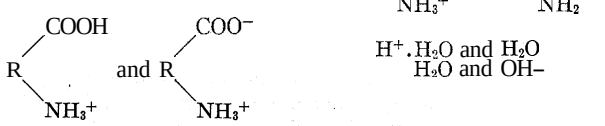
HYDROGEN IONS. A hydrogen ion may be an electrically charged molecule (or atom) of hydrogen in the gaseous state, but the term is applied more often, as it is in this article, to ions in solution arising from acids. acid salts. etc.

According to the theory of Svante Xrrhenius, hydrogen ions are produced in solution by the dissociation of acids. For example,

the acid $CH_3.COOH$ was supposed to dissociate to the anion CH_3COO^- and the hydrogen ion H^+.

The view here adopted is that the proton. the nucleus of the hydrogen atom having unit positive charge and represented by H^+, may transfer from any one of a large number of proton donors to one or another proton acceptor. Examples of proton donors and the corresponding (or conjugate) proton acceptors are:

Donor and acceptor	*Donor and acceptor*
$CH_3.COOH$ and $CH_3.COO^-$	$H^+.H_2O$ and H_2O
NH_4^+ and NH_3	H_2O and OH^-
H_3PO_4 and $H_2PO_4^-$	
$H_2PO_4^-$ and $HPO_4^=$	



In aqueous solution transfer of a proton from a proton donor to water gives the hydrogen ion. $H^+.H_2O$ of an aqueous solution. Likewise, in an ammonia solution the transfer of a proton from a proton donor to a molecule of the solvent, NH_3, gives the hydrogen ion. NH_4^+, of an ammonia solution. (The terms donor and acceptor are discussed in detail in ACIDS AND BASES.)

This article is restricted to aqueous solutions and to an elementary treatment, but the elementary principles presented are widely applicable if due consideration is given to the distinctions between different solvents.

A general, reversible process of proton exchange may be represented by: proton donor A + proton acceptor B $\rightleftharpoons$ proton acceptor A + proton donor B. Confining attention to water solutions, in which H_2O is a proton acceptor and the hydrated proton, $H^+.H_2O$, is a proton donor, we may formulate in the classical way the equilibrium equation (1).

$$\frac{[\text{Proton acceptor}][H^+.H_2O]}{[\text{Proton donor}][H_2O]} = k \qquad (1)$$

Here brackets signify the molar concentration (in the algebraic sense) of a substance the symbol of which is enclosed, and k is a constant.

Strictly. equation (1) is valid only at infinite dilution. Also at infinite dilution $[H_2O]$ is a constant. Then equation (1) may be written as (2), which expresses a limiting relation.

$$\frac{[\text{Proton acceptor}]}{[\text{Proton donor}]} = \frac{K}{[H^+.H_2O]} \qquad (2)$$

It is advantageous to preserve this limiting relation and to use its form as in the following development.

Inasmuch as equilibriums of this sort, when observed under ordinary circumstances. are not strictly determined by the concentrations of the participating substances, but rather by their chemical potentials (see THERMODYNAMICS), it has been found convenient to replace the concentration of each substance by its activity. The activity of a substance **A** may be defined by relation (3)

$$(A) = [A]f_A \qquad (3)$$

where ( ) is used here to represent activity, brackets are used as before to signify molar concentration and f_A is the activity coefficient. If concentration is expressed as molal instead of molar concentration, a different symbol should be used for the activity coefficient. This device is virtually to make equations such as equation (4) exact by definition. Accordingly equation (2) should be written as equation (4)

$$\frac{(\text{Proton acceptor})}{(\text{Proton donor})} = \frac{K}{(H^+.H_2O)} \qquad (4)$$

Introducing relations of type (3) we have:

$$\frac{[\text{Proton acceptor}]}{[\text{Proton donor}]} = \frac{K}{(H^+.H_2O)} \times \frac{f_{\text{donor}}}{f_{\text{acceptor}}} \qquad (5)$$

For a narrow range of conditions the ratio $f_{\text{donor}} / f_{\text{acceptor}}$ may not vary to an extent that will affect seriously the simpler formulation of a set of relations, and then this ratio may be combined with the true ionization constant K to give the "apparent ionization constant" K' of equation (6)

$$\frac{[\text{Proton acceptor}]}{[\text{Proton donor}]} = \frac{K'}{(H^+.H_2O)} \qquad (6)$$

It was virtually with this approximate relation, applied to each of a large number of systems, that the subject was first outlined. We shall use it for the same purpose, but it should be noted that the following comments involve approximations and that more elaborate treatments must be sought in texts.

Equation (6) suggests the fundamental reason for the widespread interest in determining the activities of hydrogen ions in aqueous solutions.

A particular proton donor will have properties that differ from those of its corresponding acceptor. Manifestation of the one or the other set of properties will depend, of course, on the amount of the respective substance, or, per unit volume, on the molar concentration, but the relative degree of manifestation will depend on ratios such as those defined by statements (7) and (8).

$$\frac{[\text{Proton acceptor}]}{[\text{Proton acceptor}] + [\text{Proton donor}]} = \alpha \qquad (7)$$

$$\frac{[\text{Proton donor}]}{[\text{Proton acceptor}] + [\text{Proton donor}]} = 1-\alpha$$

By (6), (7) and (8) one obtains (9)

$$\frac{\alpha}{1-\alpha} = \frac{K'}{(H^+.H_2O)} \qquad (9)$$

Thus, the degree to which the proton acceptor predominates, as expressed by α, is determined by the value of K', which is characteristic of each system in given circumstances, and by the hydrogen ion activity of the solution. When, for example. $K' = (H^+.H_2O)$, $\alpha = 0.5$, or, in other terms. half of the proton donor has been transformed to the corresponding acceptor. Even in solutions so complicated that it is impracticable to determine every set of proton donor and acceptor, control of the hydrogen ion activity will establish certain ratios for all pairs of these substances. This may be favourable or detrimental to complicated processes, such as the growth or metabolism of bacteria or of any of the innumerable organisms in sea water that are directly exposed to this environment. Control of $(H^+.H_2O)$ is indispensable when a particular proton donor, or its corresponding acceptor, is to be brought into prominence for any one of innumerable purposes.

Although in alkaline solutions the transfer of protons to water molecules is so little that the concentration of hydrogen ions might be regarded as of doubtful physical significance and the response of devices such as the hydrogen electrode might be regarded as due to direct transfer of protons to the electrode from proton donors, it is customary to postulate a hydrogen ion activity for all cases. Indeed, from a purely thermodynamic point of view, the postulation of the hydrogen ion as the intermediate is quite legitimate. This leads to the consideration of hydrogen ion activities ranging in values from. say, 10 to 1×10^{-14}. It is inconvenient to plot relations with this large range of values. In 1909 S. P. L. Sørensen used the function $-\log [H^+]$ and designated it by the symbol pH. Later he and others recognized that $-\log [H^+]$ should be replaced by $-\log (H^+.H_2O)$ and accordingly the modern interpretation of pH is often stated to be the "negative logarithm of hydrogen ion activity." There remains a small uncertainty in estimating a hydrogen ion activity so that pH numbers as ordinarily used are somewhat arbitrary.

If this be understood, we may proceed with the conveniences provided by the following definitions.

$$\text{pH} = -\log (H^+.H_2O) \qquad (10)$$

$$\text{pK}' = -\log K' \qquad (11)$$

By (9), (10) and (11) we reach equation (12)

$$\text{pH} = \text{pK}' + \log\frac{\alpha}{1-\alpha} \qquad (12)$$

If α be plotted as abscissa and pH as ordinate, one obtains the

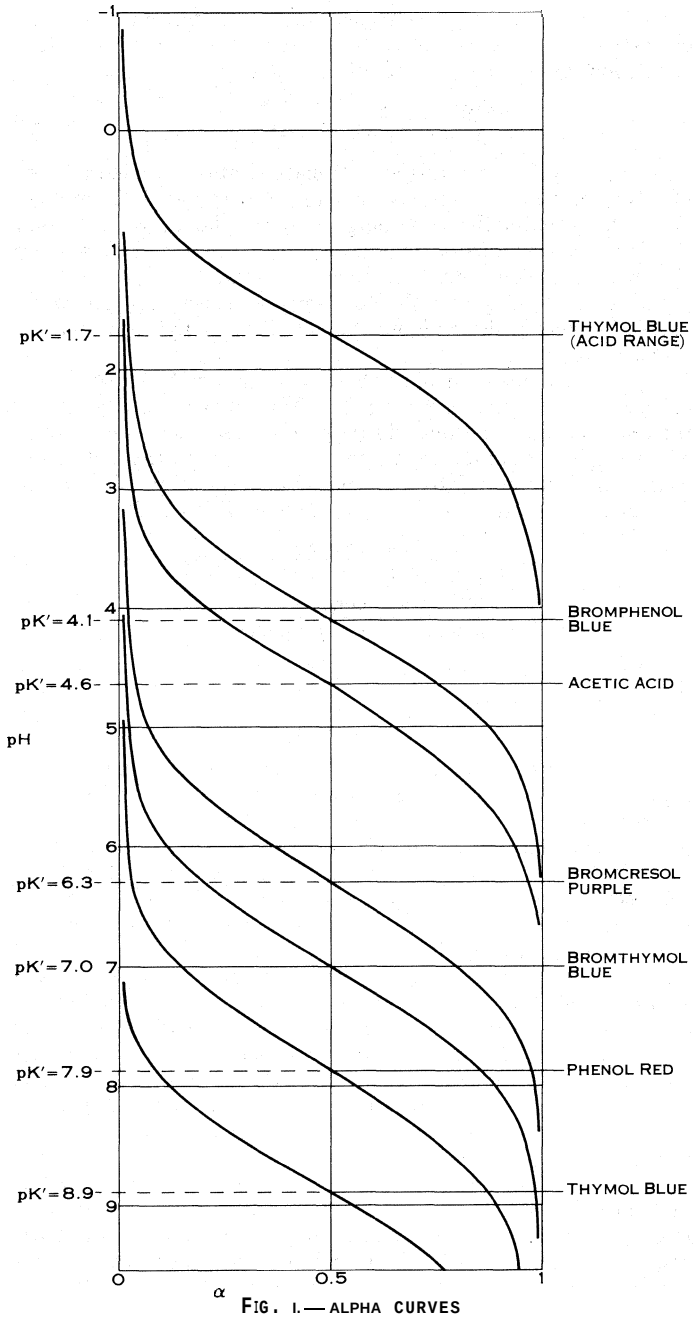


FIG. 1.—ALPHA CURVES

Relation of pH to the degree of transformation of proton donor to conjugate proton acceptor in systems of specified values of pK'

family of symmetrical curves shown in fig. 1, the position of each curve being determined by the value of pK' which is characteristic of each system under the conditions where pK' applies. The mid-point of each curve ($\alpha=0.5$) falls where $pH = pK'$. If the value of pK' is known and pH is measured, one can estimate the degree to which a particular proton donor has been transformed to the conjugate acceptor. The estimate may be made by calculation or by reading values on a carefully drawn curve such as one of those in fig. 1.

Water itself forms both hydrogen ions and hydroxyl ions, $O\bar{H}$, by the process $2H_2O \rightleftharpoons H^+.H_2O + O\bar{H}$. The equilibrium expressed in classical terms is:

$$\frac{[H^+.H_2O][O\bar{H}]}{[H_2O]^2} = k_w$$

At the limiting condition where water is the only constituent, $[H_2O]$ is a constant so that we then have the so-called ionic product of water expressed by (13).

$$[H^+.H_2O][O\bar{H}] = K_w \qquad (13)$$

For present purposes one may neglect the activity coefficients that would have to be applied to make a similar equation valid for ordinary conditions and one may use the approximate value 1×10^{-14} for the value of the "apparent" constant K'_w. Then the hydrogen ion concentration would appear to be equal to the hydroxyl ion concentration $pH = 7.0$. This is a convenient "equator" with which to demark "acid" solutions from "alkaline" solutions. If it be desired to calculate the activity of hydroxyl ions from measured values of pH, an equation similar to equation (13), but properly modified to include the values of activity coefficients for the conditions used, provides the means of calculation.

If attention be confined to simple cases, such as mixtures of an acid and its sodium salt, one can state in simple form some principles that are widely applicable. For this purpose let typography be simplified by using H^+ as the symbol of $H^+.H_2O$. Let HA represent a neutral proton donor, such as acetic acid, and A the conjugate acceptor, the anion of a simple acid. Assume a sodium salt. such as sodium acetate, to be completely ionized in aqueous solution. For a mixture of the acid and its sodium salt define:

$$S = [HA] + [A^-] \qquad (14)$$

$[A^-]$ being the concentration of anions arising from ionizations of both acid and salt, and $[HA]$ being the concentration of the acid that remains unionized. The solution must be electrically neutral. Hence:

$$[Na^+] + [H^+] = [A^-] + [O\bar{H}] \qquad (15)$$

Equations (14), (15) and (6) may be combined to give equation (16).

$$\frac{(H^+)([Na^+] + [H^+] - [O\bar{H}])}{S - ([Na^+] + [H^+] - [O\bar{H}])} = K' \qquad (16)$$

For many purposes it is unnecessary to do more with this equation than make certain approximations. Suppose, for example, in making the solution such an amount of acid and its sodium salt were used that $S = 0.1$ and $[Na^+] = 0.5$ "molar." Suppose also that a crude estimate places the value of $[H^+]$ between 1×10^{-3} and 1×10^{-4} "molar." By use of the value $K'_w \cong 1 \times 10^{-14}$ a crude estimate of the value of [OH] would be that it is between 1×10^{-11} and 1×10^{-10} "molar." Then equation (16) reduces to:

$$\frac{(H^+)[Na^+]}{S - [Na^+]} \cong K' \qquad (17)$$

But $[Na^+]$ is equivalent to the stoichiometrical concentration of salt and $S - [Na^+]$ is equivalent to the stoichiometrical concentration of acid used in making up the solution. Hence

$$pH \cong pK' + \log \frac{[Salt]}{[Acid]} \qquad (18)$$

If in equation (16) $[Na^+] = 0$, that is if the acid alone is present, $[O\bar{H}]$ usually will be negligible in the sum $[H^+] - [O\bar{H}]$ so that equation (16) reduces to:

$$\frac{(H^+)[H^+]}{S - [H^+]} \cong K' \text{ or practically to } \frac{(H^+)^2}{S - (H^+)} \cong K' \qquad (19)$$

For a weak acid the value of $S - (H^+)$ is little different from the value of S so that:

$$pH \text{ approximates } 0.5\ pK' - 0.5 \log S \qquad (20)$$

With the approximations of equations (18) and (20) one can calculate roughly the course taken by pH during the titration of a weak acid by a standard solution of an alkali. More reliable, however, are so-called titration curves obtained by plotting values of pH measured at successive intervals during stepwise addition of alkali, pH being plotted against equivalents of added alkali. Such curves are illustrated in figs. 2 and 3.

Buffer Action.—It will be noted in fig. 1 that the curves do not have as great a slope near the mid-points (where $\alpha=0.5$) as they do near the asymptotes. The flatter sections of these alpha curves correspond roughly to the flatter sections of the

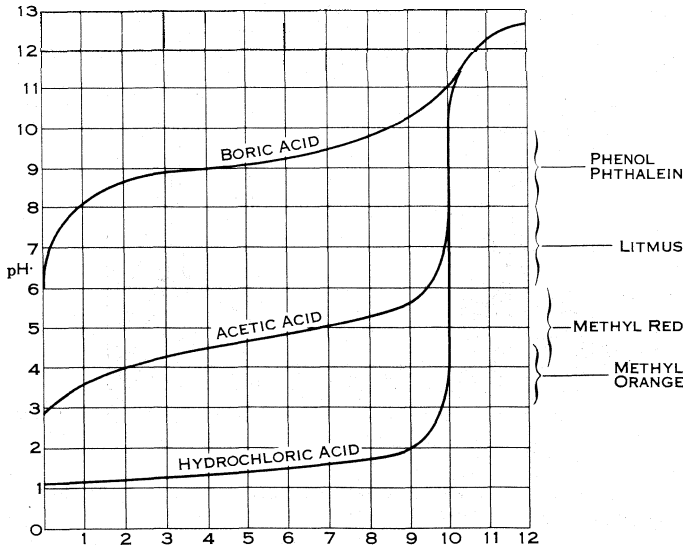
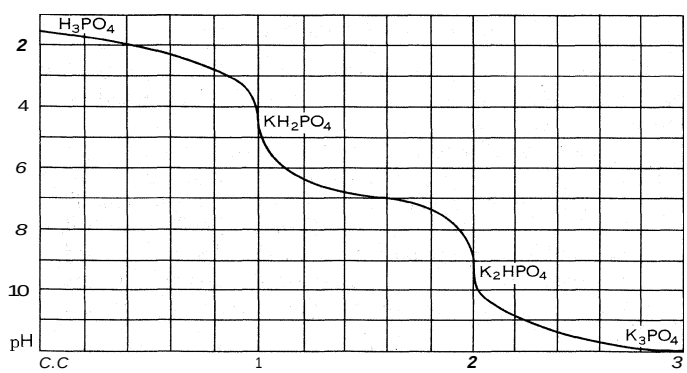


FIG. 2.— TITRATION CURVES OF THREE ACIDS SHOWING BUFFER EFFECTS. THE LIMITED RANGES OF SUCH EFFECTS AND THE DIFFERENT pH-VALUES ATTAINED AT THE EQUIVALENCE POINT

respective titration curves of the weaker acids *(see* fig. 2*)*. In other words a variable degree of stabilization of pH is associated with a mixture of a proton donor and its conjugate acceptor, the stabilization being the more pronounced the greater their concentrations and usually the nearer the ratio of concentrations approaches unity. Stabilization also occurs at each end of the pH scale where, at the one extreme. hydrogen ions as well as the conjugate proton acceptors. water molecules, are abundant. and at the other extreme where hydroxyl ions as proton acceptors as well as the conjugate donors. water molecules. become abundant. This partial stabilization of pH is called buffer action. Systems providing buffer action are called buffers. Some are used as standards of pH for the determination of pH by the indicator method (see *Indicators of* pH, below) or as solutions with which to standardize the glass electrode (see Glass *Electrode*, below). Buffers serve to condition the environments of living cells and to control innumerable chemical reactions. In the titration of an acid with a standard solution of an alkali, such as NaOH, it is necessary to know that pH at which there have been added the number of equivalents of alkali equal to the number of equivalents of acid in the original solution. This pH is called the equivalence point or end point. The calculation is simple in those cases in which both acid and alkali are completely ionized as in the case of HCl and NaOH in water. For example, when HCI is titrated by NaOH the law of electroneutrality requires:

$$[H^+]+[Na^+]=[Cl^-]+[O\bar{H}] \qquad (21)$$

$[Cl^-]$ is equivalent to the number of moles of HCI originally used,



FROM 'THE DETERMINATION OF HYDROGEN IONS" BY W. MANSFIELD CLARK (WILLIAMS AND WILKINS COMPANY)

FIG. 3.— TITRATION CURVE OF PHOSPHORIC ACID

Abscissa: equivalents of alkali per mole H_3PO_4

per litre of the solution as the solution exists at the end of the titration. $[Na^+]$ is equivalent to the number of moles of NaOH used. per litre of solution as the solution exists at the end of the titration. At the equivalence point $[Cl^-]=[Na^+]$. Hence $[H^+]=[O\bar{H}]$. Therefore, if activity coefficients be neglected, the equivalence point in this particular case is approximately at pH = 7.0 *(see* equation [13]).

In the titration of a "weak" acid, one that is only partially ionized. the equivalence point may be calculated with approximations adequate for ordinary purposes as follows. In equation (16) introduce the condition for the equivalence point that $[Na^+]=S$ *(see* equation [14]). The numerator of equation (16) then becomes $(H^+)(S+[H^+]-[OH])$ and the denominator becomes

$$-[H^+]+[O\bar{H}] \text{ or } -[H^+]+\frac{K'_w}{[H^+]} \qquad (22)$$

Usually S is so much larger than $[H^+]-[O\bar{H}]$ that the numerator closely approximates (H^+) S. If we now assume (H^+) to approximate $[H^+]$, a little algebraic manipulation will lead to equation (23):

$$pH=0.5\ pK'+0.5\ pK'_w+0.5\ \log\ (S+K') \qquad (23)$$

or, when S is much greater than K',

$$pH=0.5\ pK'+0.5\ pK'_w+0.5\ \log\ S \qquad (24)$$

Examples:

S molar	pK′	pH of eq. point	S molar	pK′	pH of eq. point
0.1	3.0	8.0	0.1	5	9.0
0.01		7.5	0.01		8.5

The greater the value of pK′ the greater will be the pH of the equivalence point and the nearer an overlap of the titration curve with the curve obtained on addition of NaOH to water. Therefore, in titrating small quantities of a weak acid the volume is kept as small as possible and a microburette is used to deliver alkali of relatively high titre.

Much the same sort of calculation may be used in making a rough estimate of the equivalence point in the titration of ammonia, for example, by a standard solution of HCl. In such cases the equivalence points for various conditions will be at pH values less than 7.0.

The pH of the equivalence point is indicated by the colour of a suitable indicator. In this use of an indicator consideration is given to the fact that in most of the ordinary titrations a large change of pH occurs near the equivalence point. Thus, in the titration of HCI with NaOH, as one equivalent of NaOH per equivalent of HCl is approached the addition of a very small fraction of one equivalent of NaOH causes a large change of pH. At pH values in the region near 6, phenol red will remain yellow. From that point an extremely small fraction of one equivalent of alkali is needed to reach pH 7.0 and within the interval phenol red will exhibit a readily detected, partial colour change. Likewise, if pH 8.5 is to be the equivalence point in the titration of a weak acid. phenolphthalein will remain colourless until this equivalence point is approached and will exhibit a partial transformation to the red form at pH 8.5.

Advanced treatises should be consulted for more elaborate treatments including those dealing with various sources of error.

Indicators of pH.—An indicator of pH is a substance capable of existing in solution as a proton donor and conjugate proton acceptor at least one of which forms absorbs visible radiant energy so that it may be distinguished by the eye. Usually an indicator is employed at a concentration so low as not to affect seriously the pH of buffered solutions.

The degree of transformation, α, of an indicator from a particular form as proton donor to the conjugate acceptor is related to the pH value of a solution by an "alpha curve" such as those shown in fig. 1.

Some indicators can form two sets of conjugate proton acceptor and donor. Such is the case in each of the sulfon-

ephthaleins. At low pH (near pH 0) each exhibits a colour change distinct from that observed in passing through a region of higher pH.

Inasmuch as a particular indicator will exhibit change of form over a limited range, or over limited ranges. of pH, as defined by its alpha curve, or curves, it is necessary to have a series of indicators for each of the various purposes.

There are two principal uses of indicators of pH. One is to determine the pH of a solution whatever it may be: the other to detect that particular pH called the equivalence point for the titration of a particular acid with a standard solution of an alkali or the equivalence point in the titration of a proton acceptor (such as NH_3) with a standard solution of an acid.

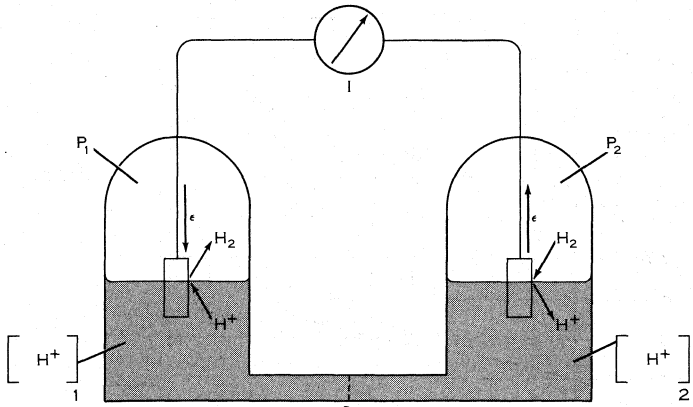
The simplest of several methods for the determination of pH with indicators is the following. It is necessary to select that indicator which shows a definite and appreciable degree of transformation when added to the solution under test. A suitable indicator having been selected by preliminary trials, one prepares a few buffer solutions having pH values within the expected range, the pH values differing by 0.2 pH unit or 0.1 pH unit. Tables giving the composition and pH values of standard buffer solutions are given in various treatises. Apportion equal volumes of these buffers in test tubes of the same internal diameter. To each of these buffer solutions and to the same volume of the tested solution in a tube of the selected. uniform bore, add precisely the same volume of the same stock solution of indicator. Illuminate compared tubes equally. When a tested solution and a standard solution have the same appearance (the same colour to a normal eye) the degree of transformation, a, of the indicator will be the same in both solutions provided no change of indicator takes place other than change between proton donor and proton acceptor forms. If the colour of the tested solution is intermediate between the colours of two standards, a judgment can be made of the standard that should match. It usually is presumed that the pH values of tested solution and standard are the same when a colour match is found. However, such a presumption would be based on equation (9) and, as noted in developing this equation, the apparent constant, pK′, includes a ratio of activity coefficients. These coefficients will vary with the salt content of the solution. Hence pK′ may not be the same in standard and tested solutions if the compositions differ considerably. The difference of pH associated with the same value of α is often called the "salt error." Among other sources of error are the combination of an indicator with proteins, precipitation by various agents and the superposition of the natural colour of the tested solution. Compensation for the latter can sometimes be made satisfactorily by devices described in texts.

Use of indicators to determine equivalence points in titrations has been noted briefly above. in the section Buffer Action.

Hydrogen Electrode (Hydrogen Cell).—A hydrogen cell is an electric cell which is conveniently regarded as made up of two half cells (see fig. 4). Each half cell contains an electrode of a noble metal, such as platinum, coated with platinum black or palladium black as catalyst. Each electrode dips into a buffer solution which maintains a constant activity of the hydrogen ions and the solution is brought into equilibrium with some definite partial pressure, **P,** of hydrogen. The process occurring at the interface between electrode and solution is one of oxidation-reduction, specifically that represented by $2H^+ + 2\epsilon \rightleftarrows H_2$ where ϵ represents an electron. This reversible process is catalyzed by the platinum, or palladium black. Postulation of the intermediate $H^+.H_2O$ will not affect the final result, if attention is confined to water solutions.

If the two solutions are joined directly there may be a large liquid junction potential. When a solution saturated with respect to KCl is interposed, the liquid junction potential is reduced to an uncertain value which is small and is frequently neglected. We shall, for the moment, neglect this junction potential.

The hydrogen at an electrode serves as an electron donor and the hydrogen ion as an electron acceptor. If the partial pressures of the hydrogen are the same in both half cells, that solution having the greater activity of hydrogen ions will have the greater



FROM "THE DETERMINATION OF HYDROGEN IONS" BY W MANSFIELD CLARK (WILLIAMS AND WILKINS COMPANY)

FIG. 4.—A HYDROGEN CELL. SCHEMATIC

L. Liquid junction (see text)
I. Current indicating instrument when cell is allowed to operate. Should be replaced by potentiometer when measurements are made

tendency to withdraw electrons from the metal of the electrode. Therefore the terminal of this electrode will be positive relative to the other. Consequently if the electrodes are joined by a wire, electrons will flow from the electrode in the solution of lesser hydrogen ion activity to that in the other solution, through the wire. To allow this to happen would violate the condition of maximal work under which condition the difference of potential between electrodes will be maximal. Therefore this potential difference is balanced by the oppositely oriented potential difference of a potentiometer both for the purpose stated above and to measure the potential difference between the electrodes (see INSTRUMENTS, ELECTRICAL MEASURING).

There are several ways of formulating the relation between the activities of the hydrogen ions in the half cells and the electromotive force of the cell. The following is based on the use of J. Willard Gibbs's chemical potential as extended to electrons and on the thermodynamic relation between the chemical potential, μ_A, of any substance A and the activity **(A)** of that substance; *i.e.*,

$$\mu_A = RT ln(A) + \mu_{0A} \qquad (25)$$

where μ_{0A} is a constant, dependent only on temperature and pressure, and is the value of μ_A when **(A)** = 1.

For the oxidation-reduction process

$$2H^+ + 2\epsilon \rightleftarrows H_2$$

there will subsist a comparable relation between chemical potentials. Distinguish by primes and double primes the cases for half cells 1 and 2, respectively

$$2\mu'_{H+} + 2\mu'_\epsilon = \mu'_{H_2} \qquad (26)$$

$$2\mu''_{H+} + 2\mu''_\epsilon = \mu''_{H_2} \qquad (27)$$

By (26) and (27):

$$\mu'_\epsilon - \mu''_\epsilon = 1/2(\mu'_{H_2} - \mu''_{H_2}) - (\mu'_{H^+} - \mu''_{H^+}) \qquad (28)$$

The difference of electron chemical potentials must be distinguished sharply from electrostatic difference of potential or electromotive force. E.M.F.

If chemical potentials are defined in terms of free energy per equivalent. $\mu'_\epsilon - \mu''_\epsilon$ has the dimensions of energy per equivalent and can be expressed in volt-faradays **EF.** Now when the E.M.F. of the cell is balanced by that of the potentiometer there is equality of the chemical potentials of the electrons in adjacent phases between which there is no passive resistance to electron transfer. Therefore the potential difference, **E,** measured at the potentiometer is given by $\frac{\mu_\epsilon - \mu_\epsilon}{\mathbf{F}}$. On the right of (28) substitute (25) in appropriate form for each item. Thus is obtained (29).

$$\mathbf{FE} = RT ln \frac{\sqrt{(H_2)'}.(H^+)''}{\sqrt{(H_2)''}.(H^+)'} \qquad (29)$$

For the ratio of proton activities in equation (29) there may be substituted the ratio of hydrogen ion activities. but to simplify typography we may let H^+ represent the hydrogen ion of a water solution. With no serious error, the ratio of the partial pressures of hydrogen, P' and P'', may be substituted for the ratio of the activities of hydrogen and we have (30).

$$\mathbf{E}=\frac{RT}{\mathbf{F}}ln\frac{(H^+)''}{\sqrt{P''}}-\frac{RT}{\mathbf{F}}ln\frac{(H^+)'}{\sqrt{P'}} \qquad (30)$$

The normal hydrogen half cell is defined as the hydrogen half cell where the partial pressure of hydrogen is one normal atmosphere and the hydrogen ion activity is 1. This is the half cell to which all other half cells are referred in systematic accounts. Therefore it is convenient and agreed that the single potential difference between electrode and solution of the normal hydrogen half cell shall be called arbitrarily zero at all temperatures.

Accordingly we shall regard the half cell identified in (30) by single primes as the normal hydrogen half cell and we shall consider E of (30) as if it were the potential of the other hydrogen half cell. To designate this system of comparison $\mathbf{E}_h$ will be used in place of E. Then:

$$\mathbf{E}_h=\frac{RT}{\mathbf{F}}ln\frac{(H^+)}{\sqrt{P}} \qquad (31)$$

The following values of R and **F** were selected by J. W. M. DuMond and E. R. Cohen (*Rev.* Mod. Phys., 25:691 [1953]):

R (gas constant) = 8.31439 absolute volt-coulombs/degree gram equivalent.

F (faraday) = 96,494 abs. coul./deg. g. equiv.

And according to a report of the National Research Council Committee on Physical Constants (issued July 1, 1949):

T (degrees Kelvin) = t (° C.) + 273.16.

The modulus for converting a logarithm with base e to the corresponding logarithm with base 10 is 2.30258j. Hence

$$\mathbf{E}_h=0.00019840T\ \log_{10}\frac{(H^+)}{\sqrt{P}} \qquad (32)$$

According to the derivation of the coefficient in this equation $\mathbf{E}_h$ should be expressed in absolute volts and not in international volts, as was the custom prior to Jan. 1, 1948 (see Circular of the National Bureau of Standards, C459 [1947]); 1 absolute volt = 0.99967 international volt.

If $P=1$ atmosphere and $t=25°$ C.

$$\mathbf{E}_h=-0.059156\ \text{pH}$$

A difficult problem is that of establishing either the conditions under which the activity of the hydrogen ions is unity as demanded in the use of the primary. standard, hydrogen half cell or a definite hydrogen ion activity in any other half cell used as a secondary standard. The difficulties are fundamentally two aspects of the same problem, that in the use of any process in which two kinds of ions are concerned it is impossible to determine experimentally the individual activity coefficients. Thus. if two hydrogen half cells are joined in liquid junction, with or without the intervening saturated solution of KC1 customarily used to reduce the potential difference at the liquid junctions. the calculation of a junction potential with the highest precision requires knowledge of the individual activity coefficients of all diffusing ions. Invaluable data can be obtained regarding solutions of HCl, for example, by the use of a cell without liquid junction, one electrode responding to the activity of the hydrogen ions and the other (such as the silver-silver chloride electrode) responding to the activity of the chloride ions. But then it is necessary to use the mean activity coefficient for these two sorts of ions. In practice it is convenient to use a "saturated calomel half cell" in place of one of the hydrogen half cells, the potential of this half cell having been determined by using a solution of known pH in the hydrogen half cell. The saturated calomel half cell is one in which the solution is saturated with KCl and Hg_2Cl_2 (calomel) and the electrode is mercury.

For precise measurements with a hydrogen cell many items of technique must be given attention.

Glass Electrode (Cell with Glass Membrane).—This is an amazingly successful device for the measurement of pH. It has been developed so largely by empiricism that its theoretical treatment will be left to advanced treatises. The description that follows outlines a method used in practically all laboratories concerned with aqueous solutions and in plants concerned with control of many industrial processes.

The cell with glass membrane may be used with solutions that cannot be studied with the hydrogen electrode. These include solutions containing substances that poison the catalyst of a hydrogen electrode or substances easily reduced. While special provisions must be made in measuring with the hydrogen electrode solutions containing CO_2, no special provisions are necessary with the glass electrode other than prevention of loss of CO_2. Coloured solutions, the pH of which cannot be measured well by the indicator method, present no special difficulty.

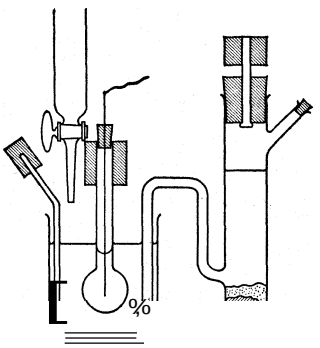


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FIG. 5.—A CELL WITH GLASS MEMBRANE IN BULB FORM

On the other hand, it must be appreciated that the method is essentially one of comparison between solution tested and a series of solutions standardized by hydrogen electrode measurements. Therefore, the precision depends primarily upon reproduction of the standards. There are also factors other than a difference of hydrogen ion activities that affect the glass membrane; in particular other cations have an effect that is prominent in alkaline solutions. Furthermore, the very high electric resistance of a cell with glass membrane makes necessary both a special null-point instrument in the potentiometry of such a cell and special precautions by the user of the instrument.

In fig. 5 a special cell containing a glass membrane is represented diagrammatically. The corresponding conventional statement of constitution is:

$$\underset{a}{Ag}\ |\ AgCl(s).HCl\ (0.1\ M)\ |\ \underset{b}{\text{Glass membrane}}\ |\ \underset{c}{\text{Solution x}}\ |\ \underset{d}{KCl\ (sat.)}\ |\ \underset{e}{Hg_2Cl_2}\ |\ Hg$$

Up to b there is a silver electrode, coated with silver chloride, immersed in a 0.1 molar solution of hydrochloric acid.

On the right is a mercury electrode overlaid by solid calomel and a solution saturated with potassium chloride. The latter is in contact with solution x. A thin glass membrane separates solution x from the 0.1 M HCl solution. In fig. 5 this membrane is the thin wall of a bulb blown with a special glass.

Although the only difference of potential made aware of by experiment is that between the silver and mercury electrodes which is to be measured by a potentiometer, it is reasonable and convenient to assume potential jumps at *a*, *b*, c, *d* and *e*. With well-prepared electrodes. a given glass membrane and constant temperature, the potential jumps at *a*, b and *e* are constant. We may assume also that the liquid junction potential at d is practically a constant. At least it will be usually the same as that involved in the measurement of the pH of a standard by the hydrogen electrode method when such a standard is placed in the position of solution x. But if solution x be very different in nature from the standards, a new error may be introduced.

With the above assumptions, the variable potential jump at *c* is found to be a function of the pH of solution x. Indeed, the remarkable fact is that with special glasses and in the pH range of about 1 to 9 the potential difference across the glass membrane varies as

$$\frac{RT}{\mathbf{F}}ln\frac{(H^+)_1}{(H^+)_2}$$

where $(H^+)_1$ is the activity of the hydrogen ions on one side of the membrane and $(H^+)_2$ is the activity of the hydrogen ions on

the other side of the membrane.

Accordingly, for the cell illustrated, there is usually a linear relation between the E.M.F. of the cell and the pH of solution x and the slope of the line relating E.M.F. to pH is

$$\frac{\Delta \text{E.M.F.}}{\Delta \text{pH}} = 0.05916 \text{ at } 25^\circ \text{ C.}$$

or other appropriate values at other temperatures. Individual glass membranes may not give such a relation exactly'and may change in behaviour from time to time.

TABLE I.—Standard Buffer Solutions. Values of pH
(M = molar. *See* original references for values at other temperatures)

Solution	pH		
	10° C.	25° C.	38° C.
0.05M K tetroxalate	1.67*	1.68*	1.70*
KH tartrate, satd. at 25° C.	—	3.56*	3.54*
0.05M KH phthalate	4.00*	4.01*	4.03*
	—	4.010†	4.025†
	—	4.000‡	4.015‡
0.025M KH_2PO_4, 0.025M Na_2HPO_4	6.92*	6.86*	6.84*
	—	6.855†	6.835†
0.01M $Na_2B_4O_7$	9.33*	9.18*	9.08*
$Ca(OH)_2$, satd. at 25° C.	13.00§	12.45§	12.055

*Standard values recommended by the National Bureau of Standards. For original references *see* R. G. Bates, *Electrometric pH Determinations* (1954).
†Hitchcock and Taylor, *J. Am. Chem. Soc.*, 60:2710 (1938).
‡MacInnes, Belcher and Shedlovsky, *J. Am. Chem. Soc.*, 60:1094 (1938).
§Bates, Bower and Smith, *J. Res. Natl. Bur. Standards*, 56:305 (1956).

For this reason, and because the method is essentially comparative and secondary. it is wiser to rely upon standardization with standard buffer solutions than to depend upon the above "ideal" relation. To this end. each of a series of standard buffer solutions is placed in turn at the position of solution x, the E.M.F. of the cell is measured and the values of E.M.F. are plotted against the corresponding values of pH supplied in the specifications of the standard buffers. (See Table I.) Then. on testing an unknown, the observed E.M.F. of the cell will give on the line chart the value of pH. If the standard values of pH lie on a straight line, interpolation by calculation may be made. Under these conditions, the pH is given by the operational definition

$$\text{pH}_x = \text{pH}_s + \frac{\mathbf{E}_x - \mathbf{E}_s}{0.059156} \text{ at } 25^\circ \text{ C.} \qquad (33)$$

where x and s refer to solution x and the standard buffer solution, respectively. The national bureau of standards in Washington, D.C., supplies certified materials for the preparation of the standard buffer solutions.

Particularly in alkaline solutions the potential becomes a function not only of pH but also of the concentration of other cations such as Na^+.

There have been several systematic studies of the relation of the compositions of glasses to the behaviour of glass electrodes. Several satisfactory glasses are available commercially. The bulb form illustrated in fig. 5 is the most frequently used but with certain modifications to lower electrical leakage around the thin glass membrane. The bulb form is especially convenient because the silver-silver chloride electrode and hydrochloric acid solution (or other electrode-solution pair) may be placed on the inside and the standard or test solution on the outside.

By reason of the high electric resistance of the glass membrane, a galvanometer usually cannot be used directly as null-point instrument in the potentiometry of these cells.

Accordingly, in commercial instruments for the potentiometry of cells with glass membrane the electron valve is nearly always used to amplify the extremely small currents which flow at imbalance. A common glass electrode p~ meter is shown in fig. 6.

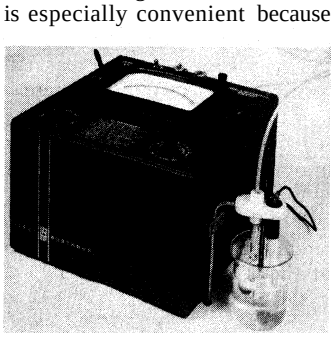

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FIG 6.—A pH METER WITH GLASS ELECTRODE AND CALOMEL ELECTRODE

BIBLIOGRAPHY.—W. M. Clark, *Topics in Physical Chemistry*, 2nd ed. (1952), *The Determination of Hydrogen Ions*, 3rd ed. (1928); D. A. MacInnes, *The Principles of Electrochemistry* (1939); H. S. Harned and B. B. Owen, *The Physical Chemistry of Electrolytic Solutions*, 2nd ed. (1950); H. T. S. Britton, *Hydrogen Ions; Their Determination and Importance in Pure and Industrial Chemistry*, 2 vol., 4th ed. (1955); R. G. Bates, *Electrometric pH Determinations* (1954); V. Gold, *pH Measurements* (1956); M. Dole, *The Glass Electrode* (1941); *I.* M. Kolthoff, *Acid-Base Indicators*, trans. *by C.* Rosenblum (1937); I. M. Kolthoff and H. A. Laitinen, *pH and Electro Titrations*, 2nd ed. (1941).
(W. M. CK., R. G. B.)

HYDROGEN PEROXIDE is a compound composed of hydrogen and oxygen. the formula for the molecule being H_2O_2. It was discovered in 1818, and in dilute solutions has been a familiar product since the turn of the 20th century, but high concentrations were considered too unstable to be practicable until World War II, when new techniques of storage and handling were developed. Hydrogen peroxide was used as a propellant for the launching of Germany's V-I missile; it has been a factor in postwar rocket experiments; and it has been used as the oxidant in a propellant mixture for submarines. Important industrial applications have also been found.

Hydrogen peroxide is of special interest in a comparison of its properties with those of water, because of its chemical relation to oxygen and water, because of the diverse reactions it undergoes and because of the numerous catalytic phenomena encountered in a study of these reactions. It is seldom prepared in the pure state. for in this condition mechanical shock or contact with many kinds of matter can result in violent explosion by decomposition. It is ordinarily handled as a solution in water, for in this state its sensitivity is much reduced.

The pure substance is a colourless liquid of melting point −0.9° C., and of density 1.442 g. per cubic centimetre at 25° C. It is considerably less volatile than water, its vapour pressure at 25° C. being 2.0 mm. as compared to 23.7 mm. for water. Hydrogen peroxide decomposes before the normal boiling point is reached. but by an extrapolation using measurements of its vapour pressure at lower temperatures, the normal boiling point has been estimated to be 151.4° C. The latent heats of vaporization and of fusion are 326 calories per gram and 79 calories per gram. respectively. The dielectric constant of hydrogen peroxide is 73.6 at 20° C. which is almost as high as that of water. As might be expected from the high value of the dielectric constant hydrogen peroxide is also a strongly dissociating solvent. Many simple salts are dissolved by the liquid and are highly dissociated in the resulting solution. Water and hydrogen peroxide are miscible in all proportions. A solid of composition $H_2O_2.H_2O$ and melting point −51° C. can be separated from the solution on lowering the temperature.

Speculation about the structure of hydrogen peroxide has been abundant, but reasoning based on purely chemical data has not led to a unique assignment of structure. However, by a combination of physical methods it has been shown that in the hydrogen peroxide molecule the oxygen atoms are directly bonded to each other, with one hydrogen atom on each oxygen atom. The molecule is not linear, but the line from a hydrogen atom to an oxygen atom makes an angle of about 100° with the line joining the two oxygen atoms. Furthermore. the hydrogen atoms do not lie in a single plane with the two oxygen atoms, but the plane defined by one hydrogen atom and the oxygen atoms makes an angle of about 100° with the plane defined by the other hydrogen atom and the oxygen atoms.

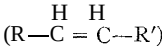
Uses of Hydrogen Peroxide and Its **Derivatives.**—Most applications of hydrogen peroxide exploit the properties it possesses as an oxidizing agent. It is a powerful oxidizing agent but is sufficiently slow so that the rate of its oxidizing action can conveniently be controlled by adjusting the conditions. Furthermore. water, the product resulting from its reduction, is not a harmful ingredient in most processes.

Hydrogen peroxide has been used in the bleaching of wool, silk, linen. furs, hair and hair products and fats. The bleaching action on animal fibres is particularly important, since such fibres

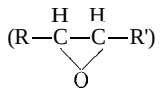
sustain less damage from the action of hydrogen peroxide than from other moderately priced oxidizing bleaches. The substance has also been applied as a preservative and as a disinfectant, since it possesses strong bacteriocidal properties. Many of the derivatives of hydrogen peroxide also are used as bleaches.

Peroxyhydrates of sodium carbonate. sodium borate and sodium phosphate are used in pharmaceutical, cosmetic and laundry preparations.

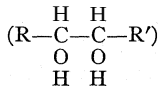
The use of peroxides as catalysts for polymerization reactions has become of great importance. Their catalytic property depends on the fact that on decomposition. or reaction with some reducing agents. unstable substances are formed which readily attack the molecules to be polymerized. Benzoyl peroxide. acetyl peroxide and peroxydisulfates have been used extensively for this type of reaction. Hydrogen peroxide and its derivatives find use in synthetic organic chemistry. for example, in converting a double bond grouping



to an epoxy grouping



or in hydroxylating it to form



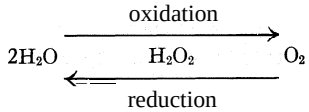
Such reactions are of importance in the chemistry of fats, waxes, terpenes and steroids.

Important developments in the use of hydrogen peroxide as a propellant appeared during World War II. The reaction $2H_2O_2 \rightarrow 2H_2O + O_2$ is exothermic. the decomposition to water vapour and oxygen of 1 g. of liquid hydrogen peroxide yielding *c.* 380 calories of heat. This reaction, catalyzed by manganese salts, was used by the Germans during World War II as a source of energy for the launching of the V-1 missiles.

The heat of reaction of hydrogen peroxide with combustible materials is greater than that of the corresponding reactions of oxygen. With methyl alcohol for example, the heat of the reaction $CH_3OH + 3H_2O_2 \rightarrow CO, + 5H_2O$ is greater than that of the reaction $CH_3OH + 3/20, + CO, + 2H_2O$ by a factor of 1.2j. This suggests the use of hydrogen peroxide as the oxidizing component of combustible mixtures, particularly where conservation of space is important. Such applications also began to be developed during World War II.

Chemical Properties. — Hydrogen peroxide possesses weakly acid character, and a metal peroxide such as barium peroxide: BaO_2, may be regarded as the salt of the acid H_2O_2 and the base $Ba(OH)_2$. In a 1% solution in water, only about 0.0003% of the hydrogen peroxide is dissociated to hydroperoxide ion. HO_2^-, and hydrogen ion. The tendency of H_2O_2 to dissociate does, however, exceed that of water. Besides the metal peroxides mentioned above, many other derivatives of hydrogen peroxide, in which the oxygen to oxygen link is maintained, are known. Some of these derivatives will be discussed below.

Hydrogen peroxide represents an intermediate stage for the transformation of oxygen to water, and for the reverse transformation. This observation is fundamental to an understanding of a large class of the reactions of the substance. The scheme below indicates the relationship of hydrogen peroxide to oxygen and to water.



The scheme also serves to illustrate the application in this system of the general terms oxidation and reduction (*q.v.*). For example, the transformations of water to hydrogen peroxide or to oxygen by the action of suitable reagents are described as oxidations of water. Agents which bring about the oxidation or the reduction of another substance are called oxidizing or reducing agents. respectively. On mutual interaction. the oxidizing agent is reduced and the reducing agent is oxidized. From its relation to water and to oxygen, it may be seen that hydrogen peroxide can function as an oxidizing agent (that is, on interaction with a reducing agent it is transformed to water) and that it can also function as a reducing agent, for on interaction with an oxidizing agent it is transformed to oxygen. This dual role which is readily displayed by the substance, makes its chemistry of unusual interest.

Hydrogen peroxide is a fairly powerful reducing agent and is much more powerful than water in this respect. The oxidizing agents chlorine, ceric salts and potassium permanganate (the last named being used in acid solution) readily oxidize hydrogen peroxide to oxygen, but the oxidation of water by these substances is slow. The reaction with potassium permanganate in acid solution may be used as a basis for the quantitative determination of hydrogen peroxide,

$$5H_2O_2 + 2MnO_4^- + 6H^+ = 2Mn^{++} + 5O_2 + 8H_2O.$$

As an oxidizing agent, hydrogen peroxide is very powerful, more powerful in fact than are oxygen and chlorine. The oxidations by hydrogen peroxide of metal iodides to iodine, of sulfites to sulfates and of ferrous salts to ferric salts, proceed readily even in dilute solution. The reaction in acid solution with potassium iodide is the basis of another method for the quantitative determination of hydrogen peroxide, $H_2O_2 + 2I^- + 2H^+ = 2H_2O + I_2$. When the hydrogen peroxide is concentrated, the oxidation of organic or other reducing substances can proceed as a combustion process and indeed with explosive violence.

Many of the reactions of hydrogen peroxide with even powerful oxidizing or reducing agents are slow, and interesting and diverse cases of catalysis are observable in these systems. For example, the rate of reduction of hydrogen peroxide by iodides is markedly accelerated by strong acids. by iron and copper salts, by soluble molybdates as well as by many other substances. The few substances named represent what are probably three essentially different modes of action for catalysts in this system. Catalysts for the reaction of hydrogen peroxide with certain reducing agents occur also in plant extracts and in blood. and are called peroxidases.

Hydrogen peroxide is unstable mith respect to decomposition into water and oxygen: $2H_2O_2 \rightarrow 2H_2O + O_2$. This reaction may be regarded as a self oxidation-reduction of hydrogen peroxide. So great is the tendency for the decomposition that in order to reverse it at room temperature a pressure of oxygen above a 1% solution of hydrogen peroxide in water in excess of 10^{30} atm. would have to be applied. Hydrogen peroxide exists only because the speed of decomposition under suitably chosen conditions is small. Most important of these conditions is the absence from the sample of catalytic impurities.

The catalysts which enhance the speed of decomposition of hydrogen peroxide are numerous and diverse in nature. Most surfaces increase the rate of decomposition noticeably. Among the more effective ones are the following: some metal surfaces, of silver, gold or platinum, for example, particularly if freshly deposited in a finely divided condition; some solid metal oxides, lead dioxide and manganese dioxide being examples. Accidental impurities such as dust are also catalytically active. Among soluble catalysts for the decomposition are iron and copper salts, particularly a mixture of the two, bromides and iodides under special conditions and alkaline substances. Catalase, an enzyme nhich occurs in plant and animal tissue, is also a catalyst for the decomposition. It has been suggested that an important function of catalase in living tissue is to bring about the destruction of the hydrogen peroxide which forms nhen oxygen is reduced by some substances during the metabolic processes. The effervescence observed when a solution of hydrogen peroxide is applied to a wound is a result of the liberation of oxygen on catalytic decomposition of the solution.

An increase in temperature or absorption of light by the substance also increases the rate of decomposition of hydrogen peroxide.

In many cases the mode of action of the catalysts which function in solution seems to involve both oxidized and reduced forms of the added substance. A schematic representation of the steps involved is given below. X and R stand, respectively, for the oxidized and reduced forms of the catalyst.

$$X + H_2O_2 \rightarrow R + O_2$$
$$R + H_2O_2 \rightarrow X + 2H_2O$$

The net result of the two steps is catalytic decomposition of the hydrogen peroxide, and it is evident, since there is no net consumption of the added substance, that a small amount can bring about the decomposition of large amounts.

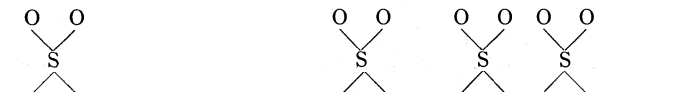
Preservation and Handling.— Hydrogen peroxide has commonly been sold dissolved in water at strengths of about 3% to 30%. Large quantities of a more concentrated product, about 90% or so in hydrogen peroxide, began to be produced at the time of World War II. The handling and storage of the unstable substance utilizes the fact that at room temperature or lower the decomposition of even the concentrated solution proceeds slowly in the absence of catalytic impurities and of light. Solutions of the lower strength are often stabilized by the addition of inhibitors; that is, catalysts which decrease the rate of reaction. A wide variety of substances function as inhibitor.' for the decomposition. One class including many mineral acids functions by keeping the solutions acid. Sodium silicate belongs to a class which functions also in basic solution. Acetanilide is a commonly employed representative of a large class of organic compounds which probably function by destroying catalysts for the decomposition which are produced by the decomposition itself.

The choice of container material is important for the handling and storage of all strengths, and particularly of the concentrated solutions. Containers of specially treated aluminum, block tin or pyrex glass have been used for the 90% solution, and these containers as well as those of ordinary glass or ceramic materials for handling solutions of lower strength.

Preparation and Manufacture.—From the relation of hydrogen peroxide to water its preparation by direct oxidation of water might be expected. No appreciable concentrations of hydrogen peroxide, however, have been built up by reactions of this type. This observation can be correlated with the fact that hydrogen peroxide is both a more rapid and more powerful reducing agent than is water, so that an oxidizing agent which oxidizes water will oxidize hydrogen peroxide even more rapidly, and thus prevent its accumulation in the system.

Production by the Electrolytic *Method.*—The direct oxidation of water to hydrogen peroxide at an anode during electrolysis is vitiated by the process mentioned above, as well as by catalytic decomposition of the substance at the electrode surface. Some derivatives of hydrogen peroxide, from which it can be prepared readily, are not so sensitive to these influences. Such derivatives do appear at high concentration when an appropriate solution is subjected to anodic oxidation, and they are thus used as intermediates in the electrolytic method for manufacture of hydrogen peroxide.

Peroxydisulfates have most commonly been employed as such intermediates. The relation of hydrogen peroxide to peroxydisulfuric acid is indicated by the structural equation below:



Peroxydisulfuric acid

The oxidation of sulfuric acid to peroxydisulfuric acid at the anode has been investigated in some detail, and the following conditions are found favourable for efficient oxidation: shiny platinum as anode material, relatively high current density at the anode, cooling below room temperature and a moderate rather than high or low concentration of sulfuric acid. The presence in the electrolyte of certain substances, among which are hydrogen fluoride and potassium ferricyanide, is found to be beneficial. These substances exert an influence even at low concentration, and probably function by changing the catalytic effect of the electrode surface, so that oxidation to peroxydisulfate rather than to oxygen occurs in the solution. Acidified solutions of ammonium sulfate and of potassium sulfate are also oxidized to peroxydisulfate with high current efficiency.

Other operational features which lead to successful commercial practice are as follo s: All materials must be of high purity to minimize decomposition of hydrogen peroxide during the concentration process. Ammonium bisulfate, potassium bisulfate and sulfuric acid are most often used as electrolytes. To prevent mixing of the anode and cathode solutions, the electrolytic cell is divided into anode and cathode compartments by the use of an unglazed porcelain diaphragm. A battery of electrolytic cells can be arranged to allow continued circulation of anode and cathode solution. This prevents local heating in the cells and leads to a cyclic rather than batch operation of the process.

Hydrogen peroxide is obtained from peroxydisulfates by the reaction with water: $H_2S_2O_8 + 2H_2O \rightarrow 2H_2SO_4 + H_2O_2$. This reaction proceeds with reasonable speed at temperatures of 60° C. or higher, if the solution is fairly acid. Hydrogen peroxide vapour mixed with water vapour is obtained from the heated anode liquor by evaporating the solution, these substances being much more volatile than other components of the solution. To minimize decomposition of hydrogen peroxide at the moderately high temperature of the evaporation step it must be carried out rapidly. One way of effecting this is to allow the anode liquor to flow in a thin film down a heated surface, thus exposing a large area of surface for unit volume of liquid.

Concentrated solutions of hydrogen peroxide can be prepared by introducing the mixed vapours of water and hydrogen peroxide into a fractionating column. Hydrogen peroxide, being less volatile than water, accumulates in the lower part of the column.

To manufacture concentrated solutions of hydrogen peroxide it is necessary to reduce the concentration of catalysts for the decomposition. This can be done by repeating the evaporation step before the final fractionation of the solution is undertaken.

Production by Methods Involving Reduction of Oxygen.—When barium oxide is heated at 500° or 600° C., it absorbs oxygen to form barium peroxide. On treatment with a suitable acid, hydrogen peroxide is obtained from this solid: $BaO_2 + H_2SO_4 \rightarrow BaSO_4 + H_2O_2$. This was the principal commercial process before the electrolytic method was developed. Several modifications have been attempted, differing from each other chiefly in the choice of acid. which in turn influences the method used for regeneration of barium oxide from the spent solid. Sulfuric acid has most often been employed, and in this case it is found desirable to convert the barium peroxide to its hydrate. $BaO_2 H_2O$, preliminary to the acid treatment. Unless this is done, a coating of barium sulfate over the solid prevents complete reaction of the barium peroxide. L. J. Thénard, who in 1818 first proved the existence of hydrogen peroxide. made use of the barium peroxide method in his preparation of the substance.

Sodium forms sodium peroxide directly on burning in excess air. Potassium, rubidium and caesium under the same conditions yield compounds containing oxygen in an oxidation state between that of peroxide and of elementary oxygen. The formulas for these compounds are KO_2, RbO_2 and CsO_2.

The interaction of some reducing agents with oxygen produces hydrogen peroxide directly. This is the case with many organic compounds. For example, the reduction of oxygen by hydrazobenzene to form hydrogen peroxide proceeds almost quantitatively. Hydrogen itself can be used as the reducing agent. Some hydrogen peroxide is formed when a mixture of hydrogen and oxygen, the former at a low partial pressure, is subjected to a silent electrical discharge, or when a mixture of the gases containing also mercury vapour absorbs ultraviolet light. The combination to hydrogen peroxide proceeds also in water containing finely divided platinum or palladium as catalysts. In slightly acid solution at a mercury cathode. substantial reduction of oxygen to hydrogen peroxide can be achieved if the partial pressure of the gas is fairly high. Efforts have been made to exploit all of these types of reaction for the commercial production of hydro-

gen peroxide. The electrolytic method remained most important in the United States at mid-20th century.

Peroxy Compounds.—The unit of structure containing two oxygen atoms bound together. each of these in turn being bound to other atoms, is present in all true peroxy compounds. Almost all true peroxy compounds yield hydrogen peroxide when treated by a strong acid such as sulfuric acid, and this fact can be used to distinguish substances containing the peroxide linkage from others of similar formula, which do not. Thus, barium peroxide, BaO_2, but not lead dioxide. PbO_2, forms hydrogen peroxide on being subjected to the test. The study of the structure of the solids using X-ray methods substantiates the conclusion that only the former is a true peroxide.

Peroxy compounds may be considered derivatives of hydrogen peroxide. and they can be classified conveniently by developing the analogy betneen peroxy compounds and similar simple oxy compounds. The analogous structural units in the two systems are indicated below:

Peroxy compounds	*Oxy compounds*
H—0—0—H	H—O—H
R—O—O—H	R—0—H
R′—O—O—R	R′—O—R

It is seen that the group –O–O– is formally equivalent to –O– and –O–O–H to –0–H.

In the classification below, the common peroxides are considered in their relation to simple oxy compounds.

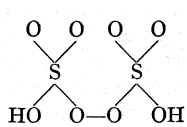
Peroxy *Analogues* of Metal *Oxides* and Hydroxides.—Some well-defined metal peroxides are: Na_2O_2, MgO_2, CaO_2, BaO_2, ZnO_2. There is evidence also for the existence of peroxides of copper mercury and other metals. These substances are solids at room temperature. the solid being compoied of the positively charged metal ions and the negatively charged peroxide ion, $O_2^{=}$.

Among the metal hydroperoxides NaOOH is the peroxy analogue of NaOH. The distinction between this class and the members of the class of the peroxy analogues of the oxyacids is not always sharp, just as a definite classification of a substance as being an acidic or basic hydroxide cannot always be made. Metal peroxides and hydroperoxides are strong oxidizing agents. Some of them, Na_2O_2 for example. react rapidly with water to yield hydrogen peroxide (which decomposes rapidly since the solution becomes basic); others require a strong acid to bring about the reaction.

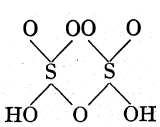
Peroxy Analogues of Oxyacids or *Their* Salts—The peroxides in this class are related to the oxyacids by replacing an –0–H group of the oxyacid by the group –O–O–H. Well-defined examples of such peroxy compounds are peroxymonosulfuric acid, H_2SO_5, peroxymonophosphoric acid, H_3PO_5, and peroxyacetic acid $CH_3CO.OOH$. Other members are derived from chromic, molybdic, tungstic, vanadic, columbic, tantalic, carbonic and germanic acids. from the hydroxides of tin, titanium, zirconium. thorium. cerium, uranium and from many organic acids. The peroxide derivative of titanium hydroxide has a deep yellow colour and is the basis of a qualitative test for the presence of hydrogen peroxide in water solution.

Some of the foregoing examples are known only as the peroxy derivatives of the salts corresponding to the acids. It is of interest to note that the –O–O–H group in the peroxy compounds is in general not so acidic as the –0–H group in the related oxy compound. All the members of this class are powerful oxidizing agents, and most of them oxidize iodides to iodine more rapidly than does hydrogen peroxide. The catalysis of the reaction between hydrogen peroxide and iodides by soluble molybdates probably results from the rapid formation of a peroxymolybdic acid, which in turn rapidly oxidizes iodides.

Peroxy Analogues of Pyroacids or of *Pyrosalts*.—A single example is cited to establish the analogy:



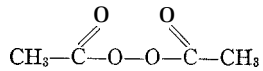
Peroxydisulfuric acid



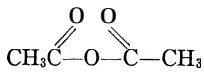
Pyrosulfuric acid

Another member of this class is peroxydiphosphoric acid, $H_4P_2O_8$. Salts of these peroxides exist, examples being $K_2S_2O_8$ and $Na_2C_2O_6$. On hydrolysis. members of this class yield the corresponding peroxymonoacid in the first step. All are powerful oxidizing agents. but are not readily oxidizable.

Peroxy *Analogues* of Acid Anhydrides.—The chemical properties are similar to those of the preceding group, except that the compounds do not possess acid properties.



Acetyl peroxide



Acetic anhydride

Benzoyl peroxide is a second common example of this class.

Peroxy *Analogues* of Alcohols, Ethers and *Other* Oxy Organic Compounds.—Some examples, with oxy analogues, are:

CH_3OOH	CH_3OH
Methyl hydroperoxide	Methyl alcohol
$CH_3—O—O—CH_3$	$CH_3—O—CH_3$
Dimethyl peroxide	Dimethyl ether

The analogy extends to many other compounds but is not complete in every case, since in a few instances the oxy analogue of a known peroxide is not known. Most members of this group are strong oxidizing agents, and in common nith other organic peroxides many are dangerous to handle in the pure state, because of the possibility of explosive decomposition initiated by shock.

Peroxy *Analogues* of Hydrates.--In these compounds, hydrogen peroxide is incorporated into crystals of various substances in the same way that nater is incorporated into hydrates. The substances in this class when dissolved in water yield a solution of hydrogen peroxide and the carrier substance, and they thus provide a convenient means of handling hydrogen peroxide. Examples are: $Na_2SO_4.9H_2O.H_2O_2$ and $Na_3PO_4.2H_2O_2$.

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HYDROGRAPHY, the science dealing with all the waters of the earth's surface, including the description of their physical features and conditions; the preparation of charts showing the position of lakes. rivers, seas, the contour of the sea bottom, the position of shallows, deeps, reefs and the direction and volume of currents; a scientific description of the position. volume, configuration, motion and condition of all the waters of the earth. See also OCEAN AND OCEANOGRAPHY. The hydrographic department of the British admiralty, established in 1795, makes charts for the admiralty, and is under the hydrographer to the admiralty. The corresponding hydrographic office in the United States was established in 1866 in connection nith the bureau of navigation in the navy department. (See CHART.)

HYDROLOGY is the science which treats of the occurrence, quality and effects of water on the land areas of the earth. It deals aith snow and ice on the land, liquid water in streams and lakes and water occurring in the interstices of soil and rock. Meteorology (*q.v.*) and oceanography (see OCEAN AXD OCEANOGRAPHY) are related sciences. Various aspects of hydrology are discussed in the separate articles: DROUGHT; FLOOD; GLACIER; RAINFALL; SNOW, etc. In addition to the references to related material given in the several sections of this article, see also GEOCHEMISTRY: Geochemistry of the Hydrosphere; GEOLOGY; GROUXD WATER; SOIL.

Hydrologic Cycle.—The central concept in hydrology is the hydrologic cycle. Water evaporated from the oceans is carried over the continents by moving air masses and precipitated as rain or snow. About one-third of this water returns to the oceans as surface streamflow or subterranean percolation. The remaining two-thirds is returned to the atmosphere by evaporation or by transpiration of plants. The energy of the sun thus serves to distill sea water and distribute the resultant fresh water over the land to supply the needs of plants, animals and man.

This fresh water is not, however, delivered continuously to all

parts of the world at a rate commensurate with local needs. Desert areas receive little or no water, while some other regions receive far too much. Even in areas where the normal precipitation is adequate. there may be prolonged periods of drought or periods when excessive precipitation causes floods. The hydrologist seeks to predict the probable magnitude of droughts and floods and the amount of water available for use in a specific area. He may also make short-term forecasts of floods and water supply for the operation of reservoirs and for emergency flood protection. The science of hydrology is, therefore, basic to planning of projects for reducing flood damage, developing water power. controlling erosion and providing adequate water for domestic, agricultural and industrial use.

Origin of Hydrologic Concept.—The source of the waters of springs and streams constituted a puzzling problem that early aroused much discussion and controversy. Before the 17th century it was generally assumed that the spring water could not be derived from rain because the rainfall was believed inadequate in quantity and the earth too impervious to permit penetration of the rain water far below the surface Some ancient philosophers assumed that the water nas derived from huge. inexhaustible, subterranean reservoirs, but others recognized that there must be replenishment of the reservoirs which supply the springs Thus arose the concept of a hydrologic cycle in which the sea water was supposed to be conducted through subterranean channels below the mountains and then, somehow. purified and raised to the springs. In the middle ages this hypothesis was based on passages in the Bible such as Eccles. i, 7, and for centuries it was heresy to doubt it.

It is now known that the ground water. which supplies the springs. wells and fair-weather flow of the streams. is derived from rain and snow by infiltration from the surface. except a minor part which is juvenile water derived from the hot magma within the earth. Among early champions of the infiltration theory mere the Roman architect Marcus Vitruvius. who lived about the time of Christ, the Italian artist and sage Leonardo da Vinci (1452–1519) and the French potter and pioneer paleontologist Bernard Palissy (1510–89).

The founders of the science of hydrology may be considered to be the French physicists Pierre Perrault (1608–80) and Edmé Mariotte (*c.* 1620–84) and the English astronomer Edmund Halley (1656–1742). First Perrault and then Mariotte made crude measurements of the precipitation in the basin of the Seine river and of the discharge of the river, and thus demonstrated that water which falls as rain and snow is ample to supply the flow of the river. Mariotte also made observations which showed that rain water penetrates the earth Halley made careful tests of the rate of evaporation and crude estimates of runoff, from which he concluded that the evaporation from the Mediterranean sea is ample to supply the inflow from streams.

Precipitation.—Water is always present in the atmosphere as an invisible gas (water vapour). Under favourable conditions this vapour condenses into droplets of water or ice crystals, forming clouds and ultimately rain or snow. If all the moisture in the atmosphere were precipitated it would cover the earth to an average depth of only about one inch However, a continued inflow of moisture-laden air into a storm area may result in precipitation of more than 40 in. in 24 hours The intensity of precipitation, the annual amount and the seasonal distribution vary greatly from place to place and from time to time in a given place. The causes of these variations are the subject matter of meteorology, but their effects on the regimen of surface and underground water create the basic problems of hydrology.

Amounts of precipitation are expressed in terms of the depth in inches or millimetres nhich would accumulate on a flat surface if none of the water nere allowed to run off. The simplest rain gauge consists of a cylindrical vessel surmounted by a funnel of larger diameter so that the depth in the cylinder is multiplied for more accurate measurement. A variety of patterns are used with the funnels ranging from 3 to 8 in. in diameter.

Snon constitutes only a minor portion of the precipitation on the norld as a whole, but in frigid zones and at high altitudes snow may be the most common form of precipitation. The snow pack accumulated in mountains adjacent to arid or semiarid regions may constitute a natural reservoir far larger than any built by man. The melting of this mountain snow during spring and early summer is often an important source of irrigation water. In many such regions snow surveys are conducted to determine the water content of the snow pack as a basis for forecasts of water yield to the adjacent valleys. The water content is determined by extracting a core of snow with a special sampling tube and weighing the tube and the snow core.

Glaciers.—Where snowfall is too heavy and the climate too cold for all of the snow to melt in summer, there is a progressive accumulation until glaciers are formed which creep down the valleys and move into warmer zones, where their fronts are melted off or are pushed into the sea. forming icebergs. Records have been kept of the annual advance or retreat of the ice fronts of many glaciers, especially in the Swiss Alps beginning in 1874. Photogrammetric maps are made of certain glaciers in the Alps, and these show the volumetric changes from year to year.

Various sources of information show that within historic times there were important cycles of advance and retreat, indicating cycles of climatic fluctuation. There was general advance from about 1600 to about 1850, and general retreat after that time. In the Pleistocene epoch (*q.v.*), covering approximately 1,000,000 years, there were four great glacial stages, when the northern parts of Europe. Asia and North America were covered with ice which at some places was thousands of feet thick. In those cold stages so much water was locked up in ice that sea level all over the earth went down a few hundred feet below the modern level. However, there is still so much ice in the polar and mountain regions that if it should all melt, the sea level would rise about 200 ft.

Runoff.—As rain falls to the earth a portion is intercepted by the leaves and stems of vegetation and eventually returned to the atmosphere by evaporation. Still another portion is retained in puddles on the ground surface. Part of this water may infiltrate into the soil but the greater portion is usually evaporated. Much of the remaining water which reaches the ground infiltrates into the soil under the action of gravity and capillarity. The infiltration capacity of soils varies greatly. Water will infiltrate more rapidly into dry soil than into moist soil. Sandy soils are more pervious than clay soils. while broken lava and cavernous limestone terranes are highly permeable. Forests and grasslands usually have a higher infiltration capacity than cultivated soils because cultivation destroys the channels created by decayed roots and by worms, and because the vegetal cover protects the soil from compaction by raindrops. The infiltration capacity of rock outcrops, paved surfaces, buildings, etc., is practically zero. Some of the infiltrated water is absorbed by the soil as soil moisture. When the soil moisture is replenished, water moves laterally through the soil toward the streams and downward toward the ground water. Only when rainfall intensity exceeds infiltration capacity does surface runoff or overland flow occur.

The quantities of water which are distributed to interception, puddles, soil moisture. lateral flow, surface runoff and ground water vary greatly from storm to storm depending on many factors. A key problem in hydrology is to determine the relations governing this distribution, so that it is possible to predict the quantity of inflow to the streams from a given storm for the determination of designs for reservoir spillways, culverts and storm drains and for flood forecasting.

Ground Water.—The term ground water is applied to water found in zones of saturation in the ground where all interstices between soil or rock grains are filled with nater. Soil or rock strata which are sufficiently permeable to yield useful quantities of water to wells are called aquifers. The upper surface of the zone of saturation is called the water table. Artesian aquifers are covered by a stratum of impermeable material and the confined water is under pressure so that it will rise in a well to a level above the top of the aquifer and may even discharge at the ground surface without pumping. Where the water table intersects streams, lakes or swamps, ground water is discharged and becomes surface water. A spring occurs when the water table intersects the ground surface.

Movement of ground water is extremely slow and years or even centuries may elapse between the time a particle of water is added to the ground water and the time it is discharged from the ground water.

Under natural conditions a ground-water basin will remain in approximate equilibrium with the water table rising slightly during wet periods and falling during droughts. When man withdraws ground water through wells this equilibrium is disturbed, A major problem in hydrology is to determine the amount of water which may be withdrawn annually from a ground-water basin without depleting the supply to such an extent that use of the water becomes uneconomical. Where large ground-water reserves exist it may be permissible to mine them in the same sense that other minerals are mined. but this must be recognized in estimating the safe yield. Water level in key wells is observed periodically or recorded continuously by automatic gauges to provide data on changes in ground-water storage. The ground water may be artificially recharged by introduction of surface water through percolation areas or recharge wells. In many areas ground-water basins are operated as reservoirs (*q.v.*) in the same manner as (and sometimes in conjunction with) surface reservoirs. *See* also SPRINGS; WELL.

Evapotranspiration.— Water in lakes and streams, soil moisture and snow on the ground is subject to evaporation. Soil moisture is also subject to transpiration, the process by which plants take up moisture through their roots and discharge it to the atmosphere through their leaves. The total of these water losses from an area is called evapotranspiration. Estimates of probable evapotranspiration from cropland serve as a basis for determining the need for irrigation water. Evaporation loss from lakes and reservoirs in arid regions may amount to as much as ten feet of depth per year. This loss can be an important factor in determining the amount of water which the reservoir can supply for beneficial use. Hydrology is concerned with land management for maximum water yield and therefore is interested in minimizing nonbeneficial evapotranspiration. Evapotranspiration by forests and grassland is a beneficial use of water insofar as the vegetation produces timber or livestock feed and protects the soil from erosion. Brush and stream bank or swamp vegetation may utilize large amounts of water without benefit to man.

There is no method for direct measurement of evaporation from lakes or evapotranspiration from land areas. The evaporation from small tanks of water can be measured, but these measurements must be adjusted to provide estimates of loss from natural water bodies. Potential evapotranspiration can be measured by determining the water loss from tanks filled with soil, planted with vegetation typical of the area and supplied with sufficient water to satisfy the needs of the plants. Actual evapotranspiration from the adjacent area will be less than the measured loss from the tank to the extent that the natural water supply for plant growth is deficient during some parts of the year.

Streamflow.— The aater in surface channels is known as streamflow and for the most part is ultimately discharged into the ocean. Some streams flow in closed basins from which there is no outlet, and their flow is ultimately evaporated or percolated to the ground water. Streams flowing entirely above the water table may lose much or all of their flow to the ground water if the stream bed is sufficiently permeable. Data for annual maximum water level on the Nile river at Cairo, Egy., are reasonably complete from AD. 622 except for the 16th and 17th centuries. However, the earliest systematic measurements of daily discharge of a stream were those on the Rhine river at Basle, Switz.. from 1809 to 1821.

Records of streamflow are usually obtained by periodic measurements of the velocity of flow with a current meter. The cross-sectional area of the stream multiplied by the measured velocity vields the flow rate. The discharge at each such measurement is correlated with the stage (water level) at the time of measurement to obtain a stage–discharge relationship. Continuous records of stage are then obtained by automatic, float-operated recorders, or frequent readings of water level are obtained from a scale set in the stream. The rate of flow at any time or the volume of streamflow for any period can be calculated from this stage record by use of the known relation between stage and flow.

In arid regions streams commonly go dry during rainless periods, while in humid regions dry-weather flows are usually small and derived largely from ground water. In response to rainfall or snowmelt the flow rate increases to a maximum and then decreases when the rain or melting ends. The response of small basins or basins with steep topography is usually very rapid. the peak relatively high and the duration of the response relatively short. Large basins or basins with flat terrane. many lakes or highly permeable soils will show slow increases. relatively low peaks and a slow decline following the peak. Many such increases of streamflow occur each year in most streams but only occasionally does the peak flow exceed the capacity of the stream channel causing a flood.

Much study has been given to the many factors which determine the magnitude and expectancy of floods and droughts. The flood history of streams that have been gauged over a long period of years may be analyzed by statistical methods to determine expectancy. Because of the difficulty of defining a drought precisely. statistical analysis of drought is less successful. Extremes of flow on ungauged streams must be estimated from physical analysis and comparison with similar streams. Despite the geologic evidence of long-term climatic changes, indications are that within the time periods of interest in most engineering designs, extremes of flow may be considered as random processes governed by chance and not subject to cyclic variation.

Water Quality.——Much of the energy of falling raindrops and flowing water is expended in erosion of soil and rock. The impact of raindrops has been shown to be important in initiating soil erosion. Vegetal cover shelters the soil from this impact and thus reduces erosion. Water in streams erodes the bed and banks, carving canyons and forming flood plains. Erosion is a natural process which has created arable valleys and fertile deltas which are important agricultural areas. However, cultivation and other activities of man may accelerate erosion of valuable topsoil, which may ultimately fill useful storage space in downstream reservoirs or clog stream channels. Hydrology is concerned with finding means of minimizing erosion on the land and with estimating the quantity of sediment carried by streams. This requires study of the mechanics of erosion of land surfaces. the influence of various protective measures on the erosion rate and the mechanics of sediment transport in flowing water. The quantity of suspended sediment in a stream is measured by lowering a sampler into the stream to extract a sample of sediment-laden water. The sample is filtered to remove the sediment, which is dried and weighed to determine the concentration of sediment in the sample. The total volume of streamflow multiplied by the concentration ratio yields the total sediment transport.

Sediment is not the only material transported by water. Most natural waters contain dissolved minerals of various kinds derived from the mineral constituents of the rocks and soil of the drainage basin. Some minerals are undesirable in water which is used for irrigation, domestic or industrial purposes. Hence, chemical analysis of natural waters is part of the task of hydrology. These analyses are used to predict the limitations on use of the water and the steps necessary to make its use possible. Chemical analysis of ground water may help in establishing its source.

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(R K. L.)

HYDROLYSIS: *see* SOLUTIONS.

HYDROMECHANICS, the branch of applied physics that deals with the equilibrium and motion of liquids, most commonly water, and with the behaviour of bodies floating or immersed in liquids. Hydromechanics finds application in widely diverse problems ranging from the design of submarines and ocean liners to the study of motion of naval torpedoes. Hydromechanics includes hydrostatics. which is the study of liquids at rest; hydraulics, which is concerned with the properties, behaviour and effects of liquids at rest or (usually) in motion (see HYDRAULICS, APPLIED);

and hydrodynamics. which is concerned with the motion of liquids and the interaction of liquids with boundary surfaces.

Liquids (*e.g.*, water) and gases (*e.g.*, air) are known collectively as fluids. The properties and actions of fluids are determined essentially by the behaviour of the molecules of which they are composed, the major difference between liquids and gases being that in the former the molecules are spaced more closely together (see LIQUID STATE, THE). Because of this similarity of molecular structure, many of the laws governing the mechanics of liquids are identical to those governing the mechanics of gases, and the growing field of study known as fluid mechanics includes both theoretical analyses and experimental results that are applicable to fluids in general (see MECHANICS, FLUID).

HYDROMEDUSAE, an obsolete term for marine animals, particularly jellyfish, of the class Hydrozoa (*q.v.*), phylum Coelenterata (*q.v.*).

HYDROMETALLURGY is the science and technology of extracting and recovering metals chemically from ores by the use of aqueous solutions, as distinct from pyrometallurgy which comprises smelting and other similar high-temperature operations. (For discussion of various methods of extracting metals see METALLURGY.) The principles involved in hydrometallurgy are those of physical chemistry, inorganic chemistry, electrochemistry and analytical chemistry: indeed, the production of metals by hydrometallurgy can be broadly described as extensions of these principles on a commercial and economic scale The procedures commonly employed in hydrometallurgical operations represent combinations of the techniques used in mineral dressing, chemical engineering and electrochemical technology.

The operations usually involved are: the dissolution of a metal or metal compound by a suitable lixiviant (water alone or with added reagents) usually termed leaching; the separation of naste and purification of the leach solution; and the precipitation of metal from the leach solution by chemical or electrolytic means.

Developed initially at the turn of the 20th century for recovering gold from low-grade ores the technology of hydrometallurgy has advanced to the point where not only have the earlier techniques been improved but such procedures as ion exchange, solvent extraction, distillation and high-pressure, high-temperature leaching and precipitation have been proved to the extent that they are recognized as conventional operations.

In addition to the cross references to related articles given under the various headings of this article, see also ELECTROCHEMISTRY; ELECTROMETALLURGY; ION EXCHANGE.

Following are the main divisions of this article:

I. HISTORICAL BACKGROUND

Hydrometallurgical processes are used commercially because they are convenient to operate. the recovery of metals is high and operating costs usually are low, and especially because of the variety of quantitative chemical separations that can be made in aqueous solutions much more readily than is possible nith the melts used in pyrometallurgical processes. The importance of these considerations is attested by the fact that hydrometallurgical techniques are used wholly or in part to produce. in commercial form, all but 6 or 7 of the 82 known metallic elements.

Of the metals produced by the use of aqueous solutions, few are converted from ore to pure metal using only hydrometallurgy: usually the "wet" methods are used in combination nith other procedures. Aluminum, for example, is produced by dissolving the ore (bauxite) in caustic soda solution, precipitating aluminum hydroxide from the solution and calcining the hydroxide to produce aluminum oxide which is treated in an electrolytic cell containing fused salts to produce pure aluminum metal. Some zinc sulfide ores are first oxidized at a high temperature to produce zinc oxide which is then dissolved in weak sulfuric acid and the acid solution electrolyzed to produce pure zinc. Simple tin ores are smelted directly. but complex ores are first treated with acid solutions to remove impurities and the remaining insoluble tin mineral is smelted to produce pure metal. Some copper ores are smelted to produce impure copper metal which is then refined by electrolysis in copper sulfate solutions: others are dissolved directly with acid solutions and the copper metal precipitated from the solutions by various means. Nickel and cobalt are produced either by purely hydrometallurgical processes or by combined pyrometallurgical and hydrometallurgical techniques. Much of the world's gold is recovered from ores by dissolution with cyanide solutions from which the gold is subsequently precipitated as metal. The list could be extended to include uranium, vanadium, chromium, rare earths, alkali metals, platinum metals, gallium, indium, germanium, tantalum, the radioactive metals and many others for which chemical techniques employing aqueous solutions are used, either alone or in combination with pyrometallurgy, to produce metals on a commercial scale.

Because the successful operation of hydrometallurgical processes depends so greatly on a knowledge of metal chemistry and of chemical engineering, it is not surprising that wide commercial application is a comparatively recent development. As early as the 16th century ferrous sulfate was produced by slowly oxidizing pyrite (FeS_2) in the open air to form $FeSO_4$, extracting the soluble sulfate with uater and evaporating to crystallize hydrated ferrous sulfate (green vitriol). During the next three centuries copper sulfate (blue vitriol) was produced in a similar manner at Rio Tinto in Spain. where chalcopyrite ($CuFeS_2$) had been mined since early in the Christian era. Some copper metal may have been produced at Rio Tinto and other copper mines from the copper sulfate solutions by precipitation with iron but the amount was negligible, as iron, which was sacrificed to precipitate the copper, was itself difficult to make and hence scarce.

With the increasing knowledge of chemistry and the advancement of chemical technology in the mid-19th century the first important commercial applications of hydrometallurgy were established. A particularly important factor was the development of commercial direct current generators in the 1860s and 1870s which provided for the first time an efficient low-cost technique for precipitating metals by electrolysis from aqueous solutions. The improvements in mechanical equipment such as extraction vessels, liquid-solid separation units and precipitation techniques devised for the treatment of gold ores following the discovery of the cyanide process (*q.v.*) in 1890 provided the full complement of tools required for broad extension of hydrometallurgical methods.

After the beginning of the 20th century methods were improved and were augmented by the addition of still other techniques such as ion exchange, solvent extraction and superatmospheric pressure extraction and metal precipitation. There evolved the great copper-leaching plants in South America, the United States and Africa; vast aluminum extraction plants throughout the world; the electrolytic zinc industry; the plants producing nickel and

cobalt from sulfide ores and from the lateritic deposits in Cuba and other tropical areas; the gold-producing plants of South Africa. Canada, Australia and the United States; and, by no means last. the gigantic plants in many parts of the world that employ hydrometallurgical techniques to extract uranium from ores that contain as little as $\frac{1}{5}$ lb. of uranium in 2,000 lb. of ore.

The exceptional advances that have been scored by hydrometallurgy in the past century can be attributed almost entirely to one factor — the better understanding of the scientific and technologic principles upon which these processes are based. It is not out of the way, therefore, at this point to review briefly the principles and procedures upon which the industry depends.

II. PRINCIPLES AND METHODS

In treating ores, minerals, scrap metals and similar material by hydrometallurgical methods one inescapable fact that must be constantly borne in mind is that because of the endless variety of sources, no two are absolutely identical. Thus every hydrometallurgical process presents a unique problem, which must be solved on the basis of the chemical, physical and economic factors peculiar to the starting material involved.

A second consideration is that. as all hydrometallurgical operations are carried out using water as a solvent, the reactions that can be used are limited by the physical and chemical properties of water. The freezing point of salt solutions represents a minimum temperature boundary; the boiling point is another boundary which. of course. can be extended if reaction vessels are enclosed and operated under superatmospheric pressure. The specific gravity and viscosity of aqueous solutions have an important bearing on the ease of separation of solids from liquids by settling, filtration, centrifuging and other physical means. Of the utmost importance are the solubilities of gases and metal salts in water or other aqueous solutions containing acids, ammonia, caustic soda, bicarbonates and cyanide at different temperatures and in the presence of various solutes.

Chemically, water can combine with certain metal salts to produce hydrated compounds. Also, it can enter into hydrolysis reactions in which it acts as a source of hydrogen ions (H^+) or hydroxyl ions (OH^-) and into oxidation-reduction reactions. In an electrolytic cell water decomposes to form H_2 at a lower voltage than do the dissolved salts of many of the metals, thus restricting the number of metals that can be electrolytically precipitated from an aqueous solution.

A third factor that influences most hydrometallurgical operations is that, as a rule, one of the reactants is a solid metal or compound which is either dissolved by the solutions during leaching or is precipitated from the leach solution by chemical or electrolytic means. Thus some limitations are imposed by the physical character of the solids present — their crystal form, porosity. particle size, surface area, solubility in the aqueous solutions used and, perhaps most important, the character and state of the solid-liquid interface layer, where the actual reaction of dissolution or precipitation takes place.

The feasibility and successful conduct of a hydrometallurgical operation depend on a variety of factors any or all of which may be critical depending on individual circumstances. The very nature of these processes postulates the need for an adequate supply of water and, because metals are present as ions in aqueous solutions, requires that a source of energy be available to convert the ions to metallic form. Beyond these essential features the practical, physical and chemical factors that must be considered are:

1. The metals or minerals that are to be dissolved must be soluble in the leaching solution used and must be accessible to the solution—*i.e.*, not occluded by insoluble constituents.
2. The solvent used must usually be such that it will dissolve selectively the desired metals or minerals leaving the other minerals or metals as an insoluble solid residue.
3. The solution, when it contains valuable metals, should be such that the metals present can be readily separated from one another.
4. The solution must also be such that the desired metals can be precipitated from it by one means or another producing either pure metal, a mixture of metals or a metal salt.
5. For economic reasons, it is usually necessary that the leach solution be capable of being regenerated and used again, or that it be treated to recover by-products: not infrequently by-product recovery from end solutions is an important source of revenue.

The various aspects of hydrometallurgical processes can be illustrated and explained by discussing in some detail the principle involved in each phase of the operation and outlining the procedures commonly used to carry them out in practice.

A. PREPARATION

The ores, concentrates, synthetic sulfides, alloys and other materials that are to be leached in aqueous solutions must be prepared physically and chemically to provide for accessibility of the lixiviant and for dissolution of the desired constituents. The extent of physical preparation required depends almost entirely upon the size of the grains of the mineral present in the ore. In general, it may be said that from the point of view of increasing rate of dissolution, it is desirable to grind the ore particles as fine as possible and thus present the greatest surface area to the lixiviant The advantages to be gained by grinding are limited, however, by the excessive cost of grinding particles to less than about 40 microns in diameter and by the difficulties involved in separating very fine particles from the aqueous solution when leaching is completed If the ore is porous the surface area is usually large and less grinding is required.

Chemical pretreatment, which is quite another matter, is carried out with the object of decomposing the constituents of the ore, concentrate or other materials to render them soluble or insoluble or to increase their porosity and thus permit access of solvent to fine particles that were originally occluded by a dense constituent. A variety of chemical pretreatments in common use are discussed below.

1. Oxidizing Roast. — Sulfide ores of zinc, copper, cobalt and some other metals are oxidized in air at temperatures above 500° C. to produce the metal sulfates or oxides which, unlike the sulfides, are readily soluble in weak sulfuric acid. Ores containing gold in the presence of sulfides such as pyrite (FeS_2) or arsenopyrite (FeAsS) are roasted in air to convert the dense sulfide minerals to porous oxides, thus permitting access of cyanide leaching solution to gold particles which were originally occluded by the sulfides.

By proper control of temperature and gas concentration cobalt and iron sulfide ore, for example, can be roasted to convert the cobalt sulfide to cobalt sulfate and the iron sulfide to iron oxide, thus giving a product from which the cobalt sulfate can be extracted with weak sulfuric acid leaving an insoluble iron oxide residue.

2. Oxidizing Roast With Added Reagents. — The object of this procedure is to convert some of the metal compounds in an ore to soluble form, leaving others as insoluble compounds. Thus residues from pyrite burning which contain small amounts of copper, cobalt, nickel, zinc, gold, silver and other valuable metals are mixed with salt (NaCl) and roasted to convert the valuable metals to soluble chlorides, leaving the iron as an insoluble oxide. Similarly, nickel oxide containing 0.1% sulfur is mixed with a small amount of soda ash (Na_2CO_3) and roasted at 1,200° C.: the soda ash reacts with the sulfur to form sodium sulfate (Na_2SO_4) which can be dissolved with water, leaving sulfur-free nickel oxide.

Also, with ores containing both uranium and vanadium, the vanadium. normally insoluble after roasting, can be rendered soluble by roasting with the admixture of calcium sulfate or salt which converts the vanadium to a soluble vanadate. In the sulfuric acid "bake" (commonly used in preparing ores, flue dusts and similar materials containing copper, cobalt, germanium and other metals for subsequent leaching) the ore is mixed with concentrated H_2SO_4 and baked at relatively low temperatures to produce soluble sulfates of the metals.

3. Nonoxidizing Roast. — Minerals such as pyrite and arsenopyrite when heated to a suitable temperature without access of air are decomposed, the "free" atoms of sulfur and arsenic being volatilized, leaving a residue which resembles pyrrhotite (Fe_nS_{n+1}). In this form they react with solutions of ferric chloride, chlorine. oxygen or other strong oxidizing agents to produce elemental sulfur.

4. Reducing Roast. — The purpose of the reducing roast is to

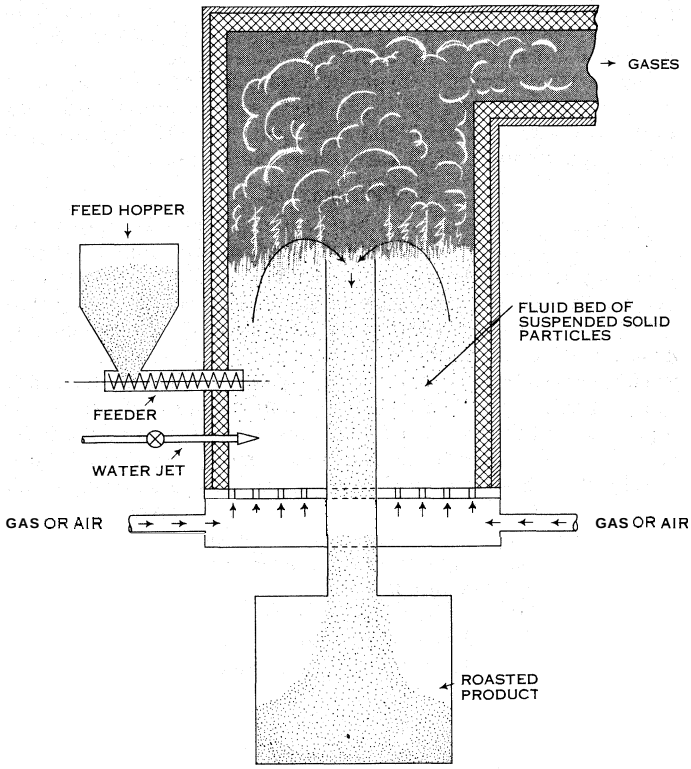

FIG. 1.- -FLUID BED ROASTER

reduce selectively metal oxides to metallic form. Nickel silicate ores, for example, containing magnesia, silica and iron oxide, as well as nickel and cobalt in oxidized form are heated in the presence of reducing gases (H_2 and CO) under such conditions that only nickel and cobalt are reduced to metallic form, the iron, silica and magnesia remaining as oxides. The metallic nickel and cobalt can then be selectively dissolved in oxidizing solutions containing ammonia and ammonium salts.

5. Fusion in Molten Salts. — Refractory minerals of tantalum and columbium are usually insoluble even in the strongest acid or alkaline solutions. It is common practice to fuse these minerals in molten caustic (NaOH) or sodium bisulfate ($NaHSO_4$), thus converting the metals to the corresponding sodium salts (sodium tantalate. columbate, etc.) which can then be dissolved in aqueous solutions, separated and recovered.

6. Technology of Preparatory Methods. — As the principal object of preparatory operations is to provide a product that is chemically and physically adapted to subsequent leaching procedures it follows that the equipment used for this purpose must be such that it can operate effectively and efficiently to give a product with controlled chemical composition, preferably in the form of finely divided, porous particles. In roasting. the temperature and chemical composition of the atmosphere surrounding the particles must be closely controlled.

The units which have been found most efficient and which are commonly used for roasting include the multiple hearth roaster, flat hearth roaster, suspension (flash) roaster and fluid bed roaster.

In the multiple hearth roaster the fine ore or concentrate is charged to the top hearth of a series of six to sixteen superimposed circular hearths each equipped with a raking mechanism. Suitable provision is made for controlled access of air and flow of gases as well as for addition of heat or reducing gases when required. The fine ore follows a zigzag path through the roaster, dropping from hearth to hearth, and is discharged from the bottom hearth.

The flat hearth roaster comprises a single circular or rectangular hearth equipped with raking mechanisms, access doors for air or reducing gases and suitable heating arrangements. In the rectangular furnaces fine ore enters at one end and is raked to the opposite end of the furnace where it is discharged.

In the suspension roaster, dry finely pulverized sulfide ore is mixed with air in a burner and is blown into a large combustion chamber where the sulfides ignite and burn in much the same way as pulverized coal burns in a steam boiler plant. The oxidized particles drop to the bottom of the combustion chamber while the gases are discharged at the top.

In the fluid bed roaster (fig. 1), which is usually circular, a mixture of sulfides and water is injected into a moving fluid bed of gases and oxidized particles kept in motion by a current of air supplied through orifices in the flat bottom of the roasting chamber. The sulfide particles are almost instantaneously oxidized by the gases, the water being evaporated equally rapidly. The heat of combustion of the sulfides maintains the necessary temperature in the roasting chamber. The oxidized particles in the moving bed may be discharged through a pipe placed halfway up the roasting chamber or with the hot gases which leave at the top of the roaster.

Each type of roaster has characteristics that determine its usefulness in hydrometallurgical operations. The multiple hearth unit is usually used where close temperature and gas composition control are not essential; the flat hearth unit is much the same but permits better control of roasting atmosphere. The suspension roaster has the advantage of high capacity, prevention of contact between roasting particles and close control of temperature, but requires the inclusion of extensive dust-handling equipment to recover the dust leaving with the gases at the top of the roaster. Also the mineral fed to the burner must be perfectly dry. The fluid bed roaster accepts very wet feed and gives excellent control of temperature and atmosphere; the output is governed by the volume of air required to maintain proper fluid characteristics in the moving bed; dust handling is an important aspect of operation.

All four types are widely used and have been found efficient in the preparation of fine porous materials chemically suited for hydrometallurgical processes.

. See also FURNACE, METALLURGICAL.

B. LEACHING

The term leaching, which is generally applied to the selective dissolution of metal compounds and minerals from ore mixtures, originated in the soap industry where, in early times, it was common practice to recover caustic potash from wood ashes by mixing the ashes with water and separating the soluble potash from the insoluble ash residue. Such a process, the dissolution of a desired metal compound with water alone, represents the simplest form of leaching. It is apparent, however, that the usefulness of this technique can be greatly extended if reagents such as acids, alkalis and salts are used in combination with the water to form a leaching solution which will convert metals and metal compounds normally insoluble in water to a water-soluble form. This, indeed, forms the basis for the whole hydrometallurgical industry.

Whatever leaching solution is used there are certain factors that affect the rate and efficiency of a leaching process. In the first place, the process involves a reaction between a solid and a liquid which can proceed only by diffusion in the very thin layer of liquid at the point of contact between the liquid and the solid. If, as sometimes occurs, it is also necessary to have present at the solid-liquid interface a dissolved gas, such as oxygen, the solubility of the gas in the leaching solution has an important effect on the rate of reaction. Thermodynamic and kinetic considerations imply that, in the majority of cases, higher temperatures provide increased reaction rates.

1. Reaction Types. — The character of a leaching operation is determined not only by the factors mentioned and the general properties of the leach solution but by the specific type of reaction involved. These types may be classified as follows:

Dissolution With All *Products* Soluble. — The metal compound is completely dissolved by the leach solution and all products of reaction are soluble. A typical example is the dissolution of zinc oxide in sulfuric acid as represented by the equation:

$$ZnO + H_2SO_4 \rightarrow ZnSO_4 + H_2O$$

Simultaneous Oxidation and Dissolution. — The solid metal or mineral must be oxidized and, upon oxidation, is then soluble in

the leach solution, all products of reaction being soluble. Examples are the dissolution of gold in cyanide solution or of uranium in a sodium carbonate solution in the presence of oxidizing agents as follows:

$$2Au + \tfrac{1}{2}O_2 + 4NaCN + H_2O \rightarrow 2Na[Au(CN)_2] + 2NaOH$$

$$U_3O_8 + \tfrac{1}{2}O_2 + 3Na_2CO_3 + 6NaHCO_3 \rightarrow 3Na_4[UO_2(CO_3)_3] + 3H_2O$$

Simultaneous Oxidation and Dissolution, One Product *Being Insoluble.*—An example of this type is the leaching of pentlandite (NiS.FeS) in an oxidative ammonia leach according to the reaction:

$$NiS\,FeS + 3FeS + 7O_2 + 8NH_3 + xH_2O \rightarrow [Ni(NH_3)_4]SO_4 + 2Fe_2O_3\,xH_2O + 2(NH_4)_2S_2O_3$$

Here the $Fe_2O_3.xH_2O$ is insoluble and forms a porous layer on the surface of the leaching particle.

Chemical Reaction With *Production* of a Soluble and a Gaseous Product.—An example is the treatment of iron sulfide with sulfuric acid: $FeS + H_2SO_4 \rightarrow FeSO_4 + H_2S$.

2. Leach Solutions.— The solutions commonly employed are chosen with a view to providing the most efficient and least costly operation. In general they should have the following characteristics:

a. The solution should be selective to the extent that it dissolves the desired metals and does not react nith valueless minerals.

b. When added reagents are used in aqueous solution they should be such that their solubility in the solution is high enough to insure adequate reaction rates.

c. The leach solution should not be reactive to the extent that corrosion of leaching vessels becomes excessive. Hydrochloric acid solution, for example, although it is a good selective solvent that can be prepared in concentrated form, is greatly restricted in use by the iact that it very readily attacks all common base metals and can thus be used only in vessels constructed of glass, stoneware, plastics or hard rubber—all costly and weak materials.

d. Reagents should be readily available at low cost or be such that they can be easily regenerated or converted to useful by-products.

Of the acidic reagents, sulfuric acid is usually lowest in cost and most readily available, largely because it can be produced as a by-product in roasting sulfide minerals or by burning elemental sulfur in air. Also dilute sulfuric acid has the advantage that it can be easily regenerated by electrolysis or by other means; it is nonvolatile at ordinary temperatures in aqueous solutions; it is reasonably selective; it can be contained in metal or wooden vessels: and it can be prepared in any desired concentration. If sulfides are present in an ore that is to be leached. sulfuric acid can be generated by oxidation of the sulfides in *situ* if the leaching is carried out at a high enough temperature in the presence of oxygen.

Providing the mineral compound reacts with sulfuric acid to produce a soluble sulfate the many properties named make sulfuric acid a desirable leaching reagent. Kot unexpectedly, sulfuric acid solution is used as a solvent for most of the copper, cobalt, zinc, cadmium, vanadium and uranium ores that are treated by hydrometallurgical processes.

Nitric acid finds little use as a leaching medium for ores, largely because of its volatility and its tendency to decompose to nitrous oxides, etc., necessitating reoxidation if the acid is to be regenerated for subsequent use. The cost is much higher than that of sulfuric acid and regeneration is essential if it is to be used for treating low-grade ores. Its use is restricted to treating alloys or oxidized ores as it is decomposed with the production of elemental sulfur and sulfates when in contact with metal sulfides. It is used for "parting" gold-silver alloys, i e , converting the silver to soluble silver nitrate and leaving the gold unattacked in the metallic form.

Hydrochloric acid is, like nitric acid, restricted in use by its tendency to volatilize. It dissolves many oxides readily and reacts vigorously with sulfides to produce H_2S and metal chlorides, but is difficult and costly to regenerate from the chlorides. The corrosive effect of chloride ions in solution, as mentioned above. limits the commercial usefulness of hydrochloric acid in leaching operations. It is used, however, successfully in two important operations: (1) in combination with NaCl in a brine solution, to leach copper, zinc. cobalt, nickel, lead and other metals from pyrite residue which has been given a chloridizing roast; (2) in treating impure tin ores containing sulfides as well as cassiterite (tin oxide) to dissolve the sulfides: leaving a residue of pure tin oxide for subsequent smelting—a "reverse" type of leaching in which the desired metal is undissolved. Hydrochloric acid and chlorides are used in other hydrometallurgical procedures in the production of magnesium, for removal of impurities from tungsten ores and, in an unusual fashion, in the production of germanium and gallium by treating the concentrates with hydrochloric acid to produce chloride solutions. These solutions are then extracted and fractionally distilled to separate pure chlorides from which the pure metals can be prepared by electrolysis or other means.

There are several less important acidic reagents that have found restricted use, among them ferric sulfate, ferric chloride, sulfur dioxide (sulfurous acid) and hydrofluoric acid. The principal use of ferric sulfate is in leaching copper ores containing both copper oxide and copper sulfide minerals. Here a leach solution containing both sulfuric acid and ferric sulfate is employed: the sulfuric acid to dissolve the copper oxides and ferric sulfate to dissolve the sulfides. Ferric chloride has been used to dissolve copper-iron sulfide minerals, producing copper sulfate. ferrous sulfate and elemental sulfur. Sulfurous acid is used to leach manganese dioxide (MnO_2) from certain ores by forming soluble manganous sulfate, together with thionates and other soluble compounds. Hydrofluoric acid is used to dissolve silica from pulverized magnetite ores where the latter are to be used for iron powder manufacture and must be substantially free of silica. These and other acid solvents are restricted in use by cost, volatility, chemical instability or other characteristics; they are used only in specific operations where the required result can not be obtained by using a cheaper, more convenient reagent.

A group with entirely different properties comprises the basic reagents—caustic soda, sodium carbonate and bicarbonate, sodium cyanide and ammonium salts in the presence of free ammonia. The general characteristic of leach solutions containing these reagents is that, differing from acid solutions, they tend to form soluble metal compounds containing oxy-anions such as CrO_4^{--}, anionic complexes such as $[UO_2(CO_3)_3]^{-4}$ or cationic complexes of the form $[Ni(NH_3)_x]^{++}$. Basic leach solutions do not generally react with basic constituents, such as carbonates. in an ore. Thus, if an ore contains a high percentage of carbonates, the useless consumption of acid solely to decompose (*e.g.*, calcium carbonate) could easily reach such proportions as to make acid leaching economically impossible. In such cases basic leaching is the first and often the only choice.

Of the basic reagents, caustic soda (NaOH) is the most widely used. It is relatively inexpensive, nonvolatile, chemically stable, selective. not too difficult to regenerate and it can be prepared at any desired concentration. Thus. where it is chemically suited, it is the preferred basic leaching reagent. Its use is limited, however, to the extraction of metals such as zinc, aluminum, silica, gallium, antimony, chromium, tungsten and other similar metals. The hydroxides of these metals are soluble in an excess of caustic soda to form the corresponding zincates, aluminates, gallates, tungstates, etc., which have various solubilities in aqueous solutions depending on the NaOH content of the solutions. Caustic soda has the added advantage that it is stable at temperatures up to 1,000° C. and can thus be used to fuse refractory minerals, such as those of tungsten, vanadium. chromium and others, forming the corresponding sodium salts (tungstate, vanadate. chromate, etc.) which, on cooling, can be leached with water or weak caustic solution.

Another useful and practical basic reagent is sodium carbonate which has the same desirable properties as caustic soda. However, because it is not so strongly basic, it forms basic salts less readily and is for that reason much more selective than caustic soda. A more unusual, much more selective and yet better-known basic leaching agent is sodium cyanide which, in an oxidizing solution dissolves gold, silver, copper and a few other metals.

Another important basic solvent is ammonia which in the presence of anions such as sulfate, carbonate. nitrate or chloride forms, with certain metals, cationic ammine complexes. Because the

number of metals that will form ammine complexes is small—copper, cobalt. nickel, zinc, cadmium, magnesium, ferrous iron, mercury, palladium, silver, etc.—ammonia is a selective reagent. It is more costly, more volatile and less stable than caustic soda or sodium carbonate, but can be very easily regenerated and has the advantage that, for example, the ammonium sulfate formed in oxidative leaching of sulfides with ammonia is itself a valuable by-product.

3. Technology. — The procedures and equipment used in commercial operations are designed primarily to provide the most efficient operation at the lowest cost. All the factors relating to reaction rate, choice of leach solution and character of the reaction are taken into consideration but the selection of equipment is also influenced by climate, labour costs, size of operation, location, grade and character of ore to be treated and other similar factors. Depending on the importance of one or more of these factors the units and techniques commonly employed are as follows:

Percolation. — When the ore is such that the desired mineral particles are exposed by relatively coarse crushing—from a coarse sand to ▮ in. maximum size—it can be leached by percolation. Tanks, usually rectangular, are constructed of mastic lined reinforced concrete with a filter bottom several inches thick consisting of silica or other inert material with jute sacking laid on the upper surface. (See fig. 2.) The crushed ore is placed in the tank to a depth of from 2 to 1 j ft. and the leach solution pumped in at the top. As the solution percolates through the bed the mineral is dissolved and clear solution is withdrawn from below the porous filter bottom. This is continued in several cycles, including washing, until the ore is completely leached and washed, when the last of the wash water is drained off and the tank excavated mechanically in preparation for a new charge. In some large copper-leaching operations each tank may hold as much as 12,000 tons of ore. requiring a week or more to leach, mash, excavate and refill.

Fine Particle *Leaching.*—In keeping nith the principle that the maximum surface area, and hence highest leaching rate. is provided by agitating a mixture of finely ground solids and leach so-

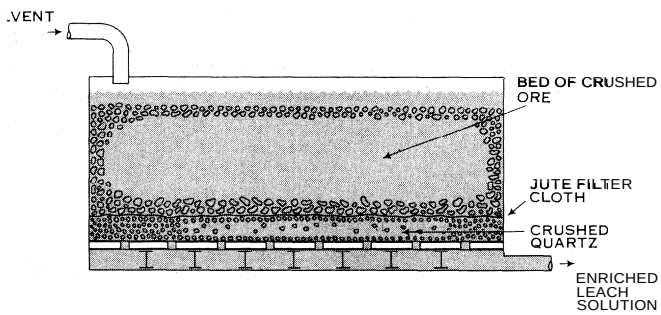

FIG. 2.— PERCOLATION LEACHING TANK

lution, the majority of leaching operations involve the treatment of a "slime." One of the simplest devices used for this purpose is the pachuca tank, first develsped in a gold ore treatment plant in Pachuca, Mex. (See CYANIDE PROCESS.) It comprises a tall circular tank, with a conical bottom, in which the leaching pulp is both aerated and vigorously agitated by a jet of compressed air entering at the bottom of the cone. In some models agitation is assisted by installing a vertical tube in the centre of the tank to give an air-lift effect. The pulp to be leached is fed and discharged continuously.

Another type of slime leaching unit consists of a large tank (up to 20 ft. in diameter) with a short central draft tube, the top being at the level of the pulp in the tank. A motor-driven impeller within the tube forces the pulp and entrained air downward through the tube thus both aerating and agitating the pulp.

When leaching is to be carried out under pressures above atmospheric pressure an autoclave of some type is required. This may take the form of a horizontal cylinder with internal impellers suspended on shafts protruding through the upper surface of the cylinder or having a slow-moving paddle type agitator. (See fig. 3.) The pulp fed to the first compartment by a pump is agitated vigorously by a mechanical agitator in the presence of compressed air. Overflowing the baffle walls into the second and third compartments it is finally discharged through an automatic valve actuated by a level controller. The gases (mostly nitrogen) leave through an automatic pressure release valve. Simple cylindrical vertical towers agitated by steam or air are also used.

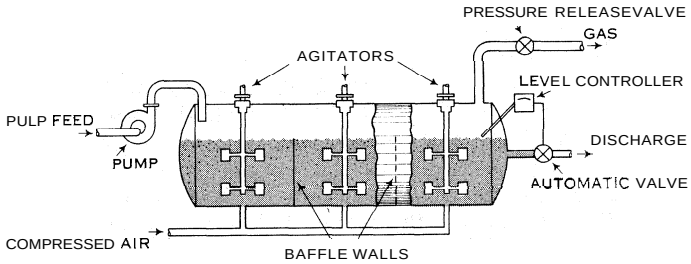

FIG. 3.— CONTINUOUSAUTOCLAVE FOR LEACHING WITH AIR OXIDATION

For certain difficult leaching operations where one of the products of reaction is a solid. such as copper sulfide in the leaching of iron-copper-cobalt-sulfide with sulfuric acid, it is customary to conduct the leach in a ball mill or other grinding unit. This removes the solid layer as it is formed and continually provides a fresh surface for reaction with the leaching solution.

Countercurrent Leaching.—If an ore, whether coarse or fine, is mixed with fresh solution, the concentration of reactants (ore and leach solution) will be high initially. As the reaction proceeds the concentration of soluble material in the ore and that of the reagent in the leach solution both decrease, thus reducing the reaction rate and rendering the operation less efficient. Theoretically the best plan would be to treat partly leached ore with strong solution and fresh unleached ore with a weaker solution. This is carried out in practice by using countercurrent leaching techniques.

In such an operation fresh ore in a first stage is leached with partially depleted solution from a second stage—this partially leaches the ore. The pulp is then filtered, the strong (pregnant) solution proceeding to metal recovery and the partially leached solids being mixed with strong leaching solution and placed in a second-stage unit. When leaching in the second stage is complete the liquids and solids are again separated by filtration, the liquid returned to mix with fresh ore in a succeeding cycle and the solids sent to waste or to such subsequent treatment as may be required. A countercurrent operation may involve as many as five individual stages.

Liquid- solid^ Separation. — When leaching is complete the liquids and solids must be separated; also the solids that are to be discarded must be nashed to prevent loss of entrained leach liquors. This can be accomplished in a variety of ways by combining settling units with filters and centrifuges.

An efficient settling unit is a thickener, a circular tank up to 200 ft. diameter nith a central feed for the pulp and an overflow trough or launder at the periphery. As the solids settle to the flat inverted conical bottom they are moved to a central discharge orifice at the bottom of the cone and removed by pumping. The overflow is substantially clear while the thickened pulp may contain 50% to 60% solids by weight even though the pulp entering at the top may have been only 1% to 2% solids by weight. By arranging several thickeners in series and by advancing thickened pulp in one direction and overflows in the opposite direction the washing process known as countercurrent-decantation is efficiently performed.

Where solids are semicolloidal or so fine that they will not settle readily, flocculating agents such as "Separan," "Aerofloc." certain natural gums, causticized starch, carboxyl methyl cellulose and other similar materials added in very small amounts to the pulp cause the fine solid particles to adhere to one another forming flocs which settle readily.

Filters may be of several types—either batch or continuous.

vacuum or pressure—but large-scale operation is carried out most efficiently and at least cost by using continuous vacuum filters (fig. 4) in which the pulp is pulled onto the surface of a rotating drum or leaf covered with a woven cloth which is immersed in the pulp. At a point in the rotation of the drum where the liquid has been drained from the solids by the vacuum and the solids washed, if necessary, by a spray wash, air pressure is substituted for the vacuum and the moist cake of solids discharged from the drum. As the drum re-enters the pulp, vacuum is substituted for compressed air and the cycle repeated.

In pressure filters which are used for pulps containing a relatively small percentage of solids, or for solids that are difficult to filter, the pulp is charged to a pressure vessel containing cloth filter diaphragms, the vessel closed and the pressure applied. When the cake has built to a suitable thickness on the diaphragms the pressure is removed, the filter opened, the cake removed mechanically or by hand and the cycle repeated.

The centrifuge, which is usually used for separating crystals and coarse oxide from liquids is a rapidly spinning circular basket with perforated sides. The pulp is fed to the centre and liquid is forced by centrifugal force through the perforations, the solids being retained. When a sufficient amount of solids has accumulated on the perforated sides the feed is discontinued and the solids removed. usually by a mechanical scraper and the cycle is repeated; continuous units are also used.

Another device that provides a somewhat less efficient but nevertheless useful liquid-solid separation is the hydroclone or hydrocyclone (see ORE DRESSING) in which the rapid circular motion of the pulp in a cylindrical vessel effects partial separation of solids and liquids by centrifugal force.

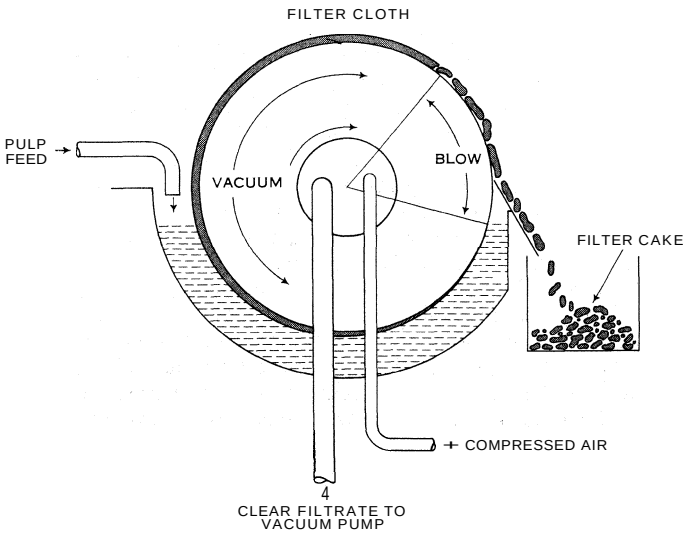

FIG. 4.— CONTINUOUS ROTARY VACUUM FILTER

Other Techniques.—In some specialized operations, such as those which require the addition or removal of heat, provision must be made for preheating the pulps or for cooling the leaching vessels. Also, with volatile solvents, condensers or other recovery units are required: if hydrogen or hydrogen sulfide is generated the gas must be effectively removed from the leaching vessel. Consideration must always be given to materials of construction: they must be inert with respect to the leach solution, to prevent corrosion and sufficiently hard or resilient to prevent erosion by sharp solid particles. Mild steel, wood, stainless steel, rubber coatings, mastic, lead, glass, stoneware, brick and combinations of two or more of these materials are used depending on the temperature, abrasive quality of the solids and the character of the solvent.

C. SOLUTION PURIFICATION

With the exception of the very few leaching operations in which the leaching solution is used to remove soluble impurities from a valuable solid, the filtered liquid resulting from the leaching step is further treated to separate and recover the metal values contained in it. The extent of treatment required depends not only upon the amount and variety of metals dissolved during leaching, but much on the chemistry of the cations and anions present in the solution. Because no two ores are similar in composition every leach solution is unique and thus requires the application of a procedure specifically suited for it. This may vary from a simple precipitation of a metal salt by pH (acidity-alkalinity) change, by hydrolysis or by addition of other metals, to separations effected by organic reagents, fractional crystallization or adsorption. The key to success in this field may be said to be a thoroughly sound knowledge of the principles of inorganic and physical chemistry and of chemical engineering.

1. The pH Change.—The solubilities of metal salts and their tendency to hydrolyze are affected in different ways by variations in pH. In commercial hydrometallurgical operations the number of reagents that can be economically used to change pH is usually restricted by cost as well as by the physical character of the precipitates produced and the possible contamination of solution or precipitate with undesirable impurities.

Acid solutions are adjusted by the addition of caustic soda, calcium carbonate. sodium carbonate, lime, magnesia or ammonia, depending on the metals present and the result desired. In solutions containing ferrous sulfate and cobaltous sulfate, for example, the ferrous sulfate can first be oxidized to ferric sulfate, the pH raised by addition of ammonia or calcium carbonate to about 4.2, and the iron precipitated as hydrated ferric oxide which can be separated from the cobaltous sulfate by filtration. If the solution contained copper it would be necessary to raise the pH to about 5.0 to precipitate the copper as hydroxide but at this pH cobalt hydroxide would also begin to precipitate and thus destroy the effectiveness of the separation.

In solutions containing ferric iron, aluminum, magnesium and uranium in the form of sulfates, it is possible, by adding ammonia to bring the pH up to about 4.0, to precipitate ferric hydroxide, aluminum hydroxide and uranium hydroxide and thus separate the uranium from the solution leaving magnesium sulfate in soluble form. Addition of ammonia to raise the pH to 5.0 instead of 4.0 would precipitate the hydroxide of magnesium along with the iron and uranium and thus not only add to the cost (for additional ammonia) but give a much more impure precipitate.

Basic solutions can be adjusted by acid additions or, in some cases, by dilution or boiling. For example, an ammoniacal solution containing nickel ammine and cobaltic ammine can be treated with sulfuric acid to reduce the pH from 8.0 to 6.j forming nickel ammonium sulfate which is relatively insoluble in the presence of ammonium sulfate at pH 6.j and leaving the cobaltic ammine in soluble form. The nickel ammonium sulfate can then be easily separated from cobaltic ammine solution by filtration or centrifuging, thus effecting a substantially quantitative separation.

In the saturated sodium aluminate solution produced by leaching bauxite in strong caustic soda, cooling to lower temperatures causes the aluminate to hydrolyze and precipitate aluminum hydroxide which can then be separated and recovered, the caustic solution being regenerated.

The pH of basic solutions containing free ammonia and copper ammines can be lowered by boiling off the ammonia to the point where the ammines hydrolyze and copper hydroxide is precipitated. A similar reaction forms the basis of the ammonia-ammonium carbonate process used in Cuba to treat oxidized nickel ores, the product of boiling being basic nickel carbonate, in this case the desired end product.

In the hydrometallurgy of zinc small amounts of arsenic, antimony. ferric iron, silica and alumina are removed from solutions by oxidation and hydrolysis at controlled pH.

2. Reduction.—In the electromotive series, if a metal high in the series is placed in contact with an aqueous solution of a metal lower in the series the general tendency is for the lower metal to be reduced and the higher metal to be oxidized and dissolved. Metals below cadmium. when reduced, mill precipitate in metallic form. Thus it is possible, for example, to precipitate copper metal from copper solution by adding iron metal to the

solution. the iron being oxidized to ferrous ion. which is soluble.

Advantage is taken of this property of metals to remove impurities from leaching solutions in the hydrometallurgy of zinc where small amounts of copper and cadmium present in the zinc sulfate solution are precipitated by the addition of zinc ponder. Similarly, in weakly acid nickel sulfate or chloride electrolytes and other similar solutions containing copper ions, the copper can be precipitated by the addition of nickel ponder, leaving a pure nickel solution.

In another comparable situation chlorine is removed from a solution in which it is present as cupric chloride by agitating the solution mith metallic copper, reducing the cupric to cuprous chloride which is insoluble and can thus be separated.

The order of some more common metals in the electromotive series is: potassium, sodium, magnesium, aluminum, zinc, iron, tin. lead, hydrogen. copper, mercury. silver, platinum and gold.

3. Reagent Additions. — An endless variety of separations can be effected by reagent additions but the commercial application is restricted by cost, physical properties of precipitates and avoidance of unwanted impurities. Hydrogen sulfide and similar sulfur-bearing reagents such as thiosulfate, thionates, SO_2 and sulfur, alkali sulfides and metal sulfides can all be used in the appropriate alkaline or acid environment to effect separations that depend on the relative solubilities of the metal sulfides.

Carbon dioxide. sulfur dioxide and chlorine can also be used where selective solubility of the products can be obtained. Carbon dioxide, for example, added to ammoniacal solutions of calcium sulfate will quantitatively precipitate the calcium as calcium carbonate.

In special circumstances salts or organic compounds can be used to effect separations. Gold, for example, can be separated from a chloride solution containing gold and platinum metal chlorides by adding to the solution ferrous sulfate which reduces and precipitates gold metal but not the platinum group metals. Thorium can be separated from small amounts of other rare earths by precipitating it as the oxalate. In the hydrometallurgy of zinc, traces of cobalt can be removed from the neutral leach solutions by the addition of α-nitroso-β-naphthol.

4. Ion Exchange.—Certain resins consist of porous rigid frameworks having replaceable hydrogen atoms or hydroxyl groups exposed: those with hydrogen ions are known as cationic exchangers and those with hydroxyl groups as anionic exchangers. When a solution containing cations is brought into contact with a cationic resin the cations replace hydrogen in the resin and hydrogen ions enter the solution. The reaction may be represented as follows:

$$\text{Hydrogen-resin} + Cu^{++} \rightarrow \text{Cu-resin} + 2H^{+}$$

The reaction is reversible and Cu-ion and hydrogen-resin can be regenerated by adding strong acid to the Cu resin. Also, the tendency of different species of cations to replace hydrogen varies. Thus, if a dilute solution containing a mixture of cations is brought into contact with a hydrogen resin, it is possible for one species of cation to react selectively and be adsorbed by the resin leaving other cations in solution. The resin can then be removed from the solution and treated with strong acid (*e.g.*, HNO_3) forming a concentrated metal nitrate and regenerating the hydrogen resin for subsequent use in another cycle.

This type of separation has proved exceptionally useful in separating rare earths, in separating hafnium from zirconium and in recovering uranium from acid solutions containing only a few milligrams per litre of uranium in the presence of salts of iron, silicon, aluminum, magnesium and other metals, all of which are largely unaffected by the resin.

Ion exchange techniques offer the prospect of obtaining separations that can not be effected by any other means. For that reason the development of new types of resins, both anionic and cationic, is a continuing objective of research in the hydrometallurgical industry.

5. Solvent Extraction. — Another method of separating metals from aqueous solutions depends on the ability of certain organic liquids to dissolve, selectively, specific metal salts by the formation of complexes which are more soluble in organic solvents than in aqueous solutions. A typical example, long recognized by analytical chemists, is the procedure in which a mixture of the chlorides of ferric iron. cobalt, copper, nickel, vanadium and chromium in a strongly acid aqueous solution is vigorously shaken with ether and allowed to settle, forming two separate layers. The upper layer of ether selectively dissolves ferric chloride leaving the chlorides of the other metals named in the aqueous layer which can be removed by decantation and an efficient separation thus effected.

This principle has been extended and applied in the separation of uranium from acid solutions in uhich it is present in amounts of 1 to j g. per litre together with salts of iron, aluminum, vanadium, magnesium, etc. In one application, the leach solution is first treated with H_2S or aluminum metal to reduce Fe^{+++} to Fe^{++} and is then agitated mith a kerosene solution of an alkyl phosphoric acid which selectively reacts with uranyl ions leaving Fe^{++} and other ions in the aqueous phase. An extractant commonly used is dodecyl phosphoric acid (DDPA). The uranium can be removed from the extractant by treatment with strong hydrochloric acid and the extractant regenerated for use in a subsequent cycle. The uranyl chloride solution is distilled, the HCl distillate recycled to a subsequent cycle and the concentrated uranium residue further treated to produce uranium metal.

As a solvent extraction process is fully cyclic and can be operated continuously, and as extractants can be developed comparatively easily. it is not unexpected that this type of separation continues to find new applications in hydrometallurgy.

6. Technology. — The equipment used for separation processes is relatively simple and is usually selected on the basis that it will provide the specific conditions required for the desired separation.

Mechanically stirred open tanks, pachuca tanks, steam-heated boilers, packed towers and similar units are used for reactions that take place at atmospheric pressure. Where high temperatures, high pressures or volatile reagents such as SO_2, CO_2, NH_3 and H_2S are involved, autoclaves or enclosed towers are used. The solid and liquid products are separated by settling, screening, filtration, centrifuging or other mechanical means.

The ion exchange process operates intermittently in such a way that the solution to be treated is passed through columns of resin until the resin becomes saturated, at which point the solution is diverted to a second similar series of resin towers. In the process used for removing the metal from the saturated resin (known as eluting), acid, etc., is passed through the first (loaded) tower to remove metal ions in an acid solution and regenerate the resin. The column then is ready for reuse in a subsequent cycle while the metal is recovered from the acid solution which is termed the eluate.

A useful variation of this technique is the resin-in-pulp (RIP) process in which the leached pulp, from which the coarser barren solids have been removed but which still contains barren slimes, is brought into contact with resin which extracts the desired metal ions from the aqueous portion of the pulp, the solids being unaffected. When the resin is saturated it is removed, eluted and regenerated; the pulp, consisting of barren leached solids and depleted solution, is discarded. This procedure which avoids the need of filtering the solids before separating and recovering the valuable metal ions from the leach solution offers a distinct advantage in certain operations where the solids are so finely divided or colloidal in nature that settling or filtration would be difficult if not impossible.

Solvent extraction is carried out in a continuously operating mixer-settler in which the pregnant leach solution and organic solvent are fed through a tube into a reaction area-at the centre of a vertical vessel, suitable agitation being provided at the point of entry. The organic extractant overflows the top of the vessel while the depleted aqueous solution is removed at the bottom.

D. Precipitation

The principal objective of many hydrometallurgical procedures is to produce the extracted metals in metallic form. As the metals

are present in solutions as cations carrying a positive charge the essential mechanism of precipitation is reduction which means the addition of electrons. This can be accomplished in several ways: by electrolysis with direct current; by using a metal higher in the electromotive series; or by treating the solution with a reducing gas such as hydrogen.

The processes in which the product is a metal hydroxide, sulfide or other insoluble metal salt have been considered in the preceding section on separations and need not be further described.

1. Electrolytic Precipitation. — The electrolytic cell used for precipitating metals from solutions comprises essentially a container for the solution (electrolyte) in which is placed (a) a cathode upon which the metal is to be plated, and (b) an anode made of some conducting material — metal or carbon — which is not soluble in the electrolyte used. The reaction can be simply represented by the following equation:

$$\text{Metal ion} + H_2O + \text{electrons} \rightarrow \text{Metal} + \tfrac{1}{2}O_2 + 2H^+$$

The net result of electrolysis is that metal is deposited on the cathode, oxygen is evolved at the anode and an equivalent amount of acid (hydrogen-ion) is generated. The amount or weight of metal plated, and of water decomposed to O_2 and hydrogen ions, is determined by Faraday's law which states that a current flow of 96,540 coulombs (ampere-seconds) will deposit an amount of metal equal to its atomic weight divided by its valence. The voltage required is at least the "decomposition voltage" of the metal salt in the electrolyte, to which must be added the voltage necessary to overcome ohmic resistance of the electrolyte and electrical contacts and the overvoltages that may be developed at either anode or cathode.

The conduct of an electrolytic operation is profoundly affected by the cations present in the electrolyte. The salts of metals below hydrogen in the electromotive series have a lower decomposition voltage than that of water and can be electrolytically decomposed and the metal readily deposited from an acid or basic solution. For the metals that lie above hydrogen the difficulty is encountered that water, which is always present. has a lower decomposition voltage than the metal salts, thus creating a tendency to produce hydrogen at the cathode instead of the desired metal, although under certain conditions the deposition of hydrogen may be suppressed. Any hydrogen produced reduces, by an exactly equivalent amount. the metal that should be precipitated according to Faraday's law and in this way reduces the current efficiency of the cell. To electrolyze these metals with high efficiency requires the provision of special conditions such as careful control of pH in the electrolyte, or the use of electrolytes in which the decomposition voltage of the metal salt is, in effect, below that of hydrogen.

It may be inferred from the above that electrolytic precipitation is selective: the metal salt having the lowest decomposition voltage of any salt present will be electrolyzed and the metal plated out in preference to all metals above it in the electromotive series. Where more than one metal salt is present the metal salt having the next highest decomposition voltage will react and deposit the second metal after the lower metal has been removed from solution. If the decomposition voltages of two metals are close, there will be some overlapping in their deposition.

Certain impurities (other cations) present in an electrolyte tend to catalyze the decomposition of water and hence to reduce the efficiency of electrolytic precipitation of metals above hydrogen in the electromotive series. For this reason and also to prevent contamination by other metals which would plate out preferentially. leach solutions must be carefully purified before being electrolyzed. The higher the metal is in the electromotive series, the more important and at the same time the more difficult, is the purification.

Notwithstanding these difficulties, leaching and purification followed by electrolysis with insoluble anodes is widely used commercially in the production of manganese, zinc, cadmium, cobalt and copper and a number of other metals.

2. Cementation. — The precipitation of metal from a solution by the addition of a more reactive metal, with dissolution of the latter, is termed cementation. A typical reaction is:

$$\underset{\text{metal}}{Fe^o} + \underset{\text{ion}}{Cu^{++}} \rightarrow \underset{\text{metal}}{Cu^o} + \underset{\text{ion}}{Fe^{++}}$$

The reactivity of a metal in this context is related to its position in the electromotive series — the higher the metal is in the series the more reactive it is. Metals higher than cadmium in the series can not be precipitated in metallic form from aqueous solution by cementation with a more reactive metal as the equilibrium between H_2O and the ions of metals above cadmium is such that the oxidation of the metal, and hence its retention as an ion, is favoured.

If a cementation reaction is to proceed to completion it is essential that the precipitated metal should not form a continuous nonporous layer on the surface of the reactive metal. Otherwise the precipitated metal would soon reach equilibrium with the surrounding metal salt solution and prevent contact between the reactive metal and the metal ions in solution and thus stop the reaction.

Reaction rates in this system are improved by increased surface area of reactive metal, by increased temperature, by increased agitation and by concentration of the ions of the less reactive metal in the solution. Thus it is advantageous to carry out cementation with finely divided reactive metal at the highest convenient temperature in an agitated mixture. Concentration of the less reactive metal in solution must decrease as the metal is precipitated and total reaction time is restricted largely by the extent to which it is desired to reduce the metal content of the solution. It is possible to precipitate metals quantitatively from solution by cementation. (The term cementation is also used to designate an outmoded process of making steel by heating iron in contact with carbon.)

3. Reducing Gases. — Under certain conditions hydrogen serves as a source of electrons to precipitate metals from aqueous solution, its behaviour in this respect resembling in some measure that of a reducing metal. It appears that metals which lie below or just above hydrogen in the electromotive series and which are either homogeneous or heterogeneous hydrogenation catalysts can be precipitated readily by molecular hydrogen. The list of these metals includes nickel, cobalt, copper, mercury, silver, gold and the platinum metals.

The precipitation by hydrogen of metals lower in the series (silver, gold, palladium, platinum etc.) can be effected at room temperature and atmospheric pressure, although the rate of precipitation is higher with increased hydrogen pressure. Copper, nickel and cobalt, however, can be rapidly precipitated with hydrogen only at temperatures above 100°–125° C. and under a pressure of at least 5 atm. of hydrogen. The rate of precipitation of nickel and cobalt is directly proportional to the surface area of the nickel or cobalt metal present to catalyze the dissociation of hydrogen. The reduction of copper salts occurs homogeneously in solution.

Hydrogen can also be used in the presence of nickel catalyst to reduce uranium from the hexavalent to the tetravalent form in carbonate solutions and to produce uranium dioxide which is insoluble in these solutions. In this way uranium and, by a similar procedure vanadium, can be quantitatively separated from carbonate solutions.

In all hydrogen reduction reactions the hydrogen is converted to hydrogen ion thus tending to increase the acidity of the solution as the reaction proceeds.

4. Technology of Precipitation. — The generators, cells and other equipment used in metal precipitation are similar to those employed in electrolytic refining. The unique characteristic of metal precipitation by electrolysis, termed "electro-winning," is the use of insoluble anodes with accompanying evolution of oxygen at the anode.

The considerable amount of gas (*e.g.*, 180 l. per kilogram of zinc) emanating from the solution carries with it a small amount of acid vapour which causes a loss of acid that tends to corrode metal parts in the cell room. Another factor that occasionally assumes serious proportions is that in an electrolyte containing chlorides, chlorine is generated at the anode which makes it necessary to use for the anode an alloy that is not at-

tacked by the chlorine.

In the electrolytic precipitation of cobalt from sulfate solutions it is necessary to maintain the pH of the electrolytic cell at about 4.5. Acid generated by electrolysis, which would tend to lower the pH of the electrolyte, is effectively neutralized by the addition to the electrolytic cell of pure cobalt hydroxide, a unique but effective procedure in electrolysis.

Electrolytic precipitation finds its principal use in the hydrometallurgical production of zinc, copper, manganese, cadmium and cobalt.

Cementation. — Precipitation by cementation, which is usually more efficient in acid solutions (below about pH4), can be effected by displacement by electropositive metal powders or metal scrap. Precipitation by cementation is used chiefly in recovering copper from acid sulfate or chloride solutions by the addition of scrap iron. Powder cementation is used to precipitate silver and gold from cyanide solutions. copper from solutions containing zinc, cobalt or nickel, cadmium from zinc sulfate solutions and silver from nitrate solutions.

Metal powder cementation is carried out by adding a slight excess of the reactive metal powder to the solution, which is agitated in an open tank. The precipitated metal and any undissolved powder are filtered off and recovered. Batch operation is preferred, the treatment being continued until precipitation is complete. If a two-stage countercurrent precipitation is used, it is possible to produce a high-grade metal precipitate with a very small excess of the reactive metal powder. The reactive metal will reduce oxidized salts such as ferric sulfate in the leach solution, to their lowest valence. It is therefore advantageous to keep oxidation at the lowest possible level and to remove dissolved oxygen from the solution before cementation. Gold cyanide solutions are deaerated by a vacuum technique before adding powdered zinc or aluminum to precipitate the gold.

When scrap metals are used for cementation the technique employed is adapted to suit the character of the scrap used. Normally the solution is poured over coarse scrap contained in launders or perforated baskets. In some important installations batches of solution are treated with bulky, irregular-shaped scrap, such as old oil drums or structural steel scrap, in large inclined rotating acid-proof vessels.

Hydrogen Precipitation. — The principal use of hydrogen precipitation is in the recoverv of nickel, cobalt and copper from ammoniacal leach solutions. For example, a suitably purified nickel solution is introduced into a horizontal cylindrical autoclave fitted with mechanically operated stirring mechanisms. A minute amount of ferrous sulfate catalyst is added (to initiate the reaction), the solution heated to 100–200° C. and hydrogen is introduced at about 400 lb. per square inch pressure. The nickel ammine sulfate present reacts rapidly with the hydrogen to produce metallic nickel powder and ammonium sulfate, the nickel content of the solution being reduced from 50 g. per litre to 0.1 g. per litre in 10 to 15 min. The agitators are stopped, the powder settled and the barren solution discharged. A second charge of nickel-rich solution is added, the agitators started and the cycle repeated. At intervals the autoclave is discharged with the agitators operating, thus removing the nickel powder with the barren solution. The powder is allowed to settle out of the barren solution and is filtered, washed, dried and packed in drums. A high-purity nickel metal is produced by this procedure. Copper and cobalt metals can be similarly precipitated: uranium and vanadium can be precipitated from carbonate solutions as UO_2 and V_2O_3 in a similar manner in the presence of a nickel catalyst.

E. Regeneration

Unless the solvent used is cheap or can be converted into a useful by-product it is desirable to regenerate it for reuse in a succeeding cycle of the leaching process. An important advantage of electrolytic precipitation of metals from acid solutions is that acid is regenerated equivalent to the metal precipitated. Thus the reagent consumption is only that necessary to make up for mechanical losses — there is theoretically no chemical consumption of reagent. The hydrometallurgical processes for producing copper and zinc depend for their economic success upon this feature.

In cyaniding gold ores the amount of sodium cyanide (NaCN) consumed is very small, theoretically only that necessary to react with the gold and silver dissolved. However, if excessive amounts of copper, cobalt, nickel or other metal salts that react with the cyanide are present, the cyanide can be regenerated by treating the solution after gold precipitation with acid to produce hydrocyanic acid (HCN) which is absorbed in caustic soda to regenerate NaCN.

Carbonate solutions of uranium are treated with caustic soda to precipitate the uranium as an insoluble uranium salt leaving a small excess of caustic in the barren sodium carbonate solution. The necessary amount of sodium bicarbonate required for leaching a succeeding lot of uranium ore is regenerated by treating the barren solution with carbon dioxide.

When cementation is used to precipitate metals the barren solutions contain the corresponding salt of the reactive metal. If the purpose of cementation is simply to remove small amounts of an undesired metal for purposes of purification, such as precipitation of copper and cadmium from zinc leach solutions or copper from cobalt solutions, the resulting solution is treated for recovery of the remaining metal. When, however, the objective is to strip the major metal constituent from the solution, as in precipitating copper from leach solutions with scrap iron, the resulting solution is usually valueless, containing (in the case mentioned) only ferrous sulfate and it is therefore discarded.

Ammonia leaching of copper-nickel-cobalt sulfides under pressure in the presence of oxygen (compressed air) with final precipitation of nickel powder by hydrogen under pressure results, as noted above, in the formation of ammonium sulfate. After removal of the nickel the barren solution can be evaporated to produce pure ammonium sulfate which can be marketed as fertilizer. If desired the ammonium sulfate solution could be reacted with lime (CaO) to precipitate calcium sulfate and regenerate ammonia for reuse in a succeeding cycle.

Leaches conducted with ammonium carbonate (*e.g.*, to dissolve copper, nickel or uranium) result in the production of an ammine solution of these metals. Upon boiling, the oxides, hydroxides or basic salts of the metals are precipitated and the volatilized NH_3 and CO, recombined to regenerate fresh ammonium carbonate solution.

In the treatment of many valuable metals to form concentrated leach solutions, as in the production of chromium salts, lithium compounds, thorium, zirconium, etc., the leach solution is usually destroyed by added chemicals and regeneration is not attempted.

III. Examples of Commercial Processes

The principles and methods of hydrometallurgical processes can best be illustrated by reference to important commercial applications. The processes described below have been selected to represent specific applications of different techniques and are intended to give one hydrometallurgical method of producing the metal concerned but not necessarily the only one.

A. Copper

In some of the great copper mines of the world which are located in semiarid areas in South America, Africa and the southwestern United States, the ores consist largely of oxidized copper minerals such as cuprite (oxide), brochanthite (sulfate), atacamite (chloride), etc., which, unlike copper sulfide minerals, are not readily amenable to concentration by froth flotation. These minerals are however all soluble in dilute sulfuric acid, which provides a basis for recovering the copper economically by leaching processes.

The largest mine of this type was at Chuquicamata, Chile, where, until a sulfide smelting plant was added in the 1950s, more than 200,000 tons of copper was produced annually from an ore containing 2% copper of which about 90% was present as oxidized copper minerals. Such an operation provides an outstanding example of countercurrent percolation leaching and electrolytic precipitation with regeneration of sulfuric acid solvent.

In an operation of this kind the ore is crushed to about 1 cm.

maximum diameter and is charged into tanks with filter bottoms, each tank holding as much as 11,000 tons of ore per charge. Several tanks are operated in series, the fresh sulfuric acid leach solution from the electrolytic cells being fed to a tank containing nearly spent ore, percolating through the interstices in the charge and passing through the filter bottom. The filtrate goes forward to the next tank. etc., until in the final tank the copper-bearing leach solution is brought into contact with fresh ore. The leaching cycle requires about four days, after which the liquor is drained from the spent ore nhich is then washed with dilute water solutions, again by percolation. The washed spent ore is excavated and discarded. By changing the flow of leach liquors each tank is in turn filled. leached, washed and excavated.

The pregnant leach solution contains some cupric chloride resulting from the dissolution of small amounts of copper chloride in the ore. To reduce the chlorine content the solution is passed through towers containing metallic copper which reduces the cupric chloride to insoluble cuprous chloride which is removed by settling and filtration.

The purified solution is electrolyzed in mastic-lined, reinforced concrete cells nith 60–70 lead-antimony anodes in each cell. The solution entering the cells contains about 3% H_2SO_4 which is increased to 6% by electrolysis and then returned to the percolation leaching plant to treat a succeeding batch of ore.

B. Zinc

Up to 1916 substantially all the world's zinc was produced by distillation of zinc vapour at high temperatures from a mixture of zinc oxide and carbon. Hydrometallurgical processes (first introduced in the U.S. at Anaconda, Mont., and in Canada at Trail, B.C.) resulted in the production of high-purity electrolytic zinc which found special application in brass manufacture and die-casting. Within a few years die-casting alone required more than 200.000 tons of high-purity zinc per year. Electrolytic zinc is profitably produced in many countries — Canada, the United States, Australia, Poland and others — where abundant low-cost electrical energy is available.

One process comprises roasting a high-grade (50%–60%) zinc sulfide concentrate, preferably with a low iron content, in such a nay that the sulfide is converted to fine porous particles of zinc oxide. The roasted oxide usually contains small amounts of the oxides of lead, copper, cadmium, arsenic and antimony as well as silica and precious metals.

The oxide is leached with sulfuric acid in a two-stage countercurrent system to produce a neutral zinc sulfate solution containing sulfates of cadmium, copper, manganese and cobalt. Iron, arsenic, antimony, lead, silica and precious metals are separated in an insoluble residue and further treated by smelting methods to recover the valuable metals present.

The neutral zinc sulfate solution is treated with zinc powder to precipitate copper and cadmium and with α-nitroso-β-naphthol to remove cobalt, leaving a pure neutral solution containing zinc and manganous sulfates. The purified solution is electrolyzed, using insoluble lead anodes, to produce pure zinc on the cathodes and manganese dioxide at the anodes and to regenerate sulfuric acid at about 10% strength, which is returned to the leaching plant to treat a succeeding lot of zinc oxide.

In this process, because of the position of zinc in the electromotive series relative to hydrogen, great care must be taken to remove impurities from the neutral zinc sulfate solution fed to the electrolytic cells. Germanium, cobalt, nickel and antimony must be maintained at very low levels as they tend to catalyze hydrogen deposition at the cathode and thus impair current efficiency.

C. Aluminum

The principal useful ore of aluminum is bauxite — a mixture of aluminum hydrates of the form $Al_2O_3.xH_2O$ in which the average ratio of H_2O to Al_2O_3 is about 2 to 1. The ores also contain, in varying amounts, iron oxides, silica, lime and magnesia as well as small but measureable amounts of vanadium and gallium.

The ore after grinding to a fine powder is treated in continuous autoclaves with strong caustic soda solution at 160° C. which rapidly dissolves the aluminum hydrates to form a hot, concentrated solution of sodium aluminate. On cooling and "seeding" with particles of aluminum hydrate the sodium aluminate decomposes to form aluminum hydrate and sodium hydroxide. The aluminum hydrate is separated by thickening and filtration and is washed and heated to remove the H_2O. The resulting pure Al_2O_3 is charged to cells containing a molten sodium aluminum fluoride electrolyte for electrolytic production of aluminum metal.

In the dissolution of aluminum ores with caustic soda some of the silica, vanadium and gallium present also dissolve. One of the most important aspects of this process is the control of temperature, concentration and seeding techniques in the various stages to hold to the lowest practical level the silica content of the precipitated aluminum hydrate. At regular intervals the caustic leach solution must be specially treated to remove vanadium, gallium and other impurities to prevent their reaching a level where they would precipitate with, and contaminate, the aluminum hydrate.

D. Nickel

There are two important types of nickel ore: (1) nickel-iron sulfides mixed with copper and cobalt sulfides and frequently platinum metals, that occur in temperate areas such as the Canadian Pre-Cambrian shield; and (2) iron-nickel-magnesium silicates found in such great abundance in tropical areas in Cuba, New Caledonia, Brazil, the East Indies and elsewhere. The sulfide ores are easily treated by pyrometallurgical methods to produce nickel; the silicate ores less easily so. Both types can be treated by hydrometallurgical processes designed to suit the requirements of each.

The silicate ores at the Nicaro mine in Cuba are first treated with reducing gases (H_2 and CO) at red heat to reduce selectively the nickel oxide present to nickel metal particles, without fusion The reduced material is leached in closed vessels with aerated ammonia-ammonium carbonate solution to oxidize and dissolve the nickel as nickel ammine carbonate. The iron, magnesia and other impurities are separated, washed and discarded.

The nickel ammine solution is boiled to drive off ammonia and carbon dioxide and to precipitate a mixture of nickel hydroxide and nickel carbonate which is dried and ignited at a red heat to remove H_2O and CO_2 and produce nickel oxide which is briquetted and sold in this form. The ammonia and carbon dioxide driven off during the boiling operation are reabsorbed in water to regenerate ammonium carbonate for a succeeding leach.

The Cuban ores contain no copper and, as relatively little cobalt is dissolved under the conditions used, the nickel oxide produced is pure enough to meet market requirements without the necessity of introducing extensive solution purification steps. These ores are a potential source of cobalt which can be recovered, if required, by varying operating techniques.

A nickel-iron-copper-cobalt sulfide concentrate from the Sherritt Gordon mine in Manitoba, Can., which contains no platinum metals, is treated by another type of ammonia process. The procedure comprises leaching the mixed sulfides in continuous autoclaves with ammonia solution and compressed air. The minerals dissolve to produce nickel, copper and cobalt ammines and ammonium sulfate. Cpon boiling to remove part of the ammonia, copper is quantitatively precipitated as sulfide. The copper-free solution is treated in autoclaves at 200° C. and 500 lb. per square inch pressure with hydrogen to selectively precipitate nickel in the form of high purity powder which is sold either in this form or as small briquets.

The cobalt remaining after nickel precipitation is removed by H_2S addition and recovered separately in metallic form while the solution (now free of metals) is evaporated to produce fertilizer grade ammonium sulfate.

E. Gold

The first hydrometallurgical process to be used widely on a commercial scale was the recovery of gold by extraction with aerated sodium cyanide solutions. developed in 1889 and 1890. The apparatus devised for this process and still in use in modern hydrometallurgical plants, such as pachuca tanks, thickeners, coun-

tercurrent washing systems and vacuum filters, provided the stimulus for the development of a, variety of other leaching processes. The procedures used have been changed but little in modern practice. For details see CYANIDE PROCESS.

F. URANIUM

One of the great triumphs in modern technology was the development of hydrometallurgical processes for extracting uranium from low-grade ores that took place during the years immediately following World War II. Because of its chemical behaviour uranium can not be separated from silica and other minerals by pyrometallurgical methods. Up to the end of World War II the production of uranium depended upon concentration of low-grade ores by physical methods (as tabling, jigging, etc.) to produce a concentrate containing 10% or more uranium, together with silica, sulfides and other gangue minerals. The concentrate was then treated by hydrometallurgical processes involving the use of sulfuric acid with sodium nitrate and other costly reagents to dissolve the uranium which was then recovered from the solutions by chemical separations.

However, ores containing pitchblende or other uranium mineral in such form that it can be efficiently concentrated by physical processes, occur only in limited quantities. The major source of uranium in the world is the disseminated ores containing from 0.01% to as much as 0.5% uranium, which are not amenable either to physical concentration or pyrometallurgical treatment.

As a result of intensive research a variety of new and useful processes were developed in a surprisingly short time. By 1954 large plants in Africa, Canada and the United States were recovering uranium successfully from phosphate liquors, gold mill tailings, low-grade ores and similar materials containing (in the case of gold mill tailings), as little as 0.01% uranium. An important outgrowth of this activity was the development and introduction on a commercial scale in metallurgical operations of the ion exchange and solvent extraction techniques.

The processes for leaching uranium ores are varied but the majority conform to the following general pattern:

The finely ground ore is leached in agitators or pachuca tanks with a dilute sulfuric acid solution to which is added an oxidizing agent, such as sodium chlorate or manganese dioxide, to convert the lower-valence uranium minerals present to the higher-valent soluble form. The, insoluble portions of the ore are separated by countercurrent decantation or filtration from the uranium sulfate solution which contains small amounts of iron, copper, aluminum and other sulfates.

The sulfate solution is passed through ion-exchange resin columns where the uranium ions become attached to the resin preferentially to the other ions present. The barren solution is discarded.

The loaded resin is eluted with nitric acid or sodium chloride solutions to produce a concentrated solution of uranium (the resin being simultaneously regenerated for reuse) which is neutralized with caustic soda or ammonia to precipitate an insoluble uranate. This high-grade precipitate is then further treated by solvent extraction and other methods to produce high-purity uranium metal.

Other methods involving the use of alkaline sodium carbonate solutions at atmospheric or elevated pressures are also employed, and there is a wide diversity in detail of both acid and alkaline procedures depending on the character of the uranium mineral in the ore and the impurities and gangue minerals associated with it.

See also COPPER; ZINC; ALUMINUM; NICKEL; **GOLD**; URANIUM; etc.

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(F. A. FD.)

HYDROMETEOR, an aggregation of particles of water or ice in the atmosphere. This includes all precipitation but excludes cloud forms (see CLOUD), nonaqueous meteors such as lithometeors (smoke, dust, sand), photometeors (halos, coronas, rainbows) and electrometeors (northern lights, lightning and thunder).

Types.—The new *International* Cloud Aflas (Geneva. 1956) lists the following hydrometeors and their definitions (abridged):

Rain.—Precipitation of liquid water particles, usually in the form of drops of more than 0.5 mm. (0.02 in.).

Drizzle—Fairly uniform precipitation composed exclusively of fine drops of water—diameter less than 0.5 mm. (0.02 in.).

Freezing *Rain* or Drizzle.—Rain or drizzle, the drops of which freeze on impact.

Snow.—Precipitation of ice crystals, most of which are branched.

Snow Pellets.—Precipitation of white and opaque spherical grains of ice. with diameters of about 2–5 mm. (0.1–0.2 in.).

Snow Grains.—Precipitation of very small, fairly flat, white and opaque grains of ice; their diameter is generally less than 1 mm. (0.04 in.).

Ice Pellets.—Precipitation of transparent or translucent spherical pellets of ice which have a diameter of 5 mm. (0.2 in.) or less.

Hail.—Precipitation of small balls or pieces of ice with a diameter ranging from 5 to 50 mm. (0.2 to 2.0 in.).

Ice Prisms.—A fall of unbranched ice crystals, in the form of needles. columns or plates, often so tiny that they seem to be suspended in the air.

Fog.—A suspension of very small water droplets in the air, generally reducing the horizontal visibility at the earth's surface to less than 1 km. ($\frac{5}{8}$ mi.).

Ice Fog.—A suspension of numerous minute ice crystals in the air, reducing the visibility at the earth's surface.

Mist.—A suspension in the air of microscopic water droplets, reducing the visibility at the earth's surface.

Drifting Snow and *Blowing Snow.*—An ensemble of snow particles raised by the wind.

Spray.—An ensemble of water droplets torn by the wind from the surface of an extensive body of water.

Dew.—This is a deposit of water drops on objects at the ground.

White dew.—Adeposit of white frozen dew drops.

Hoarfrost.—A deposit of ice having a crystalline appearance, which generally assumes the form of scales, needles, feathers or fans.

Rime.—A deposit of ice, composed of grains more or less separated by trapped air.

Glaze (Clear Ice).—A generally homogeneous and transparent deposit of ice formed by the freezing of supercooled drizzle droplets or raindrops on objects, the surface temperature of which is below or slightly above 0° C. (32° F.).

Spout.—A phenomenon consisting of an often violent whirlwind, revealed by the presence of a cloud column or inverted cloud cone (funnel cloud), protruding from the base of a cumulonimbus.

(E. M. Bs.)

HYDROMETER. A hydrometer is an instrument for measuring the density of a liquid. The first account of the use of hydrometers in England is in a paper published by Robert Boyle in the *Philosophical* Transactions in June 1675, and fig. 1 is reproduced from an illustration of a hydrometer contained in that paper.

The recognition of the fact that such an instrument provides a ready means of determining liquid density dates from early times, and there is evidence that Archimedes (287–212 B.C.) was familiar with it. The hydrometer remained of little importance until it was developed for industrial purposes. This development began with the use of hydrometers in the 18th century for determining

TABLE I.—Correction Table for Determining Petroleum Density at 60° F.

Observed reading on hydrometer	Temperature at which hydrometer reading was taken—° F.										
	50	52	54	56	58	60	62	64	66	68	70
0.700 g./ml.	−.0048	−.0038	−.0029	−.0019	−.0010	.0000	+.0009	+.0019	+.0028	+.0038	+.0048
0.750 g./ml.	−.0044	−.0035	−.0025	−.0017	−.0009	.0000	+.0009	+.0018	+.0026	+.0035	+.0043

the strength of spirits and has gone on until at the present time hydrometers have widespread industrial applications.

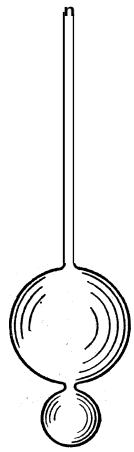

FIG. 1.—BOYLE'S HYDROMETER

Boyle's hydrometer (fig. 1) was made of glass and differs in no essential feature from modern glass hydrometers (fig. 2). The principle on which the construction of hydrometers is based is that a body floating partially immersed in a liquid is in equilibrium when the volume of liquid displaced. which is equal to the volume of the submerged portion of the body. has a mass equal to that of the floating body. A hydrometer placed in a liquid is read by noting the intersection of the level liquid surface with the stem of the hydrometer when the hydrometer is at rest and floating freely in the liquid. The reading is taken on a scale sealed inside the stem of the hydrometer. If V' is the volume of that portion of a hydrometer which is below a particular graduation mark on the scale, then $68'$ is the mass of liquid, of density 6, displaced when the hydrometer is floating freely with this graduation in the level of the liquid surface. If M is the mass of the hydrometer it follows that $\delta V' = M$ and $6 = M/V'$. Consequently if V is the volume of that portion of a hydrometer which is below the lowest graduation mark on the scale, and v is the volume of the portion of the stem between the highest and lowest graduation marks, the range of densities that can be determined is that lying between the values $6 = M/V + v$ and $6 = M/V$.

A Logical System of Hydrometry.— Neglecting, for the moment. the comparatively small effects of surface tension and changes of temperature, the plane of intersection of the level of a liquid surface with the stem of a hydrometer is determined solely by the density of the liquid. If, therefore, a scale is sealed inside a hydrometer stem having graduation marks suitably spaced and numbered to enable the density corresponding to any point on the scale to be easily read, the hydrometer will indicate directly the property of the liquid that determines the reading of the hydrometer.

These densities are generally most conveniently expressed in terms of grams per millilitre, which is therefore a convenient basis for the density scale of hydrometers.

The next thing to consider is the practical use of such a hydrometer. In the petroleum industry, density (often expressed as the equivalent specific gravity $\frac{S_{60°\,F.}}{60°\,F.}$) is used as one of the criteria of quality of petroleum products. Since these liquids have comparatively high coefficients of expansion. it is necessary to use the density at some specified temperature as a criterion for comparative purposes. The temperature generally adopted is 60° F., and a hydrometer adjusted to indicate densities at this temperature will give directly the desired density if read in a sample at 60° F. It is not always convenient, however, to bring the temperature of the sample to 60° F., and it is often more economical in expenditure of time to take the hydrometer reading at the prevailing temperature of the sample and to use tables to obtain from the hydrometer reading the density of the sample at 60° F. The correction tables can conveniently take the form shonn in Table I.

In using a density hydrometer for ascertaining the percentage composition of sugar solutions, the hydrometer is read in the solution, whose temperature is also noted, and then. by means of tables prepared as indicated in Table II, the required percentage of sugar is obtained.

Summarizing the scheme, the hydrometer is used to determine density and tables are used to convert the observations to a standard basis; *i.e.*, to percentage composition, etc. The advantages of such a system are: (1) The hydrometer scale is clearly defined and not dependent on the properties of a particular liquid; (2) the onus on the manufacturer is simply to produce accurate density hydrometers; *(3)* the conversion of density to percentage composition, etc., is left to the users, who should be in the best position to employ the most reliable data relating to the liquids in which they are interested; *(4)* tables can be revised without making hydrometers obsolete; (5) hydrometers can be used in a variety of liquids provided there are not too great variations in surface tension.

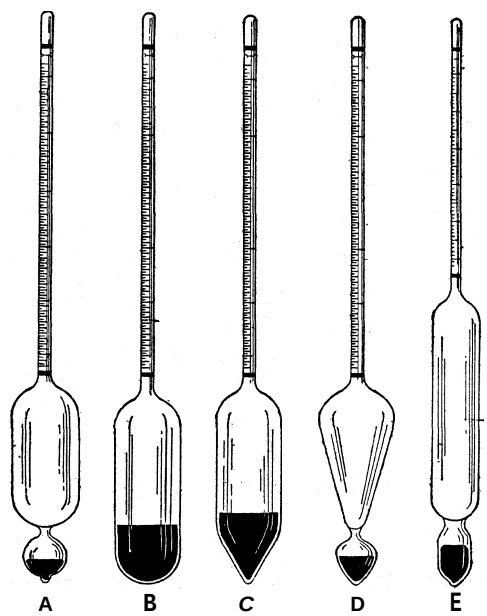

FIG. 2.— MODERN GLASS HYDROMETERS

TABLE 11.—Table for Determining Percentage Composition of Sugar Solutions

Observed Reading on Hydrometer	Temperature at which hydrometer reading was taken—° C.										
	10	11	12	13	14	15	16	17	18	19	20
1.050 g./ml.	12·38	12·41	12·46	12·50	12·54	12·59	12·63	12·68	12·73	12·78	12·84

The wide use of arbitrary scale hydrometers in the U.S., in preference to the more "scientific" instruments graduated in terms of density or specific gravity, results from the recognized advantage of using simple, easily remembered whole numbers instead of long. not so easily remembered decimals For example "62 A.P.I" motor fuel, "66 BC" sulfuric acid and *"190* proof" ethyl alcohol are more conveniently designated in terms of the arbitrary scales than they would be if designated respectively as "motor fuel having a specific gravity of *0.7292* at 60°/60° *F.,"* "sulfuric acid having a specific gravity of *1.8354* at 60°/60° *F* " and "ethyl alcohol having a specific gravity of *0.81603* at 60°/60° *F."* or as "95% ethyl alcohol by volume at 60° F."

Construction of Glass Hydrometers.— Relation Between *Volume* of *Stem* and *Volume* of Bulb.—Let M = the mass of the hydrometer in grams.

δ_0 = the density corresponding to the highest graduation mark in g./ml.

δ_1 = the density corresponding to the lowest graduation mark in g./ml.

V = volume of portion of hydrometer below the lowest graduation mark.

v = volume of stem between highest and lowest graduation marks in ml.

Then we have $M=\delta_0(V+v)=\delta_N V$,

whence $V=v\times\frac{\delta_0}{\delta_N-\delta_0}$.

Spacing of Graduation Marks on Density Hydrometer.— Let δ g /ml. be the density corresponding to any graduation mark intermediate between those corresponding to the limiting densities δ_0 and δ_N and let v' be the volume of the stem between the marks corresponding to the densities δ_0 and δ. Then we have

$$M=\delta_0(V+v)=\delta(V+v-v')=\delta_N V,$$

and by eliminating M and V we obtain

$$v'=v\times\frac{\delta-\delta_0}{\delta_N-\delta_0}\times\frac{\delta_N}{\delta}.$$

If the stem is of uniform diameter and L is the distance between the marks corresponding to δ_0 and δ_N and l is the distance from the highest graduation mark to the mark corresponding to δ then

$$l=L\times\frac{\delta-\delta_0}{\delta_N-\delta_0}\times\frac{\delta_N}{\delta}.$$

For a hydrometer of range 1.000 g./ml (δ_0) to 1.050 g./ml. (δ_N), having L = 150 mm., the above relation gives the following values:

Density corresponding to graduation mark g./ml.	1.000	1.010	1.020	1.030	1.040	1.050
Distance of graduation mark from highest graduation mark mm.	0	31.2	61.8	91.8	121.2	150.0

From the above values are derived

Distance from 1.000 g./ml. mark to 1.010 g./ml. mark = 31.2 mm.
" " 1.010 " " " " 1.020 " " " = 30.6 "
" " 1.020 " " " " 1.030 " " " = 30.0 "
" " 1.030 " " " " 1.040 " " " = 29.4 "
" " 1.040 " " " " 1.050 " " " = 28.8 "

The length corresponding to a change in density of 0.010 g./ml. therefore decreases toward the lower end of the scale; *i.e.*, the graduation marks on a density hydrometer became more closely spaced toward the lower end of the scale.

Temperature Corrections for Density Hydrometers.— Suppose a density hydrometer is adjusted to indicate densities in g./ml. correctly at t° C., to read δ g./ml. in a liquid having a temperature t° C. and also to read δ g./ml. when placed in a second liquid having a temperature t'° C.

The density of the first liquid is δ g./ml. at t° C. where $\delta=M/V$, M g. being the mass of the hydrometer and V the volume of the portion of the hydrometer below the mark δ.

When the hydrometer is reading δ g./ml. in the second liquid having a temperature t'° C. the volume of the submerged portion of the hydrometer is $V\{1+\alpha(t'-t)\}$ ml. nhere α is the coefficient of cubical expansion of the glass from which the hydrometer is made. The density δ g /ml. at t'° C. of the second liquid is therefore given by the equation

$$\delta'=\frac{M}{V\{1+\alpha(t'-t)\}},$$

or to a close approximation $\delta'=\delta\{1-\alpha(t'-t)\}$.

Let c be a correction to be applied to the reading δ g./ml. in the second liquid in order to give the density δ' g./ml. of that liquid at t'° C. Then $\delta'=\delta+c$,

whence $c=\delta\alpha\cdot(t-t')$.

An average value for a is 0.000026, so that if $(t-t')$ is equal to 10° C. we obtain the following values of c for various values of δ:

δ	0.6	1.0	1.5	2.0
c	0.0002	0.0003	0.0004	0.0005

Sow an error of 0.0005 g./ml. in density is negligible for most purposes for which hydrometers are used and so the above values of c are negligible in magnitude. Hence a density hydrometer which indicates densities correctly in g /ml. at its standard temperature t° C. may be used at any temperature within the range $(t\pm10)^\circ$ C. and will still indicate densities *at the temperature of observation* with a sufficient degree of accuracy for all ordinary purposes. It is possible to prepare tables by means of which corrections to standard temperature for individual liquids can be made, and corrections for change in volume of hydrometer as well as for density change of liquid can be included.

Effects of Surface Tension on Hydrometer Readings.— When a hydrometer is floating in a liquid the surface of the liquid does not remain level up to the point of contact with the emergent stem of the hydrometer; liquid piles up against the stem as shown in fig. 3. There is a downward pull on the stem of the hydrometer equal to the product of the surface tension of the liquid and the perimeter of the stem; *i.e.*, equal to $(T\times\pi\times d/10)$ dynes for a stem of circular cross section where T is the surface tension in dynes per centimetre and d mm. is the diameter of the stem. The effect of this is virtually to increase the mass of the hydrometer by an amount equal to $\frac{\pi dT}{10g}$ g. where g cm./sec.^{2} is the acceleration due to gravity.

Suppose that a hydrometer reads δ g./ml. in a liquid having a surface tension T, dynes/cm. and that this reading correctly represents the density of the liquid. Now suppose the hydrometer to be placed in a second liquid having the same density δ but a greater surface tension T_2 dynes/cm. The virtual increase in mass due to surface tension in the second liquid will be greater than that in the first liquid by an amount equal to

$$\frac{\pi d}{10g}\cdot\{T_2-T_1\}.$$

Hence the hydrometer will sink further in the second liquid than in the first until the increase in the mass of liquid displaced by the hydrometer is equal to the increase in the mass of liquid in the meniscus. If 1 mm. is the additional length of stem submerged in the second liquid the increase in the mass of liquid displaced by the hydrometer is

$$\frac{\pi}{4}\cdot\frac{d^2}{100}\cdot\frac{l}{10}\cdot\delta.$$

Hence we have

$$\frac{\pi d}{10g}\{T_2-T_1\}=\frac{\pi}{4}\cdot\frac{d^2}{100}\cdot\frac{l}{10}\cdot\delta,$$

from which

$$l=\frac{400}{d\delta g}\{T_2-T_1\}.$$

Let λ be the length of a subdivision on the hydrometer scale near the point corresponding to the density δ and let $\phi=l/\lambda$.

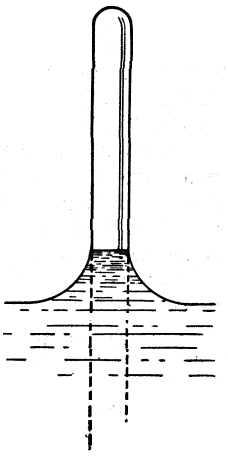

FIG. 3.— SURFACE TENSION ON A HYDROMETER

From the above equations we have

$$\phi=\frac{400}{\lambda d\delta g}\{T_2-T_1\},$$

and ϕ represents the error in terms of subdivisions corresponding to a' change in the surface tension amounting to $\{T_2-T_1\}$. It is obviously desirable that ϕ should be as small as possible; *i.e.*, that λd should be as large as possible.

The following example illustrates the magnitude of surface tension effects. For a hydrometer of range 1.000 g./ml. to 1.040 g./ml. having λ = 1.5 mm. and equivalent to 0.001 g./ml. we have if δ = 1.030 g./ml. and d = 5 mm. $\phi=0.053\{T_2-T_1\}$.

If such a hydrometer were to be adjusted to read correctly at 1.030 g./ml. in dilute sulfuric acid having a surface tension of 70 dynes/cm. and were subsequently to be used in milk of the same density but having a surface tension of 50 dynesicm.. then ϕ is 1.03, so that the hydrometer would be in error when used in milk by slightly more than one whole subdivision; *i.e.*, slightly more than 0.001 g./ml.

Some liquids. notably dilute aqueous solutions, have high surface tensions when the liquid surface is perfectly clean, but even very slight contamination may lower the surface tension considerably; *e.g.*, by as much as 20 dynes/cm. The errors consequent upon such variations in surface tension are the most serious of the limitations to the accuracy attainable with hydrometers.

Definitions of Hydrometer Scales in Common Use.— Specific *gravity*, written $S_{\frac{t_1^\circ}{t_2^\circ}}$, is the ratio of the density of the liquid at a temperature of $t_1°$ to the density of water at $t_2°$.

Hydrometers for *Ascertaining* the Strength of *Alcohol*.—Sikes's hydrometer is a metal hydrometer the mass of which can be changed by the addition of weights; it is used in Great Britain. The hydrometer reading. referred to special tables, gives the percentage of "proof spirit" (in Great Britain, 49.28% by weight of pure alcohol). Per cent of proof spirit at 60° F. is a scale widely used in the Cnited States, where proof spirit contains 50% by volume of pure alcohol). Other hydrometers for alcohol have scales indicating percentages by weight or by volume.

Saccharometers.—Bates's hydrometer is a metal hydrometer used in Great Britain: with a form of specific gravity scale. The Brix scale indicates percentage of sugar by weight at 17.5° C. In the United States, other temperatures are used as standard, the most common being 20° C.

The Twaddle scale registers degrees Twaddle

$$\text{at } 60° \text{ F.} = \frac{200(S_{\frac{60°\text{F.}}{60°\text{F.}}} - 1)}{}.$$

The *Baumé hydrometer* was invented in **1768.** Attempts to standardize this convenient, evenly spaced scale have been unsuccessful; they are graduated according to many different formulas in various countries. In the United States, the following are recognized by the national bureau of standards

For liquids heavier than water:

$$S_{\frac{60°\text{F.}}{60°\text{F.}}} = \frac{145}{145 - \text{degrees Baumé}}.$$

For liquids lighter than water:

$$S_{\frac{60°\text{F.}}{60°\text{F.}}} = \frac{140}{130 + \text{degrees Baumé}}.$$

For petroleum oils:

$$S_{\frac{60°\text{F.}}{60°\text{F}}} = \frac{141.5}{131\,5 + \text{degrees Baumé}}$$

This scale is known as the API (American Petroleum institute) scale.

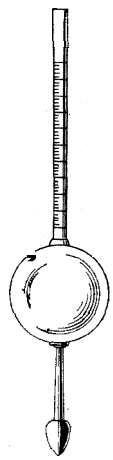

FIG 4.—SIKES S HYDROMETER

Relative Merits of Metal and Glass Hydrometers. — Disadvantages of metal hydrometers are: (1) they are liable to change in weight due to corrosion and wear; (2) the stem is not so readily wetted as that of a glass hydrometer; (3) joints are apt to develop leaks; (4) the bulbs are necessarily made of thin metal and are very liable to become dented. Through wear, slight leakage or a small dent, a metal hydrometer may become seriously in error without this being suspected unless its accuracy is checked at frequent intervals. A glass hydrometer is free from such disadvantages and provides a much more reliable instrument than a metal one. It is more liable to breakage than a metal hydrometer, but once broken the damage is apparent and there is no risk of using a hydrometer that has become seriously out of adjustment, which is one of the most important objections to a metal hydrometer.

Standardization of Hydrometers. — Since the readings on any hydrometer scale can be converted into equivalent densities, the errors of a hydrometer obviously may be obtained by reading the hydrometer in a liquid of known density. It is more convient, for example, to determine the errors of a hydrometer indicating percentages of sugar by weight by determining the densities corresponding to various points on the scale rather than by making up a series of sugar solutions to definite concentrations and reading the hydrometer in them.

The best method is to determine the density of the liquid and to observe simultaneously the reading of the hydrometer in the liquid. This can be done most conveniently by employing the sinker method of determining density. (See DENSITY.) The hydrometer and sinker can be placed side by side in the liquid and the hydrometer reading observed under precisely the same conditions as those under which the density is determined. Thorough stirring immediately previous to the observations and efficient temperature control are essential to secure uniform density throughout the liquid and to bring the temperature of the liquid to that at which the corrections to the hydrometer are required.

FIG. 5.—BATES'S SACCHAROMETER

The direct standardization of hydrometers by the above method takes considerable time and generally is employed only for hydrometers intended for use as standards for verifying other hydrometers. Given a hydrometer whose scale errors are known, a similar hydrometer may be verified by floating it side by side with the standard and taking simultaneous readings on both hydrometers. The difference between the readings combined with the known error of the standard gives the correction to the scale of the hydrometer under test. If the two hydrometers differ appreciably in dimensions, due allowance must be made for surface tension effects unless they are compared in the same liquid as that in which the hydrometer under test is to be used and the corrections to the standard in this liquid are known.

The extensive use of hydrometers in industry and the necessity for accuracy in construction has led to arrangements being made nhereby hydrometers may be submitted for verification to national institutions — in England to the National Physical laboratory: in the U S. to the national bureau of standards, Washington; in France to the Laboratoire d'Essais, Paris; and in Germany to the Physikalische Technische Reichsanstalt. Charlottenburg.

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(E. L. PR.; V. ST.; J. C. HS.)

HYDROPATHY, the treatment of disease by water, commonly called the "water cure." is a system that professes to cure all disease by water. The use of water medicinally both by application and by drinking was recognized by the ancient Greeks and Romans and older civilizations. Hydropathy as a formal system, however, came into vogue about **1829** under the leadership of Vincent Priessnitz (1801–1851), a Silesian farmer who believed in and nidely publicized the medicinal values of the water upon his paternal homestead. It became a popular and accepted form of medical treatment during the 19th century both in Europe and in America.

The term hydropathy is not widely used in modern times; the formal system of hydropathy is divided into two categories: spa therapy and hydrotherapy. Spa therapy, much more accepted medically in Europe than it is in the United States, is based on both drinking and bathing in certain waters containing agents believed to be of medicinal value. Many United States authorities believe that most of the medicinal effects of spa therapy are indirect, resulting from the relaxation of the patient as the result of the environmental factors of the spa.

There is much more widespread medical acceptance of the scientific value of hydrotherapy, the external application of water for specific therapeutic purposes. Its primary values are found

through its versatility as a medium for the external application of heat, which brings about an increase in the temperature of the tissues, vasodilation and an increase in circulation. Sedation and relief of pain and muscular tension are the best-accepted effects of heat therapy. The hydrotherapeutic means of applying heat most usually used are whirlpool baths, the Hubbard tank (underwater mechanical massage), hot packs, contrast baths and paraffin.

Because the effects of superficial heating are practically the same regardlesss of the source and type selected, its application is based on availability of source, extent of area to be treated, depth of effective penetration, time necessary to produce desired effects, ease of application, margin of safety and individual preference.

Hydrotherapy is a therapeutic modality usually employed by specialists in physical medicine and rehabilitation and by physical therapists.

See also PHYSICAL THERAPY (H. A. RK.)

HYDROPHOBIA: *see* RABIES.

HYDROPHYLLACEAE (materleaf family), a family of dicotyledonous flowering plants belonging to the Polemoniales, containing annual or perennial herbs and shrubs *(Eriodictyon, Wigandia)* with regular five-merous sympetalous flowers, the ovary usually unilocular with parietal placentae, and a several- to many-seeded capsule. The flowers. often showy and mostly insect pollinated, are chiefly blue, purple or white in one-sided (helicoid) cymes.

Similarities and affinities are perhaps greatest to Boraginaceae, from which they differ principally in the capsular fruit, an unlobed ovary and bifurcated terminal styles. They comprise a small family of about 18 genera and 250 to 300 species, found chiefly in western United States, the best-known genera being *Nemophila* (baby-blue eyes), *Phacelia* (the largest genus), *Eriodictyon* (yerba santa), *Hydrophyllum, Wigandia, Nama* and *Hydrolea* (pantropical). *(L N. C.)*

HYDROPHYLLUM, commonly called waterleaf, a small genus of mostly perennial North American herbs of the Hydrophyllaceae family. They have large, attractive, palm-shaped leaves, about a foot across, and clusters (one-sided cymes) of small bell-shaped, greenish white, blue or purple flowers. *H. canadense* and *H. virginianum* are often planted in partial shade in the wild garden.

HYDROPLANE: *see* MOTORBOAT; SEAPLANE.

HYDROPONICS, from the Greek *hydro,* water, and *ponos,* labour, refers to the groning of plants nithout soil and is sometimes called soil-less culture.

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SPRAYING SEEDLINGS AT A COMMERCIAL HYDROPONICS EXPERIMENTAL FARM IN PUERTO RICO. PLANTS ARE GROWN IN CONCRETE BEDS FILLED WITH GRAVEL; THEY ARE FED A SOLUTION OF CHEMICALS IN WATER

For many years in the study of their nutrition, plants were grown with their roots immersed in solutions. but the commercial adoption of this method of culture mas not entirely successful because of difficulties in plant support and solution aeration. Gravel culture therefore largely supplanted solution or water culture as a means of groning plants without soil. An inert medium such as gravel of various kinds. fused shale and clay, granite chips or other such materials with a particle size of one-fourth inch to three-eighths inch in diameter serves as a support for the plants This medium is placed in a watertight bed or bench and a fertilizer solution is periodically pumped each day into the bench or bed, the frequency depending upon the prevailing light intensity and temperature. and other weather factors, the size of plants or concentration of the fertilizer solution, stronger solutions being pumped more frequently. The solution drains back into a tank and the frequency of pumping usually is controlled automatically.

The solution is composed of different fertilizer-grade chemical compounds containing varying amounts of nitrogen, phosphorus and potassium, the major elements necessary for plant growth. These fertilizers also contain compounds of various trace or minor elements. such as sulfur, magnesium, calcium, etc. There are many satisfactory formulas for fertilizer solutions; one proved successful with florist crops is:

Chemical	Per 1,000 gal. of water
Potassium nitrate	5 lb. 13 oz.
Ammonium sulfate	1 lb.
Magnesium sulfate (Epsom salts)	4 lb. 8 oz.
Monocalcium phosphate	2 lb. 8 oz.
Calcium sulfate	5 lb.
Total	18 lb. 13 oz.

The chemicals can be mixed in dry form and stored if desired. The concentration of the solution is increased as the plants grow larger by using 1½ or 2 times the amount of chemicals per 1,000 gal. of water. To the above solution is added each week four ounces of iron (ferrous) sulfate and one ounce of manganous sulfate dissolved in a gallon of water acidified with several drops of sulfuric acid. Other trace elements are added if necessary. Tests of the solution are made every two or three weeks for pH (acidity) and the major elements and additions of the necessary chemicals are made as needed. The solution can be used indefinitely with the necessary additions of water and chemicals.

The main advantage of gravel culture is in the labour saved by automatic watering and fertilizing, though installation costs are higher than costs for plants grown in soil. No greater yields may be expected than from similar plants in soil in the same environment. A wide variety of vegetables and florist crops can be grown satisfactorily in gravel culture. Commercial acceptance of hydroponics is impeded by high installation costs, the necessity for frequent testing of the solutions and the greater familiarity of plant cultivators with soil. For further discussion of the elements necessary for plant growth *see* FERTILIZERS AND MANURES. *See* also PLANTS AND PLANT SCIENCE: *Metabolism.*

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HYDROSPHERE, the whole mass of oceanic waters filling the major depressions in the earth's crust, and covering about 72% of its surface. The name is used in distinction from the atmosphere (*q.v.*), the lithosphere (*q.v.*) and the centrosphere or mass within the crust.

HYDROSTATICS, the branch of hydromechanics which deals with the equilibrium of fluids *(see* MECHANICS, FLUID).

HYDROXIDE, a term used in its most general sense to designate any chemical compound containing oxygen and hydrogen bonded together in the OH group. One or more of the OH groups are in turn linked to another element or radical. Employed in this broad sense the name is indicative of the composition but not

necessarily the nature of the compound. In practice it is therefore preferable to restrict the term to those compounds containing the hydroxide ion. OH^-, and the positively charged ion of a metal or a radical. *e.g.,* sodium hydroxide; it is also preferable to characterize the presence of the hydroxyl radical, OH, by hydroxy. as in the organic compound hydroxy acetic acid, $CH_2OHCOOH$, and in co-ordination compounds by hydroxo, as in potassium tetrahydroxoaurate. $KAu(OH)_4$.

The hydroxides include the familiar bases of the laboratory and industrial processes. Those of the alkali metals, lithium, sodium, potassium, rubidium and cesium. are the strongest bases, the most stable and the most soluble of the hydroxides. Lithium hydroxide is somewhat unlike those of the other metals of this group, being less soluble and less stable; it decomposes at red heat. losing water to form the oxide Li_2O, whereas the others may be volatilized without loss of water. Sodium hydroxide (see ALKALI). NaOH, also known as caustic soda or lye, is of great industrial importance. Calcium, barium and strontium. alkaline earth metals, form soluble hydroxides which are strong bases but less stable than the alkali hydroxides. Of these calcium hydroxide or slaked lime is the most common. With the exception of thallous hydroxide, TlOH, the hydroxides of other metals such as magnesium, iron, bismuth. nickel. cobalt and copper are only sparingly soluble in water but react with acids. The hydroxides of beryllium. lead, zinc, aluminum, chromium (trivalent): tin (divalent), gold (trivalent) and certain other metals show both acidic and basic properties; that is, they dissolve in water solutions of either bases or acids. Hydroxides and other substances, *e.g.,* oxides and sulfides, with these dual properties are called amphoteric.

Oxygen acids. although structurally represented to show the presence of hydroxyl radicals, *e.g.,* boric acid. $B(OH_3)$, sulfuric acid. $SO_2(OH)_2$, and hypochlorous acid, Cl(OH), are not designated as hydroxides. (J. B. Ps.)

HYDROXYLAMINE, represented by the formula NH_2OH, was first prepared in 1865 by W. C. Lossen as the chloride by the reduction of ethyl nitrate with tin and hydrochloric acid. Hydroxylamine reacts with aldehydes and with ketones to form the important class of organic compounds known as oximes (*q.v.*). Oximes can be reduced easily to amines: they find use in the manufacture of dyes. plastics, synthetic fibres and medicinals.

The synthesis of hydroxylamine may be effected by the following general procedures: (1) chemical or electrochemical reduction of nitric acid. nitrous acid, nitrates and nitrites. and of oxides of nitrogen; (2) interaction of nitrites with acid sulfites in 1:2 molar proportions to yield the hydroxylamine disulfonates which are easily hydrolyzed to form hydrosylaminonium sulfate

$$(NO_2- + 2HSO_3- + H+ \rightarrow HON(SO_3)_2= + H_2O;$$
$$HON(SO_3)_2= + 2H_2O \rightarrow NH_2OH.H^+ + 2SO_4=);$$

(3) oxidation of ammonia; and (4) hydrolysis of nitroparaffins ($RCH_2NO_2 + H^+ + H_2O \rightarrow RCOOH + NH_2OH.H^+$). Although electrolytic reduction of nitric acid in presence of sulfuric acid at low temperatures using amalgamated lead cathodes once furnished most of the hydroxylamine, methods (2) and especially (4) have gradually assumed greater technical importance. These technical processes may. however. be supplanted by a procedure which entails the catalytic hydrogenation of nitric oxide in the presence of acid ($NO + 3[H] + H^+ \rightarrow NH_2OH.H^+$) to yield hydroxylamine salts.

Pure anhydrous hydroxylamine was first obtained by C. A. Lobry de Bruyn from the chloride by treating an absolute methyl alcoholic solution with sodium methylate ($NH_2OH.HCl + NaOCH_3 \rightarrow NaCl + NH_2OH + CH_3OH$). The precipitated sodium chloride is filtered and hydroxylamine recovered after removal of alcohol by distillation under reduced pressure. Butyl alcohol and sodium butylate are preferred since addition of ether to the solution of hydroxylamine and cooling yields the free base as a solid product. The pure compound is a colourless. odourless crystalline solid. melting at 33° C.. boiling at 58° C. (at 22 mm.) and decomposing readily at higher temperatures, sometimes with explosive violence. It is very soluble in water to give solutions which are moderately stable and less basic than aqueous solutions of either ammonia or hydrazine, both of which it resembles chemically. The dissociation constant for hydroxylamine as a base (*e.g.,* $NH_2OH.H_2O \rightleftarrows NH_2OH.H^+ + OH-$) is $K = 6.6 \times 10^{-9}$. Hydroxylamine inflames in dry chlorine and is reduced to ammonia by zinc dust. It combines with sulfur dioxide to give sulphamic acid ($NH_2OH + SO_3 \rightarrow NH_2SO_3H$). It is a strong reducing agent, giving a precipitate of cuprous oxide from alkaline copper solutions and depositing metallic silver from solutions of silver salts. Under certain conditions it may act as an oxidizing agent, as in the conversion of ferrous hydroxide to ferric hydroxide. It is highly probable that two structures may be assigned to hydroxylamine. viz., H_2NOH in acid solution and H_3NO, the amine oxide formulation. in alkaline solution (F. Haber). Although many methods have been suggested for the estimation of hydroxylamine, most of them depend on careful adjustment of the acidity of the solution. That of F. Raschig. however. is less sensitive to conditions and is the most trustworthy; the hydroxylamine solution is boiled with a considerable excess of ferric sulfate in sulfuric acid, and the ferrous salt thus formed by reduction [$2Fe_2(SO_4)_3 + 2NH_2OH = 4FeSO_4 + 2H_2SO_4 + N_2O + H_2O$] is titrated with potassium permanganate.

Hydroxylammonium salts form readily. the sulfate and the chloride being best known. Like ammonia. hydroxylainine forms co-ordination compounds such as $ZnCl_2.2NH_2OH$ and $[Co(NH_2OH_6]\ Cl_3$ (see CO-ORDINATION COMPOUNDS). The hydroxylamine derivatives of sulfuric acid include salts of the hydroxylamine mono-, di-, tri-. isodi- and isomono- sulfonic acids with the respective formulas: $HONH(SO_3H)$, $HON(SO_3H)_2$, $(HSO_3)NO(SO_3H)_2$, $(HSO_3)ONH(SO_3H)$ and $H_2NO(SO_3H)$. The hydroxylamine isoinonosulfonic acid, more properly designated as O-hydroxylamine sulfonic acid. is a powerful oxidizing and aminating agent, prepared by reaction of hydroxylamine sulfate with oleum (see G. T. Moeller Led.]. *Inorganic* Syntheses, vol. V [1958]).

Hyponitrous acid, HON = NOH, may be regarded as one of the hydroxylamine derivatives of nitrous acid. and its salts are readily prepared from hydroxylamine and an alkyl nitrite in alcoholic solution in the presence of a base. The related nitrosohydroxylamine. HN(NO)OH, is known only in the form of organic derivatives such as "cupferron." a widely used analytical reagent, which is the ammonium salt of N-phenylnitrosohydroxylamine, $C_6H_5N(NO)ONH_4$.

The organic hydroxylamines are compounds in which one, two or all three hydrogen atoms are replaced by organic radicals. Their structure may be indicated using the older convention by specifying substitution either in the α or β positions:

$$\overset{\beta}{H_2N} - \overset{\alpha}{OH}$$

but preferably by prefixing N or O to designate the point of attachment. Thus. NH_2OCH_3 is O-methylhydroxylamine, whereas C_6H_5NHOH is N-phenylhydroxylamine. Trisubstituted hydroxylamines are generally considered to be amine oxides, R_3NO (see above) and are obtainable by the action of hydrogen peroxide on tertiary amines (see AMINES). Other well-known organic derivatives include the hydroxamic acids,

$$RC(=O)-NHOH$$

and the amidoximes. $RC(NH_2)NOH$, both derivable from, and related generically to. the carboxylic acids.

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